Fordson Dexta Tractor

Foreword

This Manual has been prepared for express purpose of assisting those concerned with the servicing and repair of the Fordson Dexta Tractor.

You will find that it is divided into 10 sections, each section being, as far as possible, self-contained, with pages numbered consecutively within the section. Each page also bears the date of issue so that when changes necessitate alterations in the contents the page can be removed and replaced by a new one containing the revised information.

No attempt has been made to elaborate on established engineering principles and design but for those who are meeting the Fordson Dexta for the first time the operation of new features and repair procedures have been fully explained.

Not even the most experienced mechanic can be expected to carry in his head all the details of fits, clearances and specifications applicable to this tractor, therefore such information has been included in each section of the Manual.

Methods of repair based on the experience of Service Department, Tractor Division, are covered in full detail and where necessary, particular operations are illustrated. “Exploded” and sectioned views of the main components have been included to assist correct assembly.

Particular attention has been given to the application of specialised tolls and equipment which have been developed to ensure speedy and efficient overhaul of the tractor and a new tool numbering system has been introduced to clarify and make easy the section of adaptors for the main tools.

Whenever reference is made in the Manual to right-hand or left-hand of the tractor this is as viewed from the driver`s seat facing forward.

The tractor serial number is stamped on the left-hand side of the clutch housing/engine flange and is pre-fixed by the number, i.e. 957E.

The engine serial number is stamped on the left-hand side of the cylinder block adjacent to the water inlet elbow from the water pump.

The fuel injection pump serial number is stamped on the left-hand side (front) of the pump cambox.

Reference should be made of the tractor serial number on all correspondence relative to this tractor and, where necessary, engine and pump serial numbers should also be quoted.

Ford policy is one of continuous improvement, and the right to change prices, specifications and equipment at any time without notice is reserved.

Ford Motor Company Limited,
Service Department,
Tractor Division,
Dagenham,

England

BRAKING SYSTEM

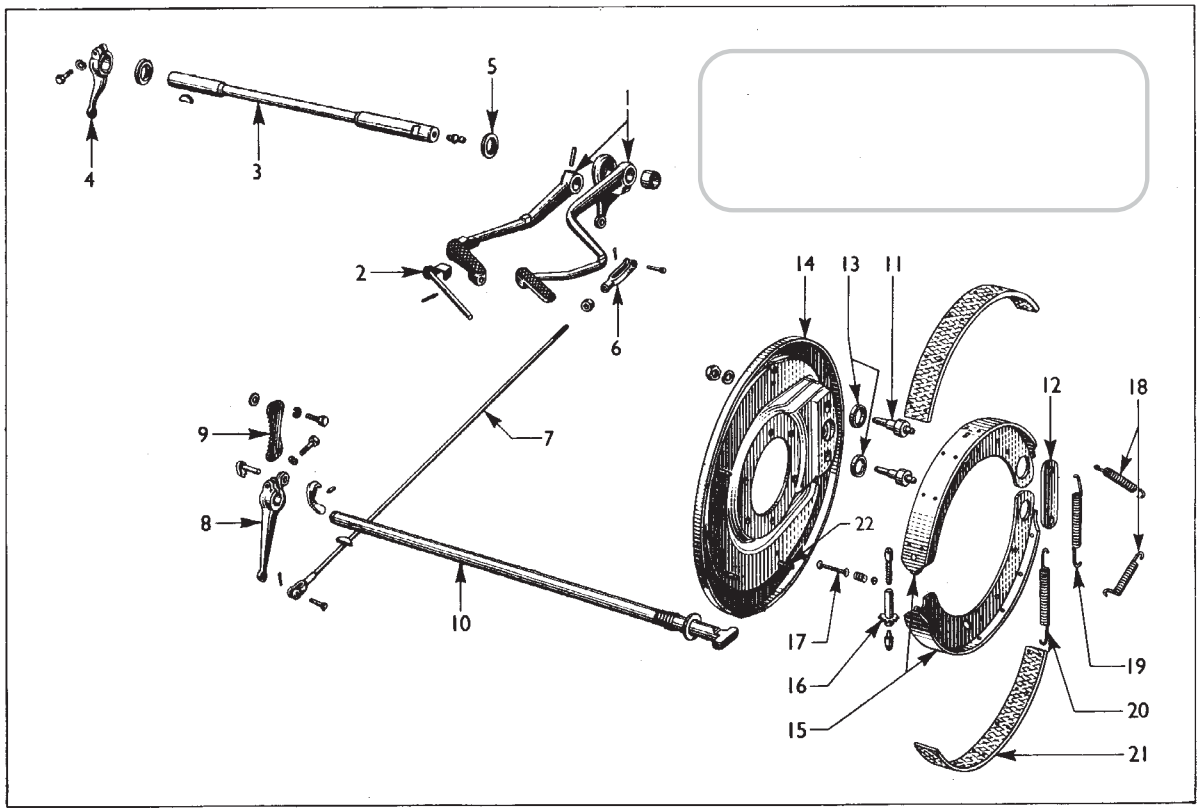

Fig. 1
Exploded View of Braking System

1 Brake Pedal
2 Pedal Kocking Latch
3 Brake Cross-shaft
4 Brake Cross-shaft Lever
5 Brake Cross-shaft Oil Seal
6 Brake Rod Clevis
7 Brake Rod
8 Brake Camshaft Lever
9 Parking Brake Sector
10 Brake Camshaft
11 Anchor Pin
12 Anchor Pin Plate
13 Anchor Pin Washers
14 Brake Back Plate
15 Brake Shoes
16 Brake Adjuster Wheel
17 Holder Down Pin
18 Secondary Springs
19 Retracting Spring
20 Adjuster End Spring
21 Brake Lining
22 Adjustable Steady Post

DESCRIPTION

The rear wheels of the tractor are equipped with two-shoe internal expanding brakes operating in 14 in. drums. The brake linings are bonded to the shoes in production, but the shoes are drilled to enable replacement linings to be riveted to the shoes should they be required in service.

The brakes are operated independently by two pedals on the right-hand side of the tractor through a suitable linkage. The left-hand brake pedal is, however, fitted with a locking pin which can be engaged with the right-hand pedal so that the brakes will operate together. This pedal lock should always be engaged when the tractor is used on fast road work.

For parking purposes the brakes may be locked "on" by a pawl on the right-hand brake camshaft which can be engaged, by means of a latch, with a fixed sector on the transmission housing (Fig.2). To lock both brakes "on" for parking the pedal lock should first be engaged and the pedals depressed while the latch is moved rearwards to engage the pawl in the sector.

BRAKE ADJUSTMENT

Wear will take place on the brake linings due to normal usage and it will be indicated by a gradual increase in pedal travel before effective braking is obtained. This will be noticeable also during the initial bedding-in of the shoes. If operating

conditions are such that one brake is consistently used more than other, uneven wear will take place and the tractor will tend to pull to one side if the brakes are applied when the pedal lock is engaged.

The brake adjustment for normal lining wear should be carried out as follows:

1. Release the parking latch and jack up each wheel in turn to adjust.
2. Slide back the plate covering the adjuster aperture at the rear of the brake plate and, using a screwdriver, turn the notched adjuster wheel towards the rear of the tractor to expand the brake shoe in the drums (see Fig. 3).
3. Continue until a definite drag is felt when the wheel is turned, then slacken back the adjuster until the wheel is just free to revolve.
4. Repeat at the opposite wheel an finally road test the tractor to check brake operation.

Check the brakes for signs of pulling to one side or over-heating due to the shoes "dragging", and readjust if necessary. Close the adjuster aperture cover plates.

MAJOR BRAKE ADJUSTMENT

When new brake shoes are fitted or when the adjustable steady posts have been disturbed, it is necessary to carry out the following major adjustment on each brake.

1. With the rear end of the tractor completely jack up and the wheels removed, disconnect the brake rods from the pedal at their front ends and ensure that the brake camshafts are free to rotate.

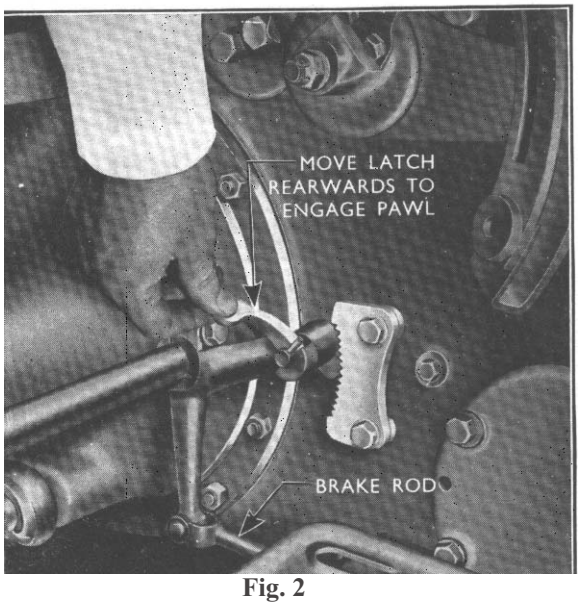

Fig. 2
Applying the Parking Latch

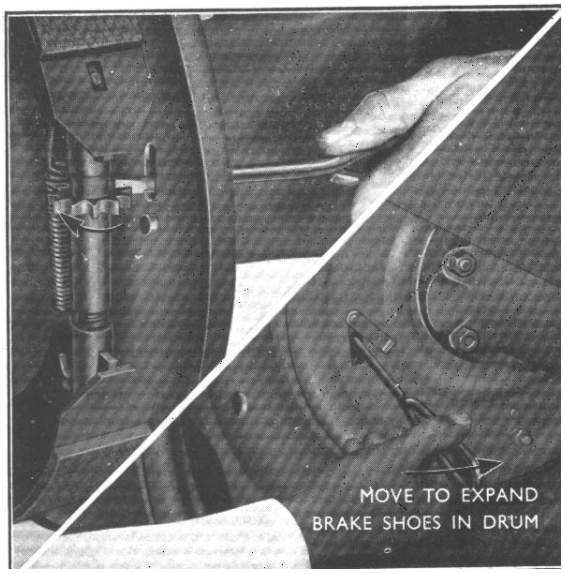

Fig. 3
Adjusting the brakes

2. To obtain an approximate setting for the adjustable steady posts, slacken off the locknuts and unscrew the posts (anti-clockwise) until they come out of contact with the shoes. The shoes will then remain against the fixed steady posts on the back plate. Screw in the adjustable steady posts until the brake shoes are lifted just clear of the fixed posts.
3. Carry out the brake minor adjustment previously described to establish a small shoe to drum clearance.
4. Working on one shoe at a time screw in the steady post clockwise until one edge of the brake lining contacts the drum causing in to drag. Next, turn the steady post anti-clockwise, again turning the drum by hand to check for dragging, and counting the number of turns on the steady post before the opposite edge of the shoe contacts the drum and causes it to drag. Finally, screw in the steady post half the number of turns counted and tighten the locknut.
5. Expand the brake shoe fully in the drums prior to reconnecting the brake linkage.
6. Block up the brake pedals in the raised position and slacken off the locknuts on the clevises at the front end of the brake rods.
7. Lightly pull on the front end of the brake rods to take up any free play in the linkage and adjust the clevises by screwing them along the rod as required, to line up the holes in the clevis with the hole in the brake pedal lever (or cross-shaft lever for left-hand side rod)
8.Fit the clevis pin, split pin securely and tighten the clevis lock nut.
9.Complete the adjustment by slackening back the adjuster unit on each brake assembly until the drums are free to turn without binding.

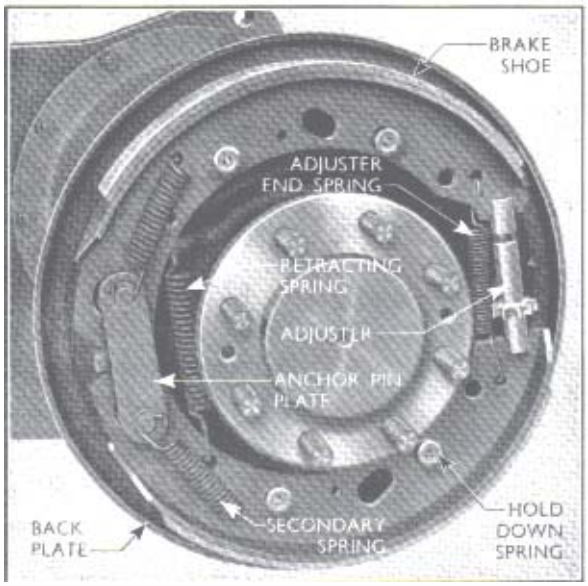

Fig. 4
Brake Shoes and Springs

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10. Finally, refit the wheels and drive the tractor to test of equal braking on both wheels and signs of overheating. Readjust if necessary on the brake adjuster wheels.
Once the brake linkage has been set as described above with the brake shoes expanded in the drums, it should not be necessary to alter the brake rod settings between major overhauls.

BRAKE OVERHAUL

To Dismantle
Jack up the rear end of the tractor and remove the wheel weights (if fitted) and wheels. Unscrew the two countersunk screws on each brake drum and remove the drums. If necessary, slacken back the brake adjuster to move the brake shoes clear of the drums to facilitate removal. Disconnect and remove the brake rods.
Each brake assembly should then be further dismantled as follows:
1. Disconnect the two secondary springs from the anchor pins. Brake spring pliers can be used for this operation or alternatiely a length of strong flexible wire looped around the spring end and used to expand the spring will facilitate removal.
2. Detach the anchor pin plate.
3. Pull the rear ends of the two brake shoes apart and lift out the brake adjuster unit. The adjuster end spring may then be detached from the shoes.
4. Remove the four hold down pins, springs and cups by compressing the outer cup inwards against the spring and turning through a quarter turn. The brake shoes may the be removed complete with the retracting spring. All four shoes are identical but as each shoe will have “bedded-in” to the drum, all shoes should me marked on dismantling so that if they are only part worn they can be reassembled in the correct location.

5. To remove the brake camshaft:
(a) Unscrew and remove the brake camshaft lever cotter bolt and slide the lever off the end of the shaft. Note that the lever is further secured by means of a Woodruff key which should be carefully removed from the keyway in the shaft
(b) Slide the camshaft over plate and retaining spring along the shaft and remove the shaft through the hole in the back plate.
6. Remove the anchor pin washers from the anchor pins. If the anchor pins are worn they may be removed by unscrewing the large nut securing them to the back plate and driving out the pins.

Inspection of Parts
Clean all parts, inspect and renew a necessary.
1. The brake shoes should not be refitted if worn to less than 1/16 in. thick at any point. The linings are bonded to the shoes in production, but the shoes are drilled to enable linings to be riveted in position in service. When inspecting riveted linings the wear limit allowed should be 1/16 in.(1,5 mm) above the heads of the rivets.
2. If the anchor pins are badly worn on one side they may be turned through an angle to equalise wear by slackening the securing nut. Tighten the nut securely after adjustmentto a torque of 150 lbs.ft. (200 Nm)
3. Check the brake springs and discard if they show signs of being weakened or if the spring ends are deformed.

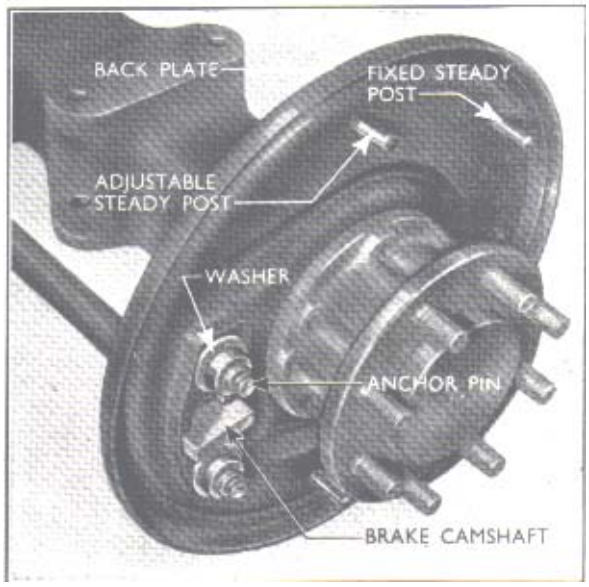

Fig. 5
Back Plate and Anchor Pins

Reassembly

On reassembly the anchor pins and washers, adjuster unit and the brake cam should be lightly lubricated with a zinc base grease. Do not use general purpose grease as it may melt under high temperatures and run onto the shoes.

1. Refit the anchor pins if removed. Grease the threads before fitting the spring washers and nuts and tighten to a torque of 150 ft.lbs(200 Nm). Place the anchor pin washers in position on the anchor pins.
2. Pass the brake camshaft through the back plate from the outside and fit the camshaft cover and retaining spring. Ensure that the camshaft lever Woodruff key and keyway are not demaged or burred and slide the lever onto the shaft. Secure by means of the cotter bolt.
3. Note that if the brake shoes are to be replaced without new linings being fitted they should be replaced in the same position from which they were removed. Fit the large retracting spring between the forward ends of the shoes and install the shoes on the anchor pins.
4. Fit the four hold down pins. Pass the pins through the back plate and the holes in the shoe and install the inner cup washer and the hold down spring. Press the outer cup washer inwards against the spring tension and turn through a quarter of a turn to lock the pin. The spring cup washers should be fitted with the convex face contacting the spring end.
5. Fit the adjuster end spring and install the brake adjuster unit between the rear ends of the brake shoes so that the notched wheel is in line with the adjusting slot in the back plate.
6. Position the anchor pin plate over the ends of the anchor pins and fit the two secondary springs. A lenght of flexible wire will again facilitate extending the springs to fit the hooked ends around the anchor pins.
7. Replace the brake drums and secure in position using the two countersunk screws.
8. Carry out the major brake adjustment previously described.

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TO RENEW THE BRAKE BACK PLATE

To renew a brake back plate it is necessary to remove the axle shaft and bearing retainer from the axle housing and the procedure for carrying out this work is described fully in the Rear axle section under the heading “To Remove an Axle Shaft”. In addition to the operations listed, the brake shoes must be removed as detailed under”Brake Overhaul”.
It will be noted that a number of steel shims are fitted between the brake back plate and the axle housing at both sides of the tractor to provide an adjustment for axle shaft end float. The two axle shafts being in direct contact at the centre of the differential, the end float of both shafts can be adjusted simultaneously by altering the shim thickness at either side of the axle. If a new back plate is fitted then, due to possible slight differences in the thickness of the old and the new back plates, the end float on the shafts may be altered and this should therefore be checked and readjusted if necessary. Refer to the Rear Axle section for full information on this adjustment.

BRAKE PEDALS AND LINKAGE

Both brake pedals pivot on a common shaft which passes through the clutch housing, where it is supported by two bronze bushes.
The right-hand side pedal turns on the shaft on two steel-backed bronze bushes, which are spaced apart. The left-hand side pedal is interposed between these bushes and is locked to the shaft by a drive fit cotter pin. A lubricator is fitted into the end of the shaft and is connected to the pedal bushes by suitable drillings.
At the left-hand end of the cross-shaft is secured the cross-shaft lever so that when the left-hand pedal is depressed, the lever moves forward actuating the left-hand brake rod and camshaft.
Rubber oil seals are fitted to the cross-shaft at both sides of the clutch housing.

To Remove the Brake Cross-shaft

1. Drain approximately one gallon of oil from the gearbox.
2. Disconnect the right- and left-hand brake rode at their forward ends, from the right-hand brake pedal and the brake cross-shaft lever respectively.
3. Remove the pinch bolt from the left-hand brake lever and pull the lever off the cross-shaft. Remove the Woodruff key from the shaft. Check that the end of the shaft is free from burrs and remove these if necessary, using a carborundum stone, before sliding the cross-shaft through the oil seals.
4. Remove the brake cross-shaft and both pedals as an assembly from the right-hand side of the clutch housing.

To Replace the Brake Cross-shaft

1. Replace the cross-shaft and pedals as an assembly taking care not to damage the seals as the shaft is passed through the housing.
2. Refit the Woodruff key to the cross-shaft.
3. Replace the cross-shaft lever and secure in position with a pinch bolt.
4. Reconnect the brake rods to the brake levers, refit the clevis pins and securely split pin.
5. Refill the gear box with an approved oil of the cottect grade.

To Renew the Cross-shaft Oil Seals

1. Remove the brake cross-shaft as previously described.
2. Using a suitable lever, remove the cross-shaft oil seals from the clutch housing.
3. Press the new seals into the housing with the steel case of the seals facing outwards, using the adaptor (Tool No. T.7078) on the universal handle (Tool No. 550).
4. Refit the brake cross-shaft as previously described.

To Overhaul the Brake Pedals

1. Remove the brake cross-shaft as previously described.
2. Suitably support the brake pedals and cross-shaft and drive out the tapered cotter pin securing the left-hand pedal to the shaft. Both pedals can then be slid off the shaft.
3. If the brake pedal bushes require renewal, press or drive out the old bushes from their locations. When fitting the new bushes it should be noted that the longitudinal grease groove in each bush should line up with a drilling in the cross-shaft. The taper pin bore in the pedal and the corresponding flat on the cross-shaft can be used as guides to obtain the correct position for the grease grooves.
The bushes are pre-sized and do not require reaming after assembly.
4. The brake pedal locking latch may be removed by first tapping out the tension pin which acts as a stop. Any worn parts can then be renewed and the locking latch reassembled.
Fit the latch into the pedal and tap in a new tension pin. The latch should be suitably supported as the pin is tapped in to prevent distortion and approximately .56 in. (14,22 mm) of the pin should be left protruding from the front of latch.

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SPECIFICATION AND REPAIR DATA - BRAKING SYSTEM

Type	...	...	...	...	Mechanical internal expanding
Brake actuation	...	...	...	...	Rod
Diameter of drums	...	...	...	...	14 inch (355,6 mm)
Brake Linings					
Material	...	...	...	...	Woven or moulded
Length per shoe	...	...	...	...	13.3 inch (337,8 mm)
Width	...	...	...	...	2 inch (50,8 mm)
Thickness	...	...	...	...	0.25 inch (6,35 mm)
Total area	...	...	...	...	106.5 sq.ins. (687 sq.cm.)
Parking brake lock	...	...			Pawl and sector to lock pedals in “down” position
Anchor pin diameter	...	...			1.122 to 1.125 inch (28,499 to 28,575 mm)
Brake Springs					
Adjuster end spring:					
Overall free length	...	...	...		5.31 inch (134,87 mm) approx
Length under load	...	5,75 inch (146,05 mm) under 36 to 44 lbs. (16,3 to 20 Kg) tension			
Retracting spring:					
Overall free length	...	..	...		5.44 inch (138,18 mm) approx
Length under load	...	6.50 inch (165,10 mm) under 90 to 110 lbs (40,8 to 49,9 Kg) tension			
Secondary springs:					
Overall free length	...	...	...		3.28 inch (83,34 mm) approx
Length under load	...	3.81 inch (96,82 mm) under 90 to 110 lbs (40,8 to 49,9 Kg) tension			

WHEELS AND TYRES

WHEEL WEIGHTS

Wheel weights are available for use on both front and rear wheels. Rear wheel weights increase wheel adhesion, whilst front wheel weights are use to counteract the effect of certain heavy rear mounted equipment where the centre of gravity is considerably overhanging the rear of the tractor.

Fitting Front Wheel Weights

Cast iron weights may be fitted to the inside of each front wheel to provide an additional 100 lbs. on each side of the tractor. To fit front wheel weights it is necessary to remove the wheel from the hub and attach the weight to the inside of the front wheel disc with four nuts, bolts and washers supplied with the weight.

Fitting Rear Wheel Weights

Each cast iron weight is approximately 80 lbs. and normally a maximum of three weights per wheel are found to be sufficient for most agricultural conditions.

If only one weight is to be fitted, assemble the three spacers to the bolts, insert the bolts from the inside of the wheel and secure the weight to the wheel disc by the bolts, nuts and lockwashers. (In the case of Power Adjusted wheels the spacers are already welded to the disc.)

If auxiliary weights are required it will be necessary to fit the three mounting bolts with the head in the recessed hole provided, before securing the weight to the rear wheel disc. The auxiliary weight can then be assembled to these three bolts using the nuts and washers provided.

If additional weight is required adopt the same procedure, making certain that the three bolts are assembled to the preceding weights, before securing it to the wheel disc or auxiliary weight.

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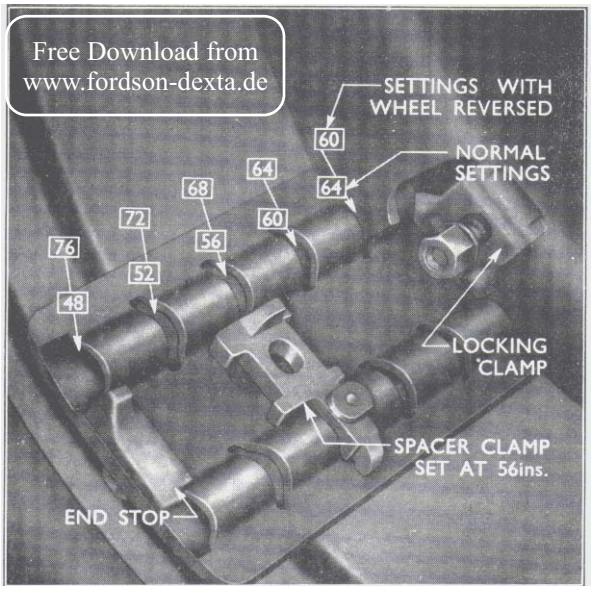

Fig. 6
Track Width Setting

Liquid Ballast

Liquid ballast may be used in the rear tyres to give increased rear wheel adhesion and full details are given in the Instruction Book.

TYRES

When refitting rear tyres or wheels care must be taken to ensure that the tyre tread is pointing in the correct direction as indicated by the arrow on the tyre wall. This will ensure maximum adhesion and that the self-cleaning action of the tyre is utilised.

POWER ADJUSTED REAR WHEELS

Power Adjusted Rear Wheels are available as an optional extra and provide a rapid means of adjusting the rear track between 48 ins. and 76 ins.(inch) Engine power is used to alter the wheel settings and an adjustment range of 48 ins. to 64 ins. is obtainable with the wheel discs mounted on the rear hubs in the standard position, i.e. dished inward from centre to rim. A further adjustment range of 60 ins. to 76 ins. may be obtained by interchanging wheel assemblies.

Changing the track with a power adjusted wheel is similar to turning a bolt in a nut. The rim acts as the nut, with slotted channel bars which serve as threads. The wheel disc acts as a bolt having a helical shape with a 2 in. pitch.

The different track widths available are shown in Fig 6 and it will be seen that one complete revolution of each wheel makes a 2 in. alteration in the track. Both rear wheels should be adjusted to symmetrical positions to obtain the settings indicated, but by placing the spacer clamp in other channels on the rim spacings at half inch intervals can be made.

It is not necessary to jack up the wheels clear of the ground and once the desired setting has been determined each wheel should be adjusted separately as follows:

1.Loosening the Rim from the wheel

(a) Remove the large nut on the spacer clamp, turn the spring loaded locating stud through 90° and remove the clamp from the wheel.

(b) Loosen the nut on each of the three rectangular. locking clamps, slide the clamps toward the hub of the wheel and tighten the nuts to hold the clamps in position.

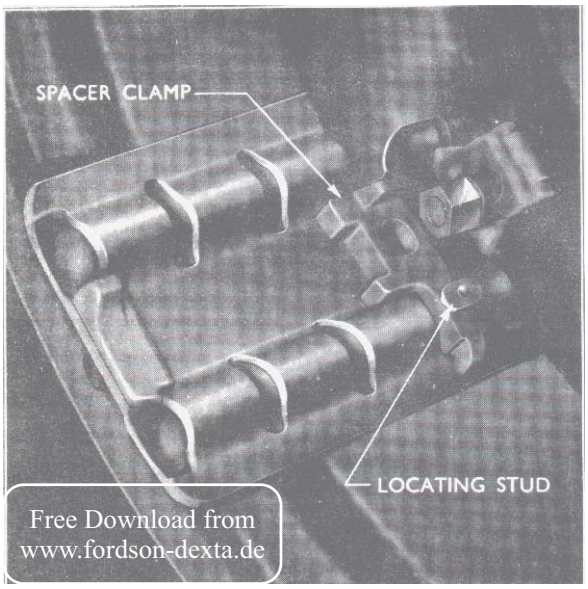

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Fig. 7
Wheel Disc Against Spacer Clamp

2. Moving the Wheel Disc in the Rim

NOTE.-To increase the track (i.e. to move the wheels outwards) use low reverse gear for the left wheel and low forward gear for the right wheel.

To decrease the track use low reverse gear for the right wheel and low forward gear for the left wheel.

(a) The final track adjustments must always be made inward (providing the wheels are not reversed). If an increase in track is required it will be necessary to go beyond the desired setting and then come back, therefore with the engine at idling speed move the tyre outward by engaging the clutch with the tractor in the correct gear and at the same time holding the opposite wheel with the brake so that the tractor rolls slowly. Disengage the clutch immediately the wheel disc strikes the end stop.

(b) Place the spacer clamp in the channel thread bar for the desired settings as shown in Fig. 6. The oval foot of the spring loaded locating stud is inserted in the channel slot, then turned so that it is secured in the channel.

(c) Move the wheel inward by selecting the correct gear, engaging the clutch with the engine at idling speed and braking the opposite wheel to let the tractor creep while the wheel disc is revolving. Disengage the clutch immediately the wheel strikes the spacer clamp, see Fig. 7.

3. Securing the Rim in Position

(a) Remove the spacer clamp from the channel bar by turning the spring loaded locating stud through 90°.

(b) Use the spacer clamp as the fourth wheel locking clamp. Place the clamp on the bolt with the lug in the holding slot and the spring loaded locating stud through the wheel disc. Install the large nut and washer and tighten the nut securely. The spacer clamp used as a driver clamp is shown in Fig. 8.

(c) Loosen the nuts on the three rectangular locking clamps and move them into the clamping position in the thread channel.

Tighten all clamp nuts securely.

NOTE: The clamp nuts should be tightened again after the tractor has been used for a short period.

4. Changing the Wheel Discs

When a track greater than 64 ins. is required wheel spacings of 68, 72 or 76 ins. can be obtained by setting the track at 48 ins. for a 76 in. track, 52 ins. for a 72 in. track and 56 ins. for a 68 in. track then reversing the wheels on the tractor.

(a) Loosen the eight nuts on the wheel stud at each rear hub.

(b) Raise the rear of the tractor and be sure it is firmly supported.

(c) Remove the nuts and interchange the wheels so that they dish outward from centre to rim. The arrow on the side wall of the tyre should always point in the direction of forward rotation of the wheel.

(d) Replace the nuts, lower the tractor and tighten the nuts securely.

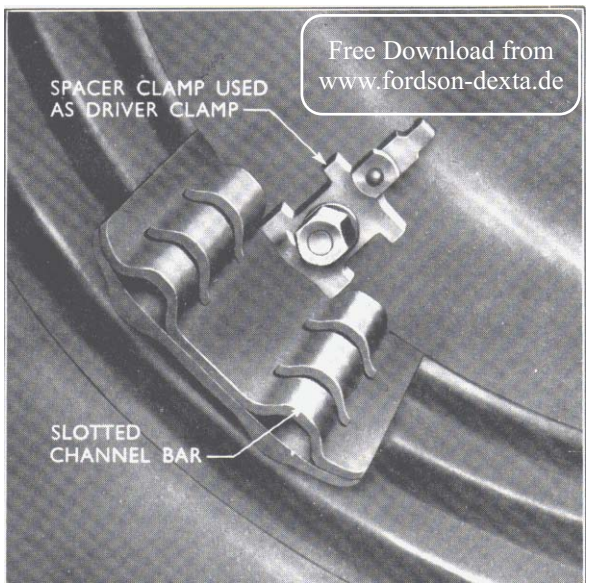

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Fig. 8
Spacer Clamp Used as a Driver Clamp

NOTE:- With the wheels reversed (dished outward) it will be necessary to set the spacer clamp ans locking clamp from the inside of each wheel when making adjustments. Disengage the spacer and locking clamps, move the tyre to its extreme "in" position and set the spacer clamp as desired. Use the tractor power to adjust the wheel to the desired width and, after adjusting, replace the spacer clamp and locking clamps and tighten them securely.

SPECIFICATION AND REPAIR DATA - WHEELS AND TYRES

Tyres	
Front	
Standard	4.00 x 19 4-ply rating
Optional	5.50 x 16 6-ply rating
Rear	
Standard	10 x 28 4-ply rating
Optional	11 x 28 4- or 6-ply rating
Tyre Pressure	
Front	
4.00 x 19	34 lbs./sq.in. (2390 gm./sq. cm.) 42 lbs./sq.in. (2950 gm./sq. cm.) with front wheel weights
5.50 x 16	20 lbs./sq.in. (1410 gm./sq. cm.) 26 lbs./sq.in. (1830 gm./sq. cm.) with front wheel weights
Rear	
10 x 28	12 lbs./sq.in. (845 gm./sq. cm.)
12 x 28	12 lbs./sq.in. (845 gm./sq. cm.)
Wheel Weights	
Front	100 lbs. (45 Kg) per wheel
Rear	80 lbs. (36 Kg) each weight, recommended up to three weights per wheel
Approximate Rolling Radius of the Rear Wheel	
10 x 28	22.13 to 22.2 ins. (56,21 to 56,39 cms)
11 x 28	22.7 to 22.8 ins. (57,66 to 57,91 cms)

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THE FRONT AXLE

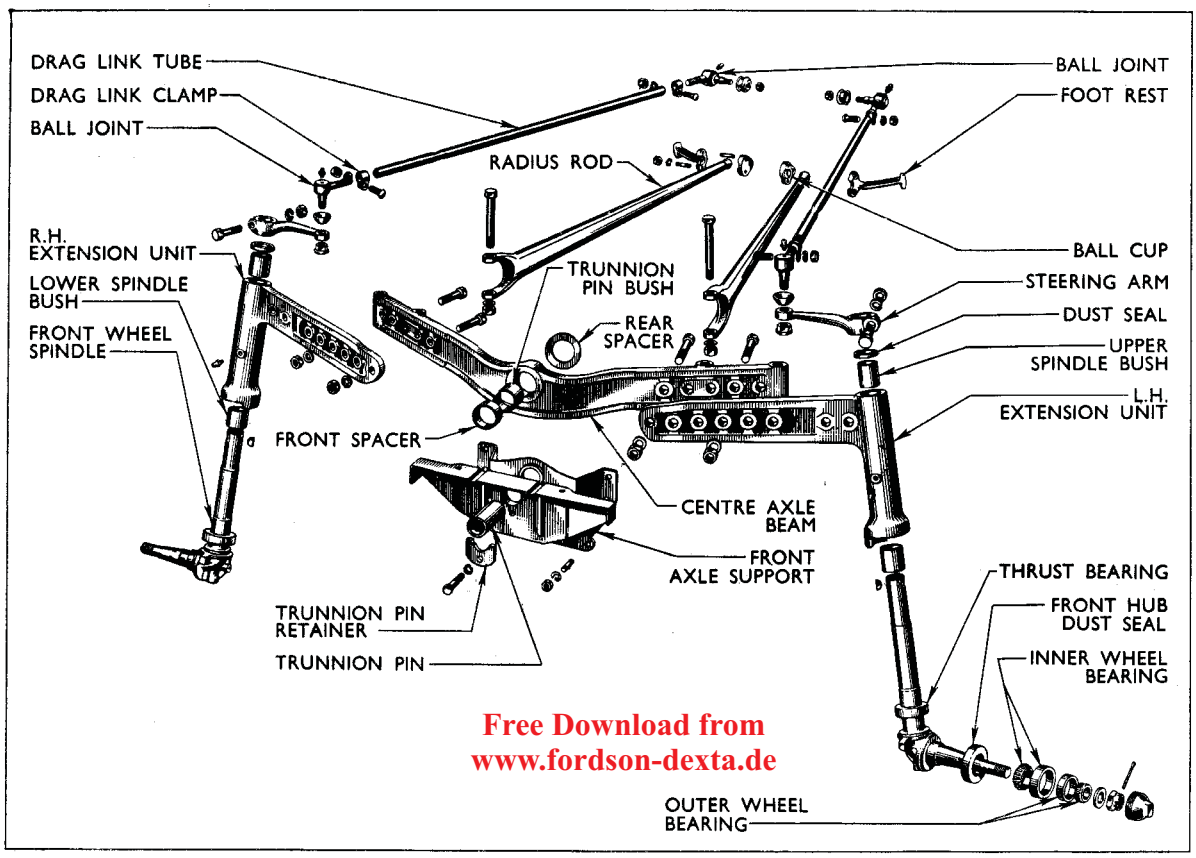

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Fig. 1
The Front Axle

The front axle consists of a centre beam, mounted to the front engine support by means of a trunnion pin, and right- and left-hand extension units which carry the wheel spindles. Two radius rods are connected between the centre beam and the gearbox housing to provide rigidity for the front axle.

Front Track Adjustment

With standard 4.00x19 tyres, the front wheels are adjustable from 48 ins. to 76 ins. in 4 in. stages when the extension units are symmetrically positioned. With optional rims and 5.50x16 tyres the smallest possible track setting is 52 ins. otherwise the tyres will rub on the radius rods when on maximum lock. The cast figures on the outer axle beams indicate the track width when both outer axle beams are symmetrically positioned. Figures marked on the top flange of the outer axles (Fig. 2) indicate the track width when they line up with the innermost hole (Hole A) of the centre beam. Similarly, the figures on the bottom flange indicate track width when lined up with the outermost hole (Hole B) of the centre beam.

CAUTION.-At least one open bolt hole must be left between the axle beam to extension fixing bolts. The wheels must not be reversed on the hubs to obtain a greater track since this results in excessive loading on the bearings and mounting bolts. With track settings at, or below, 56 ins. the radius rods should be located in the inner holes (Hole C, Fig. 2) of the centre beam, but when the track is adjusted to over 56 ins. the radius rods must be moved to the outer holes (Hole D) to maintain rigidity.

When the track has been re-set it will be necessary to adjust the toe-in as described below, both drag links being adjusted to ensure equal lock.

TOE-IN

Toe-in of the front wheels is designed to be betwen 1/4 in. ans 1/2 in. and may be regulated by adjusting the drag links. Correct toe-in is set at the factory and marked with four chisel marks, one on each spindle housing lining up with one on each steering arm. If new steering arms are fitted it will be necessary to re-align the wheels and re-mark for future reference.

If only one steering arm is to be changed, set the steering in the straight ahead position, using the marks on the opposite steering arm and axle extension as a guide.
Fit the new arm, connect its corresponding drag link and measure between the front wheels (at both front and rear) at hub height.
Adjust the drag link until the correct toe-in of 1/4 in. to 1/2 in. is obtained. Chisel mark the new arm in line with the existing mark on the axle beam. Should circumstances arise where it is not possible to use the original factory marking (i.e. if the marks become obliterated or if both steering arms or both axle extensions require renewing) it will be necessary to find first the centre of the steering box. Disconnect the drag link and count the number of turn required to move the steering wheel from lock to lock, then turn the wheel back half this number of revolutions.
Assemble the new parts and place the wheels in the straight ahead position, connect the drag links and adjust their lengths to give the specified toe-in. Chisel mark the arms and axle extensions as necessary.
The adjusted length of the drag links differ because of the position of the steering drop arms and, if fitting new drag links or drag link ends, the length of each drag link will have to be adjusted individually. The approximate lengths of the drag links with track at 52 ins. (132cm) are: R.H.- 39.1 ins. (99,3cm) and L.H.- 38.4 ins. (97,5cm). The front and rear drag link ends also differ as shown in Fig.3, and care must be taken to ensure that the links are fitted correctly.
It is most important that the drag link tube to drag link end clamp bolts are always positioned so as to lie across the split in the tube.

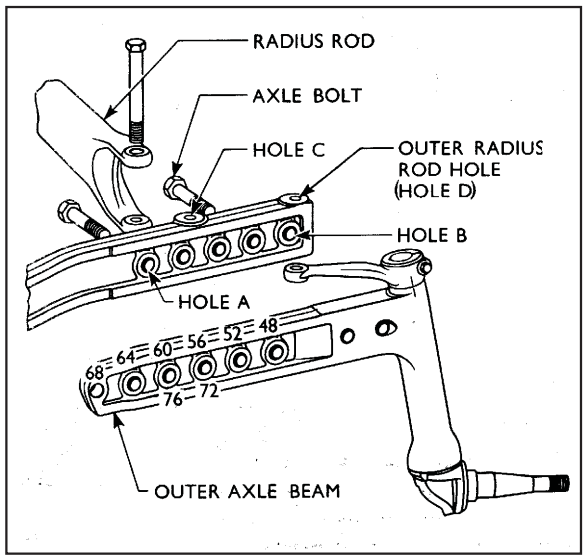

Fig. 2
Track Settings

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Fig. 3
Front and Rear Drag Link Ends

Trunnion Pin and Bush

To Remove

1. Disconnect the two radius rods from the centre beam and the drag links from the steering arms.
2. Jack up the front of the tractor to just support its weight and remove the front axle extension units.
3. Remove the trunnion pin clamping bolt and retainer and draw out trunnion pin, using Tool No. T.3051. Ensure that the spacers are maintained in their originally assembled order.
4. Slide out the centre beam sideways.
5. Drive out the trunnion pin bush using Tool No. T.3052

To Replace

1. Fit a new bush using Tool No.T.3052 and check the fit of the trunnion pin in the bush.
2. Slide the centre beam into position and align it with the front axle support.
3. Replace the trunnion pin, remembering to fit the large spacer between the front of the centre beam and the axle support. The other spacers are fitted in the position they were in before stripping.
4. Refit the trunnion pin retainer and clamping bolt.
5. Replace the axle extension units checking that the fixing bolts are located in the correct holes.

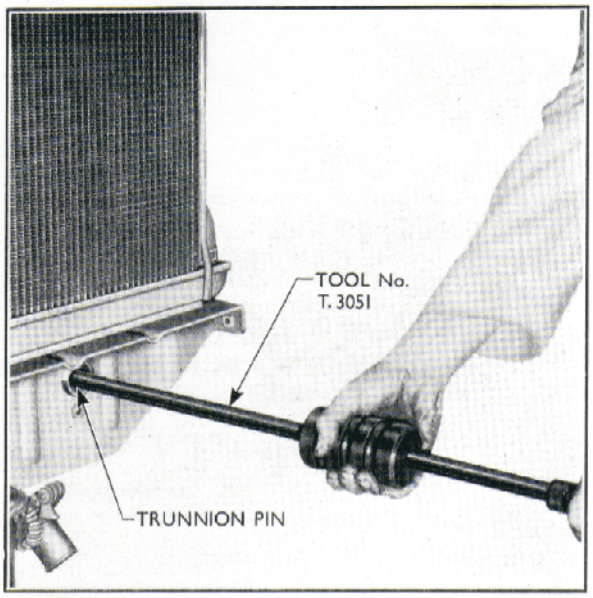

Fig. 4
Trunnion Pin Removal

6. Connect the radius rods to the centre axle beam.
7. Connects the drag links to the steering arms and check that the wheel alignment marks are correctly matched.
8. Remove the jack

Wheel Bearings
To Adjust

The following applies to both left- and right hand wheels.
1. Jack up the front of the tractor, grasp the wheel at the top and bottom and test for excessive play in the bearings. (Do not mistake worn wheel spindles or bushes for end play in the bearings.)
2. Remove the hub cap and extract the split pin from the bearing adjusting nut.
3. Rotate the wheel whilst tightening up the bearing adjusting nut and continue to tighten until a heavy drag can just be felt. Turn back the nut, one castellation at a time so that the wheel rotate freely, but with no end play. Fit a new split pin and reassemble the hub cap filled with clean grease. Finally lower the tractor to the ground.

The bearings should be tested for correct adjustment every 200 working hours and readjusted if necessary. Even if it is not necessary to adjust the bearings the hub cap should be removed and filled with clean grease.

CAUTION. Care should be taken to ensure that no dirt or water is allowed to reach the bearings, or inside the hub cap when the wheels are being readjusted

To Remove

1. Remove the hub cap and jack up the front wheel of the tractor.
2. Extract the split pin from the bearing adjusting nut and remove the nut and keyed washer.
3. Pull the wheel outwards so that the outer bearing can be detached and lift the wheel off the spindle.
4. The inner bearing can now be removed and if the dust excluder needs replacing it can be levered off its seat.
5. If the bearings need replacing press out the inner and outer bearing cup using Adaptors T.1024-4 in Tool No. T.1024.

To Replace

1. Fit the new inner and outer bearing cups using Adaptors T.1024-4 in Tool No. T.1024 and pack the hub with a good quality short fibre grease.
2. Fit a new dust excluder if required (using Tool No. T.3053) and replace the inner bearing on its seat.
3. Lift the assembly onto the spindle and locate the outer bearing and keyed washer.
4. Fit the adjusting nut and adjust the bearings as previously described.
5. Fit the new split pin and reasemble the hub cap filled with clean grease.
6. Remove the jack.

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Spindle Bushes
To Remove

1.Jack up the front of the tractor and remove the wheel.
2. Disconnect the drag link to steering arm connection.
3. Remove the front axle extension.
4. Slacken off the steering arm locking bolt, remove the steering arm, the woodruff key and the dust seal and slide out the wheel spindle (the bottom thrust bearing will come away with the wheel spindle.)

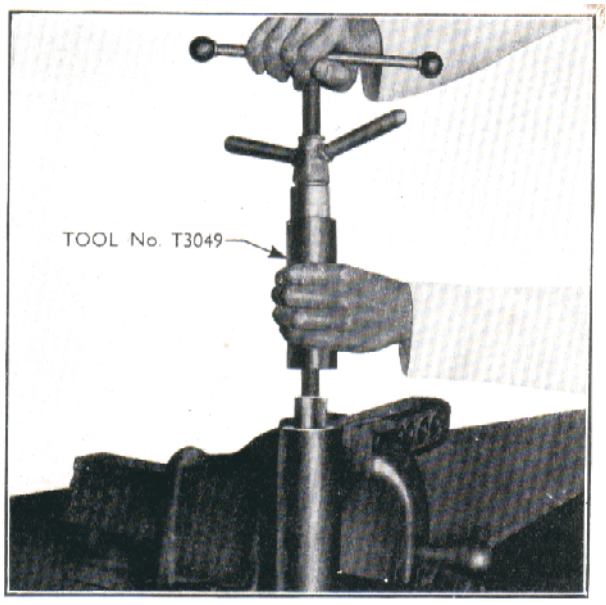

Fig. 5
Removing the Spindle Bushes

5. Pull out the bushes using Tool No. T3049 (see Fig. 5).

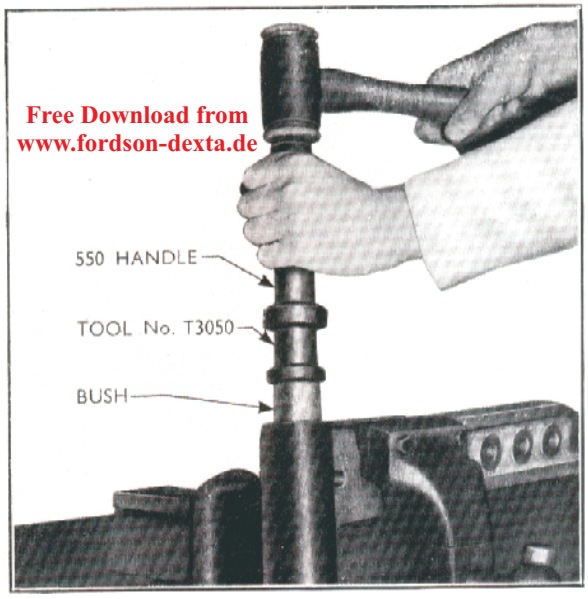

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Fig. 6
Replacing the Spindle Bushes

6. Clean out the grease and any swarf left after using the tool.

To Replace

1. Using Tool No. T.3050 and 550 handle, fit the new upper and lower bushes (see Fig. 6).

2. Check the fit of the wheel spindle in the bushes.

3. Refit the extension to the centre beam .

4. Assemble the thrust bearing on the wheel spindle ensuring that it is correct way up and locate the wheel spindle in position.

5. Replace the dust seal and woodruff key and clamp the steering arm in position.

6. Connect the drag link to the steering arm, checking that the wheel alignment marks are accurately matched.

7. Refit the wheel and adjust the bearings.

8. Remove the jack.

FRONT AXLE SPECIFICATIONS

Track with 4.00 × 19 tyres	Inches	48	52	56	60	64	68	72	76
Track with 5.00 × 16 tyres	Inches	—	52	56	60	64	68	72	76
Metric equivalent	Centimetres	122	132	142	152	163	173	183	193

Turning circle : with brakes	17 ft. (518 cm.)
without brakes	19 ft. 6 ins. (594 cm.)
Castor	4° 57′
Camber	2° 7′
Spindle pin inclination	9°
Toe-in	¼ to ½ in. (6.35 to 12.7 mm.)
Spindle pin diameter :	
Upper bearing surface	1.245 to 1.246 ins. (31.623 to 31.649 mm.)
Lower bearing surface	1.338 to 1.339 ins. (33.985 to 34.001 mm.)
Spindle pin bushes internal diameter :	
Upper	1.2495 to 1.2515 ins. (31.737 to 31.788 mm.)
Lower	1.3425 to 1.3445 ins. (34.100 to 34.150 mm.)
Clearance between pins and bushes	.0035 to .0065 in. (.089 to .165 mm.)

Tightening Torque Figures	*lbs. ft.*	*kg.m.*
Front axle extension bolts	100 to 110	13.83 to 15.21
Trunnion pin retaining plate screw	75 to 85	10.37 to 11.75
Spindle to steering arm nut	40 to 45	5.53 to 6.21

THE STEERING GEAR

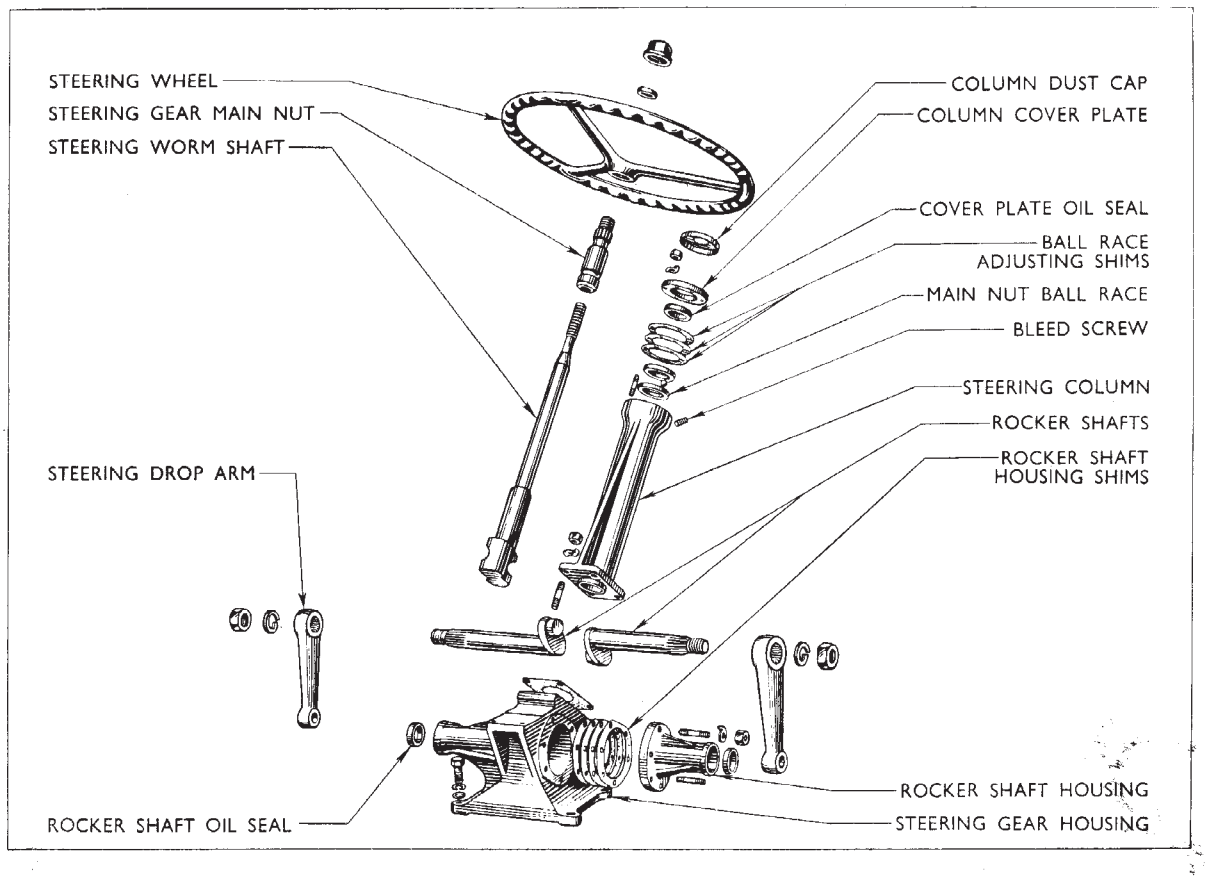

Fig. 7
The Steering Gear

The steering gear which is mounted on the top of the clutch housing is of the worm and nut type. The worm consists of a " two start " thread machined on the upper end of the steering shaft and the nut rotates in a loose ball race located in the upper end of the steering column, designed to withstand end thrust as well as radial loading.

The steering main nut has an internal " two-start " thread which engages with the worm, and is splined into the hub of the steering wheel, which is retained on the main nut by a cap nut.

The lower end of the steering worm shaft is shaped to accommodate the cranked ends of two rocker shafts which extend to either side of the tractor. The outer ends of the rocker shaft are splined into separate drop arms and these in turn are connected through individual drag links to each front wheel steering arm.

Steering wheel rotation will therefore cause the main nut to rotate within its bearing and so move the steering worm shaft vertically (up or down depending on the direction of rotation) within the steering column. Such movement of the steering worm shaft rotates the steering rocker shafts (in opposite directions) and transmits movement to the front wheels.

Each front wheel is therefore steered direct from the steering gear by its own drag link, which is adjustable for length, and the necessity for an inter-connecting track rod is eliminated.

The following operations can be carried out without removing the steering gear from the tractor.

Steering Cover Plate Oil Seal

To Remove

1. Unscrew the cap nut retaining the steering wheel to the steering main nut.

2. Lift the steering wheel from the main nut splines followed by the steering column dust cap.

3. Remove the pin securing the throttle lever to the vertical throttle rod and remove the lever.

4. Unscrew the four instrument panel securing screws, lift the panel from its location and move it clear of the top of the steering column. If necessary, the warning light bulb holders can be pulled out of their sockets to improve accessibility.

5. Bend back the locking tabs on the six steering column cover nuts and unscrew the nuts. Lift the cover plate from the studs and the steering main nut taking care not to damage the oil seal.

Note that a number of shims and gaskets are fitted between the cover plate and the column to provide adjustment on the ball race.

When the cover plate is removed a quantity of oil will run out of the column and this should not be allowed to run onto the wiring.

6. Drive the oil seal out of its location in the column cover plate.

To Replace

1. Fit the new seal, pressing it squarely into the plate with the lip facing downwards. Ensure that the seal does not stand proud of the lower face of the plate. Refit the plate to the steering column and retain with six tab washers and nuts. Tighten the nuts to a torque of 12 lbs. ft. (1.65 kg.m.).

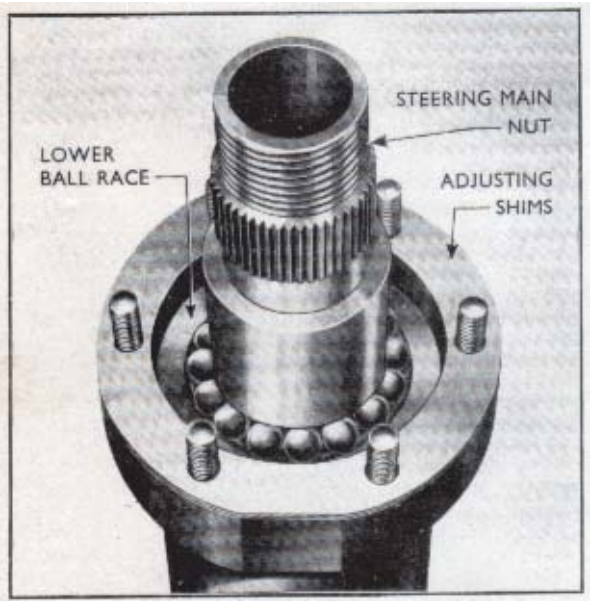

Fig. 8
The Steering Main Nut

2. Refit the warning light bulbs in their appropriate sockets (the purple wire should be connected to the oil pressure warning light on the right-hand side and the yellow and white wire to the generator charging light on the left). Ensure that the small rubber sealing ring is located correctly in the throttle rod support bush in the instrument panel.

3. Refit the instrument panel, locating the throttle rod in its support bush and ensuring that the rubber gasket seats correctly between the panel and the fuel tank. Check that warning lights and temperature gauge are seated correctly in their locations in the plate and install the instrument retaining plate and rubber gasket. Fit and tighten the four long screws to secure the assembly.

4. Replace the column dust cap and fit the steering wheel onto the main nut splines.

5. Add sufficient oil through the centre of the steering main nut to bring the level above the worm shaft. Turn the steering wheel during the replenishing operation to obviate air locks.

6. Examine the rubber sealing washer fitted inside the steering wheel cap nut and renew if it shows signs of damage or deterioration.

7. Replace the steering wheel nut and sealing washer assembly and tighten securely.

Steering Main Nut Bearing

To Adjust

Adjustment of the steering main nut bearing is achieved by varying the number and thickness of the shims between the cover plate and the steering column (see page 9, Operations 7 and 8).

To Renew

The bearing upper race and balls may be renewed after removing the steering column cover plate, but should the lower race require replacing, it will be necessary to remove the steering column and drive out the old race through the top of the column.

This involves removal of the steering gear (complete) as outlined on page 7 (with the exception that the drop arms need not be removed) followed by Operations 2 to 4 of section headed " To Dismantle the Steering Gear " page 8.

To reassemble, follow Operations 6 to 13 of section headed " To Reassemble the Steering Gear," pages 9 and 10 followed by section headed " To Replace the Steering Gear," page 8.

STEERING DROP ARMS

To Remove a Steering Drop Arm

1. Remove the self-locking nuts on the drag link rear ball joints and disconnect the drag links from the drop arms.

2. Remove the nuts and spring washers retaining the drop arms to the steering rocker shafts and, using Tool No. T.3054, pull the drop arms from the rocker shaft splines by tightening the centre screw of the tool. If necessary, strike the end of the screw a sharp blow whilst retaining a tension on the arm to free the drop arm from the rocker shaft splines.

To Replace a Steering Drop Arm

The steering rocker shafts and drop arms are fully interchangeable but care must be taken on assembly that the drop arms are fitted in correct relation to the rocker shafts.

When fitted correctly, with the steering gear in the straight-ahead position (i.e. mid-way between steering locks), the bottom ends of both drop arms should incline rearwards at an angle of approximately 13 degrees to the vertical.

To facilitate assembly, a chisel mark is made on the threaded end face of the rocker shaft and two chisel marks are placed on the outer face of the large boss on the drop arm.

Depending on which side of the steering gear the drop arm is fitted, one of the marks on the drop arm must coincide with the mark on the rocker shaft. (If an attempt is made to assemble either drop arm using the incorrect marking for that particular side of the steering gear, it will be immediately apparent, as the drop arm will not then incline at the specified angle of 13 degrees from the vertical).

1. Ensure that the rubber dust seal behind the drop arm is in good condition, fit the drop arm and retain with the appropriate spring washer and nut.

2. Refit the drag link rear ball joint to the arm and retain with the appropriate self-locking nut.

3. Check that with the steering gear in the straight-ahead position the chisel marks on the axle extensions and on the steering arms line up, thus indicating that the front wheels are also correctly aligned. Adjust the drag links if necessary to obtain the above condition.

STEERING ALIGNMENT

To carry out a complete check of the alignment of the steering gear and linkage and the front wheels :—

1. Set the steering wheel in the straight ahead position, i.e. set midway between locks with the drag links disconnected.

2. Check that the steering drop arms are correctly fitted with the chisel marks lined up as described under " To Replace a Steering Drop Arm."

3. Set the front wheels in the straight ahead position with the specified toe-in of $\frac{1}{4}$ in. to $\frac{1}{2}$ in. The chisel marks on the axle extensions and the steering arms should then be in line.

4. Slacken the clamp bolts on the drag link ends and adjust the length of the drag links to fit exactly between the steering arms and drop arms.

The standard lengths for the drag links (track set at 52 ins.) are :—

Left-hand drag link	38.4 ins. (9.75 cm.) approx.
Right-hand drag link	39.1 ins. (9.93 cm.) approx.

5. Fit the self-locking nuts on the ball joint studs and tighten securely.

STEERING GEAR OVERHAUL

To Remove the Steering Gear

1. Remove the primary air cleaner, vertical exhaust pipe (if fitted) and the bonnet (4 screws, flat washers and nuts).

2. Disconnect the battery leads and remove the battery clamping bracket and battery.

3. Unscrew the four self-tapping screws in each control panel side plate and remove the plates.

4. Drain approximately half a gallon (2.27 litres) of water from the radiator drain tap so as to bring the water level below the temperature gauge bulb unit in the cylinder head water outlet, and remove the bulb from the outlet.

5. Remove the steering wheel, release the instrument panel retaining plate screws, detach the warning light bulb holders and remove the plate as described under : " To Remove the Steering Cover Plate Oil Seal."

6. It will facilitate handling if the fuel tank is drained, but this is not absolutely necessary if care is taken to ensure that the fuel tap is fully closed. Disconnect the main fuel pipe and induction primer pipe from the fuel tap and the injector leak-off pipe from the front of the fuel tank.

7. Unscrew the three bolts securing the fuel tank to the support brackets (two bolts at front, one at rear).

8. Lift the fuel tank complete with instrument panel and temperature gauge unit over the steering column and away from the tractor. Store the tank carefully to avoid damaging the fuel unions.

9. Disconnect the vertical throttle control rod from the horizontal relay rod.

10. Disconnect the drag links and remove the drop arms as previously described.

NOTE.—This is not necessary if the steering box is not to be dismantled.

11. Unscrew the four bolts securing the steering gear to the clutch housing and the single bolt passing through the fuel tank front support bracket into the steering gear housing.

12. Remove the steering gear assembly from the tractor.

To Replace the Steering Gear

1. Install the steering gear on the clutch housing and fit the four securing bolts, spring washers and flat washers. The electric horn, if fitted, should be installed under the front right-hand side bolt.

Refit the single bolt securing the fuel tank front support bracket to the steering gear.

2. Refit the steering drop arms and reconnect the drag links as described under " To Replace a Steering Drop Arm."

3. Use a length of cord to secure the warning light bulb holders to the upper end of the steering column. Locate the vertical throttle rod in its recess in the steering gear housing and reconnect the throttle relay rod.

4. Place the fuel tank on its support brackets passing it carefully over the steering column, throttle rod and wiring. Take particular care not to trap the temperature gauge bulb or tubing when making the assembly.

5. Release the warning light wires from the steering column and feed them through the appropriate holes in the instrument panel. Replace the warning light bulbs and insert in the holders in the instrument panel retaining plate. Install the plate and retaining screws.

6. Fit the three rubber mounting pads between the fuel tank and the brackets, and replace the three mounting bolts and spring washers.

7. Reconnect the main fuel feed pipe and the induction primer pipe to the fuel tap and primer assembly and the injector leak-off pipe to the union on the front of the fuel tank. It will be necessary to bleed the fuel system to exclude air before re-starting the engine.

8. Refit the throttle control lever and the steering wheel as described under, " To Replace the Steering Cover Plate Seal."

9. Replace the battery and battery clamping bracket and reconnect the battery leads. Operate the main control key to ensure that both warning lights are working correctly.

10. Refit the control panel side plates securing each with four self-tapping screws.

11. Refit the temperature gauge bulb unit in the cylinder head outlet and refill the radiator.

12. Replace the bonnet and secure with four screws, flat washers and nuts.

13. Replace the primary air cleaner and vertical exhaust pipe (if fitted).

To Dismantle the Steering Gear

1. Remove the steering gear from the tractor as previously described (the steering wheel and steering drop arms will normally have been removed from the steering gear prior to its removal from the tractor).

2. Remove the steering column cover plate, steering main nut, bearing upper race and balls as described under " To Remove the Steering Cover Plate Oil Seal."

3. Invert the assembly and pour away the oil.

4. Bend back the locking tabs on the four steering column to steering box retaining nuts, unscrew the nuts and remove the steering column.

Examine the balls and races of the bearing and if either shows signs of pitting or excessive wear the complete bearing should be renewed.

If such replacement is necessary drive the lower race out through the top of the steering column using a long rod which should be inserted from the base of the column and located against the bottom face of the ball race.

Drive the new lower race into position to seat against the shoulder at the top of the internal bore of the column.

Fig. 9
Removing the Steering Worm Shaft

5. Separate the left-hand rocker shaft housing on the steering box by bending back the tab washers and unscrewing the six nuts. Note that a number of shims are fitted between the housings to provide an adjustment on the rocker shaft engagement with the lower end of the worm shaft.

6. To remove the steering worm shaft from the steering box, remove the lower rear rocker shaft housing stud and withdraw the shaft through the left-hand side of the steering box as shown in Fig. 9.

7. Remove the rocker shafts from their respective housings. The shafts are identical but if they are to be re-used it is recommended that they are reassembled in the same housings from which they were originally removed.

To renew the rocker shaft oil seals lever the old seals out of the housings and drive or press the new seals squarely into position with the lip on the seals facing inwards. Pressure should be applied only to the outer edge of the seals to avoid damaging the lip.

To Reassemble the Steering Gear

1. Examine the rocker shafts for burrs which could damage the oil seals on reassembly.

NOTE.—The rocker shaft housings are serviced complete with bushes, which are ball broached after assembly into the housings.

Coat the rocker shafts liberally with oil and assemble into their respective housings ensuring that they are a good fit.

2. Fit the steering worm shaft into the steering box and replace the stud previously removed to facilitate dismantling.

Fig. 10
Rocker Shaft Adjustment

3. Assemble the left-hand rocker shaft housing complete with rocker shaft and ensure that both rocker shafts engage correctly with the worm shaft. Fit the securing nuts finger tight and position the worm shaft centrally between its stops. Using feeler gauges measure the gap between the steering box and the left-hand housing ensuring it is equal at all points (Fig. 10).

4. Remove the left-hand rocker shaft housing, insert a sufficient number of shims and gaskets equal in thickness to the measured gap and replace the housing. Two sizes of steel shims are available of thickness .005 in. (.127 mm.) and .030 in. (.762 mm.). A gasket should also be fitted between the shims and the steering box and rocker shaft housing faces, and to facilitate adjustment two thicknesses of gasket are available i.e. .002 in. (.51 mm.) and .010 in. (.254 mm.). It should be noted that the compressed thickness of the .010 ins. gasket is approximately .007 in. (.178 mm.).

5. Tighten the six housing nuts fully, check that the rocker shafts turn freely without binding in any one position and bend over the tab washers to secure the nuts.

6. Fit the steering main nut in the top of the column, install the fifteen ball bearings, fit the bearing upper race and the cover plate.

7. Fit the six nuts on the cover plate studs and tighten sufficiently to remove all side movement of the main nut whilst still permitting it to turn freely.

Use feeler gauges to measure the gap between the cover and the column, ensuring that this is equal at all points, and select shims and gaskets of the equivalent thickness (see Fig. 11).

The shims available are .004 in. (.102 mm.) and there are two sizes of gaskets .002 in. (.051 mm.) and .010 in. (.254 mm.) which should be fitted between the shims and the housing and cover plate.

Note that the .010 in. (.254 mm.) gasket compresses to a thickness of approximately .007 in. (.178 mm.).

8. Remove the cover plate, insert the selected shims and gaskets and refit the cover plate. Tighten the six retaining nuts and check that the main nut turns freely without side play. If necessary, remove the cover plate to add or remove shims as required to obtain the correct adjustment.

9. When the correct adjustment is obtained bend over the tab washers to lock the retaining nuts.

10. Fill the steering gear housing with oil and fit a new paper gasket on the housing to column joint face.

11. Install the column and main nut assembly on the steering gear housing, turning the main nut clockwise to engage the worm shaft as the column is lowered into position. Tighten the column to housing nuts and bend over the tab washers.

Fig. 11
Steering Main Nut Bearing Adjustment

12. Remove the bleed screw and fill the column with oil, tilting the assembly to position the screw hole to the top.

13. Replace the bleed screw and finally top up the oil level by pouring oil into the centre of the main nut to cover the worm shaft when the steering is in the straight-ahead position (i.e. mid-way between stops).

Turn the main nut as oil is added to obviate any air locks which might possibly stop the oil from passing into the steering gear housing.

14. Rebuild the tractor as described under " To Replace the Steering Gear."

STEERING SPECIFICATIONS

Type	Worm and nut
Gear ratio	13.2 : 1 in straight-ahead position
Steering wheel diameter	18 ins. (44.72 cm.)
Turning circle	17 ft. (5.18 m.) with brakes
Main nut diameter (at oil seal location)	1.496 to 1.497 ins. (38 to 38.02 mm.)
Main nut bearing adjustment	By shims between cover plate and column
Shim thickness	.004 in. (.1016 mm.)
Gasket sizes	.002 in. (.0508 mm.) and .010 in. (.254 mm.) compressing to .007 in. (.1778 mm.)
Steering rocker shaft diameter	1.2475 to 1.2485 ins. (31.686 to 31.712 mm.)
Rocker shaft adjustment	By shims between housings to eliminate end-float
Shim thickness	.005 and .030 in. (.127 and .762 mm.)
Gasket thickness	.002 in. (.0508 mm.) and .010 in. (.254 mm.) compressing to .007 in. (.1778 mm.)
Grade of lubricant	S.A.E. 90
Capacity	$2\frac{1}{8}$ pints

Tightening Torque Figures	*lbs. ft.*	*kg.m.*
Steering column cover plate nuts	12	1.65
Steering column to steering box nuts	60	8.30
Rocker cover nuts	60	8.30

THE ENGINE

DESCRIPTION

The engines fitted to the Super Dexta and the Standard Dexta are three cylinder, four-stroke engines of 152 cu. in. (2,500 c.c.) and 144 cu. in. (2,360 c.c.) respectively. Both engines are of the same design, the difference between them being the cubic capacities. The 152 cu. in. (2,500 c.c.) capacity is obtained by having a bore of 3.6 in. (91.44 mm.) and a stroke of 5 in. (127 mm.) and the 144 cu. in. (2,360 c.c.) capacity by having a bore of 3.5 in. (88.9 mm.) and a stroke of 5 in. (127 mm.). The following description applies to both engines.

Overhead valves are employed, operated by tappets from a high-mounted, gear-driven camshaft located on the right-hand side of the cylinder block.

The valves are vertically located in replaceable guides in the cast iron, detachable cylinder head, and they have two springs per valve. The inlet valve head is larger in diameter than the exhaust valve.

Aluminium alloy pistons are fitted with five piston rings ; three compression and one oil control above the piston pin and one oil control below. The piston pins are fully floating and are retained in position by end circlips.

To ensure rigidity, an integrally cast cylinder block and crankcase is employed, and is fitted with full length, renewable, dry cylinder liners.

The crankshaft is supported in four main bearings. These bearings and the connecting rod big end bearings are of the detachable, steel backed type. Two cast iron balance weights are fitted to the crankshaft, one at the front crankweb, and the other at the rear crankweb. Crankshaft end-float is controlled by detachable thrust washers fitted at each side of the rear main bearing cap.

An enclosed camshaft, plunger type fuel injection pump is flange-mounted on the timing case, and gear driven from the crankshaft gear via an idler gear. The two-hole type injectors are located vertically in the left-hand side of the cylinder head.

On the 144 cu. in. engine, after engine No. 1530251, and on the 152 cu. in. engine, the speed is controlled by a mechanically governed fuel injection pump the operation of which is explained in the appropriate section of the Dexta Workshop Manual.

Prior to engine No. 1530251, the speed of the engine was controlled by a pneumatic governor mounted on the fuel injection pump.

To assist cold starting a heater plug and an induction primer are provided in the inlet manifold.

REPAIR PROCEDURE

The repair operations and data given in this section applies to both the 152 cu. in. and the 144 cu. in. engines and where differences between these engines apply specific reference will be made. In the case of operations affecting the pneumatically governed engine only, reference will be made in italics.

THE ROCKER SHAFT ASSEMBLY

To Remove

1. Lift off the primary air cleaner, and remove the vertical exhaust silencer (where fitted), and engine bonnet.

2. Slacken the rocker cover breather tube clip, unscrew the two self-locking nuts and remove the rocker cover and gasket.

3. Remove the union nut securing the rocker shaft oil feed pipe to the screwed adaptor at the rear right-hand corner of the cylinder head.

4. Gradually unscrew the four rocker shaft retainer nuts and lift off the rocker shaft.

To Dismantle

1. Stand the rocker shaft assembly on end with the oil pipe uppermost, remove the retaining circlip from the top end of the shaft and lift off the support brackets, spacer springs, rocker arms, spacers and the rocker shaft oil feed pipe in sequence.

To Reassemble

1. Fit the support brackets, spacer springs, spacers, rocker arms and the oil feed pipe in their correct order, as shown in Fig. 1, taking care to ensure that the stud holes in the rocker shaft support brackets are on the left when viewing the rocker shaft from the front. (Opposite end to the oil feed pipe.) The rocker arms are right- and left-handed and should be fitted with their " sets " positioned as shown in Fig. 1.

2. Complete the assembly by fitting a circlip in the groove at the end of the shaft.

To Replace

1. Fit the rocker shaft assembly to the studs on the cylinder head, entering the oil feed pipe into the screwed adaptor at the rear right-hand corner of the cylinder head.

2. Retain the rocker shaft in position with four flat washers and self-locking nuts.

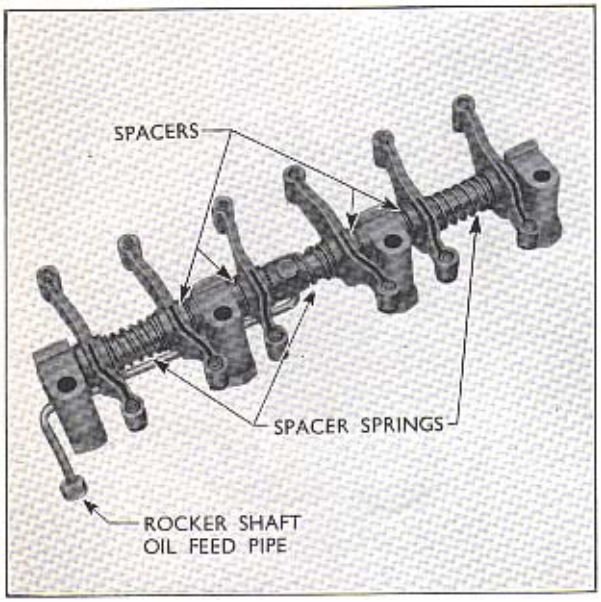

Fig. 1
Rocker Shaft Assembly

3. Tighten the rocker shaft oil feed pipe union nut securely.

4. Adjust the valve clearances as outlined on page 4.

5. Replace the rocker cover and gasket, taking care to ensure that the gasket is correctly located in the rocker cover. Refit the fibre washers, flat washers and self-locking nuts in that order, and securely tighten the nuts. Tighten the rocker cover breather tube clip.

6. Replace the primary air cleaner and vertical exhaust silencer (where fitted), and run the engine until its normal operating temperature is reached.

7. Remove the rocker cover, and if necessary readjust the valve clearances to 0.010 in. (0.25 mm.) as detailed on page 4.

8. Replace the engine bonnet.

CYLINDER HEAD ASSEMBLY AND GASKET

To Remove

1. Remove the radiator filler cap and drain the water from the cooling system through the two taps, one on the radiator and one on the left-hand side of the cylinder block.

2. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and engine bonnet.

3. Disconnect the battery leads and remove the battery.

4. Remove the water temperature gauge capillary tube retaining clip from the left-hand engine lifting plate.

5. Remove the five set-screws securing the water outlet connection to the front of the cylinder head.

6. Where a horizontal exhaust silencer is fitted, release the exhaust manifold to cylinder head nuts and pull the manifold away from the cylinder head. If, however, a vertical exhaust system is fitted, completely remove the exhaust manifold.

7. Remove the injectors as outlined in the Fuel System Section, taking the recommended precautions regarding cleanliness.

8. Remove the nut, bolt and spring washer that secure the battery heat baffle to the bracket at the left-hand rear of the cylinder head.

9. Disconnect the following items from the inlet manifold :—heater plug lead, induction primer feed pipe and the air inlet hose.

9a. *In the case of the pneumatically governed engine it will also be necessary to remove the throttle link and governor pipe.*

10. Remove the inlet manifold. (Six nuts and spring washers.)

11. Remove the two set-screws securing the battery heat baffle to the bracket at the rear right-hand corner of the cylinder head.

12. Remove the two set-screws from the right-hand engine lifting plate and remove the bracket, battery heat baffle support bracket and the crankcase breather pipe.

13. Remove the camshaft chamber to rocker shaft oil feed pipe.

13a. *Remove the fuel lift pump to fuel filter, and the fuel filter to fuel injection pump feed pipes.*

13b. *Unscrew the two set-screws securing the fuel filter to the cylinder block and remove the fuel filter.*

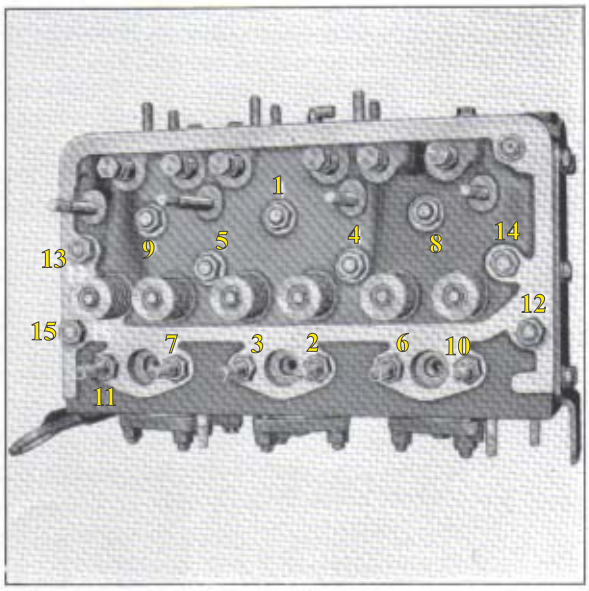

Fig. 2
Correct Sequence for Tightening Cylinder Head Nuts

13c. *Disconnect the governor pipe from the rear half of the governor case on the fuel injection pump.*

14. Remove the rocker cover and rocker shaft as outlined on page 1.

15. Unscrew the fifteen nuts retaining the cylinder head to the cylinder block in a sequence opposite to that shown on Fig. 2, using the special deep socket (Tool No. T.6095).

16. Lift off the cylinder head and remove the cylinder head gasket.

16a. *Unscrew the set-screw securing the governor pipe clip to the rear of the cylinder head, and remove the governor pipe and clip.*

To Replace

When fitting a new cylinder head take particular note of the diameter of the rear stud hole (exhaust manifold side). Where this hole is $\frac{19}{32}$ in. (15.08 mm.) diameter the current type stud (957E–6066–B) must be used and a washer fitted between the retaining nut and the head in order to provide adequate seating area for the nut. Where the hole is $\frac{15}{32}$ in. (11.91 mm.) the original type of stud, $\frac{1}{8}$ in. (3.18 mm.) shorter than that now used, will be satisfactory and no washer is needed.

1. Thoroughly clean all dirt, carbon, etc., from the cylinder block and the cylinder head faces.

2. Locate a new cylinder head gasket into correct position on the cylinder head studs.

The gasket for the 152 cu. in. engine is identified by the larger diameter bore hole. $3\frac{21}{32}$ in. (92.868 mm.) as against $3\frac{9}{32}$ in. (90.488 mm.) for the gasket of the 144 cu. in. engine. The gasket is marked to show which way it should be fitted, and it should be smeared on both sides with a coating of jointing compound.

2a. *Refit the governor pipe and clip under the appropriate set-screw at the rear of the cylinder head.*

3. Replace the cylinder head in position on the cylinder block.

4. Refit the cylinder head nuts and tighten in the correct order as shown on Fig. 2, to a torque of 55 to 60 lb. ft.

5. Replace the camshaft chamber to rocker shaft oil feed pipe.

6. Replace the right-hand lifting plate and the battery heat baffle bracket onto the cylinder head, and secure in position with two set-screws. The clip for the crankcase breather pipe fits under the lower of the set-screws.

7. Replace the set-screws securing the battery heat baffle to the cylinder head brackets.

7a. *Replace the fuel filter and fuel pipes, and bleed the fuel system as outlined in the Fuel System Section.*

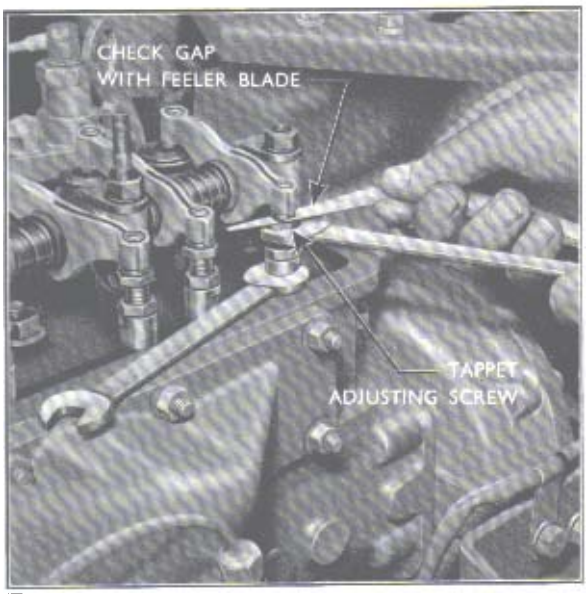

Fig. 3
Adjusting Valve Clearances

8. Replace the rocker shaft and adjust the valve clearances as outlined on page 1.

9. Replace the injectors as described in the Fuel System Section.

10. Replace the inlet and exhaust manifolds and refit the heater plug lead, induction primer feed pipe and air inlet hose.

10a. *Connect the throttle link and governor pipe to the inlet manifold.*

11. Refit the water outlet connection to the cylinder head, taking care to ensure that the gasket is correctly aligned and that there is a copper sealing washer fitted to the top left-hand retaining bolt (when viewed from the front of the engine).

12. Refit the water temperature gauge capillary tube retaining clip to the top set-screw on the left-hand engine lifting plate.

13. Refill the cooling system.

14. Replace the battery and reconnect the leads.

15. Replace the primary air cleaner and vertical exhaust silencer (where fitted).

16. Run the engine until its normal working temperature is reached, remove the rocker shaft and tighten the cylinder head nuts down to a torque of 55 to 60 lb. ft., using the sequence shown in Fig. 2.

17. Refit the rocker shaft, and check that the valve clearances are 0.010 in. (0.25 mm.). Replace the rocker cover and gasket, taking care to see that the gasket is correctly located in the rocker cover.

18. Replace the engine bonnet.

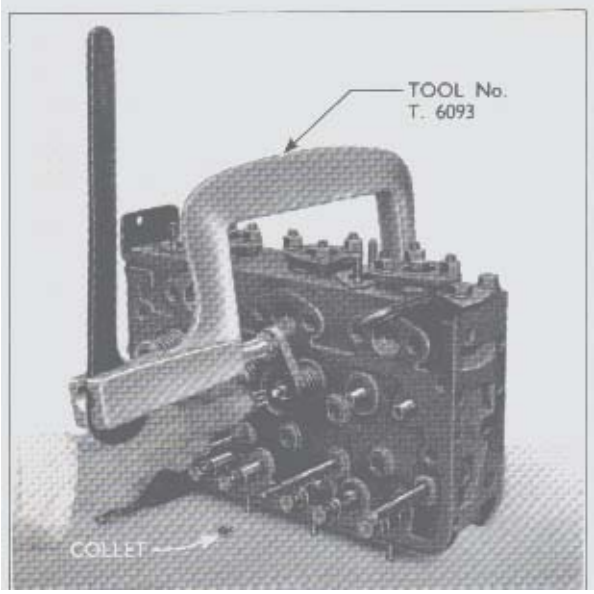

Fig. 4
Valve Spring Compressor

VALVES

The valves are mounted vertically in cast iron valve guides in the cylinder head, and are operated from a high-mounted camshaft by tappets and rocker arms. To improve engine breathing the diameter of the head of the inlet valve is greater than that of the exhaust valve.

To Adjust Valve Clearances

1. Run the engine until it is at its normal working temperature.

2. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and the engine bonnet.

3. Unscrew the two self-locking nuts and remove the rocker cover and gasket.

4. Slacken the screw retaining the flywheel inspection plate in position on the left-hand side of the clutch housing, and move the plate to one side to expose the flywheel.

5. Turn the crankshaft until the line on the flywheel marked " TDC " is in line with the notch on the clutch housing, and No. 1 piston is on its compression stroke (both valves for No. 1 cylinder closed).

6. Check the valve clearance on Nos. 1, 2, 3 and 5 valves (numbered from front to rear) using a 0.010 in. (0.25 mm.) feeler gauge, inserted between the end of the rocker lever and the top of the tappet adjusting screw. If necessary adjust the clearances as shown on Fig. 3. After adjustment fully tighten the tappet adjusting screw locknut.

7. Turn the crankshaft through 360° (TDC mark again in line with the notch in the clutch housing) and check the valve clearance on Nos. 4 and 6 valves. Adjust if necessary as detailed above.

8. Replace the flywheel inspection plate in its correct location and tighten the retaining screw.

9. Replace the rocker cover and gasket taking care to ensure that the gasket is correctly located in the rocker cover. Refit the fibre washers, flat washers and self-locking nuts respectively, and tighten the nuts.

10. Replace the engine bonnet, vertical exhaust silencer (where fitted) and the primary air cleaner.

To Remove Valves

1. Remove the rocker shaft assembly and cylinder head as detailed on pages 1 and 2.

2. Lay the cylinder head on its side on a flat surface, and using the spring compressor Tool No. T.6093 (see Fig. 4), compress the springs in turn, extract the collets and remove the spring retainer, inner and outer springs and the spring locating washer (see Fig. 5).

3. Keep the valves and their components in order, so that they can be refitted to the ports from which they were removed.

VALVE SPRINGS

Two valve springs are fitted per valve, the springs being similar on both exhaust and inlet valves. They can be fitted either way up on the valves.

Before re-use all the valve springs should be carefully examined, with particular regard to squareness of ends, and pressure developed at specified compressed lengths. (See " SPECIFICATION AND REPAIR DATA—ENGINE") on page 22.

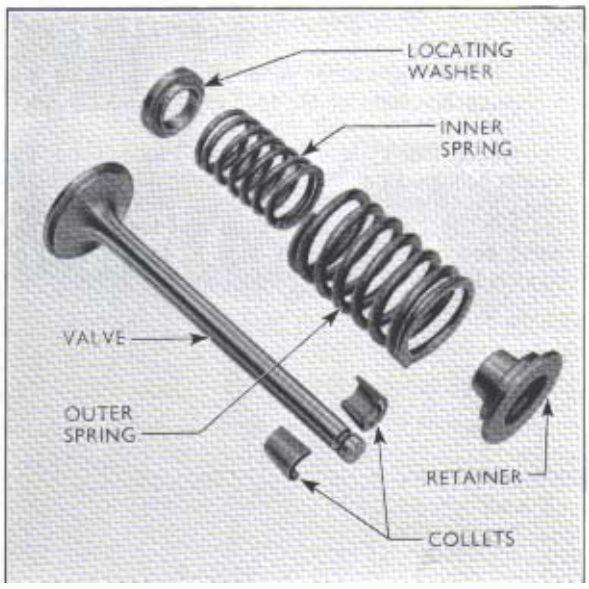

Fig. 5
Valve and Springs

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VALVE GUIDES

The valve guides are a press fit in the cylinder head.

On engines produced before tractor engine No. 1473070 the vertical location of the guide was determined by a machined stop on the outer diameter of the guide. After engine No. 1473070 the valve guides were manufactured with a parallel O.D. and to ensure the correct guide protrusion of 0.584 in. (14.83 mm.) to 0.594 in. (15.09 mm.) a replacer stop T.6073–2A/g is used in conjunction with the main tool CT.6073 to replace the guides (see Fig. 6).

To Remove

1. Pass the rod (T.6073–2A/a) of the valve guide remover and replacer (Tool No. CT.6073) through the valve guide to be removed, from the top face of the cylinder head, until the step on the rod abuts the top of the valve guide. Fit the spacer (T.6073–2A/b) to the lower end of the rod and screw on the knurled retainer (T.6073–2A/d).

2. Turn the wing nut on the main tool and pull the guide from the cylinder head.

To Replace

1. Pass the rod of the valve guide remover and replacer through the valve guide bore in the cylinder head, so that the angled adaptor (T.6073–2A/e) fitted in the tool body abuts the valve seat in the cylinder head.

2. Locate the guide on the rod, slide the replacer stop (T.6073–2A/g) over the guide, and then retain it in position with the knurled nut.

3. Turn the wing nut to pull the guide into the head (see Fig. 6), and continue until the replacer stop T.6073–2A/g is tight against the cylinder head.

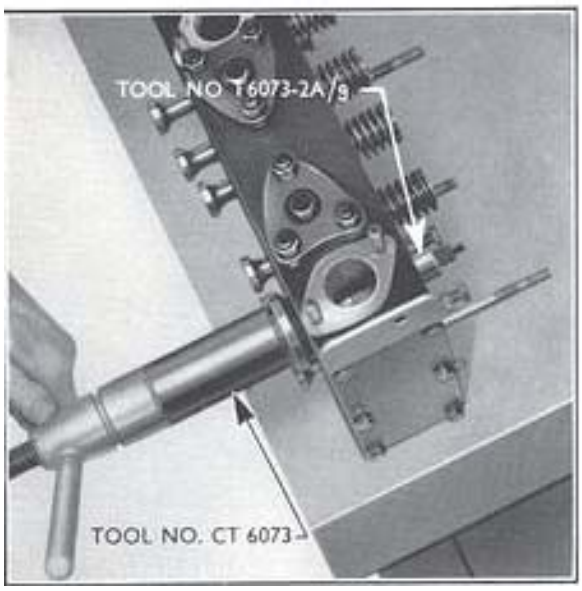

Fig. 6
Replacing a Valve Guide

Fig. 7
Checking Valve Head Clearance

VALVE SEATS

If the valve seats in the cylinder head show signs of pitting, burning or other evidence of gas leakage, they should be machined or hand ground according to their condition. Remember that hand grinding is a finishing process and on no account should excessive hand grinding be attempted ; otherwise the seat angles may be altered and the seat width increased excessively.

If it should be necessary to re-cut the valve seats, a set of valve seat cutters is available (exhaust valve seat cutter—tool No. FMC.317–23, inlet valve seat cutter—tool No. FMC.317–26, pilot—tool No. 316–10, and the handle—tool No. 316X). One of the proprietary portable valve seat grinding machines with the stone faced to 44° is also suitable.

As narrow a valve seat as possible should always be maintained.

Care should be taken when recutting the valve seats to ensure that too much metal is not removed, as the maximum clearance between the valve head and the cylinder head face should not exceed 0.140 in. (3.556 mm.). This dimension can be checked as shown in Fig. 7, using the depth gauge (tool No. T.6094), and if the measurement exceeds 0.140 in. (3.556 mm.) a new valve should be fitted.

VALVE GRINDING

If the valve face is found to be unduly pitted or distorted, it should be refaced on a suitable valve grinding machine to an angle of 45°. The grinding should continue only until the face is true and free from pits, as the removal of an excessive amount of metal may thin the edge of the valve head to a degree where it will curl and overheat under operating conditions. For a similar reason the valve will be

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unduly lowered in its seating in the cylinder head and pocketing will result. If a valve tends towards thinness at the edge, particularly after refacing, it should be replaced.

Valves which are badly burned, distorted or which have been previously ground to the limits, should be discarded, and new parts fitted as replacements. Always grind a replacement valve into its seating.

Hand Grinding

1. With the valves removed, apply a small amount of medium or fine grinding paste to the valve face and replace it in its correct port.

2. Rotate the valve lightly, using a suitable suction grinding tool, first in one direction, then in the other, raising the valve off its seat from time to time and turning it approximately one quarter of a turn to ensure a concentric seat.

3. Add more fine grinding paste if necessary and continue the operation until an even, clean, matt-grey finish has been obtained on a seating between $\frac{1}{16}$ of an inch and $\frac{3}{32}$ of an inch in width (1.58 to 2.38 mm.). If the condition cannot be reached, it will be necessary to re-face or re-cut the valves and/or seats.

4. After grinding-in the valves, carefully clean all paste and foreign matter from the valves, and the seats and guides in the cylinder head.

To Replace the Valves

1. Oil the valve stems and guides to provide initial lubrication.

2. Insert each valve into its correct port.

3. Locate the spring locating washers, valve springs and the spring retainers in their correct positions on the valve stems.

4. Using the valve spring compressor (tool No. T.6093) compress each valve spring in turn and fit the valve collets.

5. Replace the cylinder head and adjust valve clearances as described on page 4.

TAPPETS

The tappets are of the mushroom foot type and operate directly in the cylinder head. With the cylinder head removed, it is necessary to remove the tappet adjusting screw and locknut, before the tappet can be slid out of its bore.

DECARBONISING

It is difficult to lay down any set period when it will be necessary to carry out decarbonising on a Diesel engine. All other factors contributing towards loss of power, etc., such as faulty injectors and dirty air cleaners, should be checked before assuming that the engine requires decarbonising.

1. Remove the cylinder head assembly as described on page 2.

2. If the valves require attention, they should be removed and treated as described on page 4.

Carbon Removal

It is essential that absolute cleanliness is observed through the following operation to prevent the possibility of consequential damage resulting from particles of carbon falling into the engine and causing scoring of the cylinder bores, pistons, bearings, etc.

1. Clean all carbon from the face of the cylinder head and from all ports. Ensure that no burrs are made on the machined face of the cylinder head.

2. It is not as a rule necessary to remove the covers of the combustion chambers during decarbonising as carbon rarely forms in these chambers. If, however, these covers are removed, new copper joints should be fitted when the covers are replaced, and the retaining nuts tightened fully to ensure there are no leakages.

3. Apply a smear of grease inside the top of No. 1 cylinder and rotate the crankshaft until No. 1 piston is at the top of its stroke. This causes the grease to fill up the gap between the piston crown and the cylinder wall and prevents carbon particles from reaching the ring grooves and subsequently causing wear.

4. Cover up Nos. 2 and 3 bores and all water and oilways with clean rag, to prevent the entry of carbon and dirt.

5. With a suitable scraper remove all the carbon from No. 1 piston crown, taking care not to scratch the piston.

6. When No. 1 piston crown is completely free of carbon, repeat the process of cleaning, as outlined above, on No. 2 piston and in turn No. 3 piston.

NOTE.—Leave the piston crowns absolutely clean and smooth as carbon will not deposit so fast on a smooth surface, but do not use any form of abrasive, as particles may find their way into the working parts of the engine.

7. Clean all piston crowns and cylinder bores with a paraffin moistened non-fluffy rag, lubricate with engine oil and cover for protection until the cylinder head assembly is to be replaced.

8. Reassemble the valves to the cylinder head and refit the head as described on page 3.

TIMING CASE COVER AND CRANKSHAFT FRONT OIL SEAL

To Remove the Timing Case Cover

1. Remove the front axle and radiator assembly as described on page 24.

2. Slacken the generator retaining bolts and remove the fan belt. Remove the bolt securing the generator to the slotted adjustment bracket on the timing case cover.

3. Slacken off the hose clamps on the two hoses fitted to the water pump.

4. Knock back the locking washer and remove the crankshaft ratchet nut using the box spanner (Tool No. T.6098).

5. Remove the crankshaft pulley using the puller (Tool No. 555) and adaptors (Tool No. T.555–2).

6. Remove the timing case cover set-screws and the top right-hand set-screw (viewed from the front of the engine) retaining the water pump in position.

7. Remove the timing case cover and water pump, taking care not to damage the crankshaft front oil seal, which is located in the timing case cover.

To Renew the Crankshaft Front Oil Seal

1. Carefully extract the oil seal from the timing case cover using a suitable lever.

2. Locate a new seal in the timing case cover with the lip of the seal towards the inside of the cover.

3. Tap the new seal into position using the adaptor (T.6097) on the universal handle (Tool No. 550).

To Replace the Timing Case Cover

1. Replace the timing case cover and water pump taking care not to damage the crankshaft front oil seal, as the cover is entered over the front end of the crankshaft.

2. Refit the timing case cover retaining screws, using a copper washer under the head of the lower screw, and refit the top right-hand water pump set-screw.

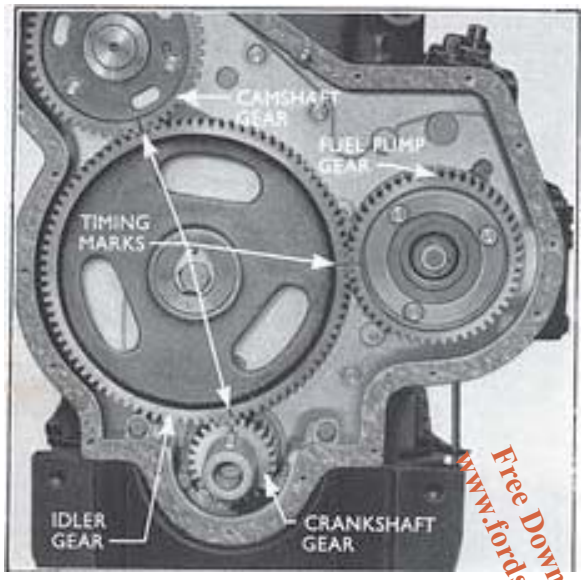

Fig. 8
Timing Marks

Fig. 9
Checking Timing Gear Backlash

3. Replace the crankshaft pulley, locking washer and ratchet nut. Tighten the ratchet nut with a box spanner (Tool No. T.6098) and bend up the locking washer.

4. Refit the two hoses to the water pump and tighten the clamps.

5. Replace the generator bracket and tighten the generator retaining bolts, so that there is 1 in. (25.4 mm.) fan belt free movement measured midway between the generator pulley and the crankshaft pulley.

6. Replace the front axle and radiator assembly as described on page 24.

TIMING GEARS

The camshaft and the fuel pump are driven by the crankshaft gear via an idler gear. All the gears are suitably marked during production to facilitate re-timing, the marks being in line, when No. 1 piston is at top dead centre on its compression stroke (see Fig. 8).

All the following operations under the general heading ' TIMING GEARS ' pre-supposes that the operations necessary to remove the timing case cover have been carried out as previously described.

To Check Timing Gear Backlash

1. Check the backlash between the gears using a suitable feeler gauge. The backlash should be between 0.003 in. to 0.006 in. (0.076 mm. to 0.152 mm.) (see Fig. 9).

2. If the backlash is within the recommended limits, replace the timing case cover as described on this page. If not, renew the gears concerned.

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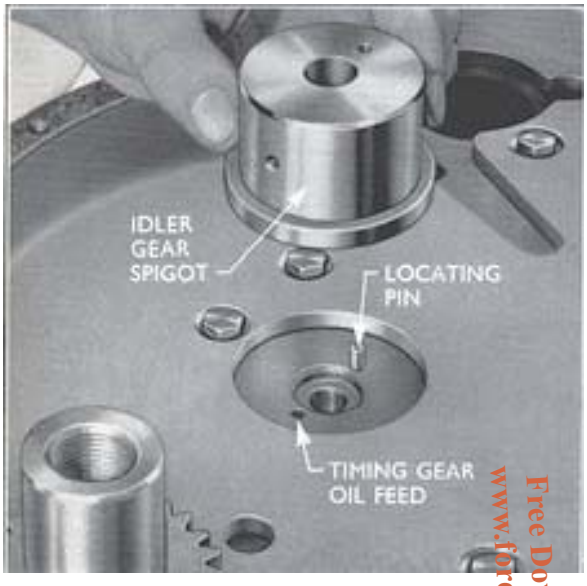

Fig. 10
Idler Gear Spigot

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To Remove the Idler Gear and Spigot

1. Turn the crankshaft until all the timing marks on the gears are in line (see Fig. 8).

2. Bend back the locking washer on the idler gear retaining set-screw, and remove the set-screw, large washer and locking washer.

3. Lift the idler gear off its spigot.

4. Remove the idler gear spigot from its machined location in the timing case.

To Replace the Idler Gear and Spigot

1. Replace the idler gear spigot so that the small locating peg is entered into the through drilling in the spigot (see Fig. 10).

2. Fit the new idler gear on the spigot with the long tapered centre boss of the gear towards the cylinder block, and the timing marks aligned (see Fig. 8).

3. Refit the large flat washer, locking washer and the retaining set-screw. Fully tighten the set-screw and bend up the locking washer. Ensure that the idler gear has end-float on the spigot.

4. Replace the timing case cover as described on page 7.

To Renew the Camshaft Gear

Camshafts used prior to engine No. 1400687 were marked with the letter ' D ' on the front end flange in a position approximately in line with the No. 2 cam. Camshaft gears supplied through service at this time did not carry a timing mark. After engine No. 1400687 the letter ' D ' was placed on the boss immediately in front of the front end flange of the camshaft in a position approximately in line with No. 1 cam. Timing marks were also placed on all camshaft gears supplied through service after this change was introduced in production. These changes affect the procedure for changing the camshaft gear.

Where the ' D ' on the Camshaft is on the Front End Flange (i.e. early type)

1. Turn the crankshaft until the timing marks on the gears line up as in Fig. 8.

2. Remove the rocker shaft assembly.

3. Remove the idler gear and the camshaft gear.

4. Turn the camshaft until No. 3 cam is upright, i.e. No. 3 tappet at its highest point.

5. Position the new camshaft gear on the camshaft so that the plain hole adjacent to the letter ' D ' on the gear is in line with the tapped hole at the top of the camshaft flange (see Fig. 11). Secure the gear in position.

6. If the camshaft gear being used does not carry any timing marks, draw a line through the centre of the camshaft and the centre of the plain hole adjacent to the letter ' D ' on the camshaft gear as shown in Fig. 12.

From this line count off eight teeth in a clockwise direction and scribe a mark on the gear between the eighth and ninth teeth.

If the new gear is already marked this procedure will not be necessary.

7. Refit the idler gear, at the same time turning the camshaft so that the timing marks on all gears line up as shown in Fig. 8.

8. Replace the rocker shaft assembly and timing case cover as previously described.

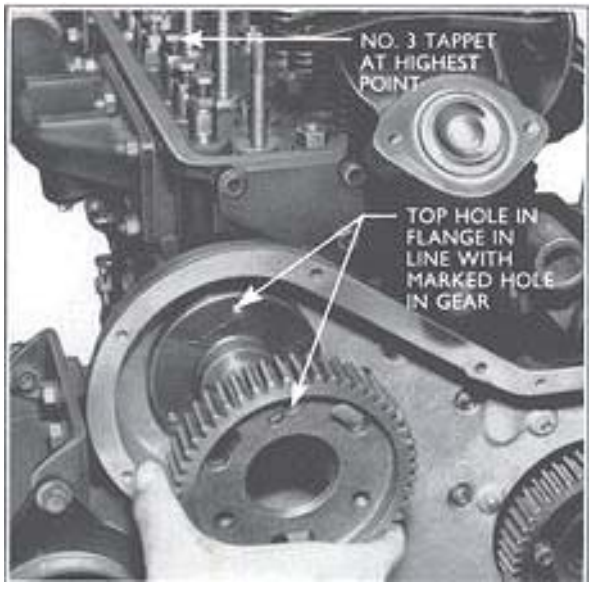

Fig. 11
Fitting the Camshaft Gear

Where the ' D ' on the Camshaft is on the Front Boss (i.e. current type)

1. Turn the crankshaft until the timing marks on the gears line up as in Fig. 8.

2. Remove the camshaft gear.

3. Fit the new camshaft gear to the camshaft, securing it in such a position that the ' D ' marking on the camshaft gear is aligned with the ' D ' marking on the camshaft.

4. If the new gear is of the original type (i.e. without a timing mark) follow the procedure for marking the gear as described under Operation 6 for the early type camshaft.

5. Check that all gear timing marks line up as shown in Fig. 8.

6. Replace the timing case cover as previously described.

To Renew the Fuel Pump Gear

1. Turn the crankshaft until all the timing marks are in line (see Fig. 8).

2. Remove the small inspection plate from the left-hand side of the timing case.

3. Remove the three set-screws that retain the fuel pump gear onto the fuel pump gear adaptor and remove the gear and large retaining washer.

When the gear is removed the fuel pump camshaft will probably revolve slightly, so that the pump timing marks are out of alignment. It will therefore be necessary when fitting the new gear to turn the fuel pump camshaft using a suitable spanner, until the line marked " S " (*pneumatic governor*) or " T.C." (mechanical governor) on the adaptor is in line with

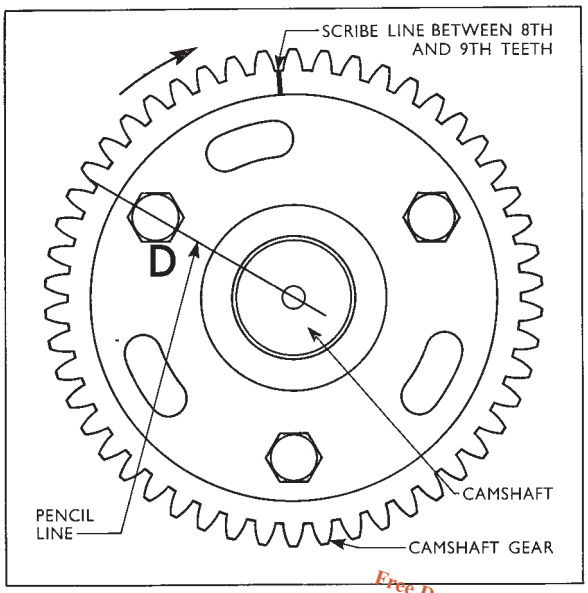

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Fig. 12
Marking New Camshaft Gear

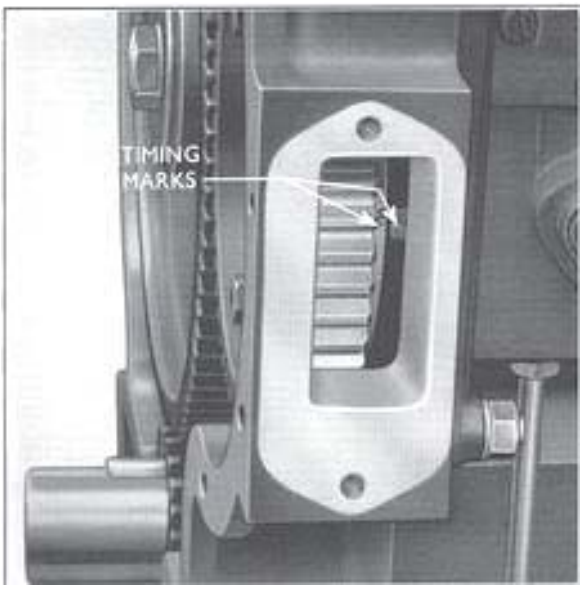

Fig. 13
Fuel Pump Timing Marks (T.D.C.)
(pneumatic governor)

the fixed pointer on the fuel pump mounting flange (see Fig. 13).

4. Fit the new fuel pump gear onto the fuel pump gear adaptor so that it meshes with the idler gear. The fuel pump gear will only fit in one position on the adaptor and the three tapped holes in the adaptor must be positioned centrally in the slots in the fuel pump gear to allow for any adjustments that may be necessary in service.

5. Replace the large retaining washer and the three set-screws to the fuel pump gear, and tighten the set-screws fully.

6. With a suitable scriber, mark the tooth on the fuel pump gear that is adjacent to the marked tooth on the idler gear.

7. Replace the timing case cover as described on page 7.

To Remove the Crankshaft Gear

1. Turn the crankshaft until all the timing marks are in line (see Fig. 8).

2. Remove the sump drain plug and drain off the engine oil. Replace the drain plug when all the oil has been removed.

3. Support the sump and unscrew the nuts and set-screws retaining it to the cylinder block and the engine adaptor plate. Remove the sump.

4. Remove the oil pump suction and delivery pipes.

5. Unscrew the two set-screws securing the small lower section of the timing case to the main timing case, and remove the lower section.

6. Remove the oil pump idler gear retaining clip and lift off the idler gear.

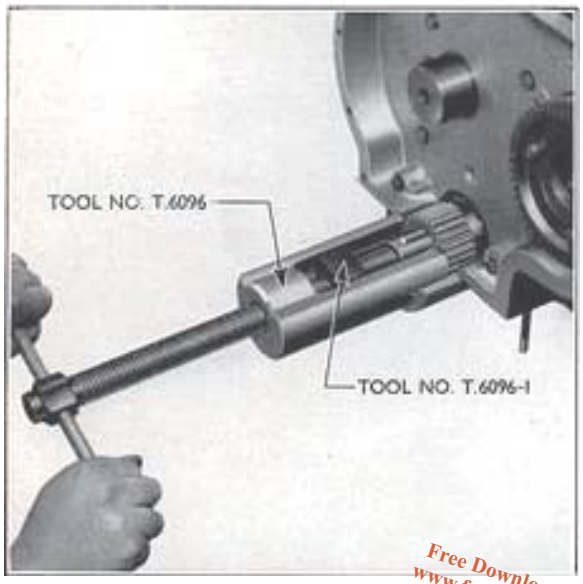

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Fig. 14
Removing Crankshaft Gear

7. Unscrew the three set-screws and remove the oil pump from its dowelled location on the front main bearing cap.

8. Remove the idler gear from its location on the idler gear spigot.

9. Remove the crankshaft gear using the puller (Tool No. T.6096), with the thrust button (T.6096–1) screwed into the front end of the crankshaft (see Fig. 14).

To Replace the Crankshaft Gear

1. Screw the alignment adaptor (T.6103–1/a) of the crankshaft gear replacer into the front of the crankshaft so that it is in as far as is possible and the pegs on the adaptor are in line with the woodruff key in the front of the crankshaft (see Fig. 15).

NOTE.—Before Engine No. 1457993 the length of the crankshaft key-way was shorter by approximately 1.125 in. (28.57 mm.).

2. Push the crankshaft gear onto the adaptor with the timing mark on the gear facing outward, until the gear contacts the end of the crankshaft.

3. Screw the centre bolt of the crankshaft gear replacer (Tool No. T.6103) into the adaptor and fit the semi-circular key locator (T.6103–1/b). The boss on the outside of the key locator must be fully entered into the slot on the tool body, and the slot on the inside of the locator must locate over the key in the crankshaft (see Fig. 16).

4. Replace the gear by screwing in the wing nut of the tool, taking care to ensure that the key does not ride out of the keyway in the crankshaft. The spacer behind the crankshaft gear is fitted with the chamfer towards the front main bearing journal on the crankshaft.

5. Replace the idler gear so that all the timing marks are in line.

6. Replace the oil pump on the front main bearing cap and secure with three set-screws and shakeproof washers.

7. Replace the oil pump idler gear and secure in position with a retaining clip.

8. Replace the lower section of the timing case, taking care to ensure that its front face is flush with the main timing case.

Before fitting the retaining screws check the height of the bosses around the screw holes. Where this height is $1\frac{3}{8}$ in. (34.9 mm.), use screws 2 in. (50.8 mm.) in length—where the boss height is $\frac{3}{4}$ in. (19 mm.), use screws $1\frac{3}{8}$ in. (34.9 mm.) in length.

9. Refit the oil pump suction and delivery pipes.

10. Fit new gaskets and cork strips, replace the sump and tighten all retaining set-screws evenly.

11. Replace the timing case cover as described on page 7.

12. Refill the sump with the approved grade of oil to the correct level.

CAMSHAFT

To Remove

1. Remove the rocker shaft assembly as described on page 2.

2. Remove the front axle and radiator assembly as described on page 24.

3. Remove the timing case cover as detailed on page 6.

4. Turn the crankshaft until the timing marks on the timing gears are in line (see Fig. 8).

5. Lift the tappets and remove the camshaft and gear from its location in the cylinder block, taking care not to damage the journals or cams.

To Replace

1. Lift the tappets and fit the camshaft and gear, with the timing marks aligned, taking care not to damage the cams or bearing journals.

2. Replace the timing case cover as outlined on page 7.

3. Refit the front axle and radiator assembly as described on page 24.

4. Replace the rocker shaft assembly as described on page 2.

TIMING CASE

To Remove

1. Remove the front axle and radiator assembly, and the timing case cover as described on pages 24 and 6 respectively.

2. Remove the rocker shaft assembly as described on page 2.

3. Remove the sump as described on page 29.

4. Unscrew the retaining set-screw and remove the idler gear and spigot.

5. Lift the tappets and remove the camshaft assembly, taking care not to damage the cams or bearing journals.

6. Disconnect the following from the fuel injection pump :—fuel tank to fuel lift pump pipe, fuel lift pump to fuel filter pipe, fuel filter to fuel pump gallery pipe, stop control cable, and the proofmeter drive cable.

7. Remove the twelve short and the two long set-screws and shakeproof washers securing the timing case to the cylinder block, and remove the timing case and fuel injection pump as an assembly.

8. Part the injection pump from the timing case by removing the five set-screws and spring washers that secure the pump to the timing case. Ensure that all fuel inlet and outlet connections on the fuel injection pump are sealed with the appropriate size plugs to stop the ingress of dirt.

To Replace

1. Refit the fuel injection pump to the timing case, and secure in position with five set-screws and spring washers.

2. Fit a new gasket to the cylinder block front face and replace the timing case and fuel injection pump as an assembly. Refit the two long and twelve short set-screws and shakeproof washers loosely in position.

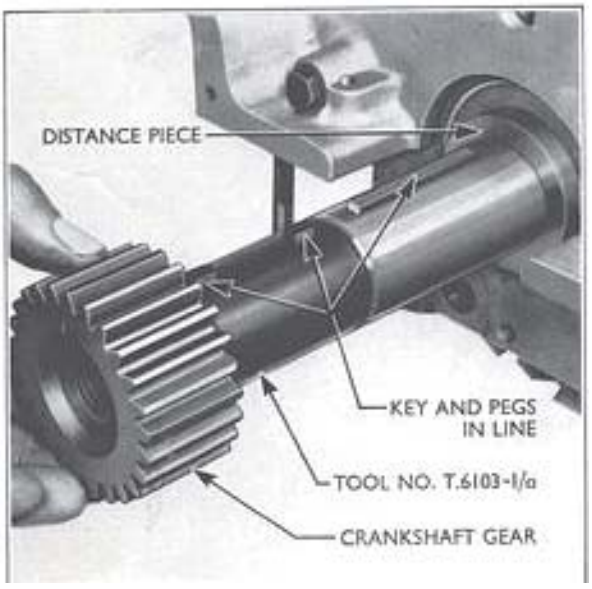

Fig. 15
Fitting the Crankshaft Gear to the Alignment Adaptor

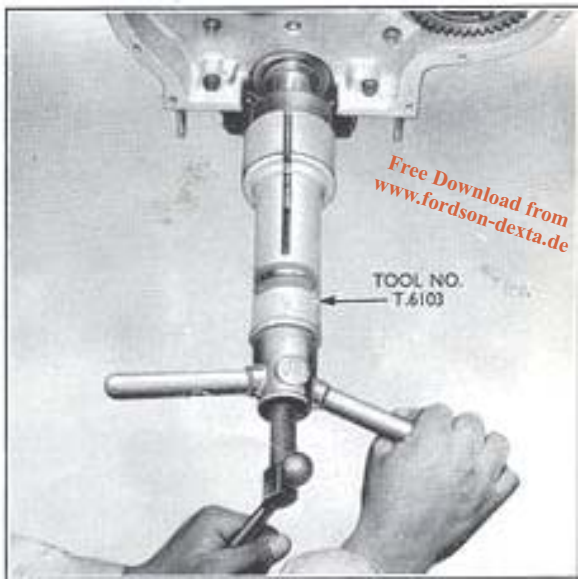

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Fig. 16
Replacing the Crankshaft Gear

3. Replace the idler gear spigot so that the locating peg locates in the through drilling in the spigot (see Fig. 10).

4. With the idler gear spigot fully located against the front of the cylinder block, tighten the timing case set-screws.

5. Turn the engine crankshaft until No. 1 piston is at top dead centre (key on the front of the crankshaft vertically upwards).

6. Replace the idler gear on its spigot, with the long tapered centre flange of the gear towards the cylinder block and the timing marks on the crankshaft gear, fuel pump gear and the idler gear in line.

7. Secure the idler gear in position with a large flat washer, locking washer and retaining set-screw. Bend the locking washer up against the head of the set-screw.

8. Lift the tappets and replace the camshaft so that the timing mark on the camshaft gear is adjacent to the timing mark on the idler gear.

9. Replace the sump as described on page 29.

10. Replace the cylinder head assembly as described on page 3.

11. Replace the timing case cover and refit the front axle and radiator assembly to the tractor as described on page 24.

12. Refit the following items to the fuel injection pump :—stop control cable, fuel filter to fuel pump gallery pipe, fuel lift pump to fuel filter pipe, fuel tank to fuel lift pump pipe and the proofmeter drive cable. When fitting the stop control cable ensure that there is approximately $\frac{1}{4}$ in. (6.3 mm.) free

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Fig. 17
Flywheel and Ring Gear

movement at the stop control knob on the control panel.

FLYWHEEL AND RING GEAR

To Remove the Flywheel

1. Separate the engine from the gearbox as described in the section dealing with this subject on page 23.

2. Evenly unscrew the set-screws and spring washers securing the clutch pressure plate assembly to the flywheel and detach the clutch assembly and disc.

NOTE.—When a double clutch is fitted it is secured to an adaptor plate which is in turn secured to the flywheel. Prior to tractor Serial No. 33407, spacing washers were fitted between the adaptor plate and the flywheel at each fixing screw location. These washers are not required with adaptor plates fitted to tractors after the above Serial number.

3. The flywheel is secured by six set-screws which are wired together. Remove the locking wire and unscrew the flywheel retaining set-screws.

4. Carefully ease the flywheel off the crankshaft spigot.

To Renew the Flywheel Ring Gear

1. Unscrew the six screws retaining the ring gear to the flywheel and remove the screws and lock-washers.

2. Tap off the ring gear. There is no necessity to apply heat to remove or refit the gear.

3. Fit a new ring gear with the lead-in on the teeth to the front of the flywheel and retain in position with six screws and lockwashers (see Fig. 17).

To Replace the Flywheel

1. Carefully clean the crankshaft flange and the mating flange on the flywheel.

2. Mount the flywheel on the crankshaft flange so that the untapped hole in the flange (in the bottom centre position when No. 1 piston is at top dead centre) is in line with the unused hole in the flywheel (smaller hole than the remaining six). This ensures that the flywheel timing marks are in the correct position when No. 1 piston is at top dead centre.

3. Fit the six set-screws and flat washers and tighten to a torque of 75 lb. ft.

Fig. 18
Checking Flywheel "Run-Out"

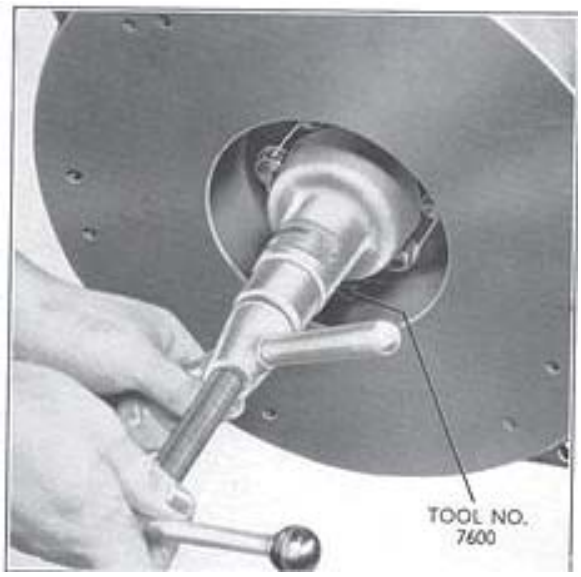

Fig. 19
Removing Clutch Pilot Bearing

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Fig. 20
Replacing Clutch Pilot Bearing

4. It is essential that the flywheel runs true, as dirt, etc., between the mating flange faces could cause it to run out of balance. The " run-out " of the flywheel should be checked with a dial indicator gauge (see Fig. 18) and the total indicator reading obtained should not exceed the figure laid down in the Specification Section on page 22.

5. If the " run-out " exceeds this figure, remove the flywheel and check the mating flanges for burrs, etc.

Refit the flywheel to the crankshaft and recheck the " run-out " as detailed above.

6. Lock the flywheel set-screws with wire.

7. Replace the clutch assembly using the clutch disc locator (Tool No. T.7079) to centralise the clutch disc (single clutch only). When fitting a double clutch assembly a centralising tool is not required.

8. Replace the engine as described on page 23.

CLUTCH PILOT BEARING

To Renew

1. Separate the engine from the gearbox as described on page 23.

2. Remove the clutch disc and pressure plate as described on page 12.

3. Withdraw the clutch pilot bearing from the flywheel, using the remover (Main Tool No. 7600 and adaptor CPT.7600–3) as shown in Fig. 19.

4. Pack the new bearing with high melting point grease and locate it in the flywheel, with the baffle face outwards. Tap the bearing in using the adaptor (CPT.7061), and the universal handle (Tool No. 550) as shown in Fig. 21.

5. Replace the clutch disc and pressure plate as outlined above.

6. Reconnect the engine and front axle assembly to the gearbox as outlined on page 23.

CRANKSHAFT REAR OIL SEAL

To Remove

1. Disconnect the engine from the transmission as described on page 23, and move the engine and front axle assembly forward away from the gearbox.

2. Remove the clutch assembly taking care to slacken the pressure plate to flywheel set-screws evenly.

3. Remove the wire from the six flywheel retaining set-screws, remove the set-screws, and lift the flywheel from its location on the crankshaft.

4. Remove the sixteen set-screws securing the engine adaptor plate to the cylinder block and sump, and remove the adaptor plate from the two dowels in the cylinder block.

5. Remove the self-locking nuts from the two bolts that pass through the half housings of the crankshaft rear oil seal retainer, and remove the bolts.

6. Unscrew the three set-screws from each of the half housings of the oil seal retainer, and remove the housings.

To Replace

1. Fit a new oil seal to each of the half housings of the oil seal retainer. The seals should previously be soaked in engine oil for one hour, and when fitted should protrude at the ends 0.010 in. (0.25 mm.) to 0.020 in. (0.51 mm.) above the respective half housing faces.

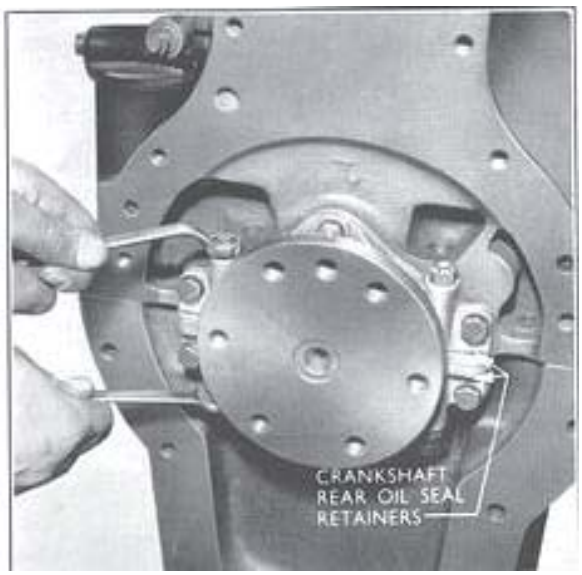

Fig. 21
Crankshaft Rear Oil Seal Retainer

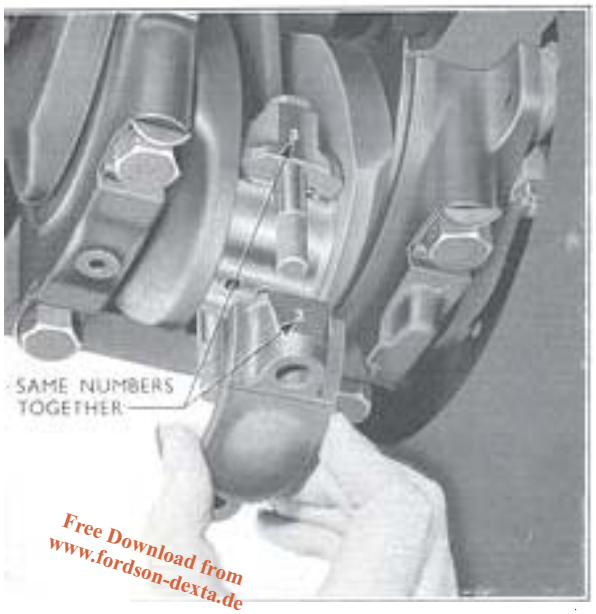

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Fig. 22
Replacing Connecting Rod

2. Remove all traces of the old gasket from the cylinder block and rear main bearing cap faces, and fit new gaskets smeared with jointing compound. Replace the half housings and retain them loosely in position with the six set-screws and shakeproof washers.

3. Refit the two long bolts and self-locking nuts and tighten fully (see Fig. 21).

4. Fully tighten the six set-screws securing the half housings of the oil seal retainer to the rear main bearing cap and cylinder block.

5. Replace the engine adaptor plate on the dowels at the rear of the cylinder block, and secure in position with sixteen set-screws. The eight long set-screws retain the adaptor plate to the cylinder block, and the other eight set-screws retain the adaptor plate to the sump.

6. Replace the flywheel as described on page 12, and check the flywheel " run-out."

7. Refit the engine and front axle assembly to the transmission as described on page 23.

PISTONS AND CONNECTING RODS

Connecting rods are numbered on rod and cap when installed in the engine to facilitate correct reassembly, should they be dismantled in service.

The numbers are stamped on the left-hand side of the big end (opposite side to camshaft) so that a cap replaced with the numbers together must be in the original position (see Fig. 22). Never reassemble the cap to the connecting rod incorrectly otherwise a true bearing surface cannot be assured.

It is advisable before removing connecting rods from an engine, to ascertain that they have been numbered, as they may have been installed at some time after the engine left the factory in which case the numbering may not have been carried out. Such connecting rods should be suitably stamped.

To Remove a Connecting Rod and Piston Assembly

1. Remove the sump as described on page 29.

2. Remove the cylinder head and gasket as described on page 2.

3. Remove the carbon from the top of the cylinder bore with a suitable scraper.

4. Remove the oil pump suction and delivery pipes.

5. Turn the crankshaft so that the piston to be removed is at the bottom of its stroke.

6. Remove the self-locking nuts from the connecting rod bolts, and remove the cap, bottom half of the big end bearing liner and the connecting rod bolts.

7. Turn the crankshaft until the piston is at the top of its stroke, and push the piston and connecting rod assembly up and out of the bore taking care not to dislodge the top half of the bearing liner. Keep the two halves of the big end liner in their respective positions in the rod and cap.

To Replace a Piston and Connecting Rod Assembly

1. Thoroughly clean out the cylinder bore with a clean dry rag.

2. Ensure that the piston is thoroughly clean and apply a liberal coating of oil to the cylinder bore, piston and rings.

3. Position the three solid piston rings (two top compression, and the lower oil control) so that the gaps are equally spaced around the piston, and no gap is in line with the piston pin bore.

4. Position the four laminations of the third compression ring, so that the gaps are 180° apart, above each end of the piston pin.

5. The ring gaps on the laminated oil control ring (one above the piston pin) should be positioned at equal distances around the piston, with none of the gaps in line with the piston pin.

6. Fit the top half of the bearing liner in the connecting rod, ensuring that the tongue on the liner engages in the machined recess in the big end bore. Smear freely with clean oil to provide initial lubrication.

7. Fit a suitable piston assembly ring on the piston, entering it over the connecting rod end with the chamfer up towards the piston, and insert the piston and connecting rod assembly in the bore. Ensure that the number stamped on the connecting rod big end is to the left-hand side of the engine (opposite side to camshaft).

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Fig. 23
Piston Ring Lay-Out

8. Push the piston down the bore through the assembly ring.

9. Turn the crankshaft until the piston is at the bottom of its stroke, and refit the big end bolts ensuring that they are fully located.

10. Locate the lower half of the big end bearing liner in the cap with the tongue registering in the machined recess, and refit the cap with the stamped numbers together (see Fig. 22), and the liner smeared freely with clean oil.

11. Fit new self-locking nuts to the connecting rod bolts and tighten to the correct torque. (See "SPECIFICATION AND REPAIR DATA—ENGINE") on page 22.

12. Refit the oil pump suction and delivery pipes. The bracket on the suction pipe fits under a set-screw on No. 2 main bearing cap.

13. Replace the cylinder head as detailed on page 3.

14. Replace the sump as described on page 29.

PISTON PIN

The piston pins are fully floating and are located in the pistons by circlips.

To Remove a Piston from a Connecting Rod

1. Remove the connecting rod and piston assembly as described on page 14. If the piston is to be used again mark the piston relative to the connecting rod, so that it can be replaced in the same position.

2. Remove the two circlips retaining the piston pin in the piston.

3. Push out the piston pin. To assist in removing the piston pin the piston may be warmed by insertion in boiling water.

To Replace a Piston on a Connecting Rod

1. Replace one circlip in position in the piston, to serve as a location for the piston pin on replacement.

2. Heat the piston in boiling water to allow easy assembly of the piston pin.

3. Insert the connecting rod between the piston bosses so that the marks made at the time of disassembly are in line. In the case of a new piston it can be fitted in either of two positions.

4. Insert the piston pin and fit the retaining circlip.

5. Oil the parts and reassemble in the engine as described on page 14.

PISTON RINGS

Three compression rings and two oil control rings are fitted to each piston. The ring lay-out is (see Fig. 23) :—top compression ring, cast iron chrome plated ; second compression ring, cast iron plain faced ; the third compression ring is made up from four $\frac{1}{32}$ in. (0.794 mm.) thick laminated rings.

The oil control ring above the piston pin is a laminated type, consisting of four segments with a spring ring between each pair, to hold them firmly against the groove sides, and an expander between the segments and the back of the groove (see Fig. 24). The oil control ring below the piston pin is a cast iron slotted type.

To Remove

1. Remove the connecting rod and piston assembly as described on page 14.

2. Remove the rings, using guide strips if necessary, and remove all the carbon from the piston crown and grooves, taking care not to damage the piston.

Checking Piston Ring Gaps

1. Insert the piston ring in the cylinder bore, centralising it by means of a piston until the ring is on an unworn part of the bore. The gap should then be checked by means of a feeler gauge to ensure that it is within the specified limits.

If necessary file the rings to give the correct gap, taking care to ensure that the ends of the rings are flat and square.

The gaps on the laminated rings are pre-set and do not require checking.

2. Check that the piston ring grooves are clean, especially the oil control ring grooves and ensure that the oil return holes are clear.

3. Check that the piston ring to groove clearance is within the specified limits—solid rings only.

To Replace

1. Replace the lower oil control ring using guide strips if necessary.

2. Refit the laminated oil control ring in the groove immediately above the piston pin. Place the expander ring in the back of the groove and spiral in two of

the laminated segments. The centre spring ring can now be fitted and then the other two segments. The last segment entered will require slight pressure applied to it to overcome the action of the centre spring ring.

3. The laminated rings for the third compression ring are concave or convex depending on which way up they are laid. When assembled to the piston the rings should be as shown on Fig. 24, i.e. the first lamination is fitted with its concave face upwards ; second lamination, convex face upwards ; third lamination, concave face upwards ; and the top lamination, convex face upwards.

4. Refit the plain cast-iron ring to the second groove, and the chrome-plated ring to the top groove.

5. Position the piston ring gaps as detailed on page 14 and lubricate the cylinder bore, piston and rings.

6. Replace the piston and connecting rod assembly as described on page 14.

PISTONS

The pistons are of high silicon aluminium alloy, and are available in service in a 0.030 in. (0.762 mm.) diameter oversize for the 144 cu. in. (2,360 c.c.) engine.

It is essential that the limit for the diameter of the finished bore of the liners, as laid down in the Specification Section, is strictly adhered to ; to ensure correct fit of the pistons.

CYLINDER LINERS

Renewable, full length, unshouldered cast-iron liners are fitted to the 144 cu. in. and the 152 cu. in. engine. The liner fitted to the 144 cu. in. engine is of the thick wall type and that fitted to the 152 cu. in. engine the thin wall type. Both types of liners are

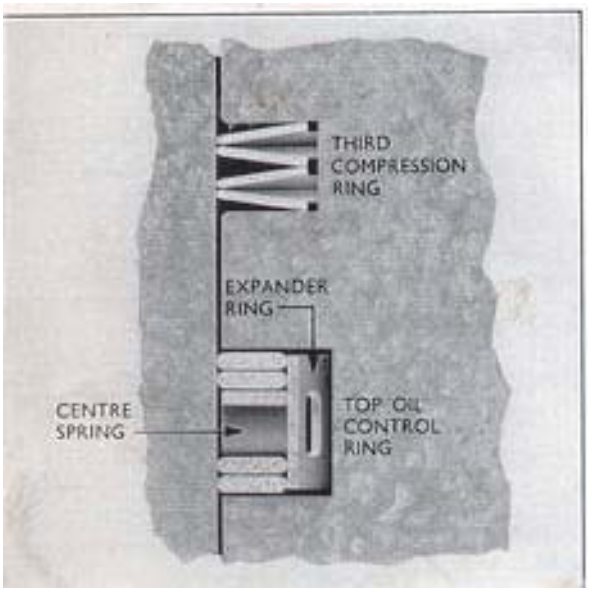

Fig. 24
Laminated Ring Arrangement

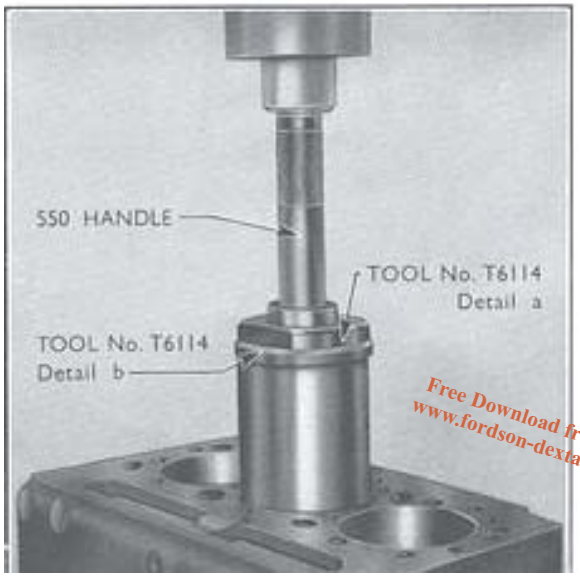

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Fig. 25
Replacing a Cylinder Liner

an interference fit in the cylinder blocks, and they are bored out to the required sizes after fitting.

If reboring equipment is available the cylinder liners may be removed as described in the next paragraph, and new liners fitted where necessary.

To Remove the Cylinder Liners

1. Remove the engine as described on page 23.
2. Completely dismantle the engine as detailed on page 25.
3. Remove the main bearing cap locating dowels.
4. Thoroughly clean the cylinder block.
5. Support the cylinder block, cylinder head face downward on a sleeving table mounted on a hydraulic press. The bore from which the liner is to be removed must be directly beneath the ram of the hydraulic press.
6. Fit the liner remover adaptor (Tool No. T.6101/a) in the bore, and press out the liner from the crankcase side.

Fitting New Cylinder Liners

1. Ensure that the outer surface of the liner and the cylinder block bore are perfectly clean. Check the cylinder block bore diameter which should be 3.6865 in. (93.637 mm.) to 3.6875 in. (93.663 mm.) for the 144 cu. in. engine and 3.6875 in. (93.663 mm.) to 3.6887 in. (93.793 mm.) for the 152 cu. in engine.
2. Support the cylinder block, cylinder head face uppermost, making sure that the bore which is to receive the liner is directly beneath the ram of the hydraulic press.
3. Apply a thin coating of tallow to the outer surface of the liner to act as a lubricant during the pressing-in operation. **Do not use oil or grease.**

4. Enter the liner into its bore in the cylinder block with the long chamfer in the line bore downwards. Assemble replacer ring (Tool No. T.6114/a to adaptor (Tool No. T.6114/b) and locate in the cylinder liner (see Fig. 25).

5. Ensure that the liner is in correct alignment with the locating bore in the cylinder block then press the liner into the block until the top of the liner is flush with the top face of the block. Use an even pressure to prevent any tendency for binding or scoring.

Using a suitable boring machine, finish bore the liners to the internal diameters shown below.

	144 *cu. in. Engine*	152 *cu. in. Engine*
Finish bore size		
	3.501 in. (88.925 mm.) to 3.502 in. (88.951 mm.)	3.600 in. (91.44 mm.) to 3.601 in. (91.465 mm.)
Liner bore size		
	3.478 in. (88.341 mm.) to 3.482 in (88.443 mm.)	3.555 in. (90.297 mm.) to 3.560 in. (90.424 mm.)

6. Thoroughly clean the cylinder block, taking great care to ensure that all oil passages and tapped holes are clear of swarf and dirt.

7. Replace the main bearing cap locating dowels.

8. Reassemble the engine as described on page 26.

9. Replace the engine in the tractor as described on page 24.

CONNECTING RODS

The connecting rods are forgings of " H " section having steel backed big end bearing liners, and separate bolts and self-locking nuts. The piston pins are fully floating and the small end of the connecting rod is fitted with a bronze lined, steel backed bush.

Renewing Connecting Rod Liners

Connecting rod liners may be changed without removing the piston and connecting rod assembly from the engine.

Connecting rod liners are available in standard and 0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.) and 0.030 in. (0.762 mm.) undersize in the bore diameter.

1. Remove the sump as described on page 29.

2. Remove the oil pump suction and delivery pipes.

3. Turn the crankshaft to bring the required big end to bottom dead centre. Remove the self-locking nuts and detach the cap.

4. Push up the connecting rods sufficiently to clear the crankpin and move the big end to one side. The upper half of the liner may now be extracted from the rod and the new one inserted with the tongue in the liner engaged in the machined recess in the big end bore.

5. The lower half of the liner may now be extracted from the cap and a new one inserted with the tongue in the liner engaging in the machined recess in the big end bore.

6. Lubricate the liner and refit the big end to the crankpin, taking care that the upper half of the liner is not dislodged.

7. Replace the big end cap with the stamped numbers together (ensure that the cap bolts are right down with the bolt heads locating against the sides of the rod).

8. Fit new self-locking nuts and tighten to the correct torque. (See " SPECIFICATION and REPAIR DATA—ENGINE ") on page 22.

9. Replace the oil pump suction and delivery pipes.

10. Fit new gaskets and cork strips and refit the sump as described on page 29.

Connecing Rod Alignment

Connecting rod alignment can be checked by using the connecting rod alignment jig (Tool No. 335) and arbor adaptor (Tool No. FMC 336–1).

Checking for Twisted Connecting Rods

1. Remove the piston as described on page 14. Insert the piston pin in the small end of the connecting rod, in which it must be a good fit otherwise misleading results will occur.

2. Bolt the connecting rod, without bearing liners to the arbor adaptor, and with the gauge mounted on the piston pin with the two horizontal pins towards the jig, move the arbor adaptor along until the pins touch the machined surface.

3. Clamp the arbor in this position. Clearance between the face of the jig and one of the pins, indicates a twist in the connecting rod.

Checking for Bent Connecting Rods

The procedure is the same as for checking for twisted connecting rods, except that the vertical pins of the gauge are brought into contact with the machined surface. Clearance between one of the pins and the machined face of the jig indicates that the small end and big end bores are out of parallel and the connecting rod is bent.

Where any connecting rods are found to be either twisted or bent, they should be replaced. No attempt should be made to straighten these connecting rods.

MAIN BEARING CAPS

The main bearing caps are of high duty cast iron, and are located on ring dowels in the cylinder block. Two high tensile set-screws are fitted per cap and are locked by tab washers. The tab washers must only be used once.

In manufacture, the main bearing liner bores in the cylinder block and caps are machined in-line, with the caps fitted in their correct location. If the caps are interchanged or replaced incorrectly, they will not then match and possibly lead to bearing failure with consequential damage to the engine.

Fig. 26
Checking Crankshaft End-float

It is for this reason that great care must be taken when the engine is dismantled, to keep its own bearing caps separate from any others and refitted in exactly the same positions from which removed.

For identification purposes there are numbers stamped on the cap and cylinder block. On reassembly the cap number must be adjacent to the corresponding number on the cylinder block.

MAIN BEARING LINERS

The main bearing liners are held in position by tongues which register with suitable locations in the cylinder block and cap, to prevent them from turning or moving out of position.

In addition to standard sizes, main bearing liners are supplied in sizes 0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.) and 0.030 in. (0.762 mm.) undersize in the bore diameter.

Should it be necessary to renew crankshaft main bearings following failure due to oil shortage, it is imperative that all oilways and the oil pump are thoroughly clean, otherwise mere replacement of liners may lead to repeated failure. In this event the engine must be removed.

It should be noted that several different types of main bearing liners have been used and it is therefore important to fit upper and lower liners of the same type to any one main bearing location. When a complete engine overhaul is being undertaken it is recommended that all main bearing liners should be fitted to the same type. Identification numbers are stamped on the back of each liner therefore each pair of top and bottom liners should have the same identification number. These numbers are not the Ford part numbers, which differ with each liner.

CRANKSHAFT END-FLOAT

The crankshaft end-float is controlled by detachable thrust washers fitted at each side of the rear main bearing cap. The lower halves of these thrust washers have suitable locating lugs to prevent them from turning out of position. Fit the crankshaft thrust washers in the recess at each side of the rear main bearing cap with their oil grooves outwards (see Fig. 27).

It should be noted that prior to Engine No. 1449364 the lower thrust washer incorporated a semi-circular off-set locating tag. Subsequent to this engine number the tag was positioned centrally on the washer and its shape was changed to rectangular form. Corresponding changes were made to the locating slots in the rear main bearing cap, care must therefore be taken to fit the correct type of thrust washer for the cap in use.

To check the crankshaft end-float, carefully push the crankshaft forward as far as it will go, and check the gap between the machined shoulder on the crankshaft web and the crankshaft thrust washers, using a feeler gauge (see Fig. 26). Check the corresponding gap on the other side of the crankweb with the crankshaft pushed fully rearward.

The gaps should be identical and within the specified limits. If the gaps are identical but outside the specified limits, a new set of thrust washers should be fitted. If, however, the gaps are not identical, it indicates that a component other than the thrust washers is affecting the end-float, i.e., incorrect radii in the corner of the main bearing journal after regrinding, main bearing liners misplaced, etc.

THE CRANKSHAFT

The crankshaft is forged from chrome molybdenum steel and the journals are induction hardened.

Two cast iron balance weights are fitted, secured

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Fig. 27
Crankshaft Thrust Washers

to the front and rear crankwebs by set-screws. The set-screws retaining the balance weights are locked in position by tab washers.

To Remove the Crankshaft

1. Separate the engine and front axle assembly away from the gearbox as described on page 23.

2. Remove the front axle from the engine as described on page 24.

3. Remove the clutch, flywheel and engine adaptor plate.

4. Fix the engine stand bracket (Tool No. T.6091), to the engine (see Fig. 28) and mount the engine on the engine stand (Tool No. 200 or 35).

5. Remove the timing case cover.

6. Remove the sump.

7. Remove the small lower section of the timing case.

8. Remove the oil pump and pipes.

9. Unscrew the connecting rod and big end cap nuts, detach the caps and push the pistons up the cylinder bores. Take care not to dislodge the big end bearing liners in the rods and caps.

10. Remove the two long bolts and self-locking nuts securing the half housings of the crankshaft rear oil seal retainer.

11. Bend down the main bearing cap set-screw locking washers and remove the set-screws. Detach the main bearing caps taking care not to drop the liners or the thrust washers.

12. Lift the crankshaft carefully out of the cylinder block.

13. Extract the upper halves of the main bearing liners and thrust washers from the cylinder block, and the halves of the crankshaft rear oil seal from their locations in the half housings on the rear main bearing cap and the cylinder block.

14. Thoroughly clean all the oil passages in the block after removing the oil filter and the oil pressure switch. The crankshaft oilways and bearing surfaces must also be cleaned.

To Replace the Crankshaft

1. Locate the upper halves of the main bearing liners in their block locations. Ensure that all oilways and passages are clear, and lightly lubricate the liners.

2. Fit the new crankshaft rear oil seal, upper half to the cylinder block and the lower half to the rear main bearing cap. The oil seal must be previously soaked in engine oil for at least one hour.

3. Locate the upper halves of the crankshaft thrust washer on either side of the rear wall of the cylinder block with the oil grooves outwards (see Fig. 27). The upper halves of these washers do not have locating tabs.

4. Check that the ends of the thrust washers are level with the cylinder block face, otherwise they may be distorted when fitting the bearing cap. A light coating of grease will assist in holding the washers in place until the crankshaft is fitted.

5. Check that the liners are seating correctly in the caps with the tongues engaging in the machined recesses, and that the crankshaft thrust washers are located on either side of the rear main bearing. The washers must be fitted with the oil grooves outwards and the locating tabs in the recesses of the cap.

6. Refit the main bearing caps so that the numbers on the caps are adjacent to the corresponding numbers on the cylinder block. The caps must be fully located on the ring dowels.

7. Refit the main bearing cap set-screws and new locking washers. Tighten the bolts to a torque of 90 to 95 lb. ft.

8. Push the crankshaft fully endwise and check the end-float as shown in Fig. 26, which should be within the limits specified. If this limit is exceeded fit new thrust washers.

9. Secure the main bearing cap set-screws by bending the tab washers up against the flats on the hexagon heads of the set-screws.

10. Refit the connecting rods to the crankpins, ensuring that the liners are correctly positioned with the tongues engaging in the machined recesses. Connecting rod caps must be fitted with the stamped numbers together and on the left-hand side of the engine (opposite side to camshaft).

11. Refit the two long bolts through the half housings of the crankshaft rear oil seal retainer and secure with two self-locking nuts.

12. Use new self-locking nuts on the big end bearing bolts and tighten to the correct specified torque. Ensure that the heads on the bolts are correctly located.

13. Replace the oil pump and pipes.

14. Replace the small lower section of the timing case ensuring that its front face is flush with the front face of the timing case.

15. Replace the sump.

16. Replace the timing case cover.

17. Support the engine and remove it from the engine stand. Unscrew the retaining bolts and remove the engine stand bracket.

18. Replace the engine adaptor plate, flywheel and clutch assembly, checking the flywheel " run-out " as described on page 13.

19. Replace the front axle to the engine as described under " MAJOR REPAIR OPERATIONS " on page 24.

20. Replace the engine and front axle assembly as described on page 24.

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SPECIFICATION AND REPAIR DATA—ENGINE

General Data

	Standard Dexta	*Super Dexta*
Bore	3.501 to 3.502 ins. (88.925 to 88.951 mm.)	3.600 to 3.601 ins. (91.44 to 91.465 mm.)
Stroke	4.995 to 5.005 ins. (126.87 to 127.127 mm.)	4.995 to 5.005 ins. (126.873 to 127.127 mm.)
Capacity	144 cu. in. (2,360 c.c.)	152 cu. in. (2,500 c.c.)
B.H.P. (Max.)	32 at 2,000 r.p.m.	39.5 at 2,000 r.p.m.
Torque (Max.)	92 lb/ft. at 1,200 r.p.m.	112 lb/ft. at 1,250 r.p.m.
Combustion system	Swirl chamber	
Compression ratio	16.5 : 1	17.4 : 1
Number of cylinders	3 in line	3 in line
Firing order	1, 2, 3	1, 2, 3
Location of No. 1 cylinder	Next to radiator	
Location of engine number	On water rail boss, at the top front of the left-hand side of the cylinder block	

Cylinder Liners

	Standard Dexta	*Super Dexta*
Method of retention	Interference fit	Interference fit
Amount of interference	0.002 to 0.004 in. (0.051 to 0.102 mm.)	0.002 to 0.005 in. (0.051 to 0.127 mm.)
Liner protrusion	Nil—Flush with top face of the cylinder block	
Outside diameter bore in cylinder block	3.6895 to 3.6905 ins. (93.637 to 93.663 mm.)	3.6915 to 3.6925 ins. (93.663 to 93.685 mm.)
Internal diameter (before finish boring)	3.478 to 3.482 ins. (88.341 to 88.443 mm.)	3.555 to 3.560 ins. (90.297 to 90.424 mm.)
Diameter of finished bore (standard)	3.501 to 3.502 ins. (88.925 to 88.951 mm.)	3.600 to 3.601 ins. (91.44 to 91.465 mm.)
Diameter of finished bore 0.030 in. (0.762 mm.) o/s	3.531 to 3.532 ins. (89.687 to 89.713 mm.)	Not applicable

Piston

Type	High silicon, aluminium alloy	
Piston diameter at bottom of skirt (standard piston) :		
At 90° to piston pin	3.4964 to 3.4974 ins. (88.808 to 88.834 mm.)	3.5945 to 3.5955 ins. (91.298 to 91.323 mm.)
In line with piston pin	3.4944 to 3.4962 ins. (88.758 to 88.803 mm.)	3.5900 to 3.5918 ins. (91.186 to 91.231 mm.)
Piston oversizes	0.030 in. (0.762 mm.)	Not applicable
Diameter of piston pin bore	1.2495 to 1.2500 ins. (31.737 to 31.750 mm.)	1.2495 to 1.2500 ins. (31.737 to 31.750 mm.)

Piston Rings

Type and material:	
Top compression	Cast iron, chrome plated
Second compression	Cast iron, plain faced
Third compression	Laminated spring steel rings
Top oil control	Laminated spring steel rings
Lower oil control	Cast iron, slotted
Width of piston ring grooves :	
Top compression	0.0957 to 0.0967 in. (0.243 to 0.246 mm.)
Second compression	0.0957 to 0.0967 in. (0.243 to 0.246 mm.)
Third compression	0.127 to 0.128 in. (0.323 to 0.325 mm.)
Top oil control	0.252 to 0.253 in. (0.640 to 0.643 mm.)
Lower oil control	0.252 to 0.253 in. (0.640 to 0.643 mm.)
Width of piston ring :	
Top compression	0.0928 to 0.0938 in. (0.236 to 0.238 mm.)
Second compression	0.0928 to 0.0938 in. (0.236 to 0.238 mm.)
Third compression	0.03125 in. (0.794 mm.) Nominal (4 rings per groove)
Top oil control	Not applicable
Lower oil control	0.249 to 0.250 in. (0.632 to 0.635 mm.)

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Piston Rings—*continued*

Ring to groove clearance :	
Top compression	0.0019 to 0.0039 in. (0.048 to 0.099 mm.)
Second compression	0.0019 to 0.0039 in. (0.048 to 0.099 mm.)
Third compression	Not applicable
Top oil control	Not applicable
Lower oil control	0.002 to 0.004 in. (0.051 to 0.102 mm.)
Piston ring gap in cylinder bore (unworn) :	
Top Compression	0.010 to 0.015 in. (0.254 to 0.381 mm.)
Second compression	0.009 to 0.013 in. (0.229 to 0.330 mm.)
Third compression	0.008 to 0.010 in. (0.203 to 0.254 mm.)
Top oil control	0.018 to 0.037 in. (0.457 to 0.940 mm.)
Lower oil control	0.009 to 0.013 in. (0.229 to 0.330 mm.)

Piston Pin

Type	Fully floating
Length	2.961 to 2.965 in. (75.2 to 75.3 mm.)
Outside diameter	1.24975 to 1.2500 in. (31.744 to 31.75 mm.)
Clearance in piston	0.00025 to 0.0005 in. (0.0064 to 0.0127 mm.)
Clearance in small end bore	0.0005 to 0.00175 in. (0.0127 to 0.0445 mm.)
Method of retention	End circlips

Connecting Rod

Length between centres	8.999 to 9.001 in. (228.575 to 228.625 mm.)
Big end bore (without liners)	2.3950 to 2.3955 in. (60.833 to 60.846 mm.)
Big end bore (with liners)	2.251 to 2.252 in. (57.175 to 57.201 mm.)
Undersizes of liners	0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.), 0.030 in. (0.762 mm.)
Connecting rod big end width	1.5502 to 1.5525 in. (39.375 to 39.434 mm.)
Liner thickness (standard)	0.07175 to 0.0720 in. (1.822 to 1.829 mm.)
Clearance on crankpin	0.002 to 0.0035 in. (0.051 to 0.089 mm.)
End-float on crankpin	0.0095 to 0.0133 in. (0.241 to 0.338 mm.)
Small end bore (with bush)	1.2505 to 1.2515 in. (31.763 to 31.788 mm.)
Clearance between small end and piston pin	0.0005 to 0.00175 in. (0.0127 to 0.0445 mm.)

Crankshaft and Main Bearings

Crankpin journal length	1.5620 to 1.5635 in. (39.675 to 39.713 mm.)
Crankpin journal diameter	2.2485 to 2.249 in. (57.112 to 57.125 mm.)
Crankshaft end-float	0.00225 to 0.01025 in. (0.0572 to 0.2604 mm.)
Rear main bearing thrust washer thickness	0.123 to 0.125 in. (3.124 to 3.175 mm.)
Main bearing liner thickness (standard)	0.08225 to 0.0825 in. (2.089 to 2.096 mm.)
Undersizes	0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.), 0.030 in. (0.762 mm.)
Main bearing journal diameter	2.7485 to 2.749 in. (69.812 to 69.825 mm.)
Main bearing journal clearance	0.0025 to 0.0045 in. (0.064 to 0.114 mm.)
Number of teeth on crankshaft gear	25
Effective diameter of crankshaft pulley	5.21875 in. (132.556 mm.)
Crankshaft pulley fit	0.00025 to 0.00175 in. clearance (0.0064 to 0.0445 mm.)
Crankshaft gear fit	0.001 in. (0.025 mm.) interference to 0.001 in. (0.025 mm.) clearance

Idler Gear

Number of teeth on idler gear	90
Internal diameter of gear	2.125 to 2.1266 in. (53.975 to 54.016 mm.)
Diameter of idler gear spigot	2.123 to 2.1238 in. (53.924 to 53.945 mm.)
Clearance between gear and spigot	0.0012 to 0.0036 in. (0.030 to 0.091 mm.)

Camshaft

Camshaft drive	Gear
Maximum cam lift	0.30955 to 0.31555 in. (7.863 to 8.015 mm.)
Maximum valve lift	0.348 in. (8.84 mm.)
Journal diameter front	1.869 to 1.870 in. (47.473 to 47.498 mm.)
Journal diameter centre	1.859 to 1.860 in. (47.219 to 47.244 mm.)
Journal diameter rear	1.839 to 1.840 in. (46.711 to 46.736 mm.)
Bearing clearance	0.004 to 0.008 in. (0.102 to 0.203 mm.)
Number of teeth on camshaft gear	50
Backlash—all timing gears	0.003 to 0.006 in. (0.076 to 0.152 mm.)

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Valves and Guides

Valve clearance—inlet and exhaust	0.010 in. (0.254 mm.) Hot
Valve head diameter—inlet	1.532 to 1.536 in. (38.913 to 39.014 mm.)
Valve head diameter—exhaust	1.313 to 1.317 in. (33.350 to 33.452 mm.)
Valve stem diameter—inlet and exhaust	0.311 to 0.312 in. (7.899 to 7.925 mm.)
Valve length—inlet and exhaust	4.486 to 4.514 in. (113.95 to 114.66 mm.)
Angle of valve head	45°
Angle of valve seat in cylinder head	44°
Length of valve guide	2.59275 to 2.59475 in. (65.856 to 65.907 mm.)
Valve guide internal diameter	0.314 to 0.3155 in. (7.976 to 8.014 mm.)
Valve guide outside diameter	0.5005 to 0.501 in. (12.713 to 12.725 mm.)
Stem to guide clearance	0.002 to 0.0045 in. (0.051 to 0.114 mm.)
Valve depth in cylinder head (new)	0.059 to 0.087 in. (1.498 to 2.210 mm.)
Valve depth in cylinder head (max.)	0.140 in. (3.556 mm.)

Valve Springs

Number of coils on valve spring :	
Inner	7.75 approx.
Outer	7.25 approx.
Free length of valve spring :	
Inner	1.365 to 1.405 in. (34.671 to 35.687 mm.)
Outer	1.783 to 1.803 in. (45.288 to 45.796 mm.)
Compressed length and load :	
Inner	0.838 in. at 21 to 25 lb. (21.285 mm. at 9.53 to 11.34 kg.)
Outer	1.151 in. at 48 to 52 lb. (29.235 mm. at 21.77 to 23.59 kg.)

Tappets

Diameter of tappet stem	0.62225 to 0,62375 in. (15.805 to 15.843 mm.)
Tappet to cylinder head clearance	0.00075 to 0,0035 in. (0.019 to 0.089 mm.)

Rocker Shaft

Rocker shaft length	12.235 to 12.265 in. (310.77 to 311.53 mm.)
Rocker shaft diameter	0.62225 to 0.62375 in. (15.805 to 15.843 mm.)
Clearance between rocker arm and shaft	0.00075 to 0.0035 in. (0.019 to 0.089 mm.)

Valve Timing

Inlet opens	13° before T.D.C.
Inlet closes	43° after B.D.C.
Exhaust opens	46° before B.D.C.
Exhaust closes	10° after T.D.C.

Flywheel

Flywheel outside diameter	15.5 in. (393.7 mm.)
Flywheel run-out clutch face (max. T.I.R.)	0.001 in. (0.025 mm.) per inch (25.4 mm.) of radius from centre of flywheel to the dial indicator
Flywheel ' run-out ' outside diameter (max. T.I.R.)	0.012 in. (0.305 mm.)
Method of flywheel retention	Spigot and six set-screws
Number of teeth on starter ring gear	122
Method of starter ring gear retention	6 cross-headed screws

Torque Tightening Figures

Cylinder head nuts	55 to 60 lb. ft. (7.601 to 8.292 kg.m.)
Main bearing cap bolts	90 to 95 lb. ft. (12.438 to 13.129 kg.m.)
Big end cap nuts	
Cadmium plated	50 to 55 lb. ft. (6.910 to 7.601 kg.m.)
Unplated	65 to 70 lb. ft. (8.893 to 9.674 kg.m.)
Flywheel bolts	75 lb. ft. (10.365 kg.m.)

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REMOVAL AND REPLACEMENT

TO SEPARATE THE ENGINE AND FRONT AXLE ASSEMBLY FROM THE GEARBOX

Should it be necessary to dismantle the tractor to carry out repairs to the clutch, gearbox, crankshaft rear oil seal, etc., the following general dismantling procedure can be adopted.

To Remove the Engine and Front Axle Assembly

1. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and the engine bonnet.

2. Disconnect the battery leads and remove the battery.

3. Disconnect the starter motor control rod and leads.

4. Disconnect the heater plug lead and induction primer atomizer feed pipe from the inlet manifold. Disconnect the governor control linkage at the right-hand end of the friction pad rod.

4a. *Remove the set-screws securing the battery heat baffle to the brackets at either side of the rear of the cylinder head. Disconnect the throttle control rod and air inlet hose from the inlet manifold.*

5. Disconnect the generator leads from the terminal posts on the generator.

6. Disconnect the headlamp wiring snap connectors at the right-hand side of the tractor, near the top radiator support bracket.

7. Remove the temperature gauge bulb from the cylinder head water outlet connection and release the capillary tube clip from beneath the upper of the two set-screws on the left-hand engine lifting plate. Replace the set-screw.

8. Remove the proofmeter drive cable by unscrewing the knurled retaining nut at the rear of the fuel injection pump.

9. Disconnect the oil pressure warning light lead from the pressure switch on the left-hand side of the cylinder block.

10. Turn the fuel tap to the " OFF " position and remove the fuel tank to lift pump pipe, at the lift pump end.

11. Unscrew the pinch screw on the stop lever, and the outer cable retaining clip, and remove the stop control inner and outer cables.

12. Disconnect the fuel leak-off pipe from the union at the rear of the cylinder head.

13. Fit suitable wedges between the front axle centre beam and the front axle support bracket to balance the engine and prevent it rotating.

14. Disconnect the radius rods and drag links at their rear ends, and tie the drag links to the radius rods so that the wheels are in the straight ahead position.

15. Using a suitable jack or lifting tackle, support the transmission under the gearbox housing.

16. Fit lifting tackle to the two lifting plates on the engine, and take the weight on a joist or gantry.

17. Remove the ten nuts and bolts securing the engine to the transmission, and wheel the engine and front axle assembly forward from its dowelled location on the clutch housing.

To Replace the Engine and Front Axle Assembly

1. Move the engine and front axle assembly towards the gearbox, ensuring that the gearbox main drive shaft lines up with the clutch disc splines and the clutch pilot bearing.

When replacing an engine fitted with a double clutch, the splines on both the power take-off input and the main drive shafts must be aligned with the splined hubs of their respective clutch discs.

2. With the engine fully located on the two dowels in the clutch housing, replace the ten nuts and bolts that secure the engine to the transmission, and tighten the nuts fully.

3. Remove the lifting tackle from the engine and the support from beneath the gearbox housing.

4. Replace the radius rods and the drag links, and tighten the securing nuts fully. Remove the front axle wedge tool.

5. Reconnect the fuel leak-off pipe to the union at the rear of the cylinder head.

6. Replace the stop control inner and outer cables, so that there is approximately $\frac{1}{4}$ in. (6.35 mm.) free movement at the stop control knob on the control panel.

7. Replace the fuel tank to fuel lift pump pipe onto the lift pump.

8. Reconnect the oil pressure warning light lead to the pressure switch on the left-hand side of the cylinder block.

9. Replace the proofmeter drive cable into the square hole at the rear of the fuel injection pump camshaft, and tighten the knurled nut fully.

10. Replace the temperature gauge bulb in the cylinder head water outlet connection and refit the capillary tube clip beneath the top set-screw on the left-hand engine lifting plate.

11. Reconnect the headlamp wiring by joining the snap connectors.

12. Reconnect the generator leads to the terminal posts on the generator.

12a. *Replace the set-screws securing the battery heat baffle to the brackets on the cylinder head and connect the throttle control rod and air inlet hose to the inlet manifold.*

13. Refit the heater plug lead and induction primer

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atomizer feed pipe, to their appropriate locations on the inlet manifold. Reconnect the governor control linkage.

14. Reconnect the starter motor control rod and leads.

15. Replace the battery and reconnect the battery leads.

16. Refit the engine bonnet, primary air cleaner and vertical exhaust silencer (where fitted).

17. Turn the fuel tap to the " ON " position and bleed all air from the fuel system (as detailed in the Fuel System Section).

TO SEPARATE THE FRONT AXLE AND RADIATOR ASSEMBLY FROM THE ENGINE

For certain repair operations on the front of the engine, it will be necessary to remove the front axle and radiator as an assembly. This can be accomplished quite easily as detailed in the following paragraphs :—

To Remove the Front Axle and Radiator Assembly

1. Drain the cooling system, through the taps on the radiator and the left-hand side of the cylinder block.

2. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and the engine bonnet.

3. Remove the four set-screws that retain the radiator top support brackets to the cylinder head water outlet connection.

4. Unscrew the two set-screws securing the water outlet adaptor to the water outlet connection.

5. Disconnect the headlamp wires at the snap connectors, on the top right-hand radiator support bracket.

6. Disconnect the lower radiator hose at the water pump.

7. Disconnect the radius rods and drag links at their rear ends, and tie the drag links to the radius rods so that the wheels are in the straight ahead position.

8. Support the front of the tractor, and fit suitable wedges in between the centre axle beam and the front axle support bracket.

9. Remove the six nuts and spring washers securing the front axle support bracket to the sump, and move the axle and radiator assembly forward away from the engine.

To Replace the Front Axle and Radiator Assembly

1. Wheel the front axle and radiator assembly back against the front axle support bracket, and secure in position on the studs with six nuts and spring washers.

2. Replace the radius rods and the drag links, and tighten the securing nuts fully. Remove the front axle wedges, and the support from under the front of the tractor.

3. Replace the lower radiator hose onto the water pump.

4. Replace the two set-screws securing the water outlet adaptor to the water outlet connection on the cylinder head.

5. Replace the radiator top support brackets on the water outlet connection, and secure with four set-screws.

6. Reconnect the headlamp wires by pushing in the snap connectors on the right-hand side of the tractor.

7. Refill the cooling system.

8. Replace the engine bonnet, primary air cleaner and the vertical exhaust silencer (where fitted).

MAJOR REPAIR OPERATIONS

Most operations of dismantling and repair on the engine, can be carried out without removing the engine from the tractor, but should removal be necessary the procedure for removing the front axle and engine assembly as detailed on page 23, should be adopted.

The following additional operations are then needed to remove the engine from the front axle.

To Remove the Engine

1. Drain the cooling system, through the taps on the radiator and the left-hand side of the cylinder block.

2. Remove the four set-screws that retain the radiator top support brackets to the water outlet connection on the cylinder head.

3. Unscrew the two set-screws securing the water outlet adaptor to the water outlet connection.

4. Disconnect the lower radiator hose at the water pump.

5. Remove the six nuts and spring washers securing the front axle support bracket to the sump, and move the axle and radiator assembly forward away from the engine.

To Replace the Engine

1. Wheel the front axle and radiator assembly back against the front axle support bracket and secure in position on the studs with six nuts and spring washers.

2. Replace the lower radiator hose onto the water pump.

3. Replace the two set-screws securing the water outlet adaptor to the water outlet connection, ensuring that the gasket is in good order.

4. Replace the radiator top support brackets on the

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water outlet connection, and secure with four set-screws.

5. Refill the cooling system.

6. Replace the engine and front axle assembly as detailed on page 24.

DISMANTLING THE ENGINE

The following sequence is given as a guide, and where necessary, reference can be made to the appropriate sections for detailed instructions covering the dismantling and reassembling of any particular sub-assembly.

1. Disconnect the governor control rod from the governor arm, remove the inlet hose from the inlet manifold and remove the set-screws securing the battery heat baffle to the engine block. Remove the heat baffle complete with air cleaner and governor linkage.

2. Remove the sump drain plug and drain off the engine oil. Replace the drain plug when all of the oil has been removed.

3. Remove the clutch assembly taking care to slacken the pressure plate to flywheel bolts evenly.

4. Unscrew the retaining set-screw and remove the starter motor.

5. Remove the wire from the six flywheel retaining bolts, unscrew the bolts, and remove the flywheel from its location on the crankshaft.

6. Remove the sixteen set-screws and spring washers securing the engine adaptor plate to the cylinder block and sump, and remove the adaptor plate from its dowelled position on the cylinder block.

7. Bolt the engine stand bracket (Tool No. T.6091) to the engine in the position shown on Fig. 28. The engine and bracket can then be positioned on the engine stand (Tool No. 200 or 35) in the normal manner.

8. Remove the thermostat from the cylinder head water outlet connection.

9. Disconnect the fuel leak-off pipe and remove the injectors, taking the recommended precautions regarding cleanliness.

10. Remove the two nuts retaining the rocket cover and lift off the cover and gasket.

11. Remove the four nuts retaining the rocker shaft assembly, detach the rocker shaft oil feed pipe from the union at the rear right-hand corner of the cylinder head, and lift off the rocker shaft assembly.

12. Remove the exhaust manifold by unscrewing the four brass nuts securing it to the cylinder head.

12a. *Remove the governor pipe from the inlet manifold and the fuel injection pump. To remove the pipe completely from the engine it is necessary to remove the clip at the rear of the cylinder head.*

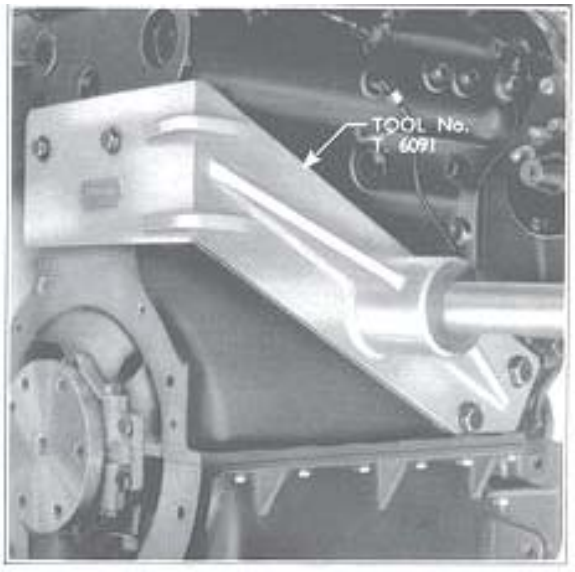

Fig. 28
Engine Stand Bracket

13. Remove the six nuts and spring washers from the inlet manifold retaining studs, and remove the inlet manifold.

14. Remove the engine lifting plate from the right-hand side of cylinder head, and remove the camshaft chamber to cylinder head and the oil pressure gallery to camshaft chamber oil pipes.

15. Unscrew the five set-screws securing the water outlet connection to the front of the cylinder head, and remove the connection and water hose.

16. Unscrew the cylinder head retaining nuts in the opposite sequence to that shown in Fig. 2, and lift off the cylinder head. To dismantle the cylinder head assembly refer to page 5.

17. Remove the generator, fan belt and the generator support brackets.

18. Remove the lubricating oil filter, cylinder block drain tap, oil pressure warning light switch and the cylinder block water connection (at the top of the left-hand side of the cylinder block).

19. Remove the fuel filter and pipes, taking the recommended precautions regarding cleanliness.

20. Remove the four nuts and shakeproof washers securing the water pump to the timing case cover, and detach the water pump.

21. Bend back the locking washer fitted behind the crankshaft ratchet nut, and unscrew the nut, using the box spanner (Tool No. T.6098).

22. Draw off the crankshaft pulley using the universal puller (Tool No. 555) and the three screwed adaptors (Tool No. T.555–2).

23. Remove the timing case cover set-screws and carefully remove the cover.

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24. Unscrew the idler gear retaining bolt, and remove the idler gear and spigot.

25. Lift the camshaft and gear from its location in the cylinder block, taking care not to damage the cams or bearing journals.

26. Invert the engine on the stand, and remove the nuts and set-screws retaining the sump to the cylinder block. Lift off the sump and gaskets.

27. Remove the oil pump suction and delivery pipes.

28. Remove the fourteen set-screws and shakeproof washers securing the timing case to the cylinder block, and remove the timing case and fuel pump as an assembly.

29. Remove the oil pump idler gear and unscrew the three set-screws retaining the oil pump to the front main bearing cap. Remove the oil pump from its dowelled location on the main bearing cap.

30. Remove the connecting rods and pistons.

31. Unscrew the two nuts and bolts holding the half housings of the crankshaft rear oil seal retainer together

32. Bend back the locking washers on the main bearing cap set-screws, and remove the set-screws, caps, liners and crankshaft thrust washers. Carefully lift out the crankshaft and extract the upper halves of the thrust washers and the main bearing liners.

33. Using a suitable stud remover, unscrew the cylinder head studs.

34. Thoroughly clean the cylinder block, before inspecting the block for cylinder bore wear, cracks, core plug leaks, etc.

REASSEMBLING THE ENGINE

Before reassembling the engine all parts will require checking dimensionally against the general specification, and where necessary new parts should be fitted. Lubricate all bearing surfaces and moving parts before assembly, and soak the new crankshaft rear oil seals in engine oil for one hour before fitting.

1. Fit new crankshaft rear oil seals to the half housings of the crankshaft rear oil seal retainer (one on the rear main bearing cap, and the other is on the rear of the cylinder block).

2. Fit the top halves of the main bearing liners and thrust washers, install the crankshaft and fit the main bearing caps, lower halves of the liners and thrust washers, new locking washers and the main bearing cap set-screws. Fully tighten the main bearing cap set-screws, and check the crankshaft end-float.

3. Replace the two bolts and self-locking nuts that hold the half housings of the crankshaft rear oil seal retainer together.

4. Locate the piston and connecting rod assemblies in their appropriate bores with the number stamped on the connecting rod big end positioned on the left-hand side of the engine (opposite side to camshaft). Compress the piston rings using a suitable piston assembly ring, push the pistons down the cylinder bores and reassemble the big end caps to the crankshaft, with the corresponding numbers on cap and rod adjacent. Always use new self-locking nuts.

5. Replace the cylinder head studs in the cylinder block. The six long studs fit in the tapped holes on the left-hand side of the cylinder block top face.

6. Replace the oil pump in the dowelled location on the front main bearing cap, and secure in position with three set-screws and shakeproof washers. Refit the oil pump idler gear and retaining clip.

7. Place the idler gear spigot and locating peg in their locations in the cylinder block, and fit the timing case, set-screws and shakeproof washers. Fully tighten the set-screws.

8. Refit the idler gear, and secure in position with a large flat washer, locking washer and bolt. Bend the locking washer up against the bolt head. Check that the idler gear has end-float on its spigot.

9. Refit the camshaft and gear, taking care not to damage the cams or bearing journals.

10. Replace the timing case cover, crankshaft pulley, locking washer and ratchet nut. Bend up the locking washer against the ratchet nut.

11. Replace the oil pump suction and delivery pipes, sump and gaskets. Tighten the sump retaining set-screws evenly.

12. Replace the cylinder head and gasket and tighten the cylinder head nuts in the correct sequence (see Fig. 2) to a torque of 55 to 60 lb. ft., using the extra deep socket (Tool No. T.6095). Before fitting the cylinder head gasket it should be covered on both sides, with a thin coating of jointing compound.

13. Replace the water outlet connection and hose.

14. Refit the oil gallery to camshaft chamber and the camshaft chamber to cylinder head oil pipes, and replace the right-hand engine lifting plate.

15. Refit the lubricating oil filter, cylinder block drain tap, oil pressure warning light switch, cylinder block water connection and the fuel filter and pipes.

16. Replace the water pump, generator support brackets, generator and fan belt. The fan belt should have 1 in. (25.4 mm.) free travel measured midway between the generator pulley and the crankshaft pulley.

17. Replace the inlet and exhaust manifolds.

17*a*. *Refit the governor pipe to the manifold and injection pump.*

18. Install the rocker shaft assembly, and reconnect the rocker shaft oil feed pipe to the union at the rear of the cylinder head.

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19. Refit the rocker cover and gasket, taking care to ensure that the gasket is correctly located in the cover.

20. Refit the injectors, injector pipes and the fuel leak-off pipe.

21. Replace the thermostat in its location in the water outlet connection.

22. Remove the engine from the engine stand, and unbolt the engine stand bracket.

23. Refit the engine adaptor plate and flywheel. Wire up the flywheel bolts, and check the flywheel run-out.

24. Replace the starter motor and secure in position with one set-screw.

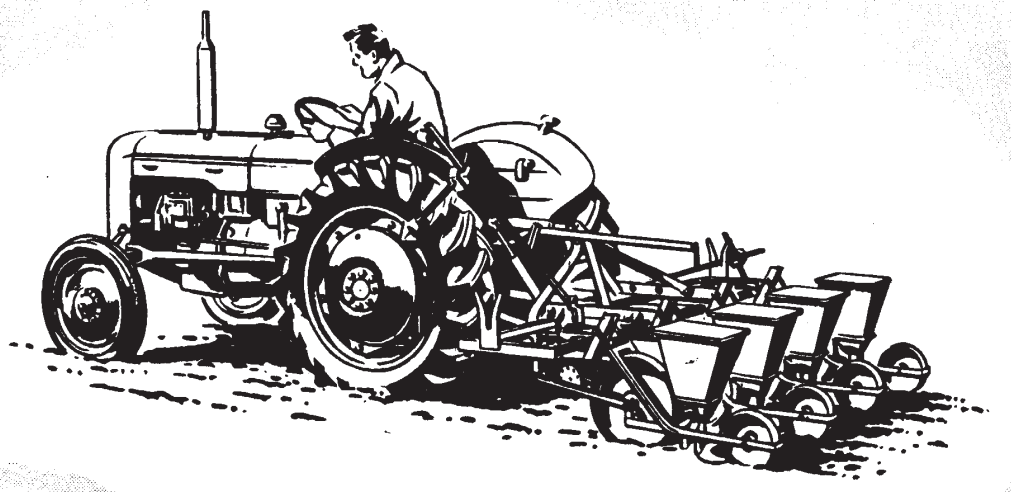
25. Replace the clutch assembly using the clutch disc locator (Tool No. T.7079), to centralise the clutch disc (single clutch only). When fitting a double clutch assembly a clutch disc locator is not required.

26. Refill the engine with clean oil of the approved grade, to the correct level.

27. Refit the battery heat baffle to the engine block and connect the air inlet hose to the inlet manifold and the governor control rod to the governor arm.

Just a joke from the Webmaster:

Two farmers are meeting together. One farmer told: I bought a new tractor, it's a english build one. You can indicate an english build tractor on the steering wheel. The other farmer: What about the steeering wheel? Farmer one: The steering wheel is fixed on the other side.



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LUBRICATION SYSTEM

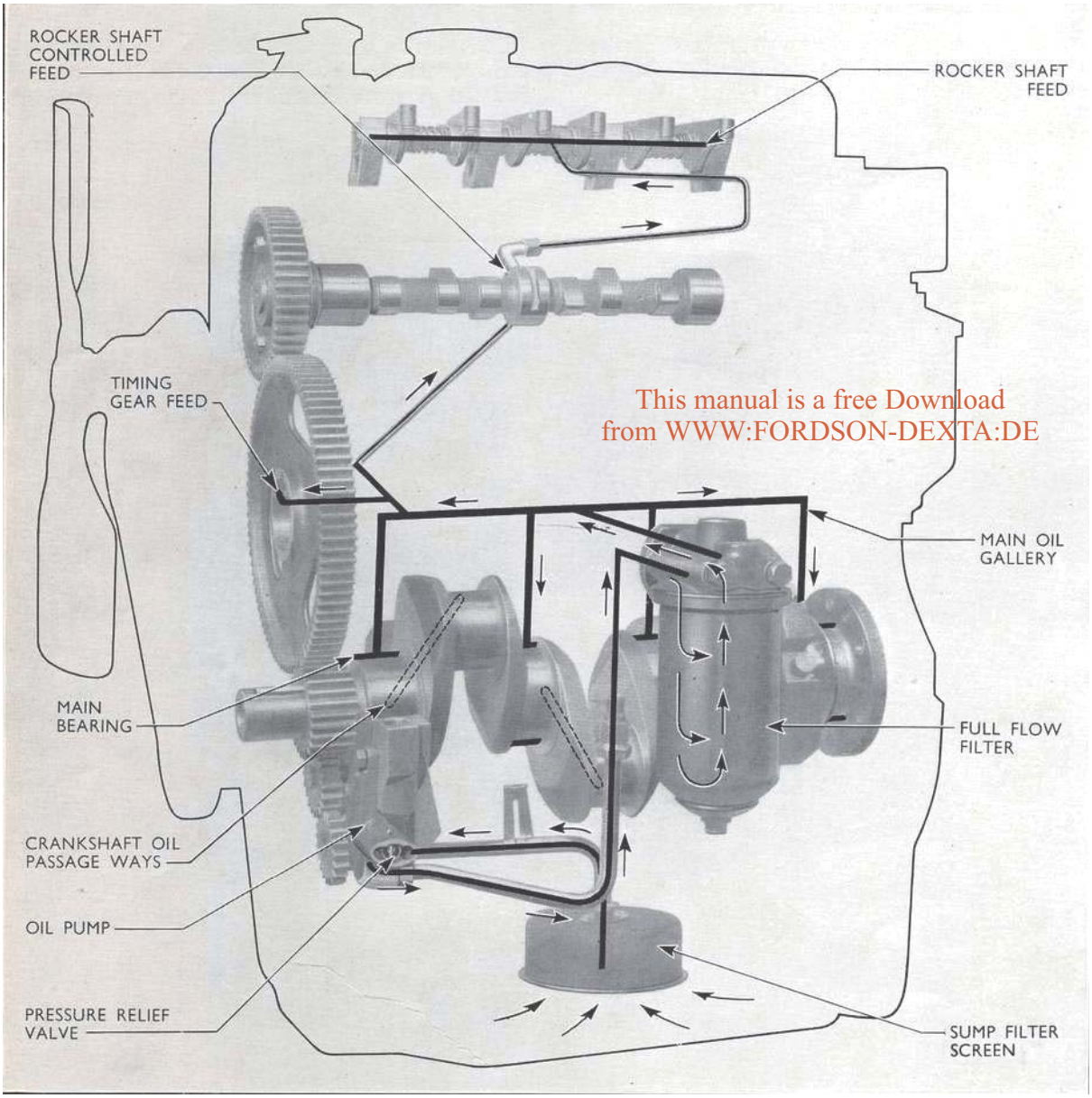

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Fig. 29
Engine Lubrication System

Description

The lubrication system is of the forced feed type, the oil being circulated, under pressure, by a rotor type pump bolted to the front main bearing cap, and driven via an idler gear by the crankshaft gear. Oil is drawn through a sump filter screen and a suction pipe before entering the pump, it is then pumped via a pipe and a drilling in the cylinder block to a renewable-element type, externally mounted, full-flow filter. Any excess pressure of oil passes back into the sump through a pressure relief valve located on the outlet side of the pump.

After passing through the filter which is located on the left-hand side of the engine, the oil passes through a drilling in the cylinder block into the main oil gallery. This gallery runs the complete length of the cylinder block, on the left-hand side of the engine.

From the main oil gallery the oil is fed through oilways in the cylinder block to Nos. 1, 2, 3 and 4 main bearings. The main bearings also supply oil, under pressure, through oilways in the crankwebs to the big end bearings. A tapping in the main oil gallery provides a location for the oil pressure warning switch, which comes into operation when the oil pressure is below 7–9 lbs. per square inch.

A transverse drilling at the front of the cylinder block, feeds oil under pressure from the main oil gallery to an external pipe located at the right-hand side of the engine. This pipe feeds oil to the centre camshaft bearing. A machined slot on the centre camshaft journal allows oil, under pressure, to be forced to the rocker shaft via an external pipe, once every revolution of the camshaft, when the slot in the camshaft journal and the oil passages in the camshaft bearing are in line.

Oil from the rocker shaft lubricates the valves, guides and tappets via a small hole in each rocker arm. The camshaft is lubricated by oil draining down from the rocker gear, the level of the oil in the camshaft chamber being controlled by a hole cast in the cylinder block, which diverts excess oil onto the timing gears.

As well as being splash lubricated the timing gears have pressure oil fed to them from a drilling in the idler gear spigot, which connects with the transverse drilling across the front of the cylinder block. A controlled feed of oil is maintained by a drilling in the idler gear that lines up with the drilling in the idler gear spigot once every revolution of the idler gear. After lubricating the timing gears the oil returns to the sump through a passage in the timing case. A spring-loaded rubber seal in the timing case cover bears on the journal of the crankshaft pulley and prevents any leakage of oil or ingress of dirt at this location.

The pistons, cylinder walls and connecting rod small-end bearings are lubricated by splash and oil mist.

Oil is prevented from leaking into the clutch housing by a rubber cored asbestos type oil seal fitted to the crankshaft at the rear of No. 4 main bearing cap, and an oil return scroll machined on the crankshaft.

ENGINE OIL

The engine oil should be changed at the initial 25 hour service and then normally at intervals of 200 hours.

The sump capacity of the engine is 12 Imperial pints (6.82 litres). In addition $\frac{3}{4}$ pint (0.43 litres) is required for a dry oil filter. The engine oil level indicator is located on the left-hand side of the sump adjacent to the oil filter.

Temperature Range	*S.A.E. H.D. Grade*
Below 20°F. (—6.6°C.)	10
20°F. to 90°F. (—6.6°C. to 32.2°C.)	20
ABOVE 90°F. (32.2°C.)	30

THE OIL SUMP

To Remove the Sump

1. Arrange the tractor on level ground, and run the engine until the normal operating temperature is reached.

2. Place a suitable can under the sump and remove the sump drain plug. When all the oil has drained out replace the drain plug.

3. Remove the front axle and radiator assembly as described on page 24.

4. Support the sump and unscrew the nuts and bolts securing it to the cylinder block and engine adaptor plate.

5. Lower the sump and remove it from beneath the engine.

To Replace the Sump

1. Wash the sump and filter screen thoroughly in petrol or paraffin.

2. Clean off the gasket faces on the sump, cylinder block, rear main bearing cap and the timing case.

3. Smear the new gaskets with jointing compound and locate them on the cylinder block faces.

4. Fit new cork strips to the timing case and the rear main bearing cap so that the ends are over the gaskets already fitted.

5. Replace the sump ensuring that all gaskets are correctly aligned. Fit and tighten all the retaining nuts and bolts evenly.

6. Replace the front axle and radiator assembly as described on page 24.

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7. Refill the sump with the approved grade of oil to the correct level.

ENGINE OIL FILTER

The oil filter is a full-flow, replaceable element type, and is secured to the left-hand side of the cylinder block by two set-screws and spring washers.

Impurities removed from the oil are collected by the element located in the filter body. The element should normally be renewed every 200 hours.

If at any time the element becomes blocked, a relief valve in the filter head set to operate between 13 to 17 lbs. per square inch differential pressure, comes into action and allows unfiltered oil to by-pass the filter and enter the engine.

Filter assemblies may be " bottom servicing " type, where the retaining bolt passes up through the filter, or " top servicing " type in which case the retaining bolt passes down through the filter head. Replaceable elements supplied through service are suitable for both types of filter but the remaining parts of the filter assembly must be of the same type as the particular filter assembly in use.

To Renew the Filter Element

1. Unscrew the centre retaining bolt and withdraw the filter body and element (see Fig. 30).

2. Discard the element, and thoroughly clean the filter body.

3. Remove the rubber sealing ring from the top casting, and replace it with a new sealing ring, having first ensured that the groove in the top casting is perfectly clean.

4. Fit a new element in the body, replace in position on the top casting and tighten the centre bolt to a torque of 10 lbs. ft.

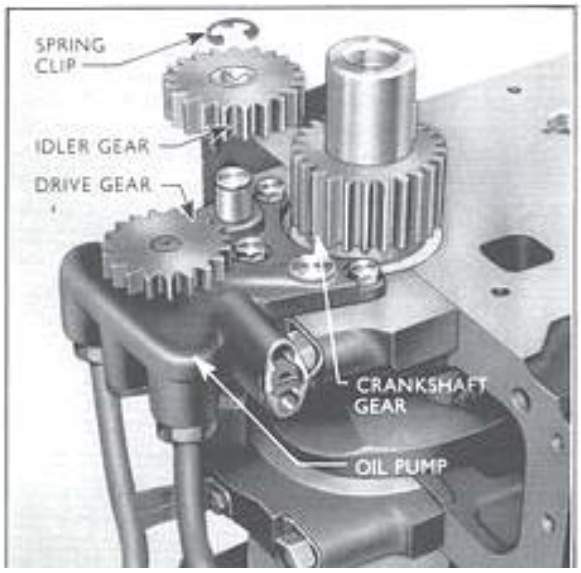

Fig. 31
Oil Pump and Idler Gear

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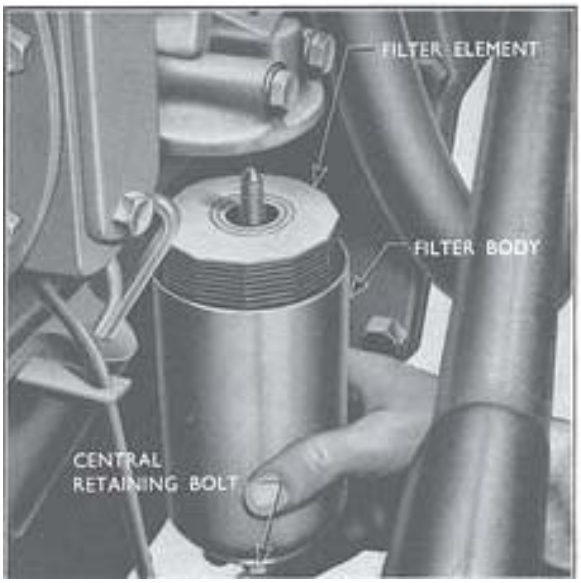
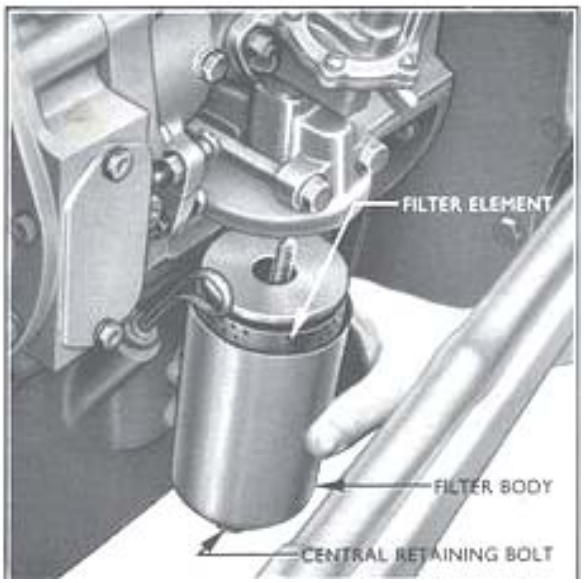
THE OIL PUMP

The oil pump is secured to the front main bearing cap by three set-screws, a dowel on the pump locating in a hole in the bearing cap to give positive location. The pump and plate is secured to the pump body by three cross-headed screws and to ensure effective sealing between the pump body and the end plate an oil sealing ring is fitted in a groove in the pump body (see Fig. 32).



Early Type



Current Type

Fig. 30
Removing Oil Filter Element

NOTE.—Prior to Engine No. 1415168 the end face of the oil pump body did not have the oil sealing ring groove present on pumps after the above engine number.

The bushed idler gear which is free to rotate on a shaft pressed into the pump body, transmits the drive from the crankshaft gear to the oil pump gear.

The oil pump gear is keyed to the pump drive shaft, to the other end of which is fitted a four-lobed drive rotor. This rotor meshes with a five-lobed driven rotor, which is free to rotate in the cast iron pump body (see Fig. 32).

As the pump rotors rotate, the pockets formed between the rotor lobes increase then decrease in volume to propel oil from the suction side to the pressure side of the pump.

A pressure relief valve mounted on the pressure side of the pump body controls the maximum oil pressure at 60 lbs. per square inch, any excess pressure oil returning direct to the sump.

The suction pipe from the filter screen and the delivery pipe to the full-flow filter are screwed into the cast inlet and outlet ports on the pump body.

Before Engine No. 1450597 two adaptors were screwed into the inlet and outlet ports on the pump body and to these were attached the suction pipe and delivery pipe.

To Remove the Oil Pump

1. Remove the timing case cover as described on page 6.
2. Remove the sump as detailed on page 29.
3. Remove the oil pump suction and delivery pipes.
4. Unscrew the two set-screws securing the small lower section of the timing case to the main timing case, and remove the lower section.
5. Remove the oil pump idler gear retaining clip and lift off the idler gear (see Fig. 31).
6. Unscrew the three set-screws and remove the oil pump from its dowelled location on the front main bearing cap.

To Dismantle

1. Remove the oil pump gear using the puller Tool No. T.6129 and the thrust button STN. 6878.
2. Remove the key from the keyway in the drive shaft.

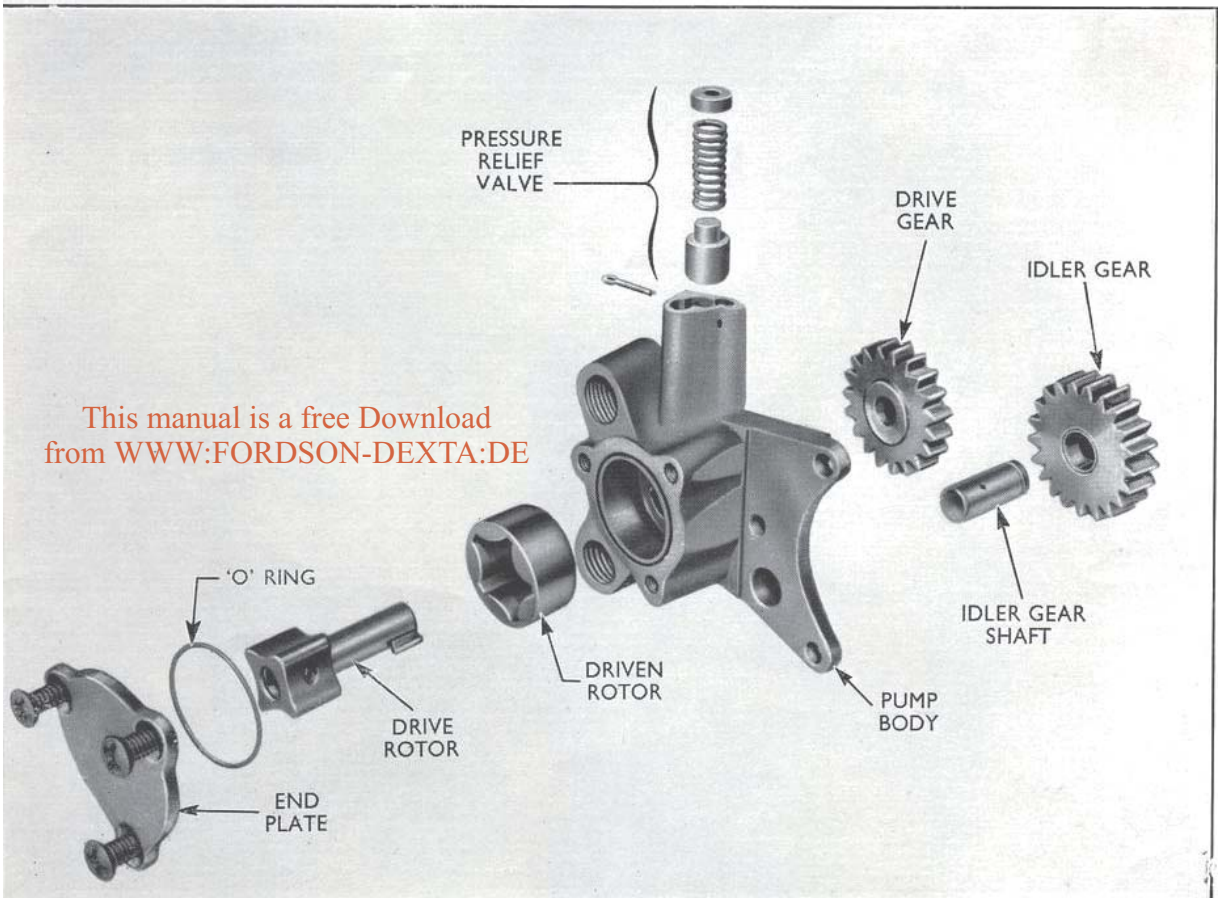


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Fig. 32
Explored View of Oil Pump

Fig. 33
Checking Drive to Driven Rotor Clearance

3. Unscrew the three countersunk screws retaining the end plate in position on the pump body, and remove the end plate. Extract the sealing ring (if fitted).

4. Carefully remove the drive and driven rotors from the pump body.

Inspection

1. Thoroughly clean all the parts, and inspect the rotors for cracks or scores.

2. Install the drive and driven rotors in the pump body, and check the clearances between the rotors, at all points, with a feeler gauge as shown in Fig. 33. If the clearance exceeds 0.006 in. (0.152 mm.) replace the drive and driven rotors as a matched assembly.

3. Check the clearance between the driven rotor and the pump body as shown in Fig. 34. If the clearance exceeds 0.010 in. (0.254 mm.) replace the pump body and rotor assembly.

4. Check the clearance between the top of the rotors and the surface of the pump body with a feeler gauge and a straight edge as shown in Fig. 35. If the clearance exceeds 0.003 in. (0.076 mm.) replace the pump body and rotor assembly.

To Assemble

1. Fit the drive and driven rotors in the body, replace the key in the key-way and press the pump gear onto the shaft until it is flush with the end of the shaft. The flat side of the gear faces outward.

NOTE.—When replacing the gear onto the drive shaft the shaft must be supported from underneath. The force should not be allowed to be transmitted through the drive rotor.

2. Fit a new sealing ring and secure the end plate to the pump body with the three cross-headed countersunk screws. Tighten the screws securely.

To Replace the Oil Pump

1. Fit the oil pump to the front main bearing cap with the dowel on the pump fully located in the dowel hole in the cap, and secure in position with three set-screws and shakeproof washers.

2. Replace the oil pump idler gear, and retain on the shaft with a spring clip.

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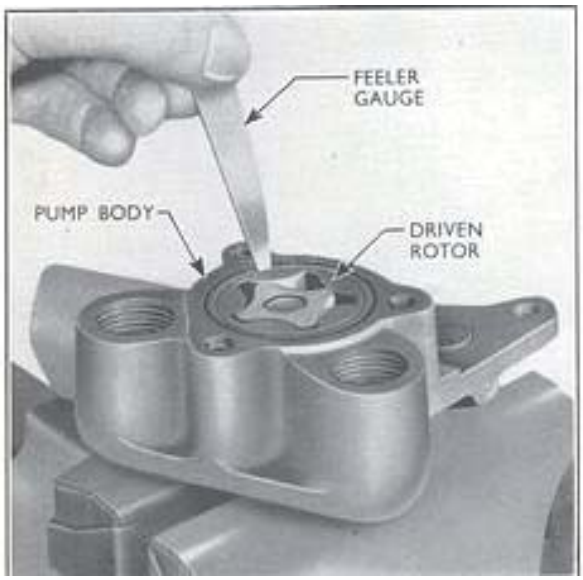

Fig. 34
Checking Driven Rotor to Body Clearance

Fig. 35
Checking Rotor End-float

3. Replace the lower section of the timing case, taking care to ensure that its front face is flush with the front face of the main timing case. Ensure that the correct length of fixing screw is used—see operation 8, page 10.

4. Refit the oil pump suction and delivery pipes. Fit the support bracket of the suction pipe to No. 2 main bearing cap.

5. Replace the sump as described on page 29.

6. Replace the front axle and radiator assembly as described on page 24.

OIL PRESSURE SWITCH

This switch is mounted externally and screws into a tapping in the main oil gallery on the left-hand side of the engine. It is connected by a purple wire to the green indicator lamp on the instrument panel.

In operation the switch breaks contact (green warning lamp on the instrument panel goes out) when the engine oil pressure reaches 7–9 lbs. per square inch, and makes contact (green warning lamp comes on) when the pressure drops below this figure.

Therefore, immediately the engine is started the green lamp should go out, if however, it does not, or the light comes on when the tractor is being operated, the engine should be immediately stopped, and the reason for the low oil pressure checked (see the Fault Diagnosis Section).

OIL PRESSURE RELIEF VALVE

The oil pressure relief valve is fitted in the cast boss on the pressure side of the pump body, and consists of a hardened seat in the pump body, a hollow plunger and a non-adjustable spacing seat, the whole assembly being held in position by a split pin (see Fig. 32). The relief valve opening pressure is pre-set at 60 lbs. per square inch in the factory and no attempt should be made to adjust it in service.

Effective with Engine No. 1400273 the ball type relief valve previously used in the oil pump was replaced by a solid plunger type valve and the adjusting screw was replaced by a non-adjustable spring seat (see Fig. 32).

A further change was made from Engine No. 1420249 when the solid plunger was replaced by a hollow type and a new spring was introduced. Only the hollow type plunger and the current type spring are supplied through service. The current type spring has a free length of 1½ in. (38 mm.) as against the previous spring which had a free length of 1.31 in. (33.34 mm.).

If it is suspected that the relief valve is not functioning correctly the oil pressure warning switch may be removed from its tapped location on the left-hand side of the cylinder block and a master oil pressure gauge located in its place. With the engine running at its normal operating speed and temperature, the pressure obtained should be 40 lbs. per square inch.

If the oil pressure is low and all other causes of low oil pressure have been checked (see Fault Diagnosis Section), the oil pump should be removed as described on page 31 and the relief valve ball examined to see that it is seating correctly. If the relief valve ball and seat appear to be satisfactory, the pump should be stripped and inspected as described on page 32.

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SPECIFICATION AND REPAIR DATA—LUBRICATION SYSTEM

Temperature Range	*H.D. Oil S.A.E. No.*
Above 90°F. (32.2°C.)	30
20°F. to 90°F. (—6.6°C. to 32.2°C.)	20
Below 20°F. (—6.6°C.)	10
Sump capacity	12 Imp. pints (6.82 litres) plus ¾ pint (0.43 litre) for a dry oil filter

Oil Filter	
Type	Full flow, pressure relief, replaceable element
By-pass valve setting	13 to 17 lbs./sq. in. (913.9 to 1195.1 gm./sq. cm.)
Tightening torque for centre bolt	10 lbs. ft. (1.382 kg.m.)

Oil Pump

Pump shaft diameter	0.498 to 0.4985 in. (12.649 to 12.662 mm.)
Diameter of shaft bore in pump housing	0.500 to 0.501 in. (12.700 to 12.725 mm.)
Shaft clearance	0.0015 to 0.003 in. (0.038 to 0.076 mm.)
Idler gear shaft diameter	0.65475 to 0.65535 in. (16.631 to 16.646 mm.)
Idler gear bush internal diameter	0.6562 to 0.6572 in. (16.667 to 16.693 mm.)
Shaft clearance	0.00085 to 0.00245 in. (0.022 to 0.062 mm.)
Fit of idler gear shaft in pump body	0.00025 to 0.00185 in. (0.0064 to 0.047 mm.) interference
Clearance between drive rotor and driven rotor	0.006 in. Max. (0.152 mm.)
Clearance between drive rotor and body	0.010 in. Max. (0.254 mm.)
End-float of rotors	0.003 in. Max. (0.076 mm.)

Oil Pressure

At normal working speed	40 lb./sq. in. (2812 gm./sq. cm.)

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FAULT DIAGNOSIS

1. Low Oil Pressure (checked by fitting a master oil pressure gauge in place of the oil pressure switch).

Possible Cause	*Possible Remedy*
(*a*) Engine oil level low.	(*a*) Add oil to bring it up to correct level.
(*b*) Wrong grade of oil.	(*b*) Drain and refill with oil of the approved grade.
(*c*) Blocked sump filter screen.	(*c*) Remove and clean the screen.
(*d*) Oil pressure relief valve not seating correctly.	(*d*) Clean the relief valve ball and seat.
(*e*) Excessive main or big end bearing clearances.	(*e*) Renew the worn parts.
(*f*) Faulty oil pump.	(*f*) Overhaul the oil pump.
(*g*) Oil pump suction or delivery pipe union nuts loose.	(*g*) Tighten the union nuts.

2. Low Oil Pressure (oil pressure warning light " ON," engine running).

Possible Cause	*Possible Remedy*
(*a*) Low oil pressure.	(*a*) See Section 1 above.
(*b*) Faulty oil pressure warning switch.	(*b*) Renew switch.
(*c*) Oil pressure warning light circuit faulty.	(*c*) Check circuit.

3. Oil Pressure Warning Light fails to Operate with Main Control Switch in the "ON" Position.

Possible Cause	*Possible Remedy*
(*a*) Faulty oil pressure warning switch.	(*a*) Renew switch.
(*b*) Oil pressure warning light circuit faulty.	(*b*) Check circuit.
(*c*) Broken filament in oil pressure warning light bulb.	(*c*) Renew the bulb.

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4. Excessive Oil Consumption

Possible Cause	*Possible Remedy*
(*a*) Engine oil level too high.	(*a*) Keep oil at the correct level.
(*b*) External oil leaks from engine.	(*b*) Renew gaskets and/or seals.
(*c*) Worn valves and guides.	(*c*) Renew.
(*d*) Excessive piston and cylinder wear.	(*d*) Rebore the cylinder liners and/or renew the pistons and rings.
(*e*) Incorrect grade of oil.	(*e*) Drain, and refill with oil of the approved grade.

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COOLING SYSTEM

DESCRIPTION

The water in the cooling system is circulated by thermo-syphon action assisted by a centrifugal type impeller pump.

A by-pass thermostat is fitted in the water outlet connection on the cylinder head, to assist in bringing the engine up to normal working temperature as quickly as possible. The most satisfactory operating temperature is when the needle of the temperature gauge is within the green sector.

A tap is provided in the base of the radiator and also in the left-hand side of the cylinder block, just below the fuel filter, to allow the system to be drained.

A radiator pressure cap is fitted as standard equipment on export tractors but on domestic tractors it is offered as an option to a normal type radiator cap. According to operating conditions a two- or four-bladed fan is used. The fan is mounted on the water pump shaft and is belt driven from the crankshaft pulley.

To Drain the Cooling System

1. With the tractor standing on level ground, open the drain taps in the radiator and the left-hand side of the cylinder block and remove the radiator cap. It is advisable to drain the water into a clean container, and retain it for further use as this will reduce the possibility of scale forming in the engine and radiator, due to impurities that are present in normal tap water.

WARNING—Do not remove the radiator cap when the cooling water is near boiling point.

2. When the water has finished running, probe the tap holes to make sure that no scale etc., has prevented the entire contents of the cooling system from draining away.

NOTE.—It is advisable to leave an indication on the tractor that the cooling water has been drained.

Under no circumstances should the tractor be started without water in the cooling system. Take the water to the tractor, not the tractor to the water.

To Fill the Cooling System

1. Close the radiator and cylinder block drain taps.

2. Pour the water that has been retained, back into the cooling system, filling slowly to avoid air locks. If the liquid present is not sufficient to fill the cooling system, and an anti-freeze is in use, add additional anti-freeze as required.

3. Replace the radiator cap securely, and check the system for water leakage.

ANTI-FREEZE MIXTURE

An anti-freeze solution should be used during the winter months to prevent damage to the engine through the water in the cooling system freezing.

Salt solutions such as calcium, sodium and magnesium chloride or organic solutions such as honey, sugar and glucose solutions are extremely harmful and should never be used. Glycerine, ethylene glycol and alcohol are solutions which are satisfactory for anti-freeze purposes, but these inorganic compounds do not contain an anti-rust inhibitor. A ' Ford ' anti-freeze solution is available which contains a suitable inhibitor which will reduce rust formation and corrosion in the cooling system to a minimum.

The percentage of anti-freeze solution in the cooling water will determine the degree of protection and it is advisable to allow a margin of safety in cases where lower temperatures may be met.

The cooling system should be flushed out thoroughly before adding anti-freeze solution, and it is advisable to mix the solution with water in a separate container before adding it to the cooling system.

The quantities of ' Ford ' anti-freeze part No. ME-1163-B for various degrees are given in the table in the Specification Section.

The approximate percentage of anti-freeze solution in the cooling system can be checked by measuring the specific gravity of the liquid and a suitable hydrometer is required having a range of 1.000 to 1.050, calibrated at 60°F. (15.5°C.).

When checking the specific gravity the temperature of the cooling water should be 58°F. to 62°F. (14.4°C. to 16.6°C.). Compare the hydrometer readings with the figures given in the Specification Section.

WATER PUMP

The water pump is mounted on the front face of the timing case cover, and is driven by a fan belt from the crankshaft pulley. Fig. 36 shows an exploded view of the water pump.

The water pump bearing is pre-packed with grease and does not require subsequent lubrication. The pump seal assembly consists of a carbon-faced rubber seal with a coil spring to maintain the carbon face in contact with the impeller. The pump shaft and bearing assembly are serviced as one unit and should not be dismantled.

To Remove the Water Pump

1. Remove the radiator assembly as described on page 39.

2. Remove the fan blades.

3. Slacken the generator adjusting locking screw and the two generator mounting bolts and move the generator in towards the engine. Detach the fan belt.

4. Loosen the clamps securing the remaining water hoses to the water pump.

5. Unscrew the four nuts retaining the water pump to the timing case cover, and remove the pump and gasket from the studs.

Overhauling the Water Pump

Throughout the following operations the water pump overhaul kit tool No. T.7000–17 is used in conjunction with the main tool No. T.7000, the appropriate adaptors for the operations being indicated by means of their respective tool numbers.

1. Remove the pump pulley from the shaft using the split adaptors (T.7000–17a) as shown on Fig. 37. Screw adaptor (T.7000–17b) onto the centre screw of the main tool, so that it pushes against the centre of the pump shaft.

2. Press the impeller, seal, slinger and the shaft and bearing assembly out of the pump housing, using the split adaptors and the adaptor (T.7000–17g). The adaptor (T.7000–17g) is hollow so that it fits over the shaft and bears against the outer diameter of the shaft bearing.

3. Press the impeller off the end of the shaft, using the solid ring adaptor (T.7000–17d) in the split adaptors as shown on Fig. 38.

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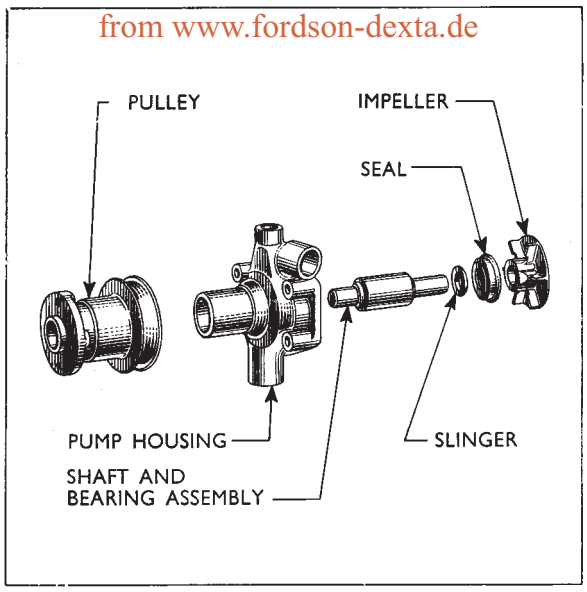

Fig. 36
Exploded View of Water Pump

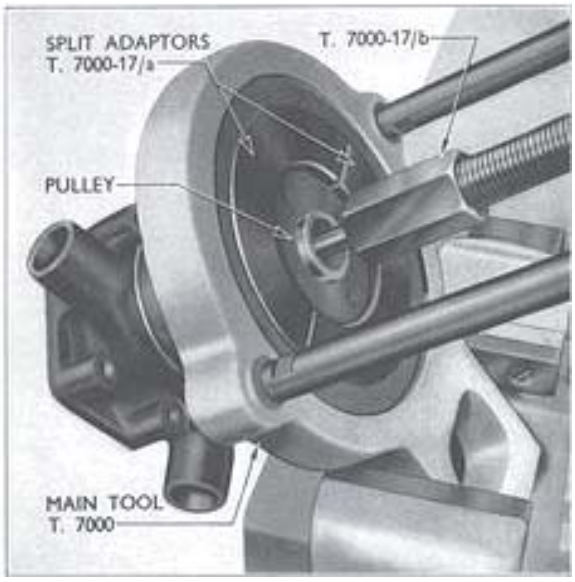

Fig. 37
Removing the Pulley

4. Remove the pump seal from the shaft and carefully split the slinger bush with a chisel to detach it from the shaft.

To Reassemble the Water Pump

1. Press the shaft and bearing assembly into the housing (long end of the shaft towards the impeller end of the pump) until the bearing is flush with the housing, using split adaptors (T.7000–17a) and the hollow adaptor (T.7000–17g) as shown on Fig. 39.

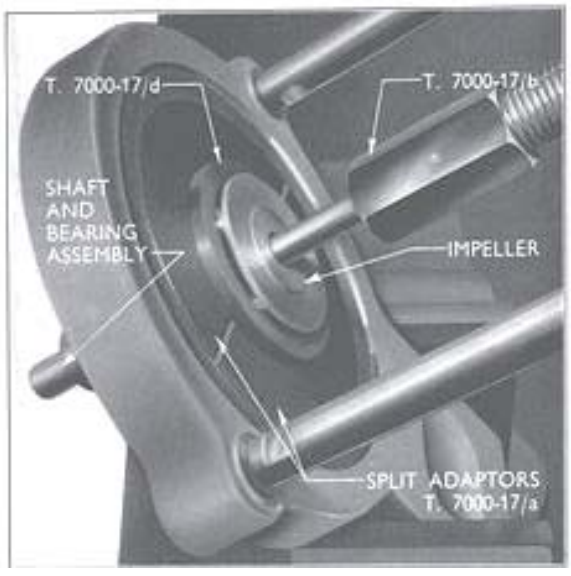

Fig. 38
Removing the Impeller

Fig. 39
Replacing the Shaft and Bearing Assembly

2. Press the pulley onto the front end of the shaft until it is flush with the end of the water pump shaft, using the split adaptors as shown in Fig. 40.

3. Replace the slinger bush (flanged end first) on the end of the shaft, using the hollow driver (T.7000–17f), and refit the pump seal on the slinger bush with the thrust face towards the impeller.

4. Press the impeller onto the shaft using the solid adaptor (T.7000–17e) fitted in the ring and split adaptors, until a clearance of 0.005 in. to 0.020 in. (0.13 mm. to 0.51 mm.) is obtained between the impeller blades and the housing face as shown on Fig. 41.

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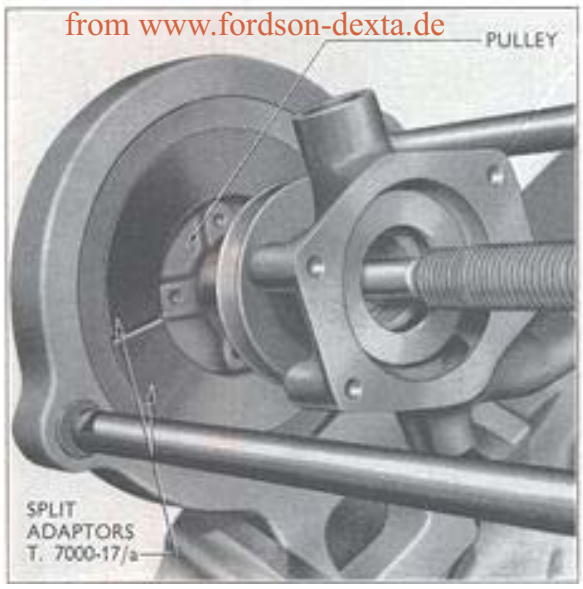

Fig. 40
Replacing the Pulley

To Replace the Water Pump

1. Clean the front face of the timing case cover, and locate a new gasket over the four studs.

2. Refit the water pump, locating the two water hoses as the pump is entered along the studs. Retain the pump with four nuts and spring washers, tightening the nuts evenly and securely.

It is most important that a watertight joint is made between the pump and the timing case cover.

3. Securely tighten the hose clamps on the water hoses.

4. Replace the fan belt and tighten the generator adjusting bolts so that there is 1 in. (25.4 mm.) free movement of the belt midway between the generator and crankshaft pulleys.

5. Replace the fan blades and tighten the set-screws evenly.

6. Replace the radiator assembly as described on page 40.

7. Refill the cooling system, run the engine and check all connections and joints for water leaks.

FAN BELT

A single V-type belt is used to drive the generator and water pump from the crankshaft pulley, the fan being mounted on the end of the water pump shaft.

Correct fan belt adjustment is important, otherwise the belt itself may be damaged or undue strain placed upon the generator or water pump bearings.

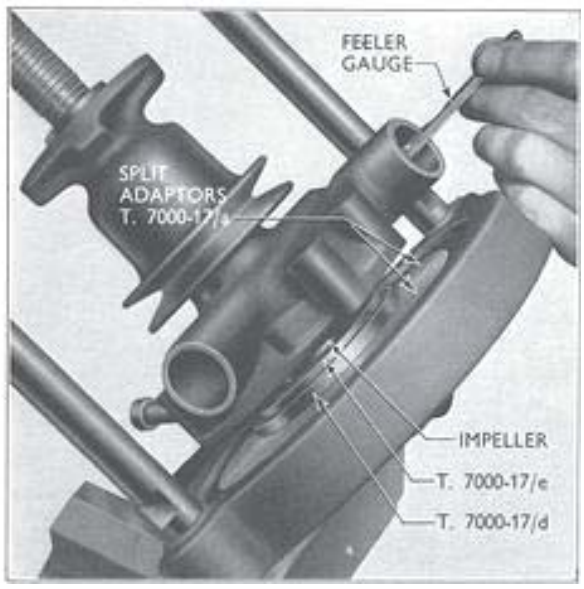

Fig. 41
Replacing the Impeller

There is provision for fan belt adjustment by moving the generator on its mountings and it is important that this adjustment be released when a new fan belt is being fitted, otherwise any attempt to strain the new belt over the sides of the pulley, using a lever, can easily cause damage to the rubber plies.

To Adjust the Fan Belt Tension

The correct tension of the fan belt is such that when the belt is alternately pushed and pulled at a point midway between the generator and crankshaft pulleys, a total movement of 1 in. (25.4 mm.) is obtained.

1. Slacken the generator adjustment locking screw and the two generator mounting bolts.

2. Move the generator towards or away from the engine as necessary until the correct belt tension is obtained, testing the tension midway between the generator and crankshaft pulleys.

3. Lock the adjustment locking screw and tighten the two generator mounting bolts.

To Renew the Fan Belt

The fan belt should be renewed when it becomes frayed, or stretched to an extent that no further adjustment is possible.

1. Slacken the generator adjustment locking screw and two mounting bolts and move the generator towards the engine.

2. Slip the belt over the edge of the generator pulley taking care not to damage the pulley. If necessary, slide the belt over the leading edge of the pulley in the same direction as it rotates and then turn the engine over to bring the belt off the pulley. The belt may then be detached from the crankshaft and the water pump pulleys.

3. Pass the new fan belt around the water pump and crankshaft pulley and engage it in the generator pulley. Readjust the fan belt tension as described above and tighten the generator adjustment locking screw and mounting bolts.

THERMOSTAT

A shrouded by-pass type thermostat is located in the cylinder head water outlet connection.

To Remove

1. Drain the cooling system as described previously.

2. Unscrew the two bolts securing the water outlet adaptor to the cylinder head water outlet connection.

3. Move the outlet adaptor to one side, lift off the gasket and remove the thermostat from the recess in the water outlet connection.

Testing the Thermostat

If it is suspected that the thermostat is not operating correctly it may be tested in the following manner :—

Immerse the thermostat in a suitable container and gradually heat the water, check the temperature at frequent intervals with an accurate thermometer. The valve should commence to open at 156°F. to 165°F. (68.8°C. to 73.9°C.) and be fully open at 185°F. (85°C.). If the thermostat does not function properly do not attempt any adjustment but replace with a new unit.

To Replace

Effective with Engine No. 1433392 (approximately) a new cylinder head water outlet adaptor was introduced. The distance between the fixing bolt holes on this adaptor is $3\frac{1}{8}$ in. (7.9 cm.) as against $2\frac{7}{8}$ in. (7.3 cm.) on the previous adaptor.

Similarly, a new gasket and cylinder head water outlet connection with hole centres to suit the adaptor were also introduced.

1. Locate the thermostat in the recess in the water outlet connection, fit a new gasket and replace the outlet adaptor, securing with two bolts and spring washers.

2. Refill the cooling system and check for leaks.

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RADIATOR

To Remove

1. Drain the cooling system.

2. Remove the primary air cleaner and the vertical exhaust silencer (where fitted).

3. Remove the engine bonnet after removing the two screws and nuts fitted front and rear, that secure the bonnet to the radiator shell and the fuel tank.

4. Disconnect the headlamp wiring from the main wiring loom.

5. Remove the two bolts, fitted on either side of the inside of the radiator shell, that secure the shell to the front end of the radiator support brackets.

6. Unscrew the two bolts on each side of the outside of the radiator shell that retain the shell in position on the front axle support bracket, and remove the radiator shell.

7. Disconnect the upper and lower radiator hoses at the radiator end by unscrewing the hose clamps.

8. Remove the plastic pipe from the overflow pipe on the radiator.

9. Unscrew the two self-locking nuts securing the radiator to the front axle support bracket, and remove the flat washers and rubber pads fitted under the nuts.

10. Lift the radiator from its location on the front axle support bracket taking care not to lose the pads fitted between the radiator and the support bracket.

11. Remove the four screws and nuts retaining the fan shroud to the radiator. Remove the shroud and the two support brackets.

To Replace

1. Fit the fan shroud and the two support brackets to the radiator (the two brackets are retained by the two top screws) and secure in position with four screws and nuts.

2. Place the radiator in position on the front axle support bracket, with the two large rubber pads between the radiator and bracket. Replace the small rubber pads, flat washers and self-locking nuts in that order on the bolt, and tighten the nuts up until the rubber pads are just compressed.

3. Replace the upper and lower hoses to the radiator, and tighten the hose clamps securely.

4. Replace the plastic pipe onto the overflow pipe on the radiator.

5. Refit the radiator shell and secure in position with four bolts, flat washers and spring washers.

6. Reconnect the headlamp wiring to the main wiring loom.

7. Refit the engine bonnet and secure with two nuts and screws, front and rear.

8. Close the drain taps on the radiator and cylinder block and fill the cooling system.

9. Replace the primary air cleaner, and the vertical exhaust silencer (where fitted), run the engine and check for water leaks.

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SPECIFICATION AND REPAIR DATA—COOLING SYSTEM

Capacity	15 Imp. pints (8.52 litres)
Fan up to 90°F. (32.2°C.)	2 blade, 15 in. (381 mm.) diameter
Fan above 90°F. (32.2°C.)	4 blade, 15 in. (381 mm.) diameter

Water Pump

Pump shaft bearing fit in pump body	0.0001 to 0.0011 in. (0.0025 to 0.0279 mm.) interference
Clearance between impeller blades and body	0.005 to 0.020 in. (0.127 to 0.508 mm.)
Pump shaft fit in impeller bore	0.00045 to 0.0017 in. (0.0114 to 0.0432 mm.) interference
Pump pulley fit on pump shaft	0.0015 to 0.0028 in. (0.0381 to 0.0711 mm.) interference

Thermostat

Opening temperature	156°F. (68.8°C.) to 165°F. (73.9°C.)
Fully open temperature	185°F. (85°C.)

Anti-Freeze

Capacity of Cooling System	*Volume of ME-1163-B in Water*	*Anti-Freeze Protection*	*Specific Gravity*	*ME-1163-B*		*Water*	
				Pints	*Litres*	*Pints*	*Litres*
15 Imp. pints (8.52 Litres)	10%	Down to 17°F. (—8.3°C.)	1.017	1.5	0.85	13.5	7.67
	15%	Down to 7°F. (—13.9°C.)	1.024	2.25	1.28	12.75	7.25
	20%	Down to —3°F. (—19.4°C.)	1.032	3.00	1.70	12.0	6.82
	25%	Down to —20°F. (—28.9°C.)	1.040	3.75	2.13	11.25	6.39

FAULT DIAGNOSIS

Engine Overheats

Possible Cause	*Possible Remedy*
(*a*) Water level low due to leaks.	(*a*) Rectify the leaks by fitting new gaskets, tightening hose clamps, etc.
(*b*) Fan belt slipping.	(*b*) Replace belt or adjust tension.
(*c*) Radiator pressure cap faulty.	(*c*) Fit a new pressure cap.
(*d*) Water leak from the hole in the underside of the water pump body.	(*d*) Overhaul the water pump.
(*e*) Temperature gauge defective.	(*e*) Check and replace if necessary.
(*f*) Fuel injection pump timing incorrect.	(*f*) Check and adjust if necessary.
(*g*) Cooling system impeded by deposits.	(*g*) Flush the system with a suitable solvent and refill with soft water.
(*h*) Radiator fins and screens clogged with dirt or chaff.	(*h*) Remove radiator chaff screens and clean radiator fins and screens with air or water under pressure.
(*j*) Thermostat stuck in closed position.	(*j*) Install a new thermostat.
(*k*) Insufficient lubricating oil.	(*k*) Fill up with the approved grade of oil to the correct level.
(*m*) Faulty injector(s).	(*m*) Change or recondition the injectors.

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FUEL SYSTEM

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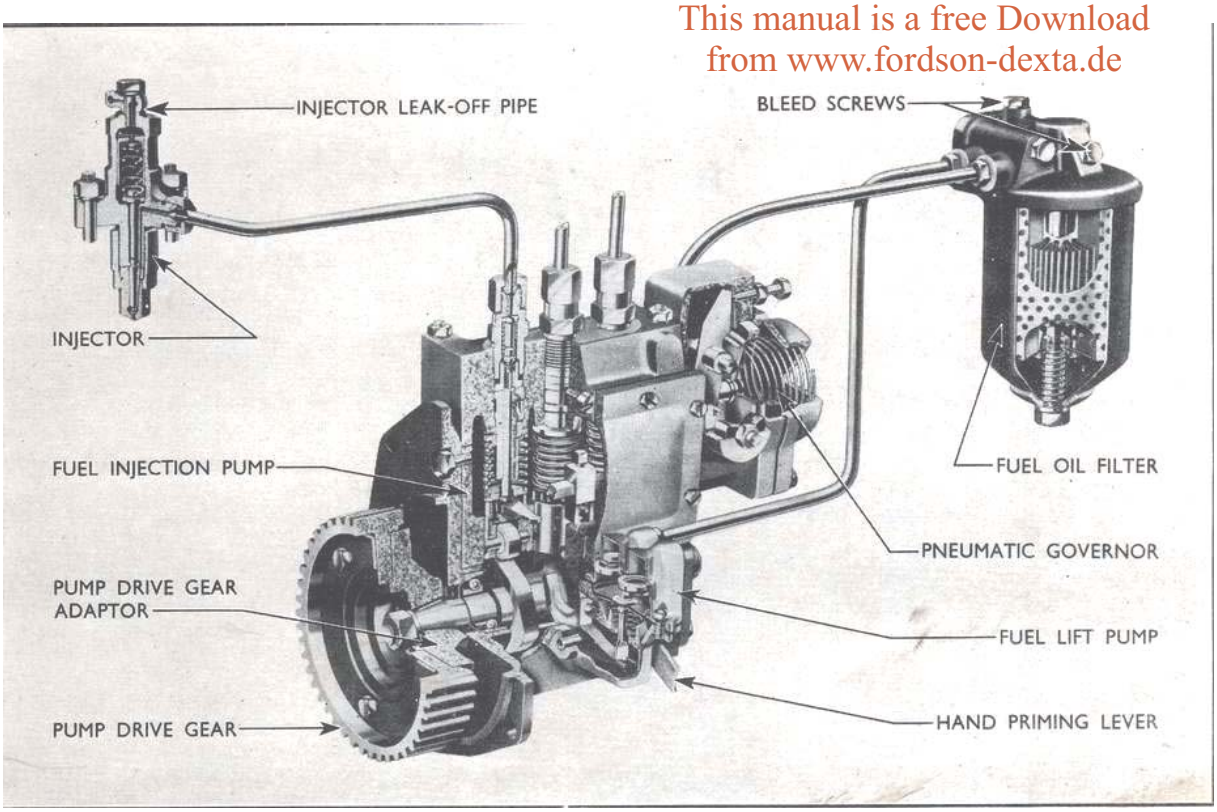

Fig. 1
Fuel Injection System

The diesel fuel system comprises a fuel tank, diaphragm type lift pump, renewable element filter, injection pump and injectors (see Fig. 1).

The lift pump, operated by an eccentric on the injection pump camshaft, supplies fuel under slight pressure, through the filter to the injection pump.

The injection pump, consisting of three pumping elements, accurately meters the fuel before passing it under high pressure to the two-hole injectors. The spring-loaded nozzle valve in each injector ensures that the high pressure fuel from the injection pump enters the cylinders in a highly atomised state. Fuel, which leaks past the injector nozzle valve, lubricates the valve stem before returning to the fuel tank via a common leak-off pipe.

Incorporated in the injection pump is a pneumatic governor which adjusts the fuel delivery according to engine speed and load requirements.

Located in the main fuel gallery of the injection pump adjacent to the inlet adaptor is a gallery damper. This consists of a rubber diaphragm fitted in a sealed metal casing ; its function being to dampen any fluctuations in fuel pressure within the gallery.

ROUTINE SERVICING OF THE FUEL SYSTEM

The purpose of the following servicing operations is to ensure that the high performance of the fuel injection system is maintained, so obtaining maximum efficiency from the engine. All the operations listed can be accomplished with the fuel injection pump installed on the tractor.

Some of the operations are regular service items and should be dealt with at the recommended intervals during normal servicing.

FUEL FILTER

The element of the fuel oil filter should be renewed at intervals not exceeding 600 working hours.

To Renew the Fuel Filter Element

1. Unscrew the centre bolt from the filter, remove the filter body and discard the element (see Fig. 2). Using a brush and clean fuel oil, thoroughly clean the interior of the filter body. **On no account use rag for this operation.**

2. Fit a new element to the filter body and a new sealing ring in the groove in the filter head. Tighten the centre bolt to a torque of 10 lbs. ft. (1.38 Kg.m.).

3. It will now be necessary to bleed the fuel system as detailed below.

BLEEDING THE FUEL SYSTEM

1. Ensure that there is sufficient fuel in the tank and that all the fuel pipe connections are tight.

2. Remove the two bleed screws from the top of the fuel filter (see Fig. 3), and operate the priming lever on the fuel lift pump until a stream of fuel free from air bubbles issues from the filter. Replace and tighten first the inlet and then the outlet bleed screws as the priming lever returns to its uppermost position.

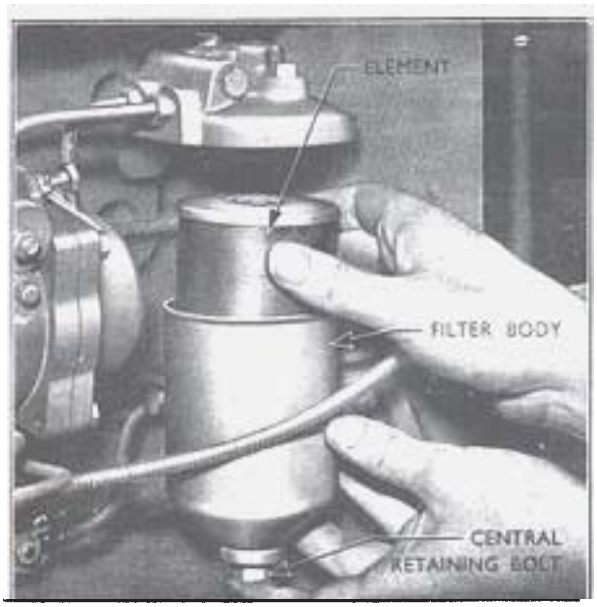

Fig. 2
Changing the Fuel Filter Element

3. Loosen the bleed screw on the fuel injection pump approximately three turns and operate the lift pump as before, tightening the bleed screw when the air bubbles cease and a solid stream of fuel flows from the pump.

4. Wipe all surplus fuel from the exterior of the filter and the fuel injection pump.

NOTE.—*Never lever the injection pump plungers up and down to bleed the injection pipes or test the injectors.*

FUEL INJECTORS

The injectors should normally be removed for testing and servicing, at intervals not exceeding 600 working hours. For details of removing, testing, cleaning and replacing, refer to page 16 of this section.

Fig. 3
Bleeding the Fuel System

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AIR CLEANER

The air cleaner consists of a primary cleaner mounted on top of the main air cleaner, the whole assembly being bolted to the battery heat baffle and connected by a rubber hose to the inlet manifold.

The air cleaner should be removed and cleaned at intervals of 600 hours, or at shorter intervals if the tractor is working in extremely dusty conditions. It must be remembered that any obstruction such as a choked primary air cleaner or gauze screen in the main air cleaner, or dirty oil in the oil bath will

Fig. 4
Removing the Air Cleaner Base

Fig. 5
Governor Filter Capsule

cause a decrease in maximum engine revolutions resulting in loss of engine power.

To Remove and Clean the Air Cleaner

1. Remove the primary air cleaner, vertical exhaust silencer (where fitted) and the engine bonnet (four nuts and screws).

2. Disconnect the battery leads and remove the battery.

3. Loosen the clamp securing the oil bath base to the main body of the air cleaner and remove the base and gauze filter (see Fig. 4).

4. Disconnect the throttle link from the outer end of the throttle friction pad lever assembly at the air cleaner bracket.

5. Loosen the clamp at the air cleaner end of the air inlet hose.

6. Remove the split pin securing the horizontal throttle operating rod to the inner end of the throttle friction pad lever assembly, and remove the flat washer and spring washer fitted behind the split pin.

7. Remove the four bolts securing the main body of the air cleaner to the battery heat baffle and remove the air cleaner.

8. Thoroughly wash out the oil bath base, removable gauze filter, primary air cleaner and the fixed gauze filter in the main body, using paraffin.

To Replace the Air Cleaner

1. Refit the main body of the air cleaner to the battery heat baffle, entering the pin on the swivel block at the end of the horizontal throttle operating rod into the hole on the inner end of the throttle friction pad lever assembly. Replace the four retaining bolts and tighten securely.

2. Replace the air inlet hose and securely tighten the clamp.

3. Reconnect the throttle link to the outer end of the throttle friction pad lever assembly.

4. Refill the oil bath base with clean engine oil of the approved grade, up to the level of the step in the base. Replace the base and gauze filter in position on the main body of the air cleaner and tighten the retaining clamp securely.

5. Replace the battery and reconnect the leads.

6. Replace the engine bonnet (four nuts and screws), vertical exhaust silencer (where fitted) and the primary air cleaner.

PNEUMATIC GOVERNOR AIR FILTER CAPSULE

To ensure satisfactory operation of the governor, the air filter capsule, fitted under the small plate on the front half of the governor case, should be inspected and cleaned if necessary, every 200 hours.

If the filter capsule is dirty it will cause sluggish operation of the governor.

To Remove, Clean and Replace

1. Unscrew the self-locking nut and remove the plate covering the filter capsule (see Fig. 5).

2. Inspect the capsule for signs of dirt and if necessary, remove the capsule, wash it thoroughly in paraffin, lubricate with engine oil and replace in position in the governor case.

3. Replace the plate and self-locking nut.

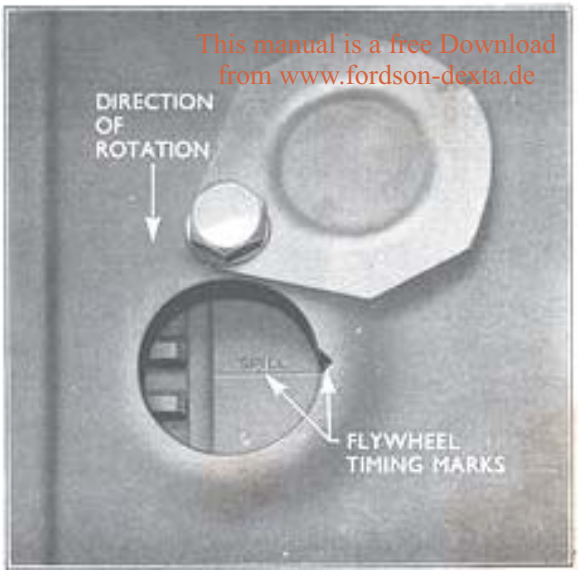

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Fig. 6
Flywheel Timing Marks

CHECKING AND ADJUSTING THE INJECTION PUMP TIMING

Correct injection pump timing can be checked as follows :—

1. Remove the flywheel inspection plate located on the left-hand side of the clutch housing and turn the engine crankshaft until the line marked " SPILL " on the flywheel corresponds with the notch in the clutch housing, with No. 1 piston on its compression stroke (see Fig. 6).

2. Remove the fuel pump timing plate from the left-hand side of the timing case, and if the injection pump is correctly timed, the timing mark on the fuel pump drive gear adaptor should coincide with the timing pointer cast on the pump mounting flange (see Fig. 7). The timing mark on the adaptor must not be confused with a second mark immediately above it stamped " S " which corresponds with T.D.C.

3. If, however, the timing mark is out of alignment with the indicator, remove the four setscrews retaining the inspection plate to the front of the timing case cover, and remove the plate.

4. Slacken the three setscrews securing the fuel pump gear to the fuel pump gear adaptor (see Fig. 8), and turn the fuel pump camshaft, using a suitable spanner on the adaptor retaining nut, until the timing marks coincide.

5. Tighten the fuel pump gear setscrews securely, taking care not to move the gear relative to the adaptor.

6. Replace the inspection plate on the timing case cover, the fuel pump timing plate on the timing case, and the flywheel inspection cover on the clutch housing.

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Fig. 7
Fuel Injection Pump Timing Marks

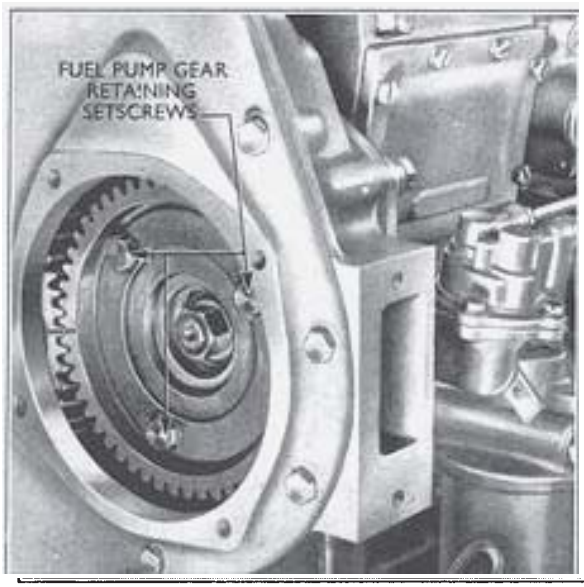

Fig. 8
Fuel Injection Pump Gear

TO RENEW THE PNEUMATIC GOVERNOR DIAPHRAGM

If it is suspected that the governor operation is faulty, the governor diaphragm can be checked for leakage by removing the governor pipe from the fuel injection pump and pulling the stop control lever rearwards to compress the diaphragm spring. Seal the governor connection, release the stop lever and there should be no movement on the control rod. If movement of the control rod is observed, it indicates a leakage past the diaphragm assembly.

1. Remove the four setscrews securing the rear half of the governor case to the front half, remove the rear half of the case and the governor spring.

2. Pull out the diaphragm assembly and remove the split pin and washer which secure it to the rocker assembly.

3. Fit the centre shaft of the new diaphragm assembly in position over the pin on the rocker assembly, and fit a flat washer and a new split pin. Push the diaphragm into position in the front half of the governor case, ensuring that the small pip on the diaphragm locates in the recess in the case (see Fig. 9).

4. Replace the governor spring and the rear half of the governor case, and tighten the four setscrews evenly. The clip for the stop control cable fits under the head of the lower right-hand screw.

5. Refit the governor pipe and test the governor operation as detailed previously.

SETTING ENGINE IDLING SPEED

With the engine at its normal operating temperature, set the idling stop screw on the inlet manifold so that the idling speed is 550 r.p.m. After adjustment secure the screw in position with the locknut.

SETTING MAXIMUM "NO LOAD" SPEED

The maximum "No Load" speed is 2,200 r.p.m., and if necessary it can be adjusted by means of the maximum speed screw on the inlet manifold. After adjustment, re-seal the screw.

The engine speed can be accurately checked and adjusted with the aid of a tachometer capable of being driven from the end of the P.T.O. shaft, rear end of the fuel injection pump camshaft or the periphery of the engine fan belt.

When checking the engine speed from the P.T.O. shaft, the P.T.O. shifter must be in the engaged position. Multiply the tachometer reading by 2.895 to obtain the engine speed.

To calculate the engine speed when the tachometer is driven from the fuel injection pump camshaft, multiply the tachometer reading by two.

If you are checking engine speed by running the tachometer from the periphery of the fan belt, divide the effective diameter of the crankshaft pulley, which is 5.2 ins. (13.2 cm.); by the diameter of the tachometer adaptor wheel. Then divide the tachometer reading by the figure thus obtained to get the equivalent engine speed.

Example—

Effective diameter of crankshaft pulley
=5.2 ins. (13.2 cm.)

Diameter of tachometer wheel adaptor
=2.0 ins. (5.1 cm.)

5.2 ins. (13.2 cm.) divided by 2 ins. (5.1 cm.)
=2.6

If a tachometer reading of 5,200 is obtained, dividing this by 2.6 gives an engine speed of 2,000 r.p.m.

TO RENEW A DELIVERY VALVE AND GUIDE

The replacement of the delivery valve and guide assembly, and/or spring, should only be carried out in an emergency, as the characteristics of the new parts may slightly alter the fuel delivery from the element concerned.

The pump calibration should therefore be checked and adjusted as soon as possible after the new parts have been fitted. The delivery valve and guide are a matched assembly and must always be replaced as a pair.

1. Remove the injector pipe from the delivery valve holder of the element concerned, unscrew the delivery valve holder (use tool No. CT.9008) and extract the valve together with the spring and volume reducer.

2. With the respective plunger at the bottom of its stroke insert the expanding end of the delivery valve guide extractor (Tool No. CT.9022) into the valve guide bore, until the projecting lips of the tool locate against the underside of the valve guide. Turn the engine slowly, and the guide, with its washer, will be pushed out of the pump body.

3. Thoroughly rinse the new delivery valve guide and washer, and press the guide and washer into the bore until it touches the top of the plunger barrel.

4. Thoroughly clean the delivery valve, spring and volume reducer and fit them to the valve guide.

5. Replace the delivery valve holder and tighten to a torque of 30 lbs. ft. (4.15 Kg.m.).

6. Replace the injector pipe and ensure that each end is seating correctly before the union nuts are tightened.

FUEL INJECTION PUMP

The injection pump is of the fully enclosed camshaft, self-contained, constant stroke type, and is gear driven at half engine speed from the crankshaft gear, by an idler gear.

The pump has three elements, each consisting of a barrel and plunger, operated by a camshaft through roller tappets. Helical springs return the plungers on their downward stroke.

An arm at the lower end of each plunger engages with a fork mounted on the control rod, and movement of this rod causes the plungers to turn within their barrels. The barrels are prevented from rotating by screws locating them in the pump housing. Attached to the control rod at the rear end by a rocker assembly are the pneumatic governor and the stop control device.

Above each pumping element is a delivery valve and guide which act as a non-return and unloading valve.

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Fig. 9
Removing the Governor Diaphragm

Fig. 10
Injection Pump Element

Fuel from the filter enters the pump at the inlet adaptor and then passes into the injection pump gallery. Fuel fills the barrels through the ports when the plungers are in their lowest positions.

The plunger and barrel assembly are of hardened steel, ground and lapped to each other to give a small working clearance. One of the two diametrically opposite ports in the barrel, through which fuel is supplied to the plunger can be seen in Fig. 10. This illustration shows the barrel on the left-hand side and the plunger on the right. The arm at the bottom of the plunger allows the plunger to be rotated in the barrel.

THE PNEUMATIC GOVERNOR

The pneumatic governor shown diagrammatically in Fig. 11, consists of two units ; the throttle unit in the inlet manifold connected by the suction pipe to a diaphragm unit mounted on the rear of the fuel injection pump.

When the engine is stopped, the governor spring pushes the diaphragm and the control rod to the left, the maximum fuel delivery position. As soon as the engine starts, the high air speed past the almost closed throttle plate and suction pipe orifice creates a high vacuum in the diaphragm chamber which causes the diaphragm and fuel pump control rod to be drawn towards the right, reducing the fuel delivery.

When the engine is operating under load with the throttle plate fully open, the vacuum in the diaphragm chamber is low, due to the low air speed past the throttle valve, and the diaphragm and control rod is held in the maximum fuel delivery position by the governor spring.

Any variation in the setting of the throttle plate or engine load causes a variation in the air speed past the throttle plate, and consequently, a change in vacuum in the diaphragm chamber, and so varies the fuel delivery.

REMOVING THE INJECTION PUMP

1. Hold the delivery valve holders (tool No. CT.9008), and remove the injector pipes by unscrewing the union nuts evenly at each end.

2. Turn the fuel tap to the " OFF " position and remove the fuel feed pipes, oil level drain pipe and the governor pipe from their locations on the injection pump.

3. If a proofmeter is fitted, remove the drive cable from the rear end of the fuel injection pump camshaft.

4. Disconnect the stop control inner and outer cables from the stop control lever and outer cable retaining clip on the fuel injection pump.

5. Unscrew the five retaining nuts and spring washers, and remove the pump from its location on the timing case.

NOTE.—Protect the pump and disconnected pipes against the entry of dirt by fitting suitable dust caps and plugs.

PRELIMINARY CHECKING

It is advisable to remove the fuel injection pump and check the phasing and calibration whenever the engine is undergoing major attention. Inaccuracies in either can then be corrected and the highest possible performance maintained.

Full details of phasing and calibrating are given on

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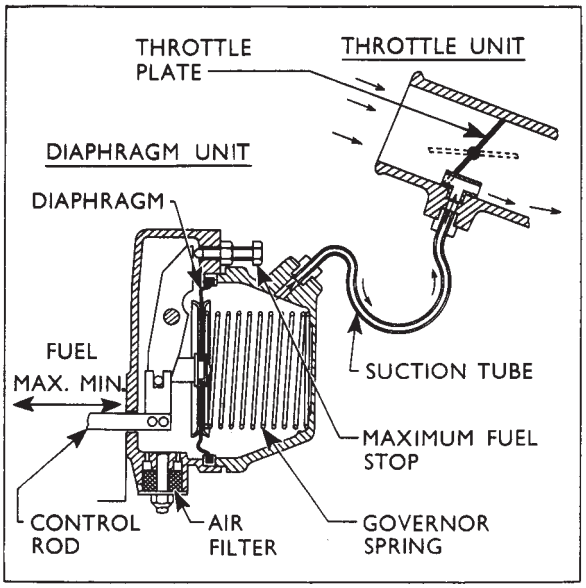

Fig. 11
Pneumatic Governor

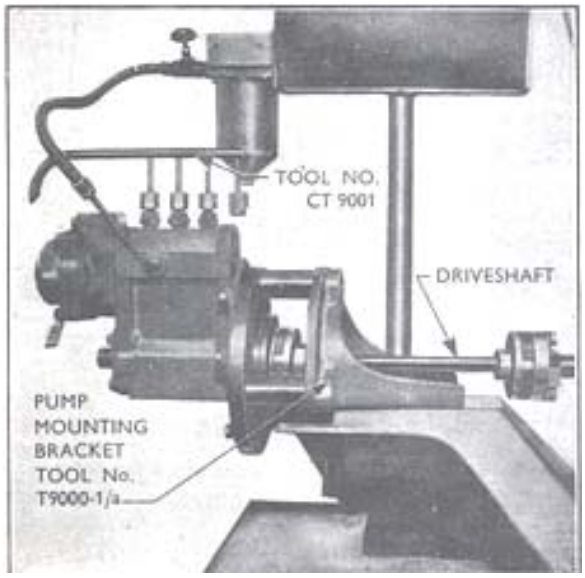

Fig. 12
Injection Pump Flushing Pipe

page 11. It should be noted, however, that it is not necessary to remove the plunger springs in order to check the phasing of a completely assembled pump.

Before carrying out any checking operations on the pump, ensure that it is thoroughly clean—internally and externally—making use of the pump flushing pipe.

Seal all unions on the pump with dust plugs and caps, and wash the exterior of the pump in clean fuel or substitute oil. Mount the pump on the calibrating machine and fit the pump flushing pipe (tool No. CT.9001) to the delivery valve holders (see Fig. 12). A blanking plug is required in the unused union on the pipe to prevent leakage at this point.

Run the pump for a short time to clear any dirt that may be present which could damage the master injectors on the calibrating machine. The fuel removed during the flushing operation must not be re-used for testing purposes.

Every precaution must be taken after cleaning the pump to ensure that dirt does not enter the pump, i.e. seal all unions with the appropriate dust plugs and always check and overhaul the pump in a dust-proof room.

Dismantling the Fuel Injection Pump

1. Unscrew the two nuts and remove the fuel lift pump from the fuel injection pump.

2. Remove the governor diaphragm as described on page 4.

3. Drive out the groove pin securing the stop control lever to the stop control shaft (see Fig. 13).

4. Remove the spring clip from the outer end of the stop control shaft (lift pump side) and if fitted, remove the shim or shims from behind the clip.

5. Pull the governor link over towards the stop control lever, compressing the return spring, and remove the spring clip which is fitted on the stop control shaft adjacent to the governor link.

6. Remove the stop control shaft from the governor housing taking care to note the number of shims fitted at the cranked end of the shaft. The shims fitted here and at the other end of the shaft are to ensure the rocker assembly is centrally located in relation to the maximum fuel stop screw.

7. Remove the governor link, stop control lever and return spring.

8. Unscrew the eight setscrews and remove the inspection cover and gasket from the front of the pump.

9. Remove the control rod after loosening the screws on the control rod forks.

10. Remove the two setscrews and the countersunk screw, retaining the front half of the governor case to the cambox, and remove the case.

11. To assist subsequent removal slacken the three delivery valve holders.

12. Lay the pump on its side and remove the four nuts and spring washers, retaining the pump body to the cambox and lift off the body complete with plungers, spring discs and springs.

NOTE.—Plungers and barrels are a lapped fit to one another. They should be kept as matched assemblies and under no circumstances must they be interchanged.

13. Remove the plungers, springs and spring discs from the barrels. The shims between the plunger foot and the lower spring disc should be retained on each plunger. Keep the plungers in sequence so that

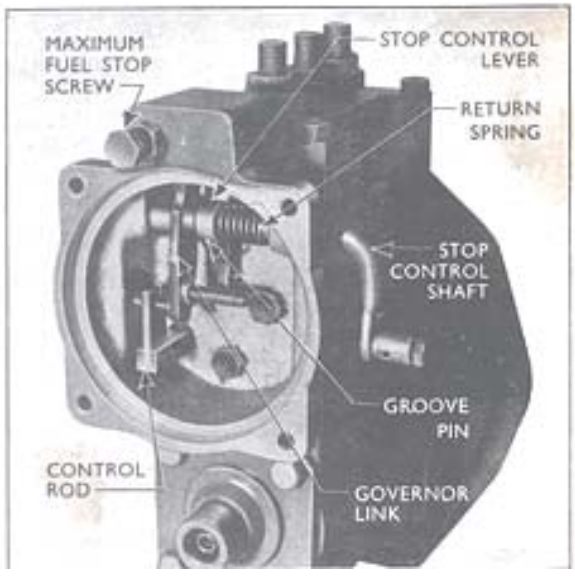

Fig. 13
Pneumatic Governor Linkage

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they can be paired up with their respective barrels when they are removed.

14. Unscrew the delivery valve holders, and lift out the volume reducer, spring and delivery valve from each element.

NOTE.—Delivery valves and their guides are a lapped fit to one another and should be kept as matched assemblies and never interchanged.

15. Unscrew the barrel locating screws, one at a time and push the barrels upwards, forcing out the delivery valve guides and washers. Then extract the barrels.

NOTE.—The delivery valves should now be paired with their respective guides and the plungers with their barrels.

16. Lift the roller type tappets from the cambox and retain them in correct sequence. Tappets should not be interchanged as the phasing spacers at their top ends have been selected to provide the correct phase angles between injections.

17. Unscrew the three setscrews retaining the injector pump gear to the adaptor, and remove the large retaining plate and gear.

18. Remove the pump gear adaptor retaining nut using a suitable spanner and the adaptor holding handle (tool No. T.9040).

19. With the thrust button (T.9041 d) located over the adaptor end of the pump camshaft, remove the adaptor, using the puller (tool No. T.9041) and the three screwed adaptors (T.9041 b). Remove the Woodruff key from the camshaft.

NOTE.—It is advisable at this stage to check the camshaft end-float as described on page 9.

Fig. 14
Removing the Camshaft Outer Races

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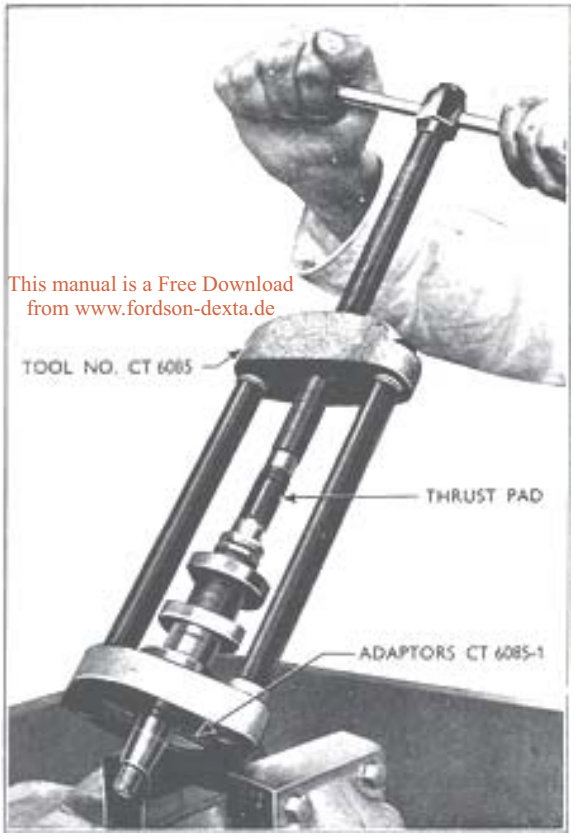

Fig. 15
Replacing the Camshaft Inner Races

20. Remove the four bolts retaining the proofmeter drive end bearing housing to the cambox, and with the thrust button (CT.6085–2b) over the mounting flange end of the camshaft, tap this end of the camshaft to remove the bearing housing from the cambox.

21. Unscrew the five bolts retaining the mounting flange bearing housing to the cambox, and with the thrust button (CT.6085–2a) over the proofmeter drive end of the camshaft, tap the camshaft at this end to remove the bearing housing.

NOTE.—A rubber " O " ring is fitted in a recess at the back of the mounting flange to prevent oil leakage at this point.

22. Withdraw the camshaft from the cambox and remove the bearing ball cages from each end of the camshaft ; these are finger-tight.

23. Remove the inner races of the bearings from the camshaft, using the puller (tool No. CT.6085) and the split adaptors (CT.6085–1). Use a thrust pad on the camshaft to avoid damage to the ends of the shaft. The long thrust pad (CT.6085–2a) fits the proofmeter drive end of the camshaft, and the short pad (CT.6085–2b) the adaptor end. Shims are fitted behind the inner races for adjusting camshaft end-float, and care should be taken to ensure that these shims are returned to their original positions on the camshaft when the pump is reassembled.

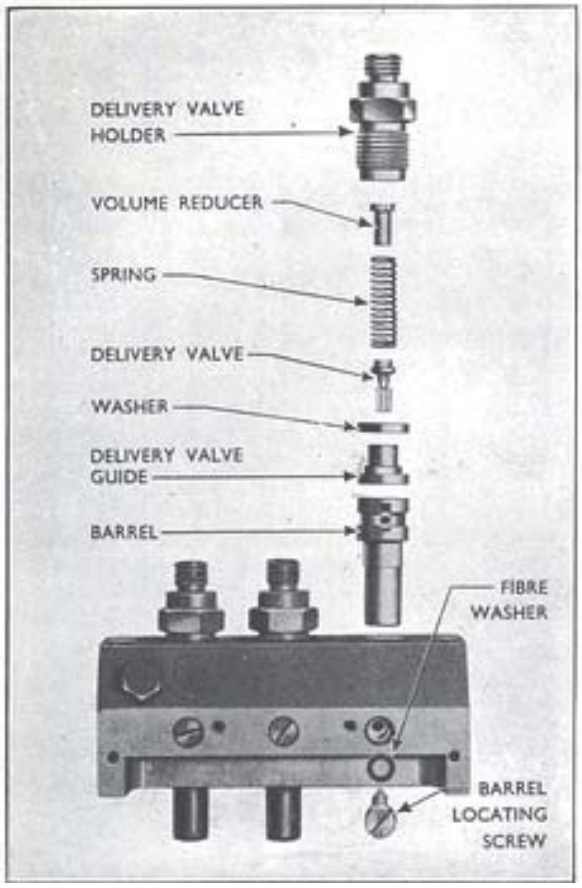

Fig. 16
Delivery Valve and Guide

24. Remove the camshaft bearing outer races from both the bearing housings using the puller (tool No. CT.9018), as shown in Fig. 14.

25. Remove the oil baffle washers and oil seals from the housings. The oil seals are a light press fit in the housings.

NOTE.—All the component parts of the pump should be thoroughly washed in clean fuel or substitute oil, inspected for wear, and new parts fitted where necessary.

Reassembling the Injection Pump

1. Fit new oil seals to the bearing housings with the seal springs facing inwards.

2. Replace the oil baffle washers with the inner step towards the oil seal and fit the outer races of the camshaft bearing into the bearing housings, using the driver (tool No. CT.9019).

3. Fit the camshaft bearing inner races with the same shims fitted behind them as were removed, using the replacer (tool No. CT.6085), split adaptors (tool No. CT.6085–1), and the appropriate thrust pad (see paragraph 23 above) as shown in Fig. 15.

4. Push the ball cages into position on the inner races by hand.

5. Refit the rubber " O " ring in the recess in the mounting flange bearing housing and replace the bearing housing. Replace the camshaft and the proofmeter drive end bearing housing, and secure both housings in position with the appropriate bolts and spring washers.

6. Using the adaptor (tool No. CT.9017–1) and a dial indicator gauge (CT.9017), check the camshaft end-float (see Fig. 17). This should be between .002 to .006 in. (.051 to .152 mm.). Shims .004 to .008 in. (.1 to .2 mm.) thick are available for correcting end-float.

When the end-float is satisfactory, remove the two bearing housings and pack the bearings with light grease. Smear the bearing housing mating faces with jointing compound and replace the housings. Retain securely in position with the appropriate bolts and spring washers.

7. Fit the Woodruff key to the end of the camshaft, replace the gear adaptor, and secure with a nut and spring washer. Tighten the nut to a torque of 45 lb. ft. (6.22 Kg.m.).

8. Refit the rollers, bushes and pins to the tappet bodies and install the tappets in their original bores in the cambox.

NOTE.—If the original plungers and barrels are being refitted to the pump there is no need to change the phasing spacers in the tappets, provided they do not show signs of wear. If, however, new plungers and barrels are being fitted, a spacer of intermediate thickness, marked 3, should be fitted in each tappet.

Use the special pliers (tool No. 7065) to remove the tappet circlip. When refitting the circlip its convex face should be adjacent to the spacer.

The following phasing spacers are available and are identified by a number stamped on their underside.

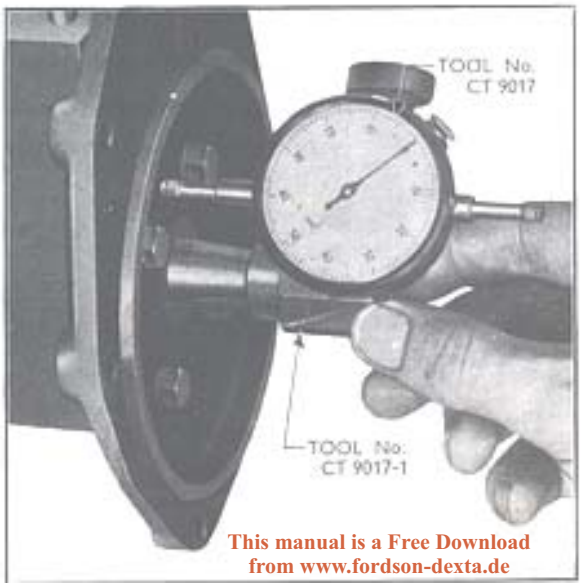

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Fig. 17
Checking Camshaft End-float

Identification No.	*Thickness*
1	0.179 in. to 0.181 in. 4.55 mm. to 4.60 mm.
2	0.183 in. to 0.185 in. 4.65 mm. to 4.70 mm.
3	0.187 in. to 0.189 in. 4.75 mm. to 4.80 mm.
4	0.191 in. to 0.193 in. 4.85 mm. to 4.90 mm.
5	0.195 in. to 0.197 in. 4.95 mm. to 5.00 mm.

It is essential that even when original barrels, plungers and tappet phasing spacers are refitted to a pump, the phasing of all elements is checked and adjusted where necessary.

9. Rinse the barrels thoroughly in clean fuel or substitute oil and fit them into their appropriate bores whilst wet. Fit the barrel locating screws, with new fibre washers, to the pump housing. Before tightening the screws, ensure that they locate in the slots in the barrels, so as to ensure that the barrels cannot rotate. Fully tighten the screws and check that the barrels are free to move up and down slightly.

10. Fit the delivery valve guides, with new sealing washers, to the pump housing after rinsing thoroughly in clean fuel or substitute oil (see Fig. 16).

11. Fit the delivery valves, springs and volume reducers to their respective guides, and loosely screw in the delivery valve holders after washing all parts in clean fuel or substitute oil.

12. Rinse the plungers, then insert them in their respective barrels and check that they are perfectly free. Refit each plunger, omitting the shim, lower spring disc, spring and upper spring disc at this stage so that the phasing may be checked more easily.

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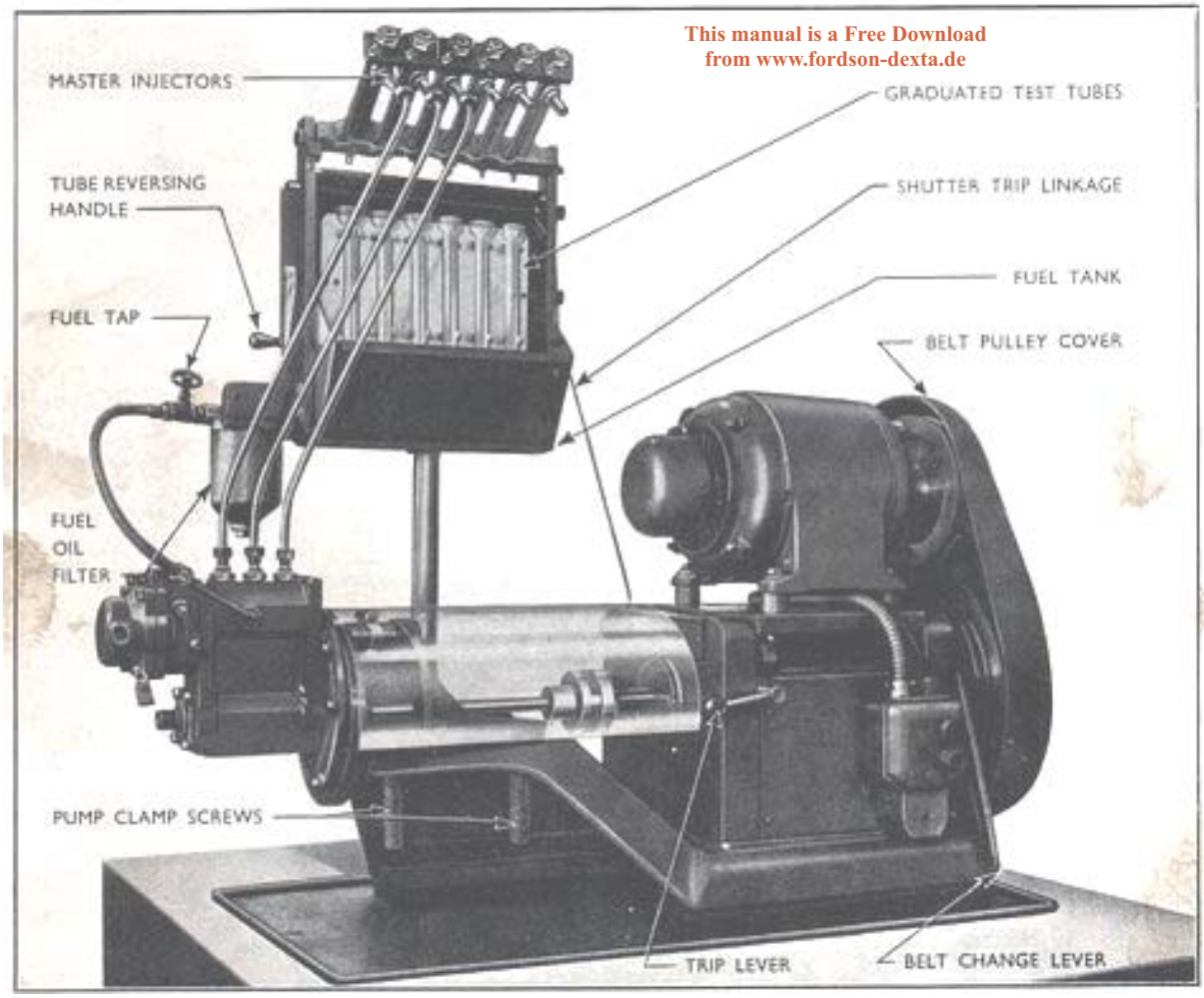

Fig. 18
Calibrating and Phasing Test Equipment

Holding the lower ends of the plungers, fit the pump housing to the cambox ensuring that with the pump laying on its side the plunger arms face upwards into their slots in the tops of the tappets. Securely tighten the four nuts, fitted with spring washers, securing the housing to the cambox.

13. Mount the pump on the calibrating machine (see Fig. 18). Ensure that there is approximately .010 in. (.25 mm.) end-float of the pump drive shaft, and that the grub screw on the movable coupling is tightened fully.

14. Refit the fuel lift pump and gasket, and secure with two nuts and spring washers. Add engine oil to the cambox until it runs out of the oil level hole at the base of the pump.

15. Check that there is sufficient clean fuel or substitute oil in the fuel container on the calibrating machine and connect the fuel feed pipe to the fuel lift pump inlet connection. Fit the special flexible pipe (tool No. T.9000–1n) between the outlet side of the fuel lift pump and the fuel injection pump gallery inlet connection. Turn on the fuel tap and bleed the system at the two air bleed screws on the filter and the one on the pump. Tighten all delivery valve holders to a torque of 30 lbs. ft. (4.15 Kg.m.).

PHASING THE FUEL INJECTION PUMP

Phasing is an adjustment whereby each successive element of the pump is timed to commence injection at the correct angle relative to the preceding one. As this is a three cylinder pump each successive element must be phased so that its spill cut-off is at 120° to the preceding one. This can be arranged by varying the thickness of the phasing spacers interposed between the camshaft roller tappet and the plunger.

The injection order of the pump is 1, 2, 3 ; No. 1 element being at the drive end.

The principle of spill timing is shown in the diagrammatic illustration (Fig. 19). Phasing operations are given in their correct sequence on this page and are followed by the method of calibrating.

SPILL CUT-OFF SETTING

Spill cut-off is the point at which the plunger top just covers the barrel ports ; this point can be set accurately by the following method:—

The left-hand view of Fig. 19 shows the pump plunger at the bottom of its stroke. Fuel can flow into the barrel through both ports and out through the spill pipe attached to the delivery valve holder.

When the camshaft is rotated, the plunger rises until it eventually just covers the supply ports, as shown in the right-hand view, cutting off the fuel supply and terminating the flow from the spill pipe.

If the camshaft is rotated very slowly, the precise point at which the fuel ceases to flow from the spill pipe can be ascertained. This is the spill cut-off point.

PHASING OPERATIONS

1. Commence phasing the injection pump at No. 1 element (nearest to the drive end). Open the belt pulley cover of the calibrating machine at right-angles so that the brake mounted behind the lower pulleys is operated against them. Then ensure that the driving belt is fitted to the 200 r.p.m. pulley (see Fig. 20).

2. Unscrew No. 1 delivery valve holder and remove the delivery valve, spring and volume reducer. Replace the delivery valve holder and tighten all the holders to a torque of 30 lbs. ft. (4.15 Kg.m.).

3. Fit the spill cut-off pipe (tool No. CT.9023) to No. 1 delivery valve holder.

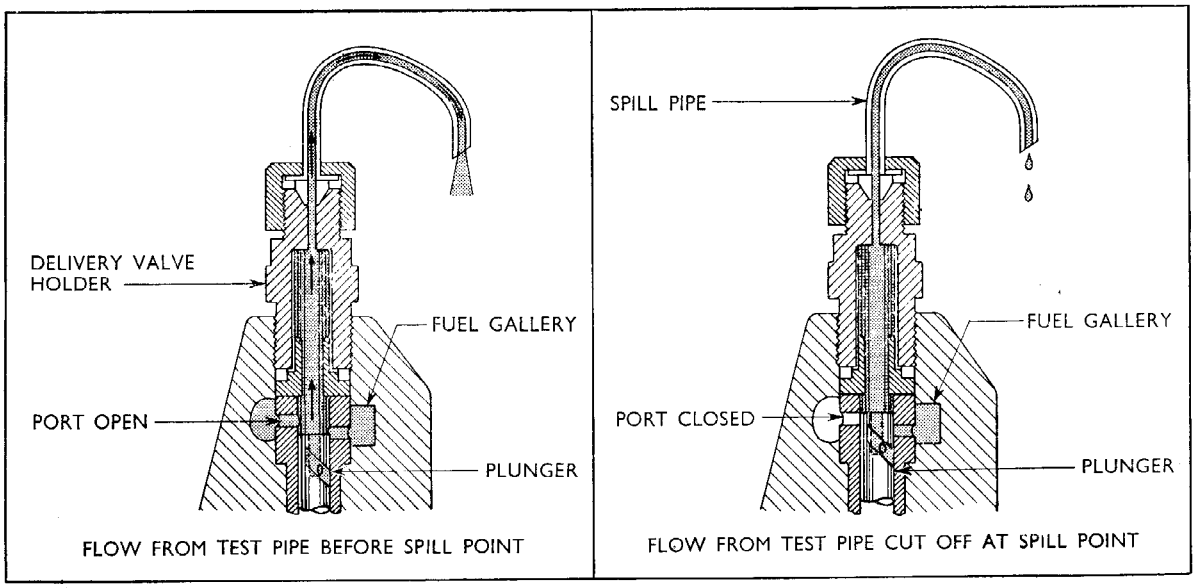

Fig. 19
Principle of Spill Timing

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4. Set the arms at the lower end of the plungers fully to the left—the maximum fuel delivery position—and rotate the camshaft until No. 1 plunger is at the bottom of its stroke. Turn on the fuel supply tap and, whilst operating the priming lever on the lift pump, rotate the pump camshaft slowly clockwise by means of the pulley on the motor shaft.

5. As the plunger in No. 1 element begins to rise, fuel will flow freely from the spill pipe until such time as the plunger covers the ports. Stop rotating the camshaft as soon as the fuel flow from the spill pipe ceases, (spill cut-off point) and set the phasing ring on the end of the lower pulleys so that one of the graduation lines marked 6C is in line with the fixed pointer (see Fig. 20).

It is advisable to repeat the above procedure to check that the phasing ring has been set accurately.

NOTE.—During phasing the spill cut-off point must always be ascertained when the plunger is rising, otherwise inaccuracies will result.

6. Turn off the fuel, remove the spill pipe and fit the delivery valve, spring and volume reducer to No. 1 element. Tighten the holder to a torque of 30 lbs. ft. (4.15 Kg.m.).

7. Phasing numbers 2 and 3 elements may now be carried out in the injection sequence 1, 2, 3. Remove the delivery valve, spring and volume reducer from No. 2 element. Refit the delivery valve holder and spill pipe, turn on the fuel and rotate the camshaft slowly clockwise as before until the spill cut-off point is reached on No. 2 element. The phasing ring should now have revolved through 120° and a graduation line marked 6C should be in line with the fixed pointer. A limit of 1° either side of the 6C mark is permitted.

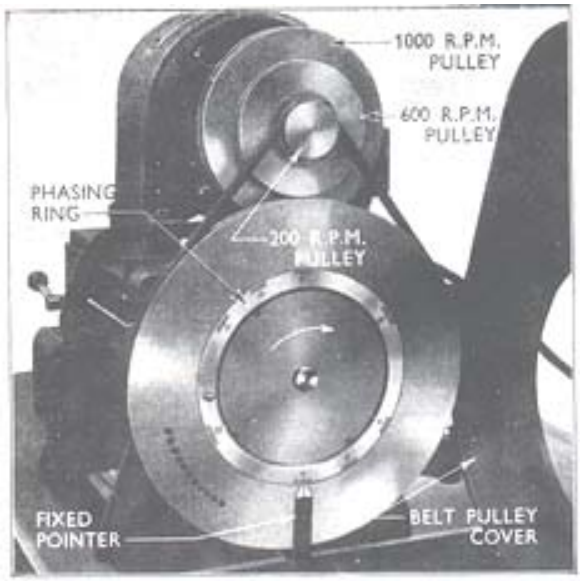

Fig. 20
Checking Pump Phasing

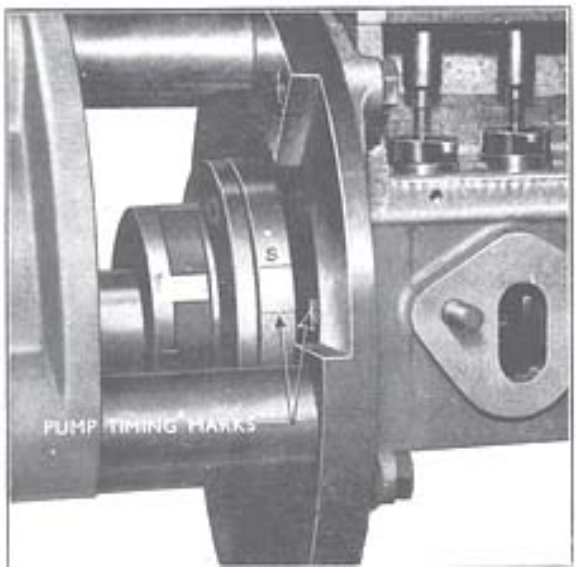

Fig. 21
Checking No. 1 Element Spill Point

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NOTE.—If the phasing is outside the above limits it will be necessary to change the phasing spacer of the element which is phased incorrectly (see paragraph 9).

It is advisable, however, to note the extent of the phasing inaccuracy, as the remaining element is phased, working to the 6C marks throughout and without moving the phasing ring on the pulley. In this way the phasing of all elements can be corrected at the same time, as it necessitates removing the pump housing and plunger tappets. Finally, check No. 1 again to ensure the original setting of the phasing ring has not been disturbed.

8. Check that when No. 1 element is at the spill cut-off position the timing marks on the drive gear adaptor and the timing pointer coincide (see Fig. 21). If not, obliterate the line on the adaptor and re-mark as necessary. The other line on the adaptor stamped " S " should also be obliterated and re-marked the appropriate distance from the line indicating the spill cut-off position.

9. If it is necessary to change the phasing spacers (as mentioned in paragraph 7) remove the pump body (four nuts and spring washers) taking care not to drop the plungers from their barrels. Lift out the tappets, one at a time, and remove the phasing spacers after extracting the circlip with the special circlip pliers (tool No. 7065).

When refitting, the convex face of the circlip should be adjacent to the phasing spacer.

There are five thicknesses of spacers available (see page 10) in steps of .004 in. (.1 mm.) which affect the phase angle in each case by approximately a $\frac{1}{2}°$. Fit a thinner spacer to increase the phase angle and vice versa.


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Fig. 22
Checking Plunger Head Clearance

10. Refit the pump body to the cambox, omitting the plunger springs at this stage. Turn the pump camshaft until No. 1 element tappet is at the top of its stroke. Lift the plunger arm upwards to ascertain that there is clearance between the top of the plunger and the underside of the delivery valve guide (see Fig. 22). Repeat on all the other elements.

NOTE.—If there is no clearance on any plunger, fit a thinner tappet spacer to establish the clearance on this plunger and phase the others to this element.

11. Withdraw the plungers, after removing the pump body from the cambox. Fit three plunger shims and the lower spring disc to each plunger (see Fig. 23). Locate the foot of the plunger on the centre of the tappet spacer, press the lower spring disc down against the tappet body, and check for free movement of the plunger. Remove shims until free movement is felt. Each plunger must be checked on its respective tappet and the free movement reduced to a minimum.

Refit the spring and upper spring disc (see Fig. 23), and refit the plungers to their respective barrels.

Holding the lower ends of the plungers, fit the pump body onto the cambox ensuring that the plunger arms face outwards into their slots in the tops of the tappets. Before finally tightening the four nuts securing the body to the cambox, ensure that the machined faces which contact the inspection cover are in alignment so that a perfect seal is obtained when the cover and gasket are fitted.

12. Refit the front half of the governor case, secure with two bolts fitted with spring washers, and one countersunk screw fitted with a shakeproof washer.

13. Enter the control rod from the governor end, with the slot in the fork facing upwards, and pass the control forks over the rod, engaging them with the plunger arms (see Fig. 24). Check that the plunger arms do not bind in the forks.

14. Loosen the locknut for the maximum fuel stop screw (see Fig. 13) and remove the stop screw.

15. Push the control rod in so that it comes into contact with the face of the fuel injection pump mounting bracket on the calibrating machine. With the control rod in this position set No. 3 control fork (one nearest governor) so that it is approximately .9 in. (21 mm.) away from the inner face of the control rod bush fitted at the governor end of the cambox, and lightly tighten the fork screw. Set No. 1 and 2 plunger arms at the same angle as No. 3 plunger arm and lightly tighten the fork screws.

The control rod and forks are now set in an approximate position for maximum fuel delivery, which will be of assistance in subsequent calibrating operations.

16. Replace the original shims on the cranked end of the stop control shaft and enter the shaft into the governor housing, from the back of the pump. Fit the return spring, stop control lever, and governor link to the shaft as it is passed through the housing. The pin at the lower end of the governor link locates in the fork on the end of the control rod.

17. Move the governor link over towards the stop control lever, compressing the return spring, and fit a spring clip in the groove in the stop control shaft adjacent to the governor link.

18. Replace the shims that were removed from the outer end of the stop control shaft and refit the spring clip in the groove at the end of the shaft.

19. Position the stop control lever so that the drilled hole in the lever is in line with the drilled hole in

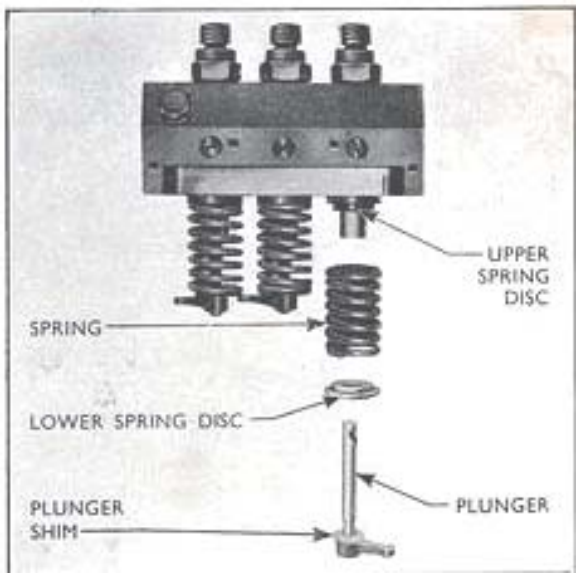

Fig. 23
Fitting Springs and Plungers

the stop control shaft, and retain the lever to the shaft with a groove pin. **Ensure that the control rod and rocker assembly are free to move fully in both directions.**

20. Move the control rod fully to the left holding it against the injection pump mounting bracket on the calibrating machine, and replace the maximum fuel stop screw, screwing it in until it just contacts the top of the governor link. Tighten the locknut fully taking care not to move the stop screw.

The injection pump mounting bracket on the calibrating machine has a shallow recess machined in it to give the correct setting for the control rod in the maximum fuel position, therefore, after the above procedure has been carried out the maximum fuel stop screw should not be disturbed.

21. Replace the governor diaphragm as described on page 4.

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CALIBRATING

Calibrating is an adjustment to ensure that each element of the pump delivers the same amount of fuel at any position of the control rod. Fuel delivered by each element over a definite number of injections is collected and measured in graduated test tubes.

When checking deliveries, use the same set of test tubes throughout, and give a constant drain period of 10 seconds when emptying on each occasion. Also allow fuel to settle in the tubes for 10 seconds after delivery has ceased, before taking the readings, which must be read from the bottom of the meniscus. This will provide constant conditions and ensure greater accuracy.

Any necessary adjustments are made by altering the position of the forks on the control rod. Moving the forks towards the right (the governor end) decreases, and towards the left (driving end) increases the fuel delivery (see Fig. 25).

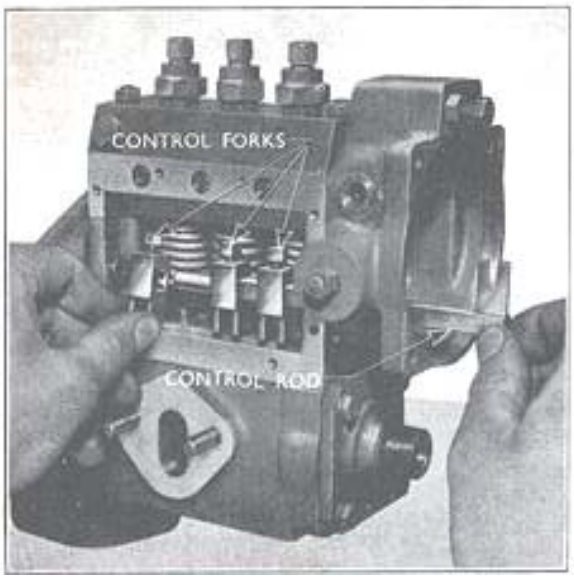

Fig. 24
Fitting the Control Rods and Forks

1. Connect the injector pipes between the injection pump and the master injectors of the calibrating machine.

2. Fit the driving belt to the 600 r.p.m. pulleys. Turn on the fuel tap and allow fuel to flow from the bleed screw on the injection pump body. Tighten the bleed screw when all air bubbles in the fuel disappear. Run the calibrating machine at 600 r.p.m. for 10 minutes to allow the injection pump and the oil to warm up.

NOTE.—It is essential that the belt pulley cover is always in the closed position before running the calibrating machine.

3. Collect 200 injections of fuel from each element in the graduated test tubes. It will be necessary to hold the trip lever of the calibrating machine downwards when a slight click will be heard as the injectors start delivering into the tubes. The lever should not be released until a second click is heard, otherwise only 100 injections will be collected.

4. Calibrate the pump by adjusting the forks, starting at No. 1 element so that the average of four deliveries, each of 200 injections from all elements is from 9.6 to 10.0 c.cs. When calibrating always disregard the first set of readings after adjustments have been made.

5. When the calibration is satisfactory, fit the driving belt to the 200 r.p.m. pulleys, run the pump at this speed and check the delivery over 200 injections. Delivery drop on each element should not exceed 2 c.c. below the figure obtained at 600 r.p.m. If the drop exceeds 2 c.c. it indicates a worn element or the angled face of the delivery valve is not seating correctly. If the delivery at 200 r.p.m. exceeds that obtained at 600 r.p.m., it indicates that the piston portion of the delivery valve is worn. In either case fit new parts as required and recheck at 200 r.p.m.

6. At 200 r.p.m. check that when the stop control device is operated, all elements cease delivery just before the control rod reaches the end of its travel towards the stop position at the governor end of the pump.

7. Fit the pump inspection cover and gasket and secure in position with eight setscrews and spring washers.

8. Wire and seal the maximum fuel stop screw.

9. Turn off the fuel tap and remove the fuel injection pump from the calibrating machine.

10. Replace the injection pump gear so that the tapped holes in the adaptor are positioned centrally in the slots in the gear. Fit the large retaining plate, replace the set-screws and spring washers, and tighten securely.

Injection Pump Storage

If after overhaul, an injection pump is being stored it should be left filled with substitute oil and all connections sealed with dust plugs and caps.

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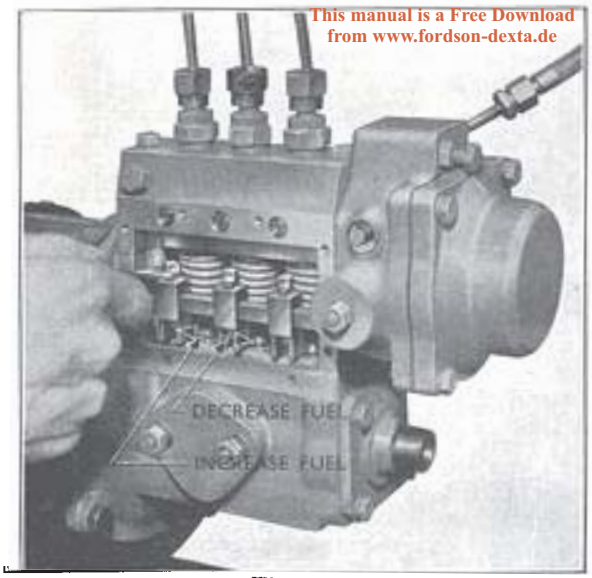

Fig. 25
Adjusting the Forks

FITTING THE INJECTION PUMP

1. Move the flywheel inspection plate on the left-hand side of the clutch housing to one side, to gain access to the flywheel timing marks. With No. 1 piston on its compression stroke, turn the crankshaft until the line marked "SPILL" on the flywheel is in line with the notch in the clutch housing (see Fig. 6).

2. Remove the inspection cover from the front of the timing case cover (four set-screws and spring washers).

3. Fit the injection pump and a new gasket to the timing case (six nuts and spring washers) so that the pump gear is in mesh with the idler gear and the pump timing marks (see Fig. 7) coincide or approximately coincide to within the nearest tooth. If the pump timing marks coincide no further adjustment is necessary, but if they are slightly out of line the procedure outlined in the next paragraph should be adopted.

4. Slacken the three setscrews retaining the fuel pump gear to the gear adaptor (see Fig. 8) and with a suitable spanner on the adaptor retaining nut turn the pump camshaft until the pump timing marks are in line. Tighten the three setscrews taking care to ensure that the gear adaptor does not turn. Replace the inspection cover and gasket onto the front of the timing case cover, and secure with four setscrews and spring washers.

5. Replace the stop control inner and outer cables onto the stop control lever and outer cable retaining clip respectively. Set the cables so that there is approximately .25 in. (6.4 mm.) free movement of the control at the dash panel.

6. If a proofmeter is fitted replace the drive cable in the square hole at the rear of the pump camshaft and tighten the knurled retaining nut securely.

7. Refit the fuel feed pipes, oil level drain pipe and the governor pipe to the injection pump ensuring that they are perfectly clean.

8. Fit the fuel injector pipes ensuring that they are perfectly clean and that the olives on the ends of the pipes are in good condition, and seat correctly before tightening the union nuts. Under no circumstances must the pipes be bent.

9. Remove the injection pump inspection cover (eight screws and spring washers) and add clean engine oil to the camshaft chamber until oil flows from the oil level drain pipe at the base of the pump. Replace the inspection cover and securely tighten the eight screws.

10. Bleed the fuel system as described on page 2, start the engine, and check the idling and maximum "No Load" engine revolutions as described on pages 4 and 5.

INJECTORS

A section through an injector is shown in Fig. 26. Fuel from the injection pump enters the injector inlet and passes through a drilling in the nozzle holder before reaching the needle valve seat. The pressure of the fuel when the ports in the injector pump barrel are closed causes the needle valve to open against the action of the injector spring. Fuel is then forced, in a highly atomised state, through the two holes in the nozzle tip. A small amount of fuel leaks up between the needle valve stem and the nozzle body, providing lubrication. The leak back fuel rises to the top of the injector where it is returned to the fuel tank by the injector leak-off pipe.

The injectors should normally be removed for testing and servicing, at intervals not exceeding 600 working hours.

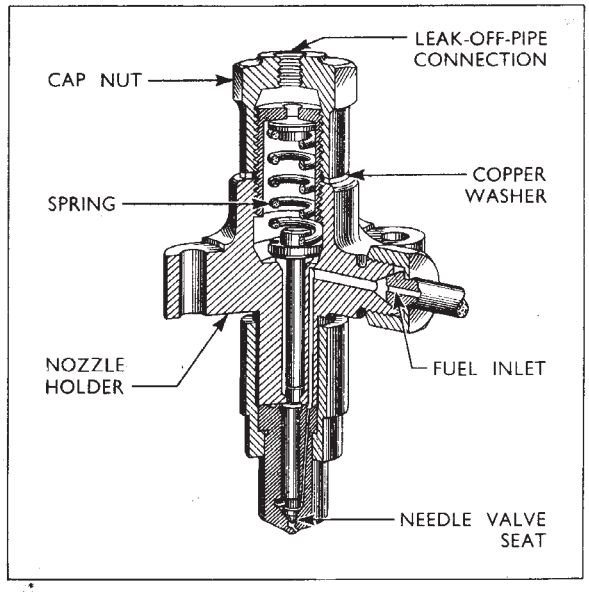

Fig. 26
Sectioned View of Injector

Removing an Injector

1. Remove the injector leak-off pipe by unscrewing the union nut at the rear of the cylinder head, and the three special slotted bolts connecting the leak-off pipe to the injectors.

2. Remove the fuel injector pipe by unscrewing the union nuts at each end of the pipe. Fit the appropriate size blanking plugs to the delivery valve holder and injector inlet.

3. Unscrew the two nuts securing the injector to the cylinder head, and carefully withdraw the injector, ensuring that no dirt or foreign matter drops down into the injector seat in the cylinder head (see Fig. 27).

Testing an Injector

Care should be taken when testing an injector to prevent the hands contacting the fuel spray. The human skin is easily penetrated by the spray which is discharged at a pressure of approximately 2,000 lbs. per sq. inch.

Before testing or dismantling an injector clean the exterior with a soft brass wire brush and substitute or fuel oil.

Fit the spacing washer (tool No. T.9025–1a), to the injector holding arm of the injector testing machine, and locate the injector on the two pegs of the spacing washer (see Fig. 28). Fit the high pressure pipe (T.9025–1b) between the injector and the injector testing machine, and slacken the injector cap nut.

Before commencing to test the injector, isolate the gauge from the injector by closing the valve on the testing machine, and turn the flywheel to ensure that the holes in the injector are not blocked.

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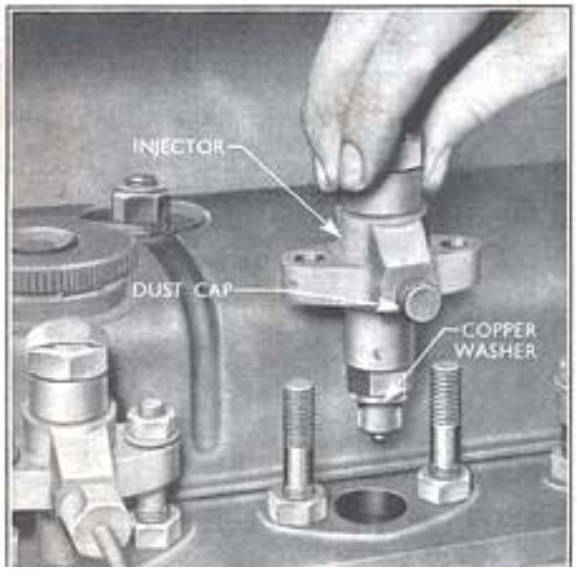
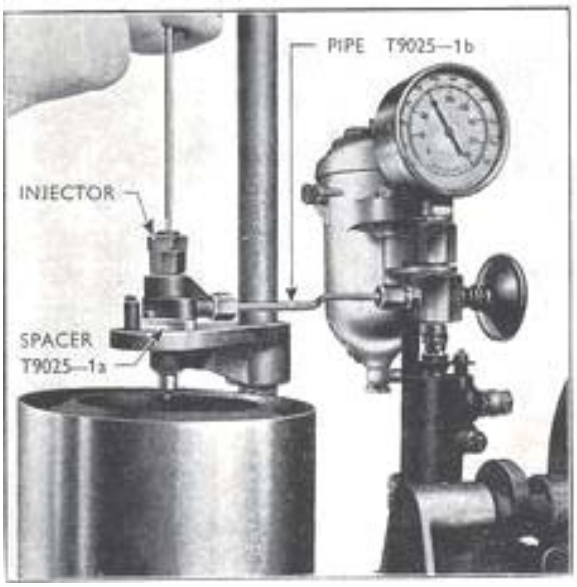


Fig. 27
Removing an Injector



Removing an Injector

1. Remove the injector leak-off pipe by unscrewing the union nut at the rear of the cylinder head, and the three special slotted bolts connecting the leak-off pipe to the injectors.

2. Remove the fuel injector pipe by unscrewing the union nuts at each end of the pipe. Fit the appropriate size blanking plugs to the delivery valve holder and injector inlet.

3. Unscrew the two nuts securing the injector to the cylinder head, and carefully withdraw the injector, ensuring that no dirt or foreign matter drops down into the injector seat in the cylinder head (see Fig. 27).

Testing an Injector

Care should be taken when testing an injector to prevent the hands contacting the fuel spray. The human skin is easily penetrated by the spray which is discharged at a pressure of approximately 2,000 lbs. per sq. inch.

Before testing or dismantling an injector clean the exterior with a soft brass wire brush and substitute or fuel oil.

Fit the spaci three or four times. T.9025–1a), to the injector h dry. In doubtful cases or testing machine, and lo at 125 atmospheres the two pegs of the spacing was at the nozzle 28). Fit the high pressure pipe (T.9025–1b) between the injector and the injector testing machine, and slacken the injector cap nut.

Before commencing to test the injector, isolate the gauge from the injector by closing the valve on the testing machine, and turn the flywheel to ensure that the holes in the injector are not blocked.

striking the side of the container. The injector should break with a hard note.

NOTE.—When checking the atomisation the valve on the nozzle tester must be kept closed to prevent damage to the gauge.

If the injector satisfactorily passes the above tests, and the nozzle opening pressure is set correctly the injector can be refitted to the engine. If, however, it fails the needle valve leakage test (seat leakage or valve stem back leakage) or if the spray is distorted or does not atomise properly, the injector should be completely dismantled, cleaned, reassembled and tested once again.

Dismantling and Cleaning an Injector

1. Fit the injector to the injector testing machine but do not connect the fuel pipe.

2. Remove the injector cap nut and copper washer, then with a screwdriver, unscrew the spring adjusting nut. Lift off the upper spring disc, injector spring and spindle.

3. Unscrew the nozzle nut, using the special socket (tool No. T.9042) and remove the nozzle and its needle valve.

NOTE.—As nozzles and their needle valves are a lapped fit, they should never be interchanged.

4. Wash all the injector parts in clean fuel or substitute oil, and using a soft brass wire brush remove all carbon from the nozzle and the needle valve.

5. Using the tools in the nozzle cleaning kit, remove all carbon from the interior of the nozzle.

If necessary, the spray holes in the nozzle can be cleaned out, using a wire probe fitted in the small hand chuck. Only use wire suitable for a .0137 in. (.35 mm.) diameter hole, and have just a small amount of the wire probe protruding from the chuck to prevent breakage. Rotate the chuck slowly without applying undue pressure to the wire probe.

When a hard carbon deposit is formed in the spray holes, it may be softened by immersing the nozzle in "Acetone" for a short period; half an hour is usually sufficient.

It is important that immediately the nozzle is removed from the fluid, it must be rinsed in clean fuel or substitute oil to prevent corrosion on the highly finished surfaces.

WARNING

"Acetone" is a highly inflammable liquid and must not be brought near a naked flame.

6. With the reverse flush adaptor (tool No. T.9043) fitted to the injector testing machine, flush out the interior of the nozzle (see Fig. 29). The nozzle fits into the body of the adaptor, tip first and is held in position by the large knurled nut. When all particles of carbon have been removed, enter the needle valve into the nozzle and ensure that it is quite free.

Reassembling an Injector

All injector parts should be reassembled wet, after rinsing in clean fuel or substitute oil. Do not use rag to clean any of the internal parts.

1. Fit the nozzle and its valve to the injector body, ensuring that the dowels in the body enter their correct location in the nozzle. Screw on the nozzle nut and tighten securely to a torque of 60 to 75 lbs. ft. (8.29 to 10.37 Kg.m.) with the special nozzle nut socket (tool No. T.9042).

NOTE.—It is essential that this torque figure is not exceeded otherwise distortion of the nozzle assembly may occur.

2. Fit the injector spindle, spring, upper spring disc and spring adjusting nut. Screw down the adjusting nut until pressure can be felt on the spring.

3. Fit the injector cap nut and copper washer, but do not tighten the cap nut.

4. Connect the injector to the testing machine pipe and test the injector as previously outlined.

NOTE.—If, after cleaning, the injector fails to pass these tests it should be replaced by a serviceable injector and the faulty one reconditioned. On no account should attempts be made to reclaim injector nozzles and valves through hand-lapping with metal polish or other abrasives.

Replacing an Injector

1. Check the injector seating in the cylinder head to ensure that it is clean and free from any carbon deposit, and locate a new copper washer in the seat.

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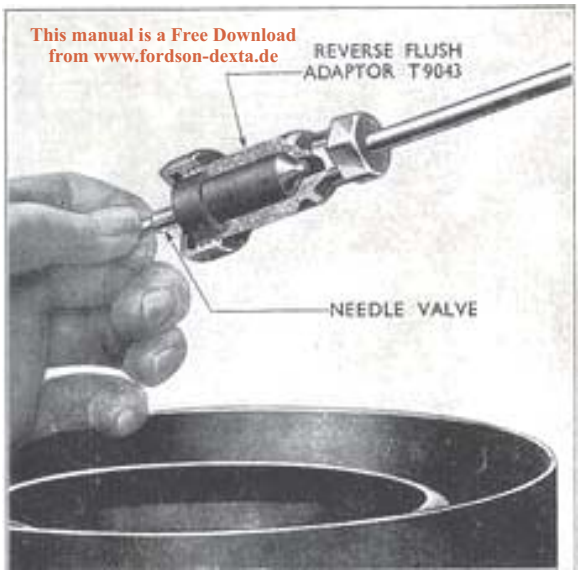

Fig. 29
Reverse Washing the Nozzle

2. Fit the injector into its bore in the cylinder head, and tighten the holding down nuts evenly. A flat washer is located under each nut.

3. Fit the injector leak-off pipe and secure in position with three special slotted bolts. Small copper washers are fitted on either side of the banjo unions on the injector leak-off pipe. Reconnect the leak-off pipe to the union at the rear of the cylinder head.

4. Fit the fuel injector pipe, ensuring that it is perfectly clean, and check that the olives at either end are in good condition and are seated correctly. Tighten the union nuts securely.

5. Run the engine for a short time to ensure that the injector is making a gas-tight seal on its seating, and that there are no leaks from the leak-off pipe and the injector pipe unions.

THE FUEL LIFT PUMP

The fuel pump is mounted on the injection pump cambox and is driven by means of a rocker arm from an eccentric on the injection pump camshaft.

On rotation of the engine, the eccentric on the camshaft pivots the fuel pump rocker arm and link and pulls the diaphragm downwards against the pressure of the return spring. This creates a partial vacuum in tne pump chamber, causing the inlet valve to open and draw fuel from the tank, through the pipe line, into the diaphragm chamber.

Further movement of the camshaft eccentric allows the rocker arm to return and the diaphragm is pushed up by the return spring, causing the inlet valve to close and the outlet valve to open. The fuel is then forced through the replaceable element filter to the injection pump.

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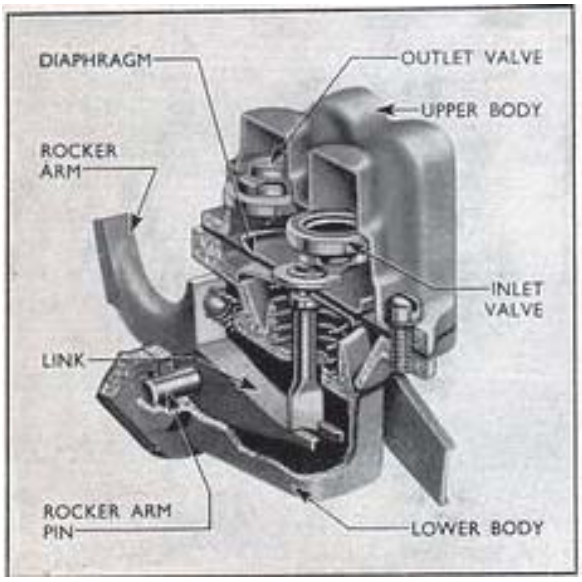


Fig. 30
Sectioned View of Fuel Lift Pump

When the injection pump gallery is filled with fuel, back pressure is created in the diaphragm chamber which holds the diaphragm down against the action of the return spring until the fuel in the injection pump gallery is delivered to the injectors.

During the time the diaphragm is held down by the fuel pressure, the rocker arm idles on the camshaft eccentric without operating the link.

Testing the Fuel Lift Pump

Providing there are no air leaks or obstructions in the fuel system, a quick check on the pump efficiency can be made as follows :—

1. Remove the air bleed screw from the inlet side of the fuel filter.

2. Operate the hand priming lever in the normal manner when there should be a well defined surge of fuel for each working stroke of the pump. If there is no resistance of the diaphragm spring it is likely that the diaphragm is held down, due to the rocker arm being held on the high point of the eccentric, and it will be necessary to rotate the engine approximately one turn.

If the pump does not operate correctly, check the inlet depression and delivery pressure, using the Diagnosis Test Set, the Gang Gauge Set No. 500–X or a suitable vacuum/pressure gauge.

Fuel Lift Pump Inlet Depression Test

1. Operate the lift pump hand priming lever to fill the injection pump gallery.

2. Disconnect the fuel inlet pipe from the lift pump and connect the vacuum gauge to the pump inlet union.

3. Start the engine and allow it to run at idling speed. The vacuum reading should be at least $8\frac{1}{2}$ in. of mercury.

4. Stop the engine and the needle should take at least a minute to drop from $8\frac{1}{2}$ in. of mercury to zero. Should the reading drop quicker than this, it indicates an air leak or faulty outlet valve.

5. Disconnect the vacuum gauge, replace the fuel inlet pipe and bleed the fuel system as described on page 2.

Fuel Lift Pump Delivery Pressure Test

1. Operate the lift pump hand priming lever to fill the injection pump gallery.

2. Disconnect the fuel outlet pipe from the lift pump and connect the pressure gauge to the pump outlet union.

3. Start the engine and observe the pressure at idling speed. Increase the speed and check throughout the speed range that the pressure is between 6 and 10 lbs./sq. inch (.42 to .70 Kg./sq. cm.).

NOTE.—Low fuel pump pressure may affect engine performance due to lack of fuel.

4. Disconnect the pressure gauge, replace the fuel outlet pipe and bleed the system as outlined on page 2.

OVERHAULING THE FUEL LIFT PUMP

To Remove

1. Turn the fuel tap to the "off" position and disconnect the fuel inlet and outlet pipes from the fuel lift pump.

2. Unscrew the two nuts securing the pump to the injection pump cambox and detach the pump. Remove the pump gasket.

To Dismantle

1. Mark the upper and lower body flanges to facilitate their correct reassembly and remove the five screws securing the fuel pump upper body to the lower body. Remove the upper body, taking care not to damage the diaphragm when separating these parts.

2. Push down the diaphragm and turn it 90° in either direction when the diaphragm pull rod will be disconnected from the operating link and the diaphragm can then be detached.

3. Remove the fabric oil seal from the diaphragm pull rod. Turn the oil seal washer through 90° and detach the washer and diaphragm return spring. The diaphragm and pull rod are riveted together and should not be dismantled.

4. The inlet and outlet valve assemblies are retained by a plate secured by two round-headed screws. Remove the two screws, lift off the plate, valve assemblies and gasket.

5. Should it be necessary to dismantle the lower half of the pump body, remove the staking from around the rocker arm pin retainers and pull them from the slots in the body. The rocker arm pin, rocker arm, link, spring and thrust washers will then be freed and may be removed, leaving the priming lever in position.

Reassembly

If the lower body has been dismantled, replace the rocker arm and link as follows :—

1. Insert the rocker arm pin, rocker arm, link, spring and thrust washers into the lower pump body, replace the rocker arm pin retainers in their slots, and securely stake them in position.

Test the operation of the rocker arm and link by moving the rocker arm towards the body when the link should be moved downwards. Depress the link, and the rocker arm should move freely without transmitting movement to the link. Ensure that the priming lever operates correctly and returns freely to the normal position.

2. Locate the diaphragm return spring on the pull rod, fit the oil seal washer, depress the washer and turn it through 90° to lock it on the pull rod. Fit a new fabric oil seal washer.

3. Enter the diaphragm pull rod in the slotted end of the link and turn it through 90° to lock it in position. Check that when assembled the small tab on the diaphragm is located directly below the outlet port in the top body.

4. Inspect the valve assemblies to see that the valves are seating correctly. Locate a new gasket in the upper body and replace the valve assemblies. Secure the valves in position with the retaining plate and two round-headed screws. The retaining plate fits with the bowed centre towards the diaphragm.

5. Fit the upper body to the lower body so that the mating marks, previously made, line up. Fit the five securing screws and spring washers, operate the rocker arm to compress the spring and tighten the screws evenly and securely.

To Replace

1. Ensure that both the lift and injection pump mounting faces are clean, fit a new gasket, and secure the pump to the injection pump cambox with two nuts and spring washers.

2. Reconnect the fuel inlet and outlet pipes.

3. Bleed the fuel system as described on page 2.

FUEL TANK

The fuel tank is located at the rear of the engine above the gearbox housing, and is of seven gallons capacity (one gallon reserve).

A combined fuel supply tap and induction priming pump assembly (for cold starting) is located at the base of the tank on the left-hand side.

The tap has three positions, i.e. closed, main supply and reserve supply. When the tap is screwed in completely, the fuel supply is cut off ; with the tap two turns open the main fuel supply comes into operation and, when unscrewed fully the reserve supply of one gallon is available.

To Remove the Fuel Tank

1. Remove the primary air cleaner, vertical exhaust pipe (if fitted) and the bonnet (four screws, flat washers and nuts).

2. Disconnect the battery leads.

3. Unscrew the four self-tapping screws in each control panel side plate and remove the plates.

4. Drain approximately half-a-gallon (2.5 litres) of water from the radiator drain tap so as to bring the water level below the temperature gauge bulb unit in the cylinder head water outlet connection, and remove the bulb. Detach the temperature gauge capillary tubing from the clips on the engine.

5. Ensure that the fuel tap is fully closed, disconnect the main fuel pipe and induction primer pipe from the fuel tap, and the injector leak-off pipe from the front of the fuel tank.

6. Unscrew the cap nut retaining the steering wheel in position and remove the steering wheel and steering column dust cap.

7. Push out the tension pin securing the throttle lever to the vertical throttle rod and remove the lever.

8. Unscrew the four instrument panel securing screws, lift the panel from its location and remove the warning light bulb holders from their sockets in the instrument panel. Use a length of cord to secure the bulb holders to the upper end of the steering column.

9. Unscrew the three bolts securing the fuel tank to the support brackets (two bolts at front, one at rear). If necessary, unscrew the two bolts securing the control panel to the fuel tank rear support and move the panel rearwards prior to removing the rear fuel tank mounting bolt.

10. Draw the temperature gauge unit up through the centre of the fuel tank, moving the tank slightly to one side if necessary, and remove the instrument panel and temperature gauge as an assembly.

11. Lift the fuel tank over the steering column and away from the tractor.

To Replace the Fuel Tank

1. Place the fuel tank on its support brackets passing it carefully over the steering column, vertical throttle rod and wiring.

2. Pass the bulb unit of the temperature gauge down through the centre of the fuel tank and locate the instrument panel and temperature gauge onto the top of the steering column.

3. Fit the three rubber mounting pads between the fuel tank and the brackets, and replace the three mounting bolts and spring washers.

Refit the two control panel to fuel tank support bracket bolts.

4. Refit the warning light bulb holders in their appropriate sockets on the instrument panel (the purple wire should be connected to the oil pressure warning light on the right-hand side, and the yellow and white wire to the generator charging light on the left).

5. Enter the instrument panel over the throttle rod and replace the four instrument panel securing screws. Ensure that the instrument panel gasket seats correctly and the small rubber sealing ring in the throttle rod support bush is not displaced.

6. Replace the throttle lever and secure it to the throttle rod with a tension pin. A thin dished washer fits between the throttle lever and the instrument panel.

7. Replace the steering column dust cap, fit the steering wheel in position and tighten the cap nut securely.

8. Reconnect the main fuel feed pipe and the induction primer pipe to the fuel tap and priming pump assembly, and the injector leak-off pipe to the union on the front of the fuel tank. It will be necessary to bleed the fuel system as detailed on page 2, before re-starting the engine.

9. Refit the control panel side plates securing each with four self-tapping screws.

10. Reconnect the battery leads and operate the main control key to ensure that both warning lights are working correctly.

11. Refit the temperature gauge bulb unit in the cylinder head water outlet and the capillary tubing into the retaining clips on the engine.

12. Top-up the cooling system with water or anti-freeze as required.

13. Replace the bonnet and secure with four screws, flat washers and nuts.

14. Replace the primary air cleaner and vertical exhaust pipe (if fitted).

THE FUEL TAP AND PRIMING PUMP ASSEMBLY

This comprises the three-position fuel supply tap and the push button operated induction priming pump.

The push button of the priming pump operates on a spring-loaded rubber diaphragm in the sealed body of the pump, and injects fuel through the atomiser located in the inlet manifold, when starting under cold conditions.

The fuel tap valve seals can be replaced with the tap in position by removing the valve retaining spring and unscrewing the valve from the body.

If it is necessary to remove the tap and priming pump assembly to renew it, or to clean the filter gauze, the tank must be raised (as outlined in " To Remove the Fuel Tank " on page 19) to facilitate removal of this assembly.

FAULT DIAGNOSIS

Fault diagnosis on the diesel engine is a straightforward operation if carried out methodically.

To distinguish between a mechanical knock and a fuel knock, run the engine at maximum speed and pull the stop control, if the knock is no longer present it is due to the fuel ; if it is audible, it is due to mechanical reasons. When the fuel supply to the engine is cut off, the mechanical knock will be reduced in volume, but will still be present.

Running faults will be due mainly to faults arising in one or more of the following sections. By checking through as outlined, the faulty component or section can be isolated.

Fuel System

1. Bleed all air from the fuel system in the normal manner, if it cannot be eliminated, check back over the pipe line from the lift pump to the fuel tank.

2. Loosen off the injector pipes at the injector end, and operate the starter motor, observing approximate equal delivery from each fuel pipe.

3. Pull the stop control with the pipes still disconnected from the injectors and operate the lift pump hand primer. Any flow of fuel indicates a faulty delivery valve or broken delivery valve spring.

4. Reconnect the pipes to the injectors and start the engine if possible. As a rough check of injector condition, run the engine just above the idling speed, and loosen the injector pipes one at a time. As each injector is cut out in this way, a definite drop-off in speed should be noticed if the injector is operating correctly.

Timing

1. Check the fuel injection pump timing by turning the engine crankshaft as described on page 4, and adjust if necessary.

2. If any doubt arises as to the accuracy of the timing marks on the fuel injection pump gear adaptor, the fuel injection pump should be spill timed to the engine.

To carry out this operation, set the engine on the spill point for No. 1 cylinder as described above. Disconnect No. 1 injector pipe, remove the delivery valve holder and extract the volume reducer, delivery valve and spring. Refit the delivery valve holder to the pump body, tighten to a torque of 30 lbs. ft. (4.15 kg.m.) and fit the spill pipe (tool No. CT.9023) to the holder.

Unscrew the four set-screws and remove the inspection cover from the front of the timing case cover. Slacken the three set-screws securing the fuel pump gear to the gear adaptor and with a suitable socket spanner on the adaptor retaining nut, fully retard the adaptor by turning it anti-clockwise. Operate the hand primer on the fuel lift pump and fuel should run from the end of the spill pipe. Slowly advance the gear adaptor until the flow of oil from the spill pipe just ceases, and tighten the three set-screws securing the gear to the adaptor. The injection pump is now timed correctly to the engine.

Refit the delivery valve, spring and volume reducer, tighten the delivery valve holder to a torque of 30 lbs. ft. (4.15 kg.m.) and reconnect the injector pipe.

Air Supply

1. Remove and clean the air filter as described on page 3.

2. Remove the rubber hose between the main air cleaner and the inlet manifold, check for obstructions and operate the throttle lever to ensure that the throttle plate travels as far as its stop, giving sufficient opening at the throttle.

3. Check all valve clearances.

4. Check the evenness of the cylinder compressions by turning the crankshaft with the starting handle.

Governing

1. Check the maximum " No Load " speed of the engine. This should be 2,200 r.p.m. If the air system has previously been checked as outlined, and the maximum " No Load " speed is low, check the governor main spring. The length of the spring should be as outlined in the Specification Section on page 25.

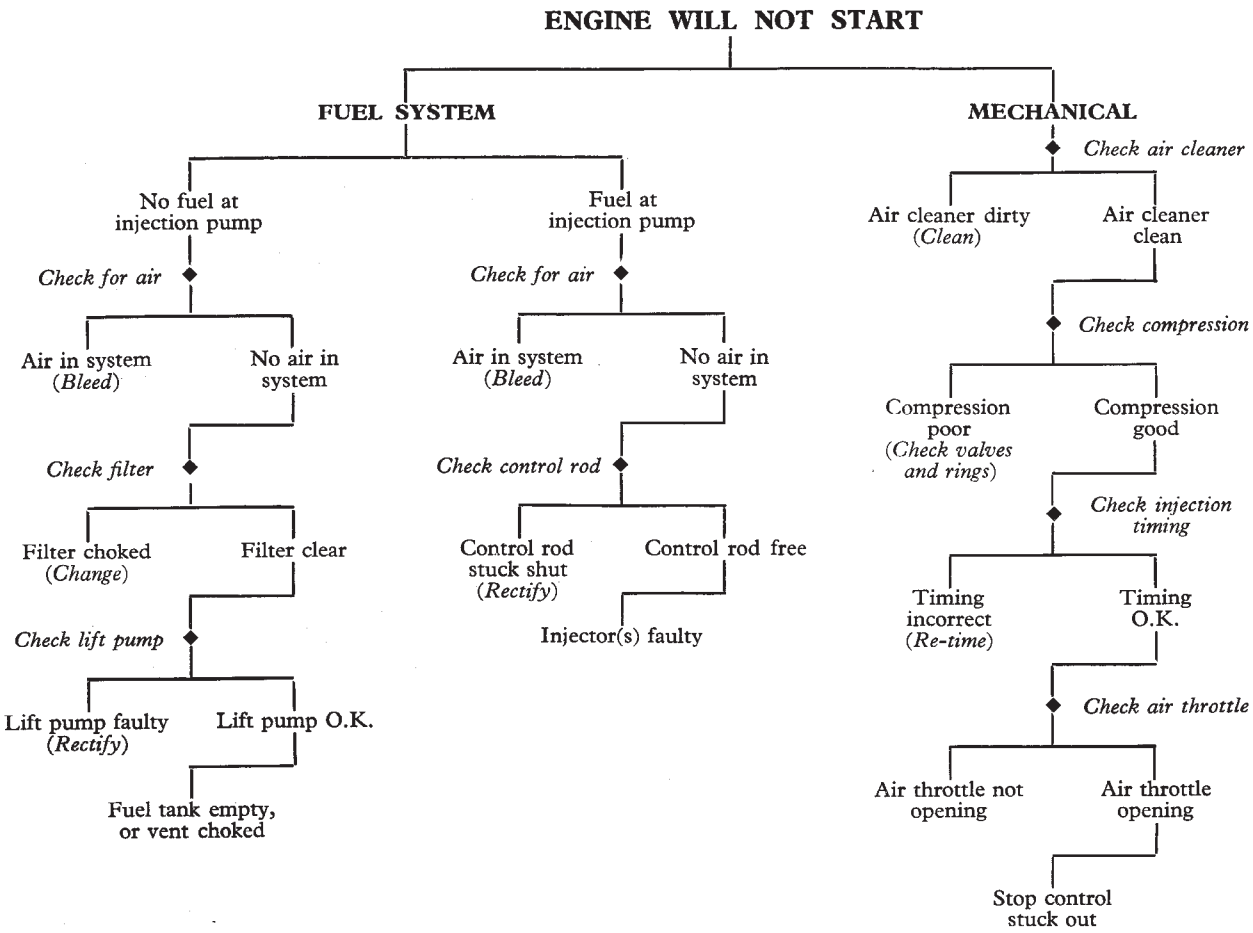
2. If the air supply has not previously been checked, and the maximum " No Load " speed is low, it is advisable to carry out the complete check as outlined.

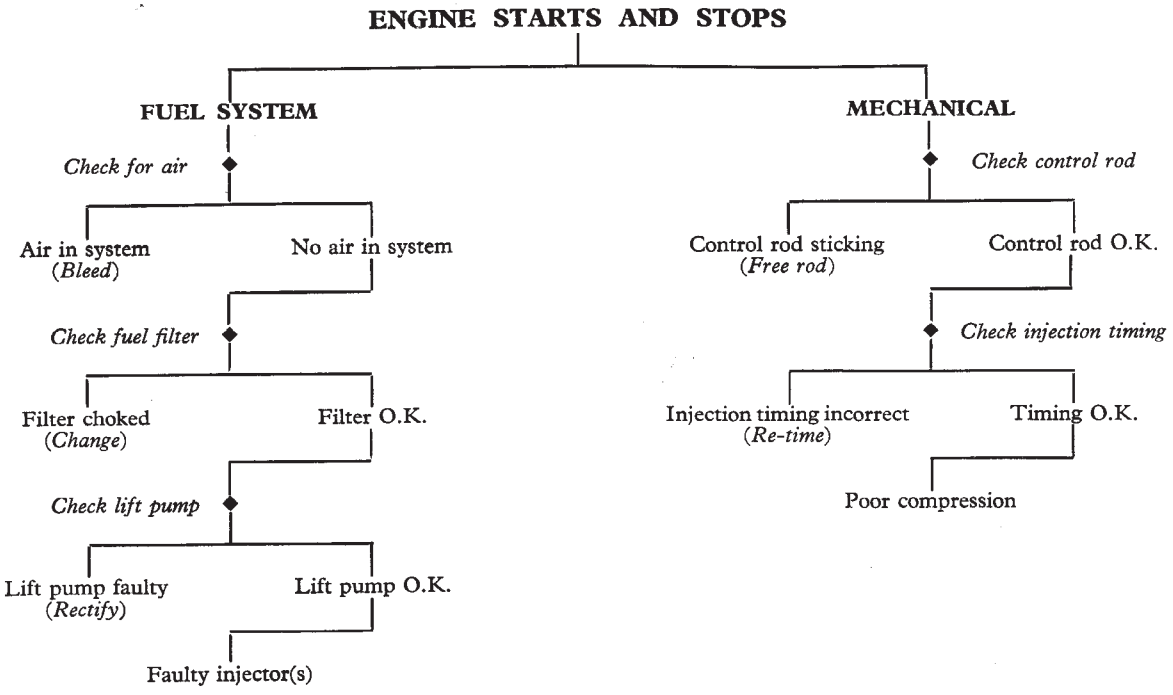
3. If erratic running is experienced under load conditions, check the fuel injection pump control rod for stickiness.

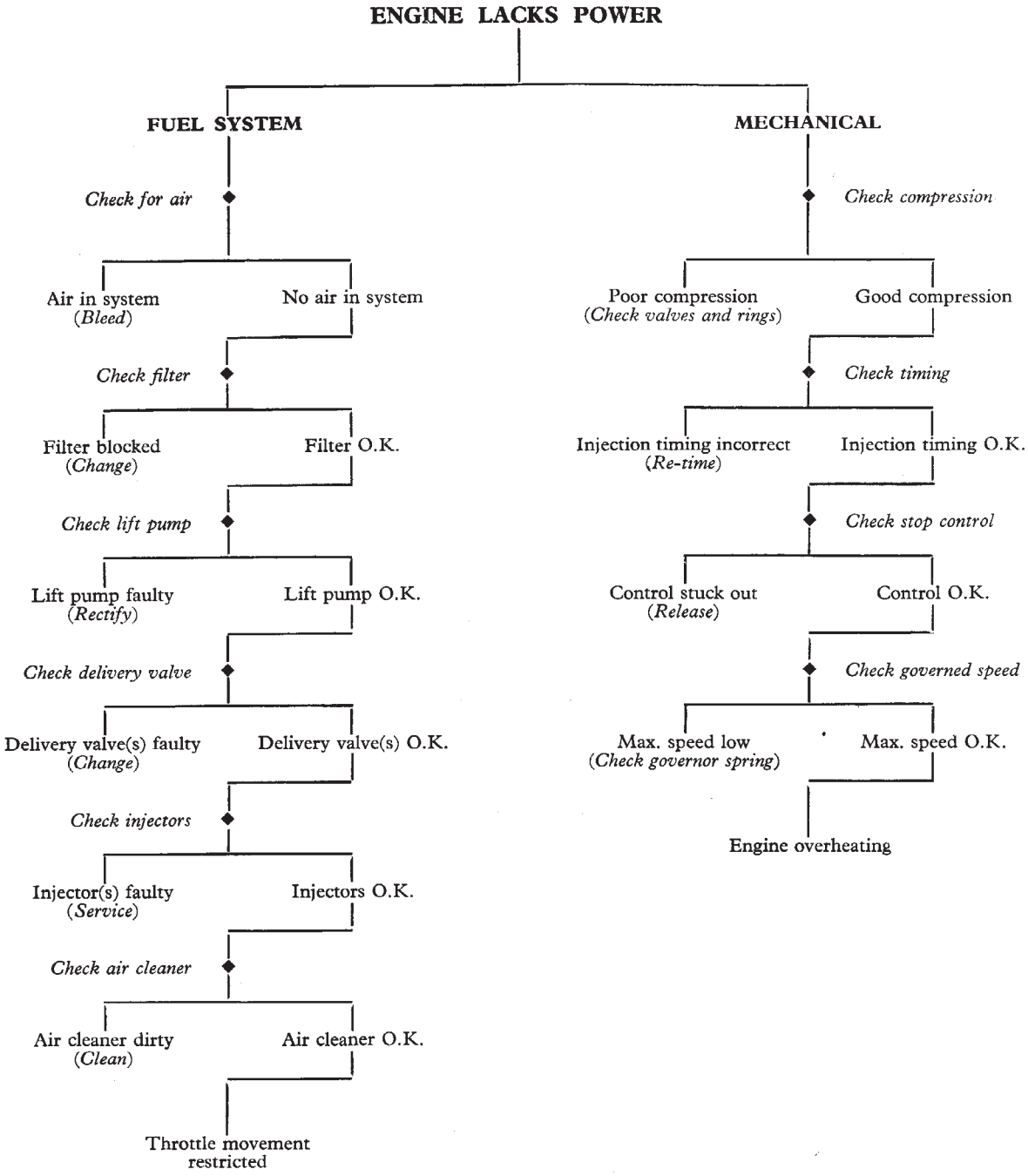
4. If the engine " No Load " speed is too high, check for leaks in the system between the inlet manifold and the governor diaphragm.

To check the governor diaphragm for leaks, disconnect the suction pipe from the governor housing. Pull the stop control lever to the " stop " position, and seal the hole in the governor housing, release the stop control lever and there should be no movement on the control rod. If movement of the control rod is observed, it indicates a leaking diaphragm.

The foregoing is intended as a guide for a complete diagnosis of running faults. By carrying out the checks as outlined, faulty components, such as injectors or injection pumps, can be easily and accurately diagnosed.


ENGINE WILL NOT START
FUEL SYSTEM
MECHANICAL
No fuel at injection pump
Fuel at injection pump
Check air cleaner
Air cleaner dirty (Clean)
Air cleaner clean
Check for air
Check for air
Check compression
Air in system (Bleed)
No air in system
Air in system (Bleed)
No air in system
Compression poor (Check valves and rings)
Compression good
Check filter
Check control rod
Check injection timing
Filter choked (Change)
Filter clear
Control rod stuck shut (Rectify)
Control rod free
Timing incorrect (Re-time)
Timing O.K.
Check lift pump
Injector(s) faulty
Check air throttle
Lift pump faulty (Rectify)
Lift pump O.K.
Air throttle not opening
Air throttle opening
Fuel tank empty, or vent choked
Stop control stuck out


ENGINE STARTS AND STOPS
FUEL SYSTEM
MECHANICAL
Check for air
Check control rod
Air in system (Bleed)
No air in system
Control rod sticking (Free rod)
Control rod O.K.
Check fuel filter
Check injection timing
Filter choked (Change)
Filter O.K.
Injection timing incorrect (Re-time)
Timing O.K.
Check lift pump
Poor compression
Lift pump faulty (Rectify)
Lift pump O.K.
Faulty injector(s)


ENGINE LACKS POWER
FUEL SYSTEM
MECHANICAL
Check for air
Air in system
(Bleed)
No air in system
Check filter
Filter blocked
(Change)
Filter O.K.
Check lift pump
Lift pump faulty
(Rectify)
Lift pump O.K.
Check delivery valve
Delivery valve(s) faulty
(Change)
Delivery valve(s) O.K.
Check injectors
Injector(s) faulty
(Service)
Injectors O.K.
Check air cleaner
Air cleaner dirty
(Clean)
Air cleaner O.K.
Throttle movement
restricted
Check compression
Poor compression
(Check valves and rings)
Good compression
Check timing
Injection timing incorrect
(Re-time)
Injection timing O.K.
Check stop control
Control stuck out
(Release)
Control O.K.
Check governed speed
Max. speed low
(Check governor spring)
Max. speed O.K.
Engine overheating

ENGINE KNOCKS

FUEL SYSTEM

- Injector pipe partially blocked
- Faulty injectors
- Faulty calibration
- Faulty induction priming pump

MECHANICAL

- Injection timing too early
- Bearing(s) worn
- Piston(s) worn
- Broken valve spring(s)

ENGINE EMITS EXCESSIVE SMOKE

- Maximum stop screw incorrectly set
- Injection retarded
- Faulty delivery valve(s)
- Faulty injector(s)
- Poor compression

FUEL SYSTEM SPECIFICATION

Fuel Tank

Capacity	7 Imp. gallons (31.8 litres) including 1 gallon (4.55 litres) reserve

Fuel Lift Pump

Type	Diaphragm with hand primer. Mechanically operated from the injection pump camshaft
Delivery pressure	6 to 10 lbs./sq. in. (421 to 703 gm/sq. cm.)

Fuel Oil Filter

Type	Replaceable paper element

Air Cleaner

Type	Oil bath
Oil capacity	Approx. 1 Imp. pint (.57 litre)
Grade of oil	As for engine

Fuel Injection Pump

Type	Enclosed camshaft with pneumatic governor
Plunger stroke and diameter	7 mm. × 6 mm.
Camshaft rotation	Clockwise from drive end
Lubrication	Self-lubricating after initial filling
Camshaft end-float	.002 to .006 in. (.051 to .152 mm.)
Camshaft end-float shims	.004 and .008 in. (.1 and .2 mm.) thick
Phasing spacers :—	
No. 1	.179 to .181 in. (4.55 to 4.60 mm.) thick
No. 2	.183 to .185 in. (4.65 to 4.70 mm.) thick
No. 3	.187 to .189 in. (4.75 to 4.80 mm.) thick
No. 4	.191 to .193 in. (4.85 to 4.90 mm.) thick
No. 5	.195 to .197 in. (4.95 to 5.00 mm.) thick
Phasing tolerance	1° (pump) between elements
Plunger head clearance	.031 to .051 in. (.8 to 1.3 mm.)
Plunger arm shims	.009 in. (.229 mm.) thick
Fuel delivery, control rod set 2 mm. proud of face of mounting flange :—	
200 injections at 600 r.p.m.	9.6 to 10.0 c.cs.
Tightening torques :—	
Delivery valve holders	30 lbs. ft. (4.14 kg.m.)
Fuel pump drive gear adaptor retaining nut	45 lbs. ft. (6.21 kg.m.)

Fuel Injectors

Number of spray holes	2
Diameter of spray holes	.013 in. (.35 mm.)
Spray holes	30° and 80° to vertical axis
Setting pressure	160 ats.
Back leak test	Time for pressure to fall from 125 to 90 ats. should be between 6 secs. and 45 secs.
Needle seat leakage	Hold pressure at 150 ats. for 1 min. with blotting paper at nozzle tip and spot on paper should not exceed ½ in. (12.7 mm.) diameter
Injector pipes :—	
Inner diameter	.06 in. (1.5 mm.)
Outer diameter	.233 to .238 in. (5.9 to 6.06 mm.)
Nozzle nut tightening torque	60 to 75 lbs. ft. (8.29 to 10.37 kg.m.)

Governor

Type	Pneumatic
Maximum speed :—	
" No Load "	2,200 r.p.m.
Under load	2,000 r.p.m.
Idling speed	550 to 600 r.p.m.
Governor spring test length (L1)	1.969 in. (50 mm.)
Governor spring test load	3 lbs. 13½ ozs. to 4 lbs. 1 oz. (1.744 to 1.843 kg.)
Governor spring length (L2) to be	1.693 in. (43 mm.)
with a test load of	4 lbs. ½ oz. to 4 lbs. 4 ozs. (1.829 to 1.928 kg.)
Difference between load at L1 and L2	3 ozs. (.085 kg.)

CLUTCH

A normal single clutch is fitted to all models having the Standard power take-off ; a double clutch incorporating separate clutches for the transmission and the power take-off is fitted to tractors equipped with " Live " power take-off.

The single clutch and double clutch are described in detail under their respective headings.

SINGLE CLUTCH

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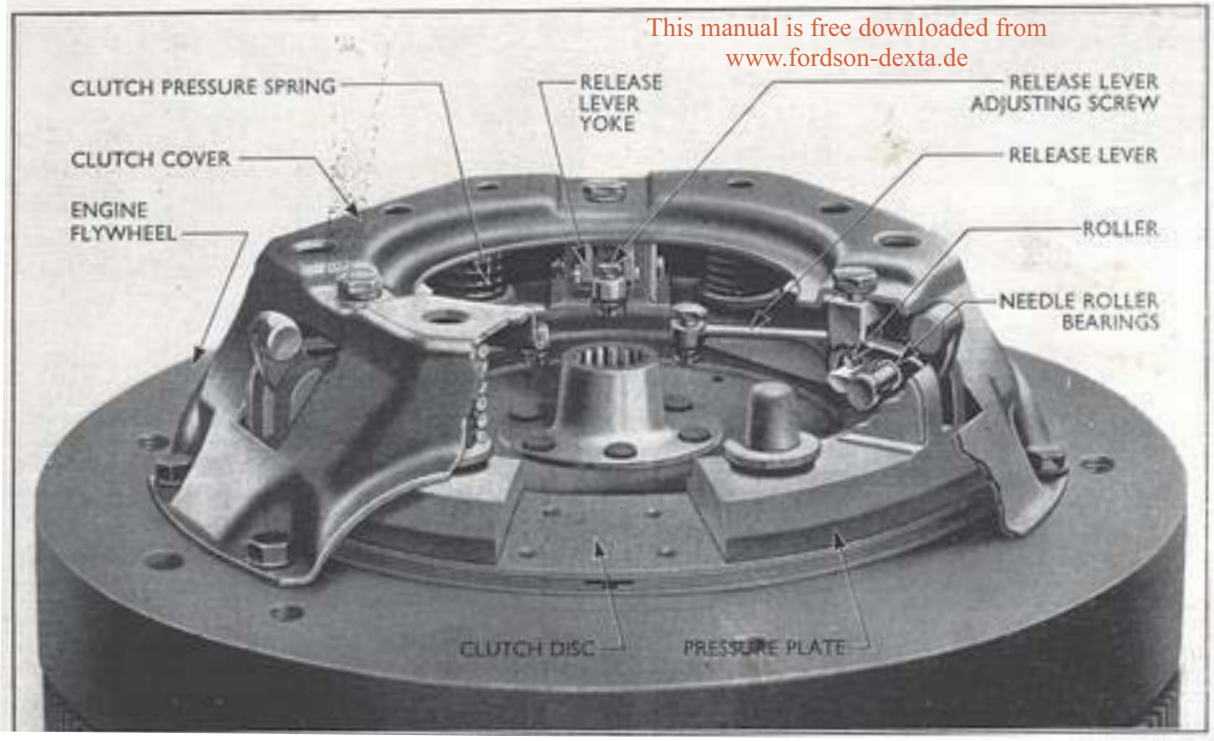

Fig. 1
Cut-away View of the Single Clutch

General Description

This is an 11 in. (279.40 mm.) diameter single disc dry clutch consisting of two main parts, the friction disc and the pressure plate assembly, the latter incorporating the clutch cover and release levers.

The friction disc which locates between the pressure plate and the flywheel is a sliding fit on the splines of the main drive shaft. On the pressure plate side of the disc " leaf " type cushion springs are positioned between the friction lining and disc centre plate to give a smooth " take-up " of the engine drive as the clutch is engaged.

Six special dowel screws fitted through the clutch cover secure the pressure plate assembly to the flywheel, three release levers providing the connection between the driving lugs cast in the pressure plate and yokes secured to the inside of the cover. The release lever pivot pins located in the pressure plate driving lugs operate on needle roller bearings which, in conjunction with a pivot pin and single roller attachment at the yokes, ensures free movement of the release levers.

The three pressure plate driving lugs locate in slots in the cover so enabling engine power to be transmitted from the flywheel to the cover and then to the pressure plate. Nine springs fitted inside the cover exert the necessary force on the pressure plate to ensure the clutch disc will transmit engine torque to the transmission.

At higher engine speeds when greater torque is transmitted, centrifugal force tends to move the weighted outer ends of the release levers towards the

flywheel. This action in effect supplements the spring loading on the pressure plate and therefore the disc.

Clutch Release Mechanism

A pre-lubricated clutch release bearing is fitted to a hub which operates on an extension of the main drive shaft oil seal retainer. Slotted arms, one either side of the release hub, engage the open ends of a fork which is fitted to a cross-shaft located in the clutch housing. An arm on the outer end of the cross-shaft is connected by suitable linkage to the clutch pedal. A torsion spring fitted on the cross-shaft contacts the fork and a cast location in the clutch housing ensuring positive return of the release bearing and clutch pedal when the pedal is released.

Operation

Depressing the clutch pedal causes the cross-shaft to rotate and so moves the release bearing against the spherical headed adjusting screws at the inner ends of the clutch release levers, moving the inner ends of the levers towards the flywheel thereby drawing the pressure plate away from the disc. With the clutch disc free no power will be applied to the transmission and gear selection can be accomplished.

OPERATING ADJUSTMENTS (Single Clutch)

The only routine adjustment necessary with regard to the single clutch is that for clutch pedal free movement. This is the initial movement of the pedal from the fully engaged position, pedal against the stop bracket, to the point where clutch resistance is felt. When correctly adjusted this movement should be $\frac{3}{4}$ in. (19.05 mm.), measured at the pedal pad (see Fig. 3). As it is most important that correct clutch pedal free movement be maintained, the movement should be checked periodically during service and adjusted when necessary to compensate

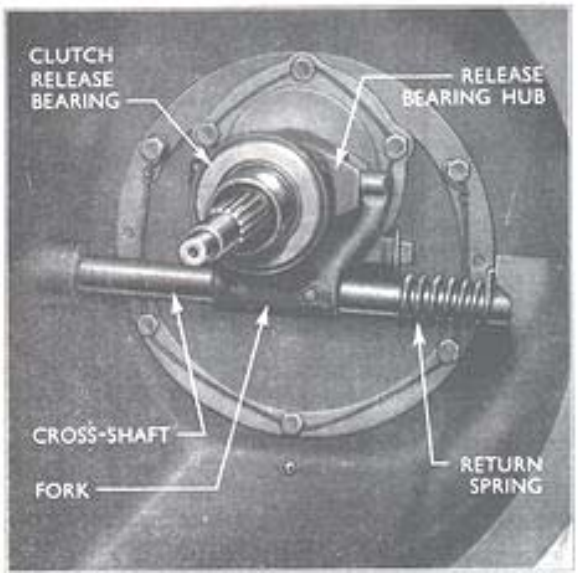

Fig. 2
Clutch Release Mechanism

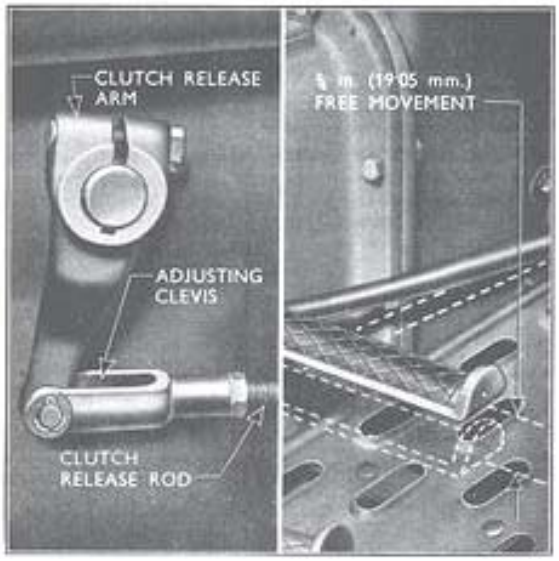

Fig. 3
Clutch Pedal Free Movement Adjustment (Single Clutch)

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for normal wear of the clutch disc linings. Operating the tractor with insufficient clutch pedal free movement will cause clutch slip, resulting in excessive wear on the clutch release bearing, clutch disc linings and pressure plate. In extreme cases the heat developed through clutch slip may distort the clutch pressure plate.

The following procedure should be adopted when setting clutch pedal free movement on tractors fitted with the single clutch.

On tractors fitted with the double clutch the method outlined below must not be used in an attempt to compensate for clutch pedal free movement. (See "OPERATING ADJUSTMENTS—Double Clutch")

1. Loosen the clevis locknut on the clutch release rod, remove the split pin and clevis pin connecting the rod to the clutch release arm.

2. Unscrew the clevis from the release rod to increase the free movement of the pedal or vice-versa. Reconnect the rod to the clutch release arm with the clevis pin and check that the clutch pedal has the necessary $\frac{3}{4}$ in. (19.05 mm.) free movement at the pedal pad (see Fig. 3).

3. After correctly setting the free movement, tighten the clevis locknut and fit a split pin to the clevis pin.

REPAIR OPERATIONS

To Remove the Single Clutch

1. Separate the engine and front axle assembly from the transmission as described in the "ENGINE" section under the heading "To Remove the Engine and Front Axle Assembly."

2. Loosen the six special dowel screws securing the pressure plate assembly to the flywheel, releasing the screws alternately to prevent springing the cover. Support the pressure plate and disc, remove the screws then lift the pressure plate and disc away from the flywheel.

Inspection

Inspect the clutch disc to ensure that the linings are not loose, worn or oil soaked and that the rivets securing the disc to the hub are secure. The disc should be replaced if there is any indication of overheating or distortion due to clutch slip. Investigate the source of any oil or grease on the linings and rectify before fitting a new disc.

Examine the pressure plate assembly to ensure the release levers are not binding and that there has been no overheating of the pressure plate, which would be indicated by surface discoloration. Also check that the face of the pressure plate is not scored, distorted or cracked.

Ensure the adjusting screws are secure in the release levers. **The screws are set and locked in position during initial assembly; in service no attempt should be made to alter the setting.**

To Refit the Single Clutch

Before refitting the clutch, the clutch pilot bearing should be checked and renewed if worn as described in the "ENGINE" section under the heading "CLUTCH PILOT BEARING." The recess in the flywheel behind the bearing should be lightly packed with a good quality high melting point grease to ensure satisfactory lubrication of the bearing. Ensure that the flywheel and pressure plate faces are completely free from oil and grease.

1. Locate the clutch disc on the clutch disc locator (Tool No. T.7079) with the longer boss of the disc hub adjacent to the handle of the tool and insert the small diameter end of the tool into the clutch pilot bearing so that the clutch disc is against the face of the flywheel (see Fig. 4).

2. Place the pressure plate assembly over the disc, position on the flywheel, and fit the six special dowel screws. Fully tighten the screws alternately to prevent springing the clutch cover and remove the clutch disc locator.

3. Reconnect the engine and front axle assembly to the transmission as described in the "ENGINE" section under the heading "To Replace the Engine and Front Axle Assembly."

4. Check and adjust if necessary the clutch pedal free movement.

To Remove the Single Clutch Release Bearing

The clutch release bearing is pre-lubricated and should require little attention in service.

Examine the release bearing for evidence of looseness on the hub. If the bearing does not run smoothly or if there is excessive side movement it should be replaced. **Being pre-lubricated, on no account must the bearing be cleaned in solvent.**

1. Separate the engine and front axle assembly from the transmission as described in the "ENGINE" section under the heading "To Remove the Engine and Front Axle Assembly."

2. Disconnect the clutch release rod from the clutch release arm by removing the split pin and clevis pin.

3. Lift the inner end of the return spring away from the clutch fork, rotate the fork towards the front of the clutch housing and withdraw the release bearing and hub assembly.

4. Remove the release bearing from the hub.

To Replace the Single Clutch Release Bearing

1. Fit a new release bearing to the hub, thrust face outwards.

2. Pack the recess in the release hub bore with a good quality high melting point extreme pressure grease.

3. Rotate the fork towards the front of the clutch housing and slide the release bearing and hub assembly, bearing outermost, into position, at the same time engaging the fork with the slotted arms of the hub. Rotate the fork to the rear and, with the hooked end of the return spring located around the lug cast in the housing, engage the inner end of the spring with the front face of the small projection on the side of the fork (see Fig. 2).

4. Reconnect the engine and front axle assembly to the transmission as described in the "ENGINE" section under the heading "To Replace the Engine and Front Axle Assembly."

5. Connect the clutch release rod to the clutch release arm with a clevis pin, check and adjust if necessary the clutch pedal free movement, ensuring that on completion the release rod clevis pin is secured with a split pin.

Fig. 4
Positioning the Clutch Disc on the Flywheel

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To Remove the Clutch Pedal (Single Clutch)

1. Unclip the armoured side and rear light cable from the underside of the left-hand footplate.

2. Remove the three footplate to fender bolts and the four footplate to support bracket bolts then lift the footplate away from the tractor.

3. Disconnect the clutch release rod from the clutch pedal by removing the split pin and clevis pin.

4. Withdraw the P.T.O. shifter lever after removing the nut, spring washer and cotter bolt securing it to the P.T.O. shifter arm.

5. The clutch pedal can now be withdrawn from its bearing on the P.T.O. shifter plate.

To Refit the Clutch Pedal (Single Clutch)

1. Fit the clutch pedal on its bearing on the P.T.O. shifter plate ensuring the pedal arm which connects with the release rod is positioned to the rear of the clutch pedal stop bracket.

2. Locate the P.T.O. shifter lever on the end of the P.T.O. shifter arm with the offset in the lever towards the housing and secure in position with the cotter bolt, spring washer and nut.

3. Connect the clutch release rod to the pedal with a clevis pin and secure with a split pin.

4. Place the footplate in position on the two support brackets ensuring that the armoured side and rear light cable is positioned in the locations provided by the formed corner of the front support bracket and the groove in the rear bracket. Fit the bolts to secure the footplate to the support brackets and fender.

5. Locate the armoured side and rear light cable in the clip provided at the rear of the footplate.

6. Check and adjust if necessary the clutch pedal free movement.

DOUBLE CLUTCH

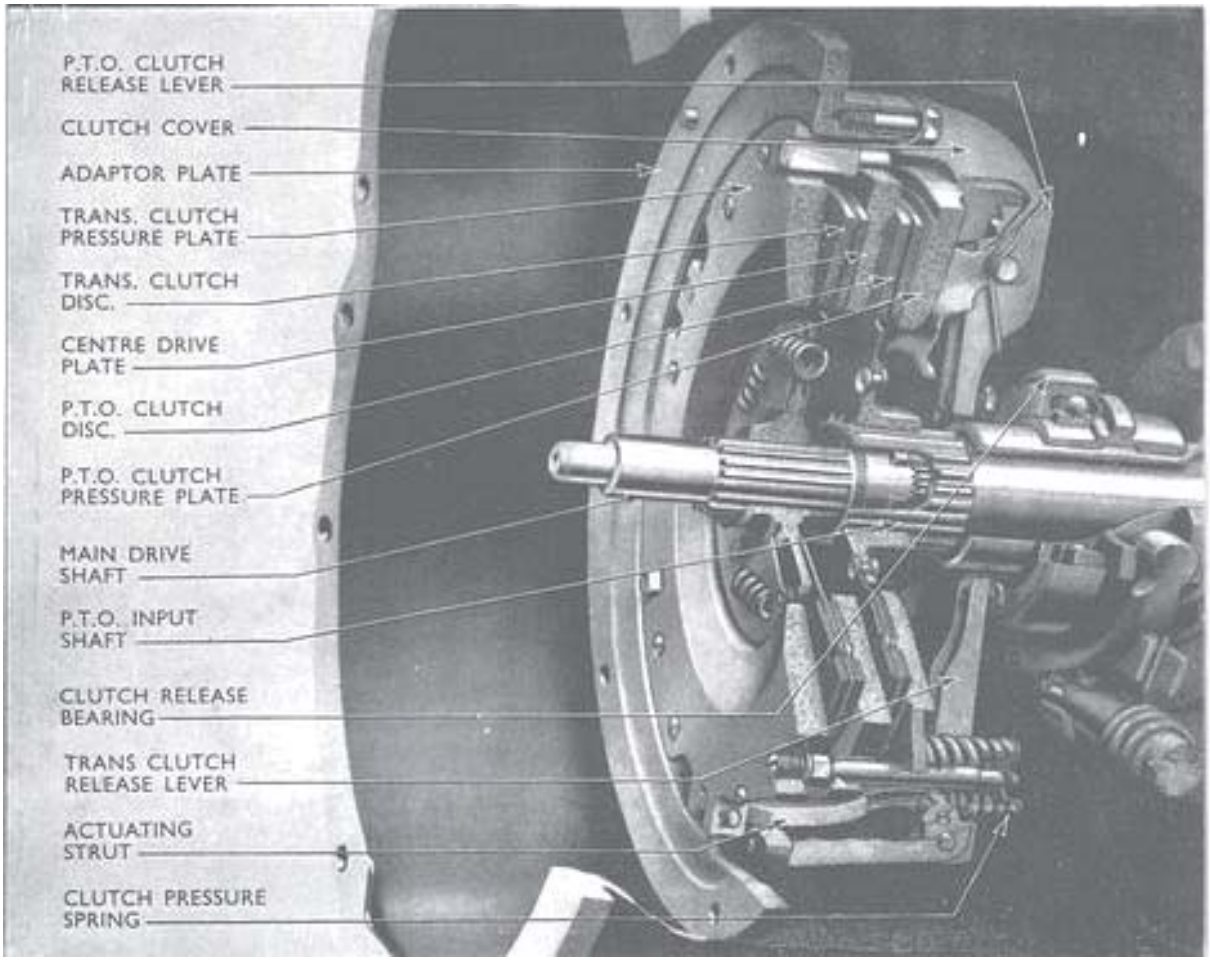

Fig. 5
Clutch Housing Cut-away showing Sectioned View of the Double Clutch Installation

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General Description

A 9 in. (228.60 mm.) diameter double disc dry clutch is fitted to tractors equipped with " Live " P.T.O. so as to enable the drive to be disconnected from the main transmission without affecting the drive to the P.T.O. The double clutch is actually two clutches embodied in a single assembly ; the forward clutch transmitting the drive from the engine to the transmission and the rear clutch transmitting the drive from the engine to the P.T.O.

The engine flywheel is common to tractors with Standard and " Live " P.T.O. but to accommodate the double clutch an adaptor plate is fitted between the flywheel and centre drive plate of the double clutch assembly. This plate is doweled to the flywheel and secured by six self-locking screws. A similar number of special dowel screws fitted with spring washers secure the double clutch centre drive plate to the adaptor plate.

The transmission clutch disc consists of two friction linings riveted one either side of a spring steel plate which is mounted on a hub incorporating six circumferentially arranged coil springs to dampen torsional vibration. The splined bore of the hub is a sliding fit on the main drive shaft. The P.T.O. clutch disc also consists of two friction linings riveted to a centre plate which in turn is attached to a rigid type hub ; the splined bore of the hub being a sliding fit on the P.T.O. input shaft.

The drive to the transmission clutch pressure plate is transmitted by three square pins riveted to the centre drive plate which engage in slots in the transmission clutch pressure plate. Twelve spring retaining pins equally spaced around the edge of the transmission pressure plate pass through clearance holes in the centre drive plate and P.T.O. clutch pressure plate, the latter being located at the rear of the centre drive plate.

Twelve springs fitted over the retaining pins exert the necessary force on both pressure plates to ensure the discs are held against the centre drive plate, thus enabling engine power to be transmitted to the transmission and P.T.O.

Three driving lugs cast in the P.T.O. pressure plate locate in rectangular holes in a pressed steel cover which is secured to the centre drive plate by six shoulder screws and spring washers. Three release levers which are free to pivot on the clutch cover engage, by means of pins, with machined slots in the driving lugs of the P.T.O. pressure plate. A further three release levers pivot on pins in the cover and connect to the transmission pressure plate by means of struts which pass through clearance holes in the cover and centre drive plate. Hardened spherical headed screws fitted to the inner ends of the release levers provide adjustment for the levers.

The transmission clutch release levers are positioned in the clutch assembly so that they are approximately $\frac{3}{4}$ in. (19.05 mm.) nearer the clutch release bearing than the P.T.O. clutch release levers. This permits complete disengagement of the transmission clutch without actuating the P.T.O. clutch, thus allowing gear changing to be carried out without stopping the drive to the P.T.O.

Clutch Release Mechanism

The clutch release mechanism is similar to that used with the single clutch fitted to tractors equipped with Standard P.T.O. but the pre-lubricated release bearing is of more robust construction and is mounted on a shorter hub. Because of the two-stage action of the double clutch the external linkage differs from that used with the single clutch, as does the method of adjusting the clutch pedal free movement.

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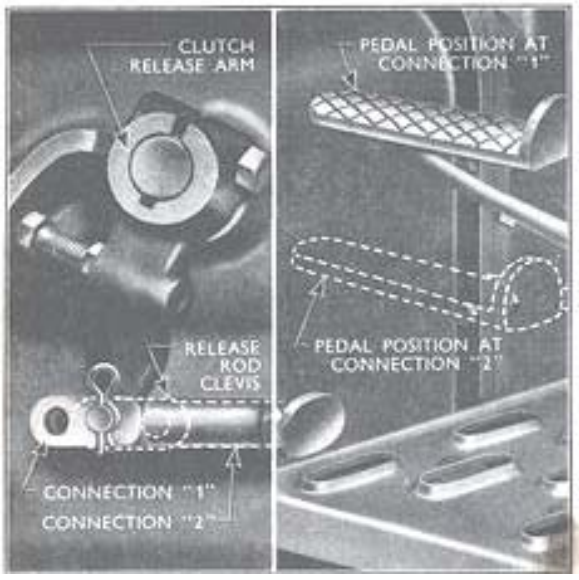

Fig. 6
Alternative Release Rod Connections and Resultant Clutch Pedal Positions

Operation

With the clutch pedal in the fully engaged position engine power is transmitted to both the transmission and P.T.O. drives. Depressing the clutch pedal through approximately the first half of its total travel, the point at which increased resistance is felt, actuates the transmission clutch, freeing the disc and disconnecting the drive to the transmission. Depressing the pedal through the remainder of its travel frees the P.T.O. clutch disc, disconnecting the drive between the engine and P.T.O. When the pedal is depressed to its fullest extent, therefore, the drive is disconnected from both the transmission and P.T.O. Initial movement of the pedal as it is released causes engagement of the P.T.O. clutch, followed by engagement of the transmission clutch as the pedal moves to the fully returned position.

Two holes in the clevis at the front end of the clutch release rod provide alternative points for connecting the clutch release rod to the release arm. For operations necessitating the use of both the transmission and P.T.O. clutches the pin connecting the clutch release rod to the release arm must be inserted through the rear hole in the release rod clevis (see Fig. 6—CONNECTION " 1 "). For operations requiring the use of the transmission clutch only the connection should be made by inserting the pin through the front hole in the clevis. In this position the height of the clutch pedal is reduced, the limited pedal movement then available being sufficient only to operate the transmission clutch (see Fig. 6—CONNECTION " 2 "). This arrangement is particularly advantageous when using hydraulically operated equipment such as mounted loaders, earth scoops, etc., as continuous operation of the hydraulic pump is ensured.

It is most important when operating P.T.O. driven equipment that the pin connecting the clutch release rod to the release arm be inserted through the rear hole of the release rod clevis, so enabling the P.T.O. drive to be readily stopped in an emergency.

A spring retaining clip fitted to the release rod clevis pin facilitates changing the pin from one hole to the other.

OPERATING ADJUSTMENTS (Double Clutch)

In service normal clutch disc lining wear will tend to reduce clutch pedal free movement. This is the initial movement of the clutch pedal from the fully engaged position to the point where clutch resistance is felt. When correctly adjusted this movement should be $\frac{3}{4}$ in. (19.05 mm.), measured at the pedal pad (see Fig. 14). It is essential that the clutch pedal free movement be checked periodically during service and adjusted when necessary, as operating the tractor with insufficient free movement will result in excessive wear on the clutch components and clutch release bearing.

The two-stage action of the double clutch necessitates a different method of adjustment for clutch pedal free movement to that employed on tractors incorporating the single clutch and a stop screw which projects from the front of the clutch release

arm (see Fig. 14) is fitted to provide the necessary means of adjustment. Screw the stop screw into the release arm to increase clutch pedal free movement and vice-versa. Ensure the stop screw locknut is re-tightened after adjustment.

On tractors fitted with the double clutch adjustment of the clevis on the clutch release rod will not alter the clutch pedal free movement. (See "To Adjust the Clutch Pedal Linkage—Double Clutch").

REPAIR OPERATIONS

Individual replacement of worn discs is not recommended, i.e. if it is necessary to replace either a worn P.T.O. or transmission clutch disc both discs should be renewed.

To Remove the Double Clutch

1. Separate the engine and front axle assembly from the transmission as described in the "ENGINE" section under the heading "To Remove the Engine and Front Axle Assembly."

2. Support the clutch assembly, remove the six special dowel screws and spring washers securing the clutch centre drive plate to the adaptor plate and remove the clutch.

3. The adaptor plate is positioned on the flywheel by two dowels and may be removed after unscrewing the six self-locking screws.

To Dismantle the Double Clutch

1. Mark the centre drive plate, transmission clutch pressure plate and P.T.O. clutch pressure plate so that they may be replaced in the same relative position, to ensure balance.

2. With the three centre drive plate locating pegs removed from the Double Clutch Assembly Fixture (Tool No. 7502), place the clutch assembly on the fixture with the cover upwards. The large diameter at the bottom of the fixture centre spindle should locate in the bore of the transmission clutch disc hub with the transmission clutch pressure plate resting on the three lugs cast in the fixture base.

3. Remove the split pin and pivot pin connecting each of the three actuating struts to the transmission pressure plate.

4. Unlock the twelve clutch pressure spring retainers, then, moving the clutch assembly on the fixture as required, compress each spring using the spring compressor (Tool No. 7502–1) and remove the retainers, spring seats, and springs.

NOTE.—To facilitate removal of the spring retainers set the position of the spring compressor head by means of the two knurled adjusting nuts provided, so that the springs are compressed to an almost coil bound condition when the compressor handle is in the locked position. Care should be taken, however, not to over-adjust the compressor so that excessive force is required to move the compressor handle into the locked position, otherwise damage to the tool may result.

5. Remove the six shoulder screws and spring washers securing the cover to the centre drive plate and lift off the cover complete with release levers and P.T.O. pressure plate.

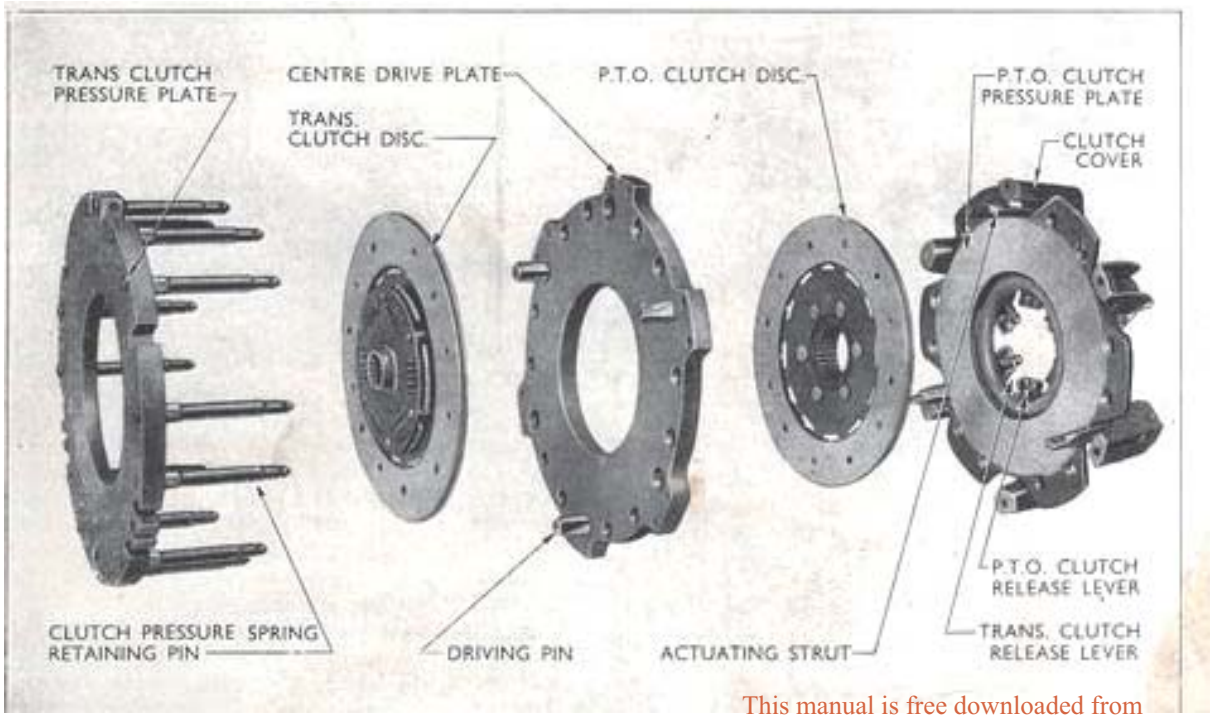

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Fig. 7
Exploded View of the Double Clutch

6. The P.T.O. clutch disc, centre drive plate, transmission clutch disc and transmission clutch pressure plate can now be lifted off the fixture, one at a time, for cleaning and inspection.

Inspection

Inspect each clutch disc to ensure that the linings are not loose, worn or oil soaked and that the rivets holding the discs to the hubs are secure. The discs should be replaced if there is any indication of overheating due to clutch slip or if there appears to be any distortion.

Examine the pressure plates and centre drive plate for signs of binding or overheating, which would be indicated by surface discoloration, and check that they are not scored, cracked or distorted. Replace any damaged clutch spring retaining pins and ensure that these pins are all securely " staked " in position. Check that the three driving pins are securely riveted to the centre drive plate.

The adjusting screws in the clutch release levers should be checked to ensure that they cannot be turned with a torque of less than 5 lbs. ft. (.691 kg.m.). If the specified torque cannot be obtained replace either or both of these parts to obtain the required condition.

All clutch springs requiring a force of less than 98 to 108 lbs. (44.45 to 48.99 kg.) to compress them to a length of 1.67 ins. (42.42 mm.) should be replaced.

To Dismantle the Clutch Cover and P.T.O. Pressure Plate Assembly

At initial assembly the pivot pins securing the six clutch release levers to the clutch cover are pressed into position and the ends " staked." If the clutch has been serviced since initial assembly and any of the clutch release levers are secured by means of the special service pivot pins which have provision for split pin retention, it will of course, to detach these levers, be necessary to withdraw the split pins before removing the pivot pins.

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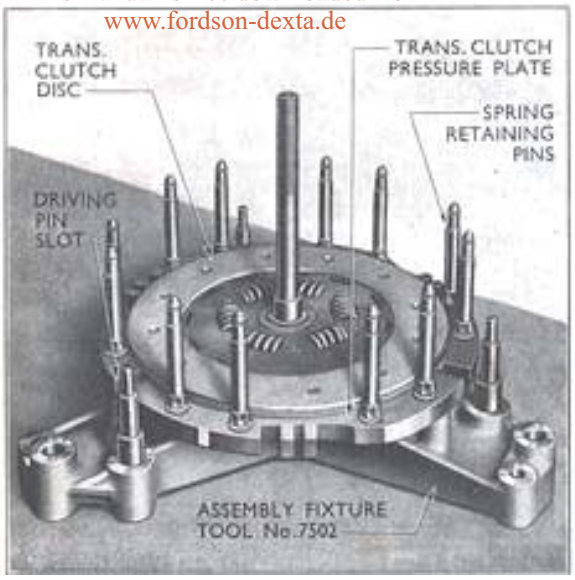

Fig. 8
Transmission Clutch Pressure Plate and Disc Installed on Assembly Fixture

1. Place the cover and P.T.O. pressure plate, cover upwards, on a suitable block of wood so that the actuating struts are free.

2. Remove the pivot pins securing the three transmission clutch release levers to the cover and lift each lever, complete with actuating strut, out of its location in the cover.

3. Push out the pivot pins connecting the actuating struts to their release levers, remove the actuating struts and small torsion springs.

4. Remove the pivot pins, also small torsion springs, securing the three P.T.O. clutch release levers to the cover.

5. Move each P.T.O. clutch release lever towards the centre of the cover so as to disengage the pivot pin in the lever from the slot in the P.T.O. pressure plate driving lug and withdraw the levers from their locations in the cover. Remove the lever to pressure plate pivot pin from each release lever.

6. The clutch cover can now be lifted away from the P.T.O. pressure plate.

To Rebuild the Clutch Cover and P.T.O. Pressure Plate Assembly

In service, " staked " pivot pins, fitted at initial assembly to secure the clutch release levers to the clutch cover, must, if removed, be replaced with the special service pivot pins which have provision for split pin retention.

Pivot points, sliding surfaces of release levers, etc., and P.T.O. pressure plate driving lugs should be lightly lubricated with a good quality high melting point extreme pressure grease.

1. To facilitate assembly of the transmission clutch release levers and actuating struts, it is suggested that the P.T.O. pressure plate be placed on a suitable piece of wood, machined face downwards.

2. Instal the clutch cover over the P.T.O. pressure plate, locating the three pressure plate driving lugs in the rectangular holes provided in the cover.

3. Locate a parallel pivot pin through the hole at the extreme outer end of each short P.T.O. clutch release lever. Slide the end of each lever into position on the clutch cover so that the pin in the lever engages with the slot machined in the P.T.O. pressure plate driving lug which protrudes through the cover. Position a hook ended torsion spring on the plain diameter under the head of each of the three long pivot pins with the shorter arm of the spring adjacent to the head of the pin. Align each P.T.O. release lever in the clutch cover and fit the pivot pins through the cover and levers locating the appropriate ends of each torsion spring in the hole provided in the release lever and over the vertical edge of the cover (see Fig. 10). Secure the three pivot pins with split pins.

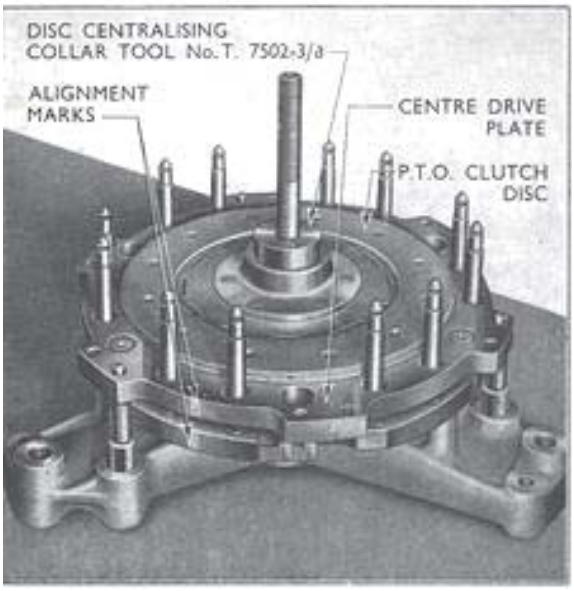

Fig. 9
Installation of Centre Drive Plate and P.T.O. Clutch Disc on Assembly Fixture

4. Assemble each of the three actuating struts to the three transmission release levers by positioning the larger end of the strut inside the outer end of the release lever so that the open side of the strut faces away from the release lever adjusting screw. Align the hole in the strut with the inner hole of the release lever. Position the torsion spring so that the coil is in line with the hole in the strut and the longer arm is located inside the strut with the formed end of the spring arm turned outwards. Insert a parallel pivot pin through the lever, strut and spring.

5. Position the three transmission release lever and actuating strut assemblies in their locations in the clutch cover, with the struts passing through the clearance holes provided in the cover. Align each transmission release lever, fit the pivot pins through the cover and levers then secure the pins with split pins. The pivot pins should pass through the cover and transmission levers in the opposite direction to those securing the P.T.O. release levers.

To Rebuild the Double Clutch

It is essential that used clutch spring retainers be regarded as expendable and new ones fitted.

NOTE.—The centre drive plate, P.T.O. and transmission clutch pressure plates are balanced separately before initial assembly. To facilitate reassembly in service, a yellow paint mark is placed on the edge of each of the above-mentioned components to indicate the heavy point. If for any reason it is necessary to renew one or more of these plates their relative position in the complete clutch assembly should be such that the three yellow paint marks are as evenly spaced as possible around the circumference of the assembly. If, however, the original parts are to be reassembled they should be positioned in the complete clutch in accordance with the marking made when dismantling.

Lubricate sliding surfaces of the driving pins with a light smear of good quality high melting point extreme pressure grease. Ensure the operating faces of the centre drive plate and pressure plates are completely free from oil and grease.

1. Position the three centre drive plate locating pegs of the Double Clutch Assembly Fixture (Tool No. 7502) in the three holes machined closest to the centre spindle in the base arms of the fixture.

2. Locate the transmission clutch pressure plate centrally on the three lugs cast in the base arms of the fixture and, to facilitate installation of the centre drive plate, position the pressure plate so that the centres of the three driving pin slots are offset approximately $1\frac{1}{8}$ ins. (28.57 mm.) in a clockwise direction from the centres of the fixture locating pegs (see Fig. 8).

3. Place the transmission clutch disc, sprung hub downwards, on the transmission clutch pressure plate, locating the bore of the disc hub on the large diameter at the bottom of the fixture centre spindle (see Fig. 8).

4. Aligning the marks made on the centre drive plate and transmission pressure plate at the time of dismantling (see previous Note), locate the centre drive plate on the fixture so that the driving pins engage in the transmission pressure plate slots and the fixture locating pegs fit in three of the plain holes at the edge of the centre drive plate (see Fig. 9).

5. Locate the P.T.O. clutch disc centralising collar (Tool No. T.7502–3/a) on the fixture centre spindle, ensuring that the collar abuts the shoulder of the spindle. Place the P.T.O. clutch disc, hub upwards, on the centre drive plate, locating the bore of the disc hub on the centralising collar (see Fig. 9).

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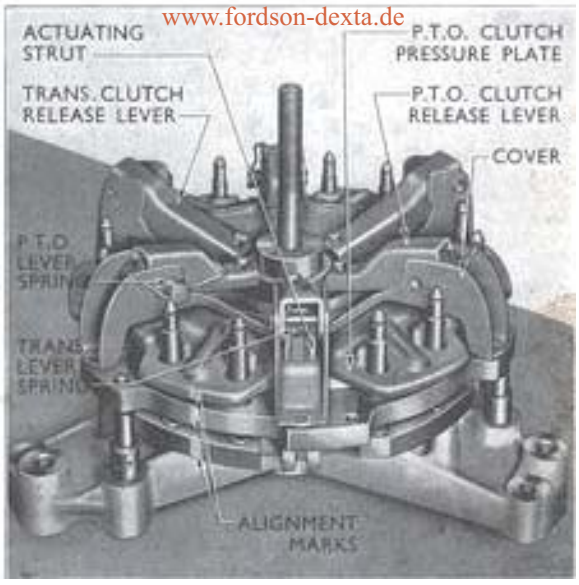

Fig. 10
Installation of Clutch and P.T.O. Pressure Plate Assembly on Fixture

6. Place the clutch cover and P.T.O. pressure plate assembly over the P.T.O. disc (see Fig. 10) ensuring the mark made on the P.T.O. pressure plate during dismantling is aligned with the corresponding marks on the centre drive plate and transmission clutch pressure plate (see previous Note). The three release lever actuating struts pass through clearance holes in the centre drive plate and engage in slots in the transmission pressure plate.

7. Align the six securing screw holes in the clutch cover with the threaded holes at the edge of the centre drive plate, fit the six shoulder screws and spring washers, fully tighten the screws.

NOTE.—When fully tightened, the ends of the screws must not protrude from the centre drive plate otherwise when refitting the clutch assembly the centre drive plate will not locate correctly on the adaptor plate.

8. Fit the twelve clutch pressure springs over the retaining pins, locating the bottom ends of the springs around the semi-circular lugs cast in the P.T.O. pressure plate and fit the spring seats to the springs. Moving the clutch assembly on the fixture as required, compress the springs one at a time with the spring compressor (Tool No. 7502–1) and, as each spring is compressed, fit a **new** spring retainer through the cut-away provided in the spring compressor head, locating it in the groove in the spring retaining pin.

Turn the retainer so that the open end is towards the clutch centre.

As the spring compressor is removed from each spring ensure the spring seat locates fully on the retainer. Close in the open ends of the retainers to lock them securely in position.

NOTE.—To facilitate replacement of the spring retainers the spring compressor should be adjusted

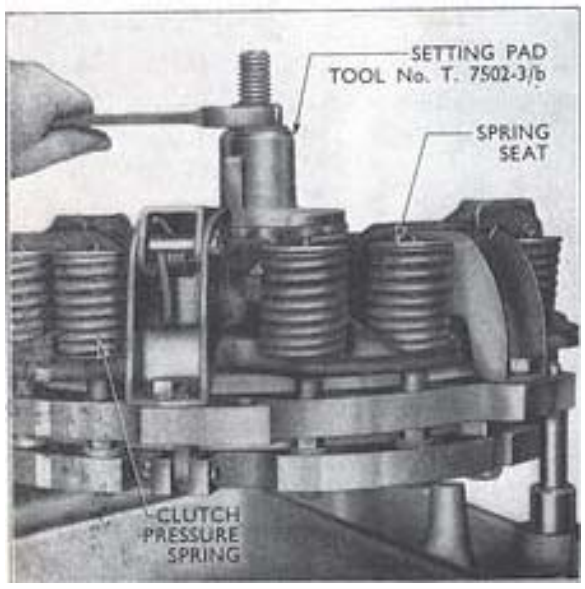

Fig. 11
Clutch Assembled - Depressing Release Levers to Insert Setting Blocks

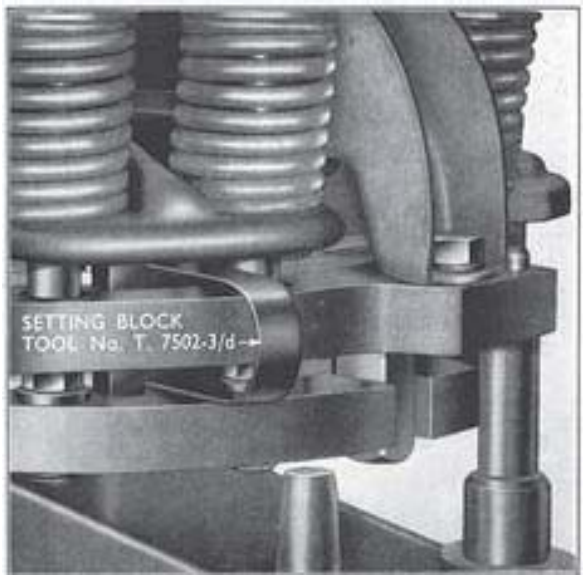

Fig. 12
Setting Block in Position

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as outlined for removing the retainers under the heading " To Dismantle the Double Clutch."

9. Align the ends of the three actuating struts in the transmission pressure plate slots, fit the pivot pins and retain with split pins.

NOTE.—After rebuilding the double clutch, whether new parts have been fitted or not, the setting of the clutch release lever screws should be checked and adjusted where necessary, as described below.

To Adjust the Double Clutch Release Levers

1. Locate the setting pad (Tool No. T.7502–3/b) over the centre spindle of the assembly fixture so that the large end face of the pad contacts the transmission clutch release lever screws. Fit the flat washer and nut to the centre spindle then screw down the nut so that the setting pad depresses the transmission and P.T.O. release levers (see Fig. 11), moving the pressure plates away from the centre drive plate. When carrying out this operation, ensure the P.T.O. and transmission lever adjusting screws project out of the levers approximately the same distance ($\frac{3}{8}$ in. (9.53 mm.) will be suitable), otherwise a fouling condition may occur which will prevent sufficient movement of the pressure plates. **Discontinue screwing down the nut immediately if the levers are depressed to the point where they strike the clutch cover.**

2. When the pressure plates have moved sufficiently, insert the three setting blocks (Tool No. T.7502–3/d) between the operating faces of the pressure plates and the centre drive plate until they touch the periphery of the clutch discs (see Fig. 12) ; the setting blocks should be positioned at 120° intervals around the clutch so that each is directly below one of the small webs which, cast in the top face of the P.T.O. pressure plate, separate adjacent clutch pressure springs (see Fig. 13).

NOTE.—Only by positioning the setting blocks as described above can it be assured that the upper section of the blocks contact the machined operating face of the P.T.O. pressure plate and correct release lever adjustment obtained.

3. Remove the nut, washer and setting pad from the fixture centre spindle ensuring that as the pressure is taken off the release levers and the pressure plates clamp the setting blocks against the centre drive plate the blocks do not move from the correct position.

4. Ensure the P.T.O. clutch disc centralising collar is contacting the shoulder of the fixture centre spindle and replace the setting pad on the fixture so that the small diameter face abuts the centralising collar. Two lugs are provided on the setting pad for checking the setting of the release lever adjusting screws, the longer lug for the transmission release levers and the smaller one for the P.T.O. release levers. Set each of the six release lever adjusting screws separately, turning each screw so that when the setting pad is held down firmly on the centralising collar with the appropriate lug directly above the screw being adjusted, a .005 in. (.127 mm.) feeler gauge can just be inserted between the top of the screw and the machined surface on the underside of the lug (see Fig. 13).

NOTE.—Press firmly at the inner end of the release lever before checking the adjusting screw setting to ensure that any free movement of the lever is taken up.

5. Invert the setting pad on the fixture centre spindle so that the large end face contacts the transmission release lever adjusting screws (as in Fig. 11). Fit the washer and nut to the centre spindle, screw down the nut then extract the three setting blocks. Remove the nut, washer and setting pad from the fixture centre spindle.

6. The clutch assembly can now be lifted off the fixture and the centralising collar removed from the hub of the P.T.O. disc.

To Refit the Double Clutch

Before installing the clutch assembly the flywheel pilot bearing should be checked and replaced if worn as described in the " ENGINE " section under the heading " CLUTCH PILOT BEARING." The recess in the flywheel behind the bearing should be lightly packed with a good quality high melting point grease to ensure satisfactory lubrication of the bearing.

1. If the adaptor plate has been removed from the flywheel, check that both the large diameter end face of the adaptor plate and the face of the flywheel are free from burrs then refit the adaptor plate so that the dowels in the plate locate in the appropriate holes in the flywheel. Fit and fully tighten the six self-locking screws.

2. Ensuring that the mounting faces of the centre drive plate and adaptor plate are free from burrs, refit the clutch assembly to the adaptor plate and secure with the six special dowel screws and spring washers.

3. Reconnect the engine and front axle assembly to the transmission as described in the " ENGINE " section under the heading " To Replace the Engine and Front Axle Assembly."

4. Check and adjust if necessary the clutch pedal linkage, adopting the procedure outlined as follows under the heading " To Adjust the Clutch Pedal Linkage (Double Clutch)."

To Adjust the Clutch Pedal Linkage (Double Clutch)

Adjusting the effective length of the clutch release rod, by screwing the clevis onto the rod or vice-versa, provides on tractors fitted with the double clutch a means of controlling the total effective movement of the clutch pedal which, due to the two-stage action of the clutch, is necessary to ensure correct clutch operation.

The release rod which is set correctly at initial assembly should be checked and adjusted if necessary after the normal " bedding-in " period, after extended periods of usage or after carrying out any repair operation on the clutch or associated parts.

Operating the tractor with the release rod incorrectly set can result in unsatisfactory clutch action or excessive clutch wear and could in extreme cases cause damage to the clutch. It is essential, therefore, that care is taken when making this adjustment and that the following procedure be strictly adhered to.

1. Remove the P.T.O. shaft guard and cover from the rear of the tractor to expose the shaft. (Not necessary if a belt pulley is fitted.)

2. Loosen the clutch release rod clevis locknut, disconnect the release rod from the release arm by

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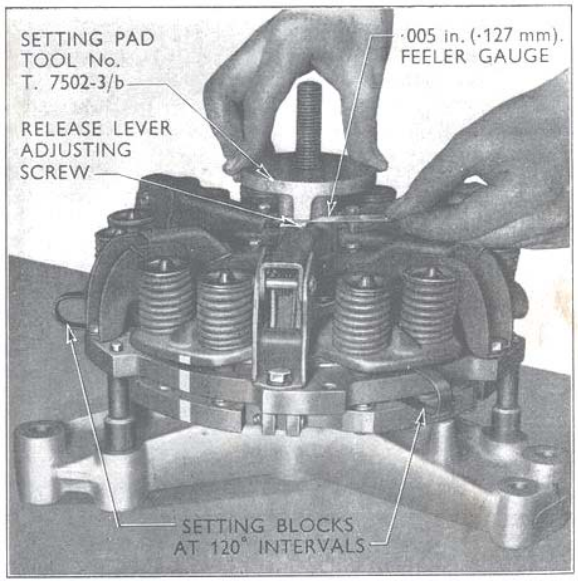

Fig. 13
Checking the Setting of a Release Lever Adjusting Screw

removing the spring retaining clip and withdrawing the clevis pin (see Fig. 14).

3. Move the P.T.O. lever into the engaged position and start the engine.

4. Adjust the release rod, by screwing the clevis onto the rod or vice-versa, so that with the rod reconnected to the release arm as shown in Fig. 6—CONNECTION " 1 " (i.e. pin inserted through the rear hole in the clevis) the P.T.O. shaft (or belt pulley if fitted) stops revolving just as, or just before the clutch pedal, when depressed, contacts the footplate.

NOTE.—Do not screw the clevis onto the rod to such an extent that the total release movement of the clutch is taken up **before** the clutch pedal contacts the footplate. If the clevis is screwed on too far the clutch mechanism will " bottom " before the pedal meets the footplate—this can be felt if the pedal is slowly depressed. Movement of the pedal beyond this point may cause damage to the clutch and under such circumstances the clutch and its associated parts should be removed for examination to determine why over-adjustment of the release rod has been necessary.

5. Having carried out the above adjustment alter the connection of the release rod to the release arm by inserting the pin through the front hole in the clevis (as in Fig. 6—CONNECTION " 2 ").

6. Again depress the clutch pedal until it contacts the footplate, at which point the transmission clutch should be completely disengaged and this can be verified by engaging and disengaging a gear. If this condition is in effect no further adjustment of the release rod is required, if not it will be necessary to re-adjust the release rod, screwing the clevis onto the rod to obtain the required condition.

NOTE.—If re-adjustment of the release rod has been necessary, connect the rear hole in the release rod clevis to the release arm and carry out a final check to ensure that the clutch pedal, when depressed, contacts the footplate before the total clutch release movement is expended. (See previous NOTE under Operation 4.)

7. With the release rod adjustment completed move the P.T.O. lever into the disengaged position and stop the engine.

8. Tighten the release rod clevis locknut and with the release rod connected to the release arm to give the required pedal operation, fit the spring retaining clip to the clevis pin.

9. If necessary, adjust the stop screw projecting from the front of the clutch release arm until there is the required $\frac{3}{4}$ in. (19.05 mm.) clutch pedal free movement at the pedal pad and tighten the locknut (see Fig. 14).

10. Refit the P.T.O. shaft cover and guard to the rear of the tractor. (Not necessary if a belt pulley is fitted.)

To Remove and Replace the Double Clutch Release Bearing

The clutch release mechanism used with the double clutch is similar to that used with the single clutch although the release bearing is of more robust construction and is mounted on a shorter hub. The bearing should require little attention in service, it is pre-lubricated and must not be cleaned in solvent. If the bearing has excessive side movement or is loose on the hub it should be renewed following the procedure outlined under the headings " To Remove the Single Clutch Release

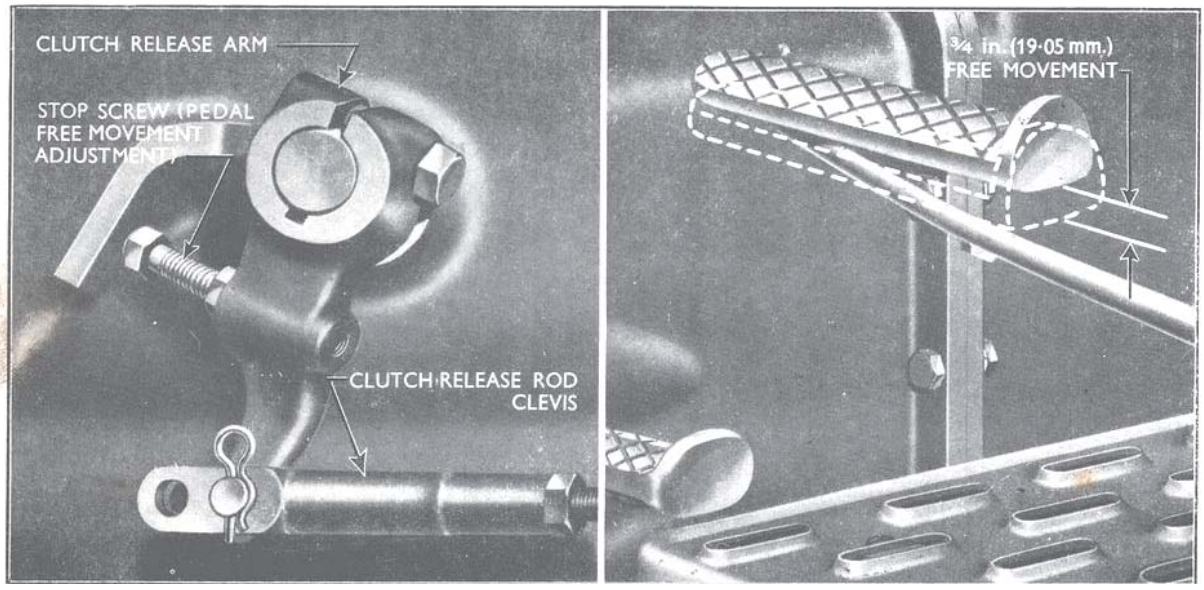

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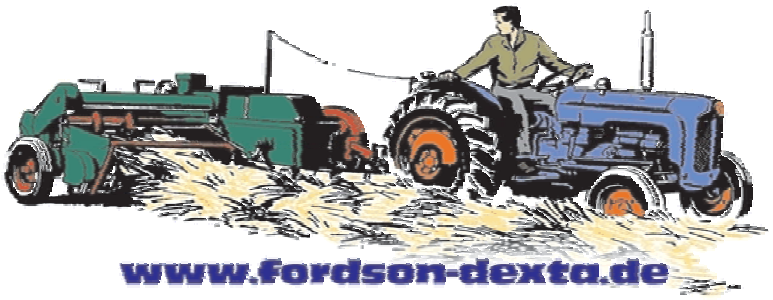
Fig. 14
Clutch Pedal and Linkage (Double Clutch)

Bearing" and "To Replace the Single Clutch Release Bearing." When carrying out these operations on tractors fitted with the double clutch, however, it should be borne in mind that a spring retaining clip secures the clutch release rod clevis pin and the same clip should be fitted at reassembly, also after replacing the release bearing, check and adjust if necessary the clutch pedal free movement **and** the clutch release rod setting following the procedure outlined under the heading "To Adjust the Clutch Pedal Linkage (Double Clutch)."

To Remove and Refit the Clutch Pedal (Double Clutch)

The clutch pedal mounting on tractors incorporating the double clutch is identical to that on tractors fitted with the single clutch with the exception that the clutch pedal stop bracket is not fitted. If it is required therefore to remove and replace the clutch pedal on tractors fitted with the double clutch follow the procedure outlined under the headings "To Remove the Clutch Pedal (Single Clutch)" and "To Refit the Clutch Pedal (Single Clutch)" disregarding the instruction for positioning the pedal relative to the stop bracket when refitting the pedal. In addition, after refitting the clutch pedal, check and adjust if necessary the clutch pedal free movement **and** the clutch release rod setting following the procedure outlined under the heading "To Adjust the Clutch Pedal Linkage (Double Clutch)."



SINGLE CLUTCH SPECIFICATIONS

Size	11 ins. (279.40 mm.)
Type	Single disc; dry

Disc Assembly

Lining O.D.	10.969 to 11.031 ins. (278.61 to 280.19 mm.)
Lining I.D.	6.469 to 6.531 ins. (164.31 to 165.89 mm.)
Total mean effective friction area (both sides of disc assembly)	116 sq. ins. (748.39 sq. cm.) approx.
Number and type of cushion springs	6—" leaf " type
Cushion spring location	Between lining and centre plate on pressure plate side of disc assembly
Number and type of splines in hub	15—involute form

Pressure Plate and Cover Assembly

Pressure plate O.D.	11.06 ins. (280.92 mm.)
Number of pressure springs	9
Pressure spring free length	2.59 ins. (65.79 mm.)
Pressure spring length under compression	1.56 ins. (39.62 mm.) under load of 85 to 95 lbs. (38.56 to 43.09 kg.)
Pressure spring colour coding	Dark blue paint
Total mean spring pressure (clutch engaged—new disc)	14 lbs./sq. in. (.984 kg./sq. cm.) approx.

Release Bearing and Hub

Type	Pre-lubricated ball bearing
Size	3.38 ins. (85.85 mm.) O.D. ; 2.0622 to 2.0627 ins. (52.380 to 52.393 mm.) I.D. ; .792 in. (20.12 mm.) overall length
Hub length	4.00 ins. (101.60 mm.)
Hub lubrication	Pack recess in bore with a good quality high melting point extreme pressure grease

Clutch Pedal

Free movement	$\frac{3}{4}$ in. (19.05 mm.)

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DOUBLE CLUTCH SPECIFICATIONS

Size	9 ins. (228.60 mm.)
Type	Double disc; dry

Transmission Disc Assembly

Lining O.D.	8.969 to 9.031 ins. (227.81 to 229.39 mm.)
Lining I.D.	5.969 to 6.031 ins. (151.61 to 153.19 mm.)
Total mean effective friction area (both sides of disc assembly)	68 sq. ins. (438.71 sq. cm.) approx.
Number of dampener springs	6
Dampener spring free length	1.002 to 1.022 ins. (25.45 to 25.96 mm.)
Dampener spring length under compression	.80 in. (20.32 mm.) under load of 185 to 205 lbs. (83.92 to 92.99 kg.)
Dampener spring colour coding	Orange paint
Number and type of splines in hub	15—involute form

P.T.O. Disc Assembly

Lining O.D.	8.969 to 9.031 ins. (227.81 to 229.39 mm.)
Lining I.D.	5.969 to 6.031 ins. (151.61 to 153.19 mm.)
Total mean effective friction area (both sides of disc assembly)	68 sq. ins. (438.71 sq. cm.) approx.
Number and type of splines in hub	29—involute form

Pressure Plates

Transmission pressure plate O.D.	10.68 ins. (271.27 mm.)
Nominal diameter of P.T.O. pressure plate operating surface	9.12 ins. (231.65 mm.)

Clutch Cover and Release Levers

Transmission release levers	3—overall length 3.34 ins. (84.84 mm.)
P.T.O. release levers	3—overall length 4.37 ins. (111.00 mm.)
Transmission release lever securing pin overall length	1.46 ins. (37.08 mm.)
P.T.O. release lever securing pin overall length	1.87 ins. (47.50 mm.)
Minimum turning torque for release lever adjusting screws	5 lbs. ft. (.691 kg.m.)

Clutch Pressure Springs

Number of springs	12
Free length	2.77 ins. (70.36 mm.) approx.
Length under compression	1.67 ins. (42.42 mm.) under load of 98 to 108 lbs. (44.45 to 48.99 kg.)
Colour coding	Violet paint
Total mean spring pressure (clutch fully engaged—new discs)	36 lbs./sq. in. (2.531 kg /sq. cm.) approx.

Release Bearing and Hub

Type	Pre-lubricated ball bearing
Size	3.95 ins. (100.33 mm.) O.D. ; 2.4997 to 2.5002 ins. (63.493 to 63.505 mm.) I.D. ; 1.12 ins. (28.45 mm.) overall length
Hub length	2.38 ins. (60.45 mm.)
Hub lubrication	Pack recess in bore with a good quality high melting point extreme pressure grease

Clutch Pedal

Free movement	¾ in. (19.05 mm.)

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THE GEARBOX

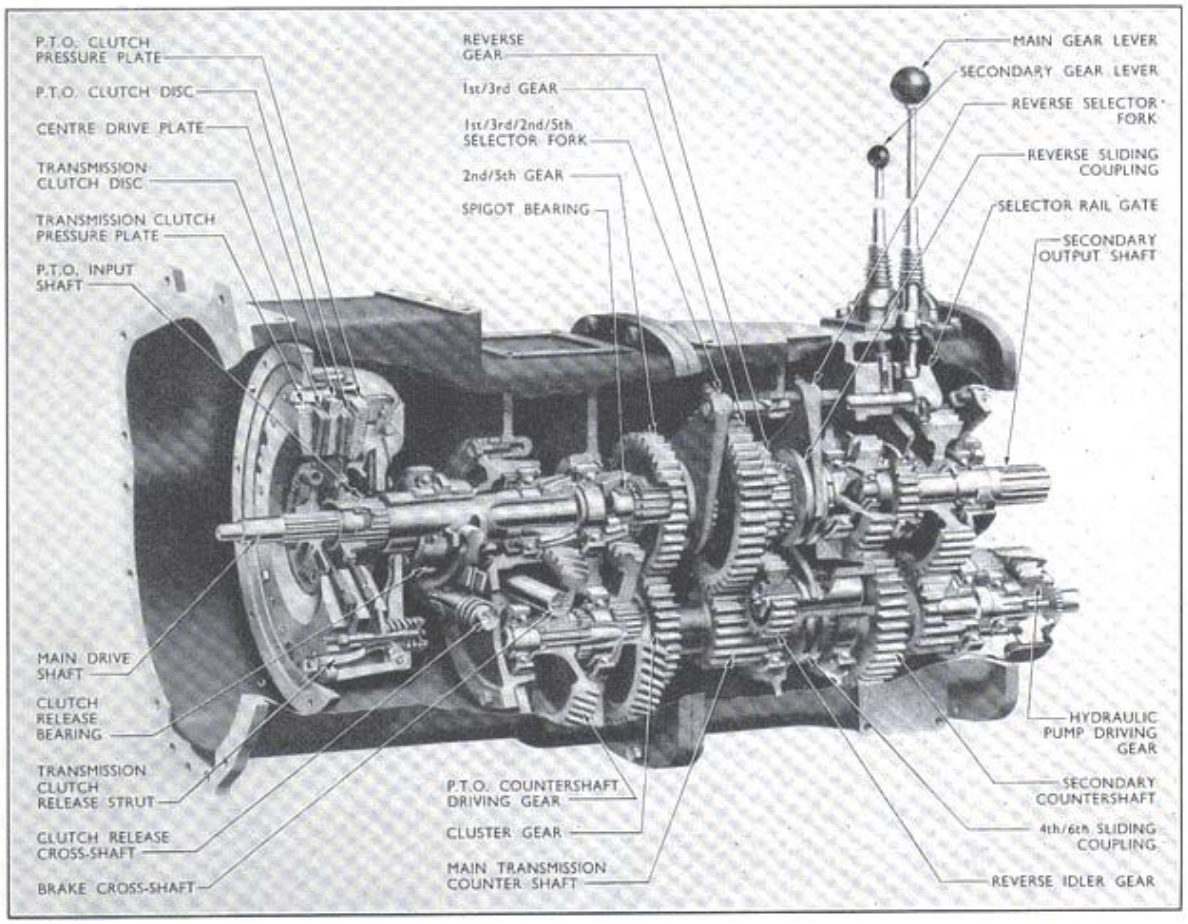

Fig. 1
Sectioned Gearbox

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Providing six forward and two reverse ratios, the gearbox is virtually two units in one. The basic gears are housed in the forward portion of the gearbox casing whilst a secondary gear train is mounted in the rear compartment to divide the drive and give ' High ' and ' Low ' speeds.

Gear selection is made by operating two levers, the left-hand (larger) lever controlling the main gearbox and selecting three forward and one reverse ratio, whilst the right-hand (smaller) lever enables the number of reductions throughout the transmission system to be doubled. The main gear lever positions are marked on the corresponding selector lever knob whilst the ' High ' and ' Low ' positions for the secondary gear lever are cast in the gear change cover.

Helical gears transmit the drive to the gearbox countershaft but the remainder of the gears are spur type which are either integral with, or revolve freely on, the shafts. Constant mesh gears are therefore used throughout the gearbox and sliding couplings connect dog teeth on the selected gears to fixed connectors on the shafts. This enables the gears to be of particularly robust construction whilst eliminating the tendency for gear ' crashing ' and reducing damage and wear of the gear teeth to a minimum.

When a ' Live ' power take-off is fitted, an extra pair of constant mesh helical gears transmit the drive from the P.T.O. clutch to the P.T.O. countershaft. One of these is integral with the P.T.O. input shaft, which operates on the outside of the main drive shaft, whilst the other replaces the P.T.O. countershaft driving coupling used on standard gearboxes. Fig. 2 illustrates these gears, together with the additional bearings and oil seals required to effect a conversion.

REPAIR OPERATIONS

The following operations apply basically to tractors fitted with a single clutch and standard transmission, but where variations exist due to the fitting of additional components to suit a double clutch and ' Live ' P.T.O., the additional or alternative operations are shown in heavy type and the operation numbers given a suffix letter, i.e. **3a, 3b, 3c,** etc.

Effective with Serial No. 957E–63953 new ratio gearboxes were introduced and although the basic design remained unchanged, dimensional changes were made to shafts and gears which affected certain tools and procedures detailed in previous issues of this section.

The following repair operations are applicable to all Dexta gearboxes and specific reference has been made where differences exist which affect the procedure. It should be noted also that in a few instances a note has been made that certain tools are suitable for use on gearboxes prior to Serial No. 957E–63953 and no reference has been made to modified or new tools for these applications on current gearboxes. This is because a re-appraisal has been made of the necessary tools and where no specific tool is mentioned it has been possible to perform the operations without special equipment.

A further point to be noted is that prior to Serial No. 957E–63953 the main drive shaft oil seal retainer and gearbox front cover plate screws were retained by locking wire, but subsequent to this number, special locking plates with turn-over tabs to lock the screw heads were introduced. In this section reference is made to locking tabs only, but where locking wire was originally used this method of locking may still be applied if so desired.

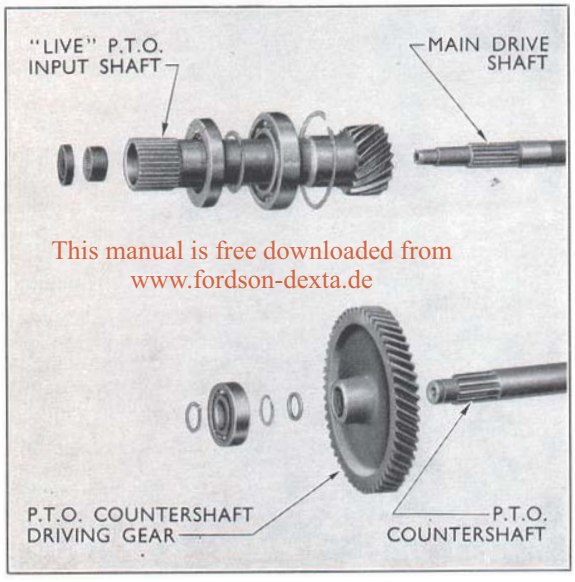

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Fig. 2
Live P.T.O. Shaft and Gears

Fig. 3
Refitting P.T.O. Input Shaft

To Remove the Main Drive Shaft Oil Seal (Standard Transmission)

To Remove the P.T.O. Input Shaft Oil Seals (' Live ' P.T.O. Transmission)

1. Split the tractor at the engine/clutch flange (see Engine section ' To Remove the Engine and Front Axle Assembly '). Disconnect the clutch release rod from the clutch release arm, lift away the return spring from the release fork and remove the clutch release bearing.

2. Extract the split pins and clevis pins retaining the clutch release fork to the cross-shaft and withdraw the shaft. Remove the clutch return spring and fork from the housing.

3. Remove the oil seal retainer after straightening the locking tabs and removing the five securing screws. Withdraw the oil seal from the retainer housing.

3a. Remove the P.T.O. input shaft and oil seal retainer (as an assembly). This assembly is retained by the same securing screws and locking tabs as are used on standard transmissions (see operation 3).

3b. Detach the circlip securing the P.T.O. input shaft rear bearing to the retainer and withdraw the retainer and rear oil seal assembly from the shaft.

3c. Extract the rear oil seal from the retainer.

3d. Extract the front oil seal from the internal bore of the shaft, being careful not to damage the needle roller bearing which is located behind the oil seal.

To Replace the Main Drive Shaft Oil Seal (Standard Transmission)

To Replace the P.T.O. Input Shaft Oil Seals (' Live ' P.T.O. Transmission)

1. Assemble the main drive shaft oil seal to the retainer with sharp edge of the seal facing outwards (i.e. towards the gearbox) using Tool No. T.7067 with 550 handle.

1a. Assemble the front oil seal to the P.T.O. input shaft using Tool No. T.7071 with 550 handle, ensuring that the sharp edge of the seal faces inwards. Take particular care not to damage the front roller bearing during this operation. The seal locates on the first shoulder in the bore at the front end of the shaft.

1b. Replace the rear oil seal in the retainer with the sharp edge of the seal facing outwards (i.e. towards the gearbox) using Tool No. T.7076 with 550 handle.

1c. Assemble the P.T.O. input shaft to the retainer (see Fig. 3) and secure by fitting the appropriate circlip in the retainer housing, locating it directly behind the rear bearing.

2. Slide the retainer over the main drive shaft and secure to the front cover plate with the five set screws and locking tabs.

Note.—The top screw passes through both the retainer and the front cover plate and is therefore longer than the other four screws.

Tighten the retaining screws to 40 lb./ft. torque and secure by means of the locking tabs.

2a. Slide the P.T.O. input shaft and oil seal retainer assembly over the main drive shaft and secure the retainer to the front cover plate observing the same precautions as for the assembly of the oil seal retainer on standard transmissions.

3. Enter the clutch cross-shaft into the clutch housing sufficiently to enable the release bearing return spring to be placed over the inner end of the shaft with the hooked end of the spring facing the left-hand side of the clutch housing. Place the release fork in the housing with the lug on the fork adjacent to the spring. Fully assemble the cross-shaft picking up the release fork.

Retain the fork to the cross-shaft with two clevis pins and secure with the appropriate split pins. The fork must project upwards with the release arm in the normal working position.

4. Rotate the fork in a forward direction, locate the release bearing on the oil seal retainer and link the fork with the slots in the bearing hub.

5. Place the outer end of the return spring in the pocket formed in the side of the clutch housing and link the inner end of the spring with the lug on the side of the release fork. Connect the clutch release rod to the release arm with a clevis pin and split pin.

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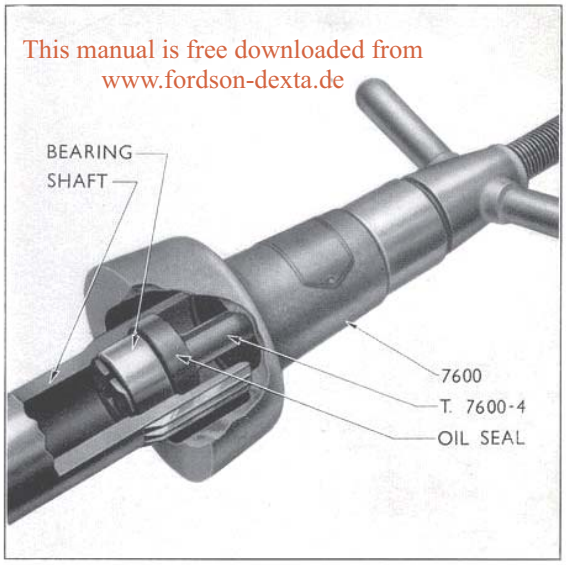

Fig. 4
Removing P.T.O. Input Shaft Front Bearing

6. Join the clutch housing to the engine as outlined in the Engine Section ' To Replace the Engine and Front Axle Assembly '.

To Remove the P.T.O. Input Shaft Front and Rear Bearings (' Live ' P.T.O. Transmission only).

1. Refer to the instructions for removal of the P.T.O. input shaft oil seals and withdraw the P.T.O. input shaft and oil seal retainer assembly. Extract the rear circlip and remove the shaft from the retainer.

2. If the front bearing requires servicing first extract the oil seal then remove the bearing using Main Tool No. 7600 and split collets T.7600–4 (see Fig. 4).

3. Remove the circlip retaining the rear bearing to the shaft and drive the bearing from the shaft by means of a suitable drift located between the teeth of the ' Live ' P.T.O. input shaft behind the bearing. On tractors produced before Serial No. 957E–63953 this bearing may be removed using adaptors T.7000–16 with Main Tool No. T.7000.

To Replace the P.T.O. Input Shaft Front and Rear Bearings (' Live ' P.T.O. Transmission only).

1. To assemble the rear bearing on to the shaft, place adaptors No. T.7000–10 in Tool No. T.7000, locate the bearing within the adaptors and pass the shaft through the bearing. Insert thrust pad T.7000–10/b into the bore at the gear end of the shaft, press the bearing into position and retain with the appropriate circlip.

2. Whenever the front bearing has been removed it should be regarded as expendable and both the bearing and the oil seal should be replaced by new parts.

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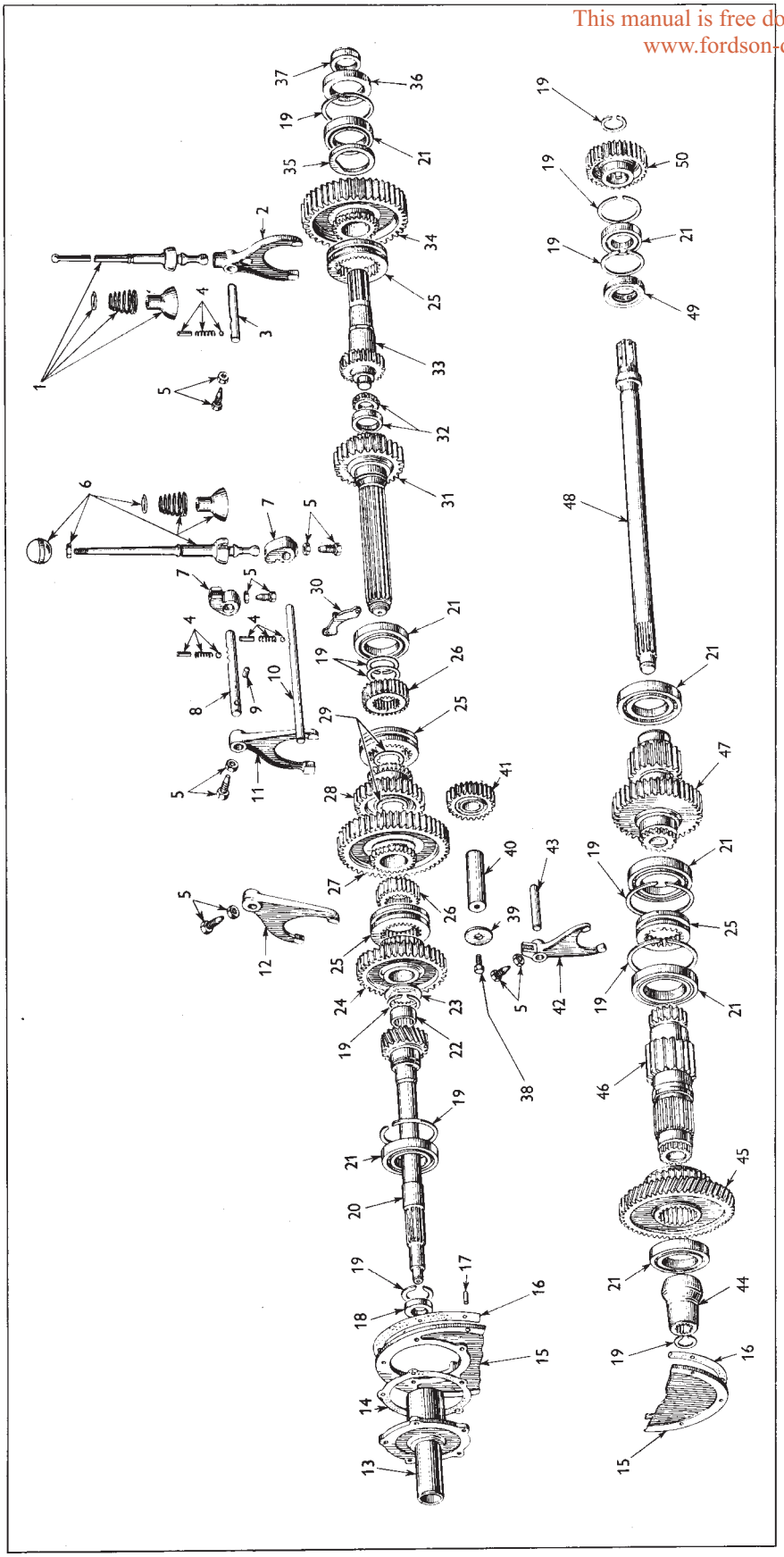

Fig. 5 Exploded View of Gearbox (Standard Transmission)

1 Secondary Gear Change Lever Assembly
2 High/Low Selector Fork
3 High/Low Selector Rail
4 Selector Plunger, Spring and Ball
5 Selector Fork Retaining Screw and Locknut
6 Main Gear Change Lever Assembly
7 Selector Rail Gates
8 Reverse Selector Rail
9 Selector Rail Interlock
10 1st/3rd/2nd/5th Selector Rail
11 Reverse Selector Fork
12 1st/3rd/2nd/5th Selector Fork
13 Oil Seal Retainer
14 Oil Seal Retainer Gasket
15 Front Cover Plate
16 Front Cover Plate Gasket
17 Front Cover Plate Dowel
18 Main Drive Shaft Oil Seal
19 Circlip
20 Main Drive Shaft
21 Ball Bearing
22 Spigot Roller Bearing
23 Thrust Washer
24 2nd/5th Gear
25 Sliding Coupling
26 Connector
27 1st/3rd Gear
28 Reverse Gear
29 Thrust Washer
30 Main Shaft Retaining Plate
31 Main Shaft
32 Spigot Bearing
33 Secondary Output Shaft
34 Secondary Output Shaft Gear
35 Thrust Washer
36 Oil Seal
37 Oil Seal Sleeve
38 Reverse Idler Retaining Bolt
39 Flat Washer
40 Reverse Idler Shaft
41 Reverse Idler Gear Assembly
42 4th/6th Selector Fork
43 4th/6th Selector Fork Supporting Rail
44 P.T.O. Driving Coupling
45 Transmission Countershaft Cluster Gear
46 Transmission Countershaft
47 Secondary Transmission Countershaft
48 P.T.O. Countershaft
49 Oil Seal
50 Hydraulic Pump Driving Gear

It is most important that the new bearing is fitted at the correct distance, i.e. 1·01 in. (25·65 mm.) from the front face of the shaft. Ring adaptor No. T.7000–20/a and its corresponding thrust pad T.7000–20/b used with guide sleeve T.7000–20/e in Tool No. T.7000 ensures that this distance is correct.

First place the new front bearing on the thrust pad with the end carrying the manufacturer's name facing towards the pad (i.e. away from the bore in the shaft). Place the guide sleeve in the front end of the shaft, locating the gear end in the slave ring of Main Tool No. T.7000.

Enter the bearing and pad into the guide sleeve and operate the centre screw of Tool No. T.7000 to press the bearing into the correct position. *It must* **not** *be pressed on to the shoulder at the inner end of the counterbore in the shaft.*

3. Replace the front oil seal and complete the assembly as previously described on page 2.

To Remove the Main Drive Shaft Assembly

1. Drain the oil from the gearbox.

2. Remove the bonnet, disconnect the battery and remove the control panel side plates (four self-tapping screws in each plate).

Disconnect the two rear lamp wires from the main wiring loom (snap connectors).

3. Disconnect the brake and clutch rod clevises at their front ends.

3a. Remove the brake cross-shaft lever and key and withdraw the brake pedals and cross-shaft as an assembly.

4. Remove the horizontal exhaust pipe (if fitted).

5. Disconnect the front axle radius rods at their rear ends.

Remove the steering wheel and throttle control lever from the vertical control shaft. Release the instrument panel by removing the four screws securing it to the fuel tank and lift the instrument panel away from the steering column leaving all wiring connections attached.

Remove the three bolts retaining the fuel tank rear support bracket to the gearbox housing and the two bolts securing the fuel tank to its front support bracket.

Lift the tank sufficiently for the rear support to clear the gearbox flange and insert suitable wooden wedges between the steering drop arm and the tank to hold it in this position.

Firmly support the gearbox housing and install lifting tackle on the engine.

Remove the retaining bolts and nuts securing the gearbox to the clutch housing and move the engine and clutch housing assembly complete with steering box and fuel tank away from the gearbox.

5a. Suitably support the gearbox/clutch unit and split the tractor at the engine/clutch housing flange (see Engine Section ' To Remove the Engine and Front Axle Assembly ').

5b. Open the fuel tank tap and drain off the contents through the main fuel feed pipe.

5c. Disconnect the injector leak-off pipe from the tank and remove the pipe.

5d. Move the throttle lever upwards, so pushing the forward end of the throttle horizontal operating rod through the adjacent slot in the battery heat baffle. Release the operating rod block from the linkage friction pad by removing the retaining linkage clip.

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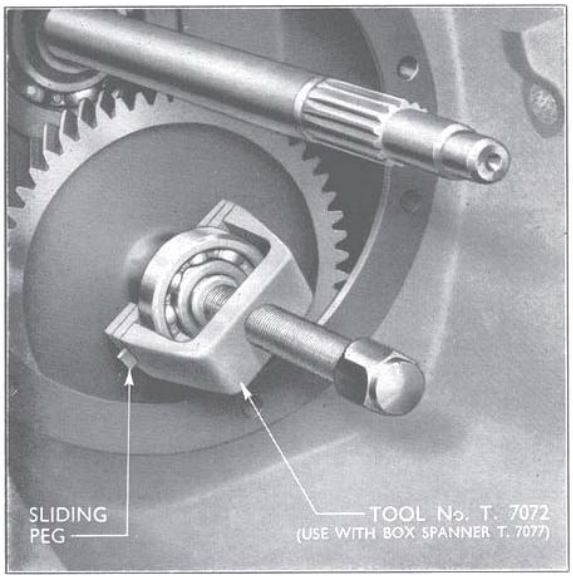

Fig. 6

Removing P.T.O. Countershaft Front Bearing

5e. Remove the five bolts retaining the battery heat baffle and battery tray to the top of the clutch housing and lift away the tray and baffle complete with air cleaner and forward controls of the throttle linkage. Removing these bolts also releases the battery earth strap and the earth lead from the main wiring loom.

5f. Remove the bolts securing the front and rear fuel tank support brackets to the clutch and gearbox housing.

5g. Unscrew the four bolts securing the steering gear to the clutch housing.

5h. Lift away the steering gear, fuel tank and support brackets, control panel and wiring as one complete assembly. The assembly should be handled and stored carefully to avoid damaging any parts.

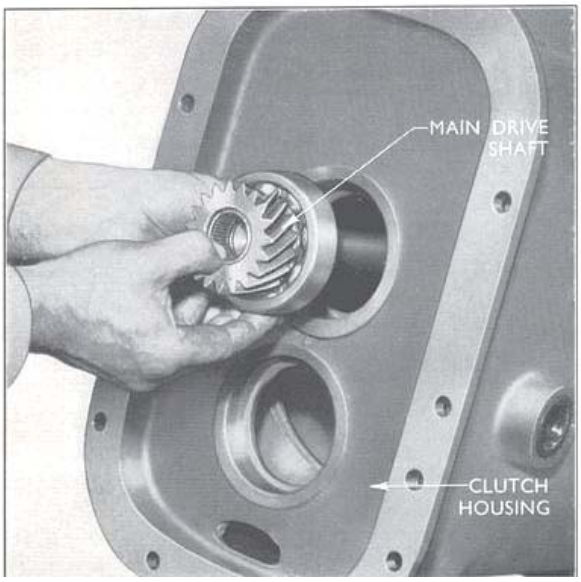

Fig. 7
Removing Main Drive Shaft

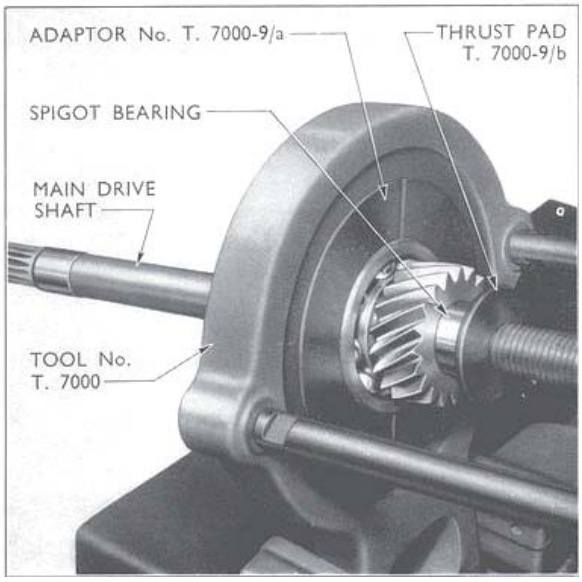

Fig. 8
Replacing Main Drive Shaft Spigot Bearing

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5i. Remove the clutch release bearing, return spring and fork and withdraw the clutch cross-shaft.

5j. Straighten the locking tabs and remove the screws retaining the front cover plate (the top screw passes through both the oil seal retainer and the cover plate) and remove the cover plate, P.T.O. input shaft and oil seal retainer as an assembly.

5k. Remove the circlip retaining the P.T.O. countershaft front bearing to the countershaft and using Tool No. T.7072 with special box spanner T.7077 withdraw the bearing from the shaft (see Fig. 6). Ensure that the small sliding pegs of the tool fit snugly behind the inner race of the bearing when carrying out this operation.

5l. Remove the bolts, nuts and spring washers securing the clutch housing to the gearbox and lift away the clutch housing.

6. Extract the circlip retaining the main drive shaft ball bearing to the clutch housing and withdraw the shaft and bearing assembly (see Fig. 7).

To Overhaul the Main Drive Shaft Assembly

Either the ball or the spigot (roller) bearing may be serviced independently but the ball bearing must be in position before assembling the spigot bearing to the shaft.

(i) *Remove the circlip retaining the ball bearing to the shaft and drive the bearing from the shaft by means of a suitable drift located between the helical teeth behind the bearing. On tractors produced before Serial No. 957E–63953 the bearing may be removed using adaptors T.7000–9/a with Main Tool No. T.7000.*

(ii) *If necessary, withdraw the spigot (roller) bearing from the gear end of the shaft using Main Tool No. 7600 and split collets T.7600–5.*

Whenever the spigot bearing is removed, it is recommended that it is discarded and a new bearing used on reassembly.

(iii) *Reverse the shaft and ball bearing in the Main Tool T.7000 and using adaptors T.7000–9/a and thrust pad T.7000–9/b in the spigot bearing end of the shaft, draw the ball bearing into position and retain with an appropriate circlip.*

(iv) *If the spigot bearing has been removed, assemble a new spigot bearing to the main drive shaft as illustrated in Fig. 8.*

It is important that when the new spigot bearing is fitted, it is assembled at a depth of ·09 in. (2·29 mm.) from the drive shaft rear face, and that the end of the bearing carrying the manufacturer's name faces away from the bore in the shaft. Thrust pad T.7000–9/b ensures that the correct depth is maintained.

It must **not** *be pressed to such a depth as to seat on the bottom of the counterbore in the shaft.*

To Replace the Main Drive Shaft Assembly

1. Place the main drive shaft assembly in the clutch housing and retain by fitting a circlip behind the ball bearing. Where a single clutch is fitted careful assembly is necessary to obviate damage to oil seal, clutch disc splines and spigot bearing.

2. Using a new gasket and guide studs (Tool No. T.7068) join the engine/clutch housing assembly to the gearbox.

Note.—It may be necessary to use an extra long bolt and nut on each side of the assembly in order to draw the two housings completely together and ensure that the main transmission countershaft front bearing seats fully into its location in the clutch housing.

Insert the retaining bolts, spring washers and nuts and tighten securely.

Locate the ball ends of the front axle radius rods in the ball cups on the gearbox housing and refit the radius rod ball caps.

Remove the wooden wedges, lower the fuel tank into position and replace the tank to front support bracket bolts and the fuel tank rear support bracket to gearbox housing bolts.

Refit the instrument panel and warning light retaining plate.

Replace the throttle control lever and the steering wheel.

2a. Place the P.T.O. driving gear within the rear compartment of the clutch housing and install guide studs (Tool No. T.7068) in diametrically opposite holes in the gearbox flange. Using a new gasket, join the clutch and gearbox housings, assembling the P.T.O. driving gear to the splines of the P.T.O. countershaft as the housings are moved together. Insert the retaining bolts, nuts and spring washers and tighten securely.

2b. Tap the front ball bearing onto the P.T.O. countershaft and retain with the appropriate circlip.

2c. Replace the front cover plate, P.T.O. input shaft and oil seal retainer assembly, using a new gasket between the cover and housing. Fit the locking plates and retaining screws. Tighten the retaining screws to a torque of 40 lb. ft. and secure by means of the locking tabs.

2d. Assemble the clutch cross-shaft, fork, return spring and release bearing.

2e. Replace the steering gear, fuel tank and support brackets, control panel and wiring assembly. Secure the steering box to the clutch housing with four bolts (the forward bolt on the right-hand side also retains the horn assembly), and the fuel tank rear support bracket to the gearbox housing with three bolts.

2f. Refit the battery heat baffle and air cleaner assembly and the battery tray. Secure the fuel tank front support bracket and the rear of the battery tray to the clutch housing with three bolts. (The right-hand bolt also secures the main wiring loom earth connection and the left-hand bolt the battery earth strap.)

Secure the front of the battery tray and the heat baffle to the clutch housing with two bolts. (The right-hand bolt also secures the main wiring loom clip.)

2g. Reconnect the throttle horizontal operating rod block to the linkage friction pad (at the heat baffle) and retain with the linkage clip.

Connect the injector leak-off pipe to the fuel tank.

2h. Join the engine to the clutch housing as described in the Engine Section ' To Replace the Engine and Front Axle Assembly '.

2i. Refit the brake pedals and cross-shaft assembly, fit a Woodruff key to the left-hand end of the cross-shaft, assemble the cross-shaft arm and retain with a pinch bolt.

3. Reconnect the clutch and brake operating rods.

4. Refit the horizontal exhaust pipe (if required).

5. Reconnect the rear lamp wiring to the main wiring loom and replace the control panel side plates.

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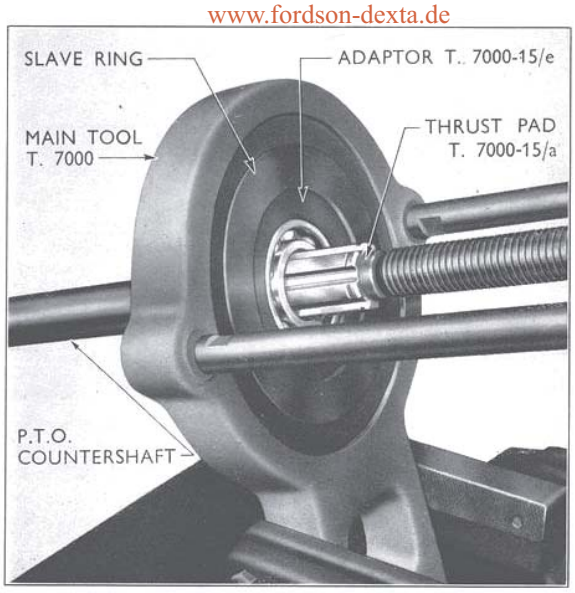

Fig. 9
Removing P.T.O. Countershaft Rear Bearing

6. Replace the battery leads and refit the bonnet.

7. Fill the gearbox with the correct grade of lubricant (see specification).

7a. Fill the fuel tank and bleed the injection system.

To Remove the Secondary Transmission

1. Drain the oil from rear transmission and follow operations 1, 2, 3, 4 and 5 of sub-section headed 'To Remove the Main Drive Shaft Assembly' then remove the circlip retaining the P.T.O. countershaft driving coupling to the countershaft and extract the coupling.

1a. Drain the oil from the rear transmission and follow operations 1, 2, 3, 3a, 4, 5a, 5i, 5j and 5k of sub-section headed 'To Remove the Main Drive Shaft Assembly'.

2. Remove the front foot plate bracket to gearbox housing bolts on either side of the tractor.

3. Firmly support the rear transmission housing, remove the bolts and nuts securing the gearbox to the rear transmission and separate these assemblies.

4. Remove the hydraulic pump driving gear shroud, extract the circlip retaining the hydraulic pump driving gear to the rear of the P.T.O. countershaft and withdraw the gear from the shaft.

5. Remove the locking wire and retaining screws and lift away the rear cover plate assembly complete with P.T.O. countershaft.

6. If necessary extract the circlip retaining the P.T.O. countershaft rear bearing to the rear cover plate and withdraw the countershaft and bearing.

To Renew the P.T.O. Countershaft Rear Bearing

Main Tool No. T.7000 with slave ring may be used to withdraw and replace the P.T.O. countershaft rear bearing.

(i) *Locate adaptor T.7000–15/e behind the bearing and place the shaft and bearing assembly together with the adaptor in the Main Tool (in which the slave ring has already been assembled).*

(ii) *Place thrust pad T.7000–15/a between the rear end of the shaft and the centre screw of the tool (see Fig. 9) and press the shaft through the bearing.*

(iii) *To replace the bearing, first place adaptor T.7000–15/d within ring T.7000–15/e and assemble to the P.T.O. countershaft so that the inner adaptor locates against the front face of the oil seal journal.*

Fig. 10
Replacing Secondary Output Shaft Oil Seal

(iv) *Place this assembly in Main Tool T.7000, using the Main Tool slave ring to locate the outer adaptor.*

(v) *Position the bearing on the rear end of the P.T.O. countershaft and using replacement thrust sleeve T.7000–15/b between the bearing and the centre screw of the Main Tool press the bearing onto the shaft until it seats against the rear face of the oil seal journal.*

To Overhaul the Rear Cover Plate Assembly

(i) *Extract the secondary transmission output shaft oil seal.*

(ii) *Extract the P.T.O. countershaft oil seal.*

(iii) *Using adaptor T.7073 with 550 handle, fit a new secondary transmission output shaft oil seal to the rear cover plate, making the assembly from the outside of the cover and driving the seal as far as possible into the retainer (see Fig. 10) without actually contacting the circlip when the circlip is against the rear face of its groove. Several alternative types of oil seal are used in this location but if the type being fitted has a spring loaded main sealing edge, ensure that this edge faces the inside of the cover plate.*

(iv) *Using adaptor T.7074 with 550 handle, fit a new P.T.O. countershaft rear oil seal to the rear cover plate ensuring that the main sealing edge faces the inside of the cover. Make the assembly from the inside of the cover and drive the seal into position to seat against the retaining circlip.*

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7. Partially remove the secondary transmission countershaft gear assembly so that the inner bearing is free from its locating bore and lower the assembly on to the floor of the gearbox rear compartment. Withdraw the secondary transmission output shaft and gear assembly followed by the secondary countershaft assembly (see Fig. 11).

To Overhaul the Secondary Countershaft Assembly

(i) *Remove the front bearing from the countershaft. On tractors produced before Serial No. 957E–63953 the bearing may be removed using adaptors T.7000–14 with the Main Tool T.7000.*

(ii) *Repeat the operation on the rear bearing using the same adaptors and Main Tool.*

(iii) *New bearings may be fitted with these adaptors by reversing the dismantling procedure.*

To Overhaul the Secondary Transmission Output Shaft Assembly

The following procedure pre-supposes that a complete overhaul of the assembly is to be undertaken. If required, however, the front bearing inner race may be removed, using the same tools, without disturbing the gear, rear bearing and oil seal sleeve, and vice versa.

The front (spigot) bearing inner race is a press fit on the output shaft and it must be serviced as a matched assembly with the cup which is held in the rear counterbore of the transmission main shaft. (Refer to page 13 'To Overhaul the Main Shaft' and note that the tool for replacement of the cup has been designed for use with the inner race assembled to the cup. The cup must therefore be assembled to the main shaft before the assembly of the inner race to the secondary transmission output shaft.)

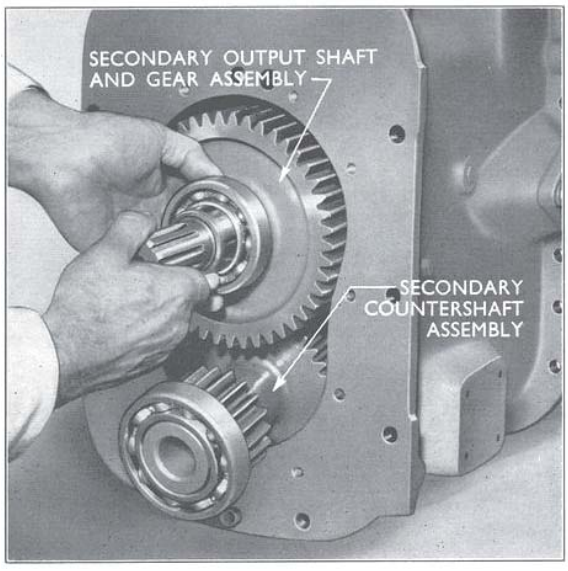

Fig. 11
Removing Secondary Gearbox Shafts

(i) *Assemble split adaptors T.7000–12 around the front bearing inner race and place the assembly in Main Tool T.7000. (See Fig. 12.) Apply pressure to the front end of the shaft by tightening the centre screw of the tool and withdraw the bearing inner race.*

(ii) *Place the output shaft assembly in Tool No. T.7000 (without adaptors) with the front face of the gear against the tool frame and the splined end of the shaft towards the centre screw of the tool. The gear, thrust washer, rear bearing and oil seal sleeve may then be withdrawn in one operation (see Fig. 13).*

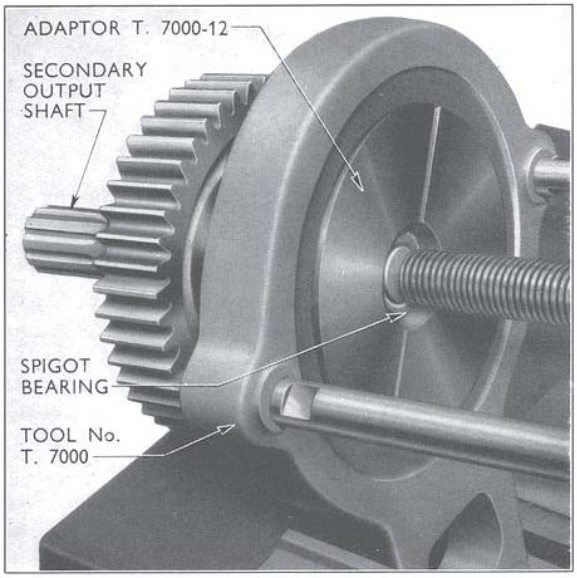

Fig. 12
Removing Secondary Output Shaft Spigot Bearing

(iii) *To rebuild the assembly, replace the gear on the shaft with the dog teeth adjacent to the splined connector. Fit the thrust washer and note that a flat on the washer matches a corresponding flat on the outside diameter of the shoulder on the shaft.*

(iv) *Place ring adaptor T.7000–13 within slave ring of Tool No. T.7000, locate the bearing on the shaft and pass the rear end of the shaft through the ring adaptor so that the spigot end of the shaft faces towards the centre screw of the tool. Press the bearing into position to seat against the thrust washer.*

(v) *Remove the shaft assembly from the tool, locate the oil seal sleeve on the shaft (with the chamfered end of the sleeve facing away from the bearing) and replace this assembly in the Main Tool. (See Fig. 14.)*

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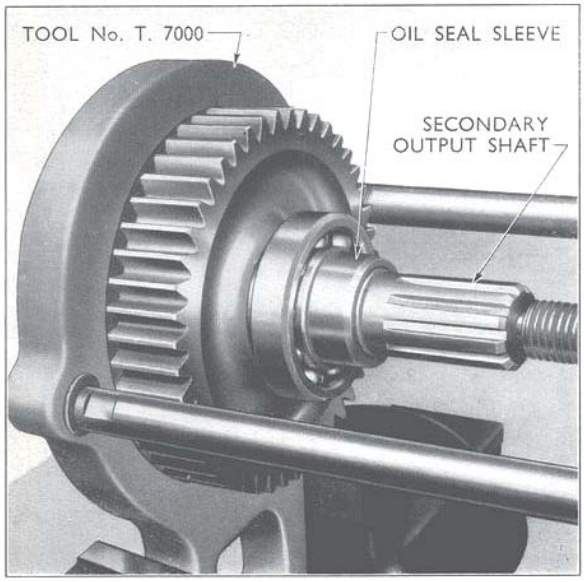

Fig. 13
Dismantling Secondary Output Shaft

Press the oil seal sleeve into position to seat against the bearing.

(vi) *Remove the assembly and substitute split adaptors T.7000–12 for those formerly used. Place the front bearing inner race in the adaptors and locate the output shaft assembly between the bearing race and the centre screw of the tool. Press the shaft into the bearing until it seats securely against the shoulder on the shaft.*

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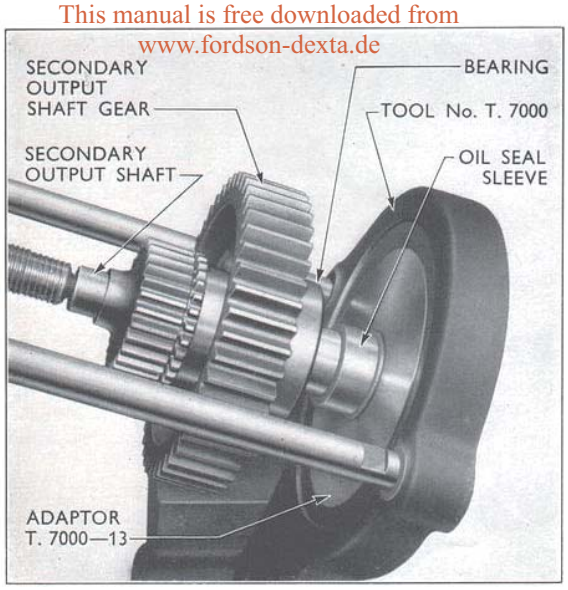

Fig. 14
Replacing Secondary Output Shaft Oil Seal Sleeve

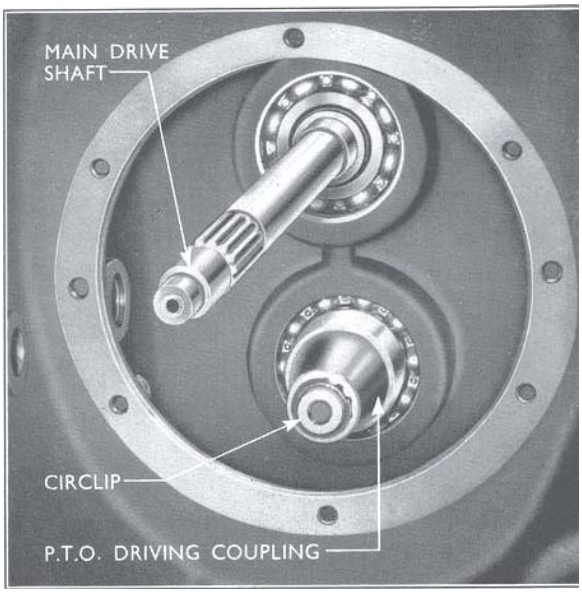

Fig. 15
P.T.O. Countershaft Driving Coupling

To Replace the Secondary Transmission

1. Ensure that the High/Low sliding coupling is located within the jaws of the fork and move to the ' High ' speed engaged position on the main shaft.

2. Place the secondary countershaft assembly within the rear compartment of the gearbox, but do not press the front bearing into its bore otherwise it will be impossible to assemble the secondary transmission output shaft assembly.

3. Install the secondary output shaft assembly, then press the secondary countershaft and bearing assembly fully into position.

Note:—The secondary output shaft and the High/Low sliding coupling are serviced as a matched assembly, the faces of the splines on shaft and coupling being marked to show their relative radial assembled position. These marks must coincide when assembly of the output shaft is completed.

4. Assemble the P.T.O. countershaft and bearing assembly to the rear cover plate, using guide sleeve T.7097 to prevent damage to the oil seal, and secure with the appropriate circlip.

5. Using a new gasket between the cover plate and gearbox, replace the cover plate and P.T.O. countershaft assembly. Ensure that the two dowels, fitted at the top and bottom of the cover plate, locate correctly in the corresponding dowel holes in the rear face of the gearbox housing.

5a. Examine the P.T.O. countershaft driving gear to ensure that the thrust washer and circlip are fitted to the internal bore. Place the gear in the rear compartment of the clutch housing.

Using a new gasket between cover plate and gearbox, replace the rear cover plate and P.T.O. countershaft assembly picking up the P.T.O. driving gear on the forward splines of the countershaft as the assembly is made.

6. Fit and tighten the rear cover plate retaining screws to a torque of 40 lb./ft., then secure with locking wire.

7. Assemble the P.T.O. countershaft driving coupling to the splines of the P.T.O. and main transmission countershafts and secure with the appropriate circlip (see Fig. 15).

7a. Support the rear of the P.T.O. countershaft and tap the front bearing onto the shaft. Insert a circlip in the groove in the P.T.O. countershaft directly in front of the bearing location to retain the bearing in position.

8. Replace the hydraulic pump driving gear (see Fig. 16), retaining it to the countershaft with the appropriate circlip.

9. Fit the hydraulic pump driving gear shroud and ensure that the small tab at the bottom of the shroud is turned up to correctly locate in the cut-out of the boss in the base of the rear cover plate. Stake the edge of the shroud into the groove machined in the cover boss.

10. Locate a new gasket on the rear axle housing flange and assemble two guide studs (Tool No. T.7068/a) to the gearbox flange. The threaded ends of the guide studs must first be screwed into the retaining plates (T.7068/b) and the protruding threaded ends then inserted in the bolt holes in the flange and retained by the appropriate nuts.

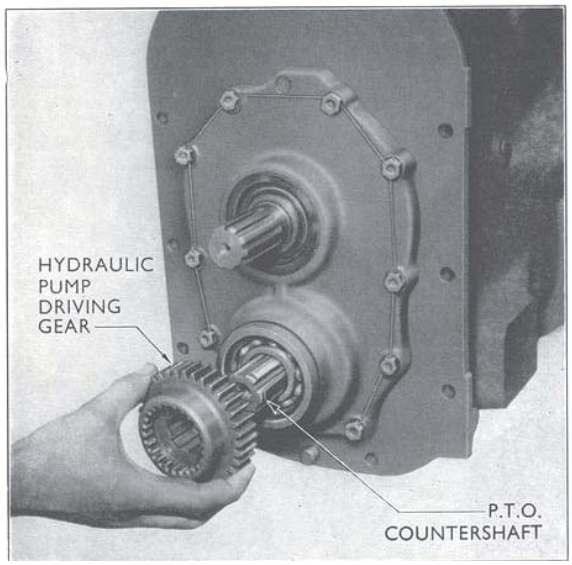

Fig. 16
Replacing Hydraulic Pump Driving Gear

11. Locate the main drive coupling well forward on the rear axle drive pinion splines with the P.T.O. shifter lever in the disengaged position.

12. Join the gearbox and rear transmission housings, lining them up carefully on the guide studs so as to engage the main drive coupling splines with the secondary output shaft of the gearbox. Fit the flange bolts, nuts and spring washers and tighten securely.

13. Refit the footplate bracket to gearbox housing bolts. **The lower bolt on the left-hand side also secures the clutch pedal return spring tab on 'Live' P.T.O. transmissions.**

14. Refer to section headed 'To Replace the Main Drive Shaft' and follow operation 2.

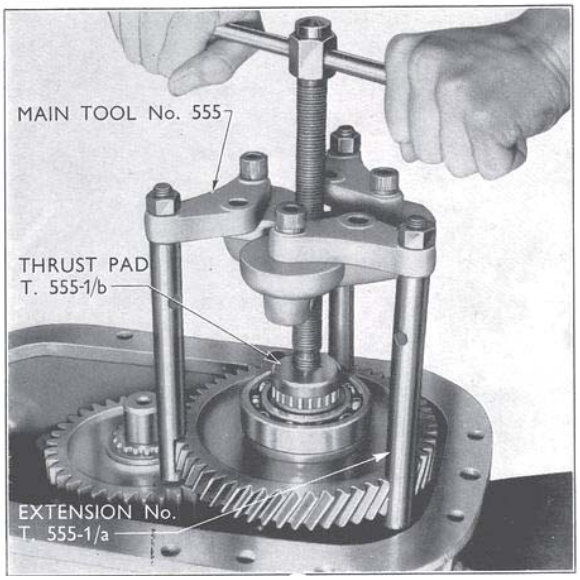

Fig. 17
Removing Main Countershaft Gear and Bearing

14a. Refer to section headed 'To Replace the Main Drive Shaft' and follow operations 2c, 2d and 2i.

15. Refer to section headed 'To Replace the Main Drive Shaft' and follow operations 3, 4, 5, 6 and 7.

16. Refill the rear transmission with the same type of oil as was used in the gearbox.

To Remove the Transmission Main Shaft Assembly

1. Remove the secondary transmission output shaft and countershaft assemblies as outlined in section headed 'To Remove the Secondary Transmission'.

1a. Remove the clutch housing as outlined in operations 1 to 5l of sub-section headed 'To Remove the Main Drive Shaft', drain the oil from the rear transmission and carry out operations 2 to 7 of sub-section headed 'To Remove the Secondary Transmission'.

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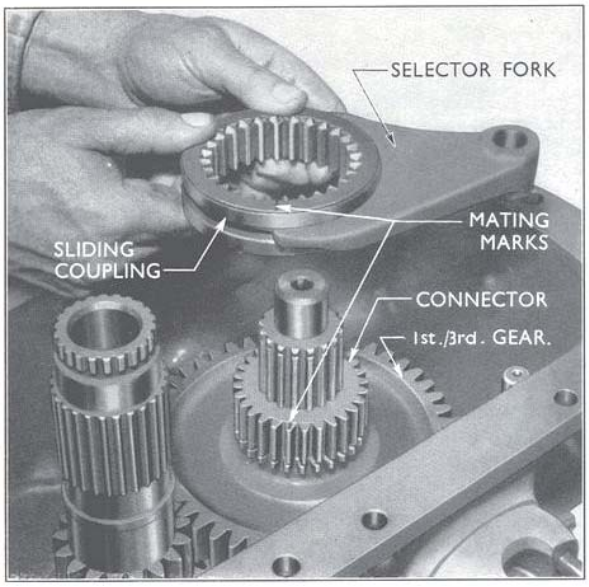

Fig. 18
Removing 1st/3rd; 2nd/5th Sliding Coupling

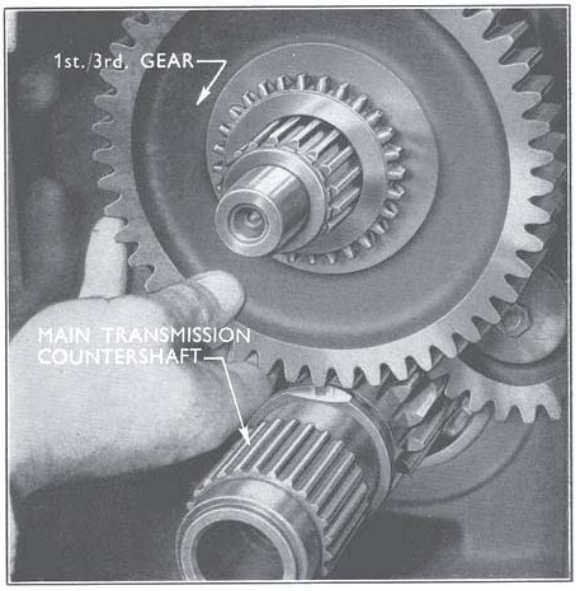

Fig. 19
Removing First/Third Gear

2. Place the gearbox on its rear face.

3. Draw the main transmission countershaft cluster gear and front bearing from the countershaft, using extension legs T.555–1/a in Main Tool No. 555. When using this tool, first assemble the legs to the outer holes in the swinging arms, but do not tighten the retaining nuts. Locate thrust pad T.555–1/b in the end of the countershaft and place the tool so that the recess in each leg fits around the teeth of the large gear of the cluster (see Fig. 17). The arms of the tool should always ' trail ' and care should be taken to ensure that the lower edges of the recesses in the legs seat firmly behind the gear teeth.

Tighten the nuts retaining the legs to the swinging arms and operate the centre screw of the tool to withdraw the gear and bearing in one operation.

4. Extract the circlip from the front end of the mainshaft and remove the splined thrust washer, followed by the second/fifth gear. Loosen the locknut and remove the screw from the first/third/second/fifth speed selector fork and withdraw the fork and sliding coupling (see Fig. 18).

Remove the corresponding splined connector followed by the first/third gear, thrust washer, reverse idler driven gear and the second thrust washer.

When removing the first/third gear from the mainshaft, the main transmission countershaft should be positioned so that the flat machined face on the tapered portion of the shaft is facing the mainshaft as illustrated in Fig. 19.

5. Turn the gearbox on to its base, remove the selector cover and levers as an assembly, and extract the three selector plungers and springs. Suitably seal off the holes from which the springs and plungers have been removed so that the balls are not lost during subsequent operations.

6. Remove the high/low speed sliding coupling, loosen the corresponding selector fork retaining screw locknut, extract the screw and withdraw the selector rail and fork. The selector ball will drop and care should be taken not to lose it.

7. Free the transmission main shaft by removing the rear bearing retaining plate which is held by two self-locking screws. Withdraw the main shaft, bearing and reverse connector as an assembly.

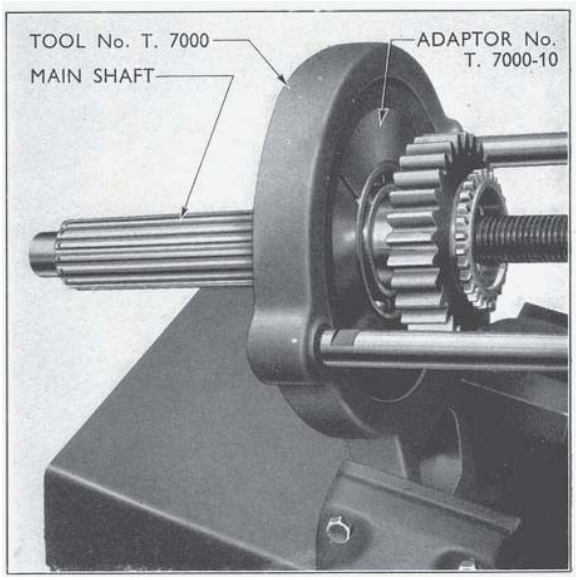

Fig. 20
Replacing Main Shaft Bearing

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To Overhaul the Transmission Main Shaft Assembly

(i) *Withdraw the connector from the shaft and remove the circlip against which the connector was located. Remove the circlip retaining the ball bearing and remove the bearing from the mainshaft using split adaptors T.7000–10 with the Main Tool T.7000.*

On tractors produced before Serial No. 957E–63953 the mainshaft bearing is retained by means of a circlip in front of the connector and a spacing collar is located between the connector and the bearing. Remove the circlip, connector and spacer before removing the bearing as described above.

(ii) *To assemble the ball bearing to the shaft, place adaptors T.7000–10 in Tool No. T.7000, locate the bearing on the shaft and place this assembly in the tool with the front face of the bearing located in the adaptors (see Fig. 20). Press the bearing into position to seat against the shoulder directly behind the gear.*

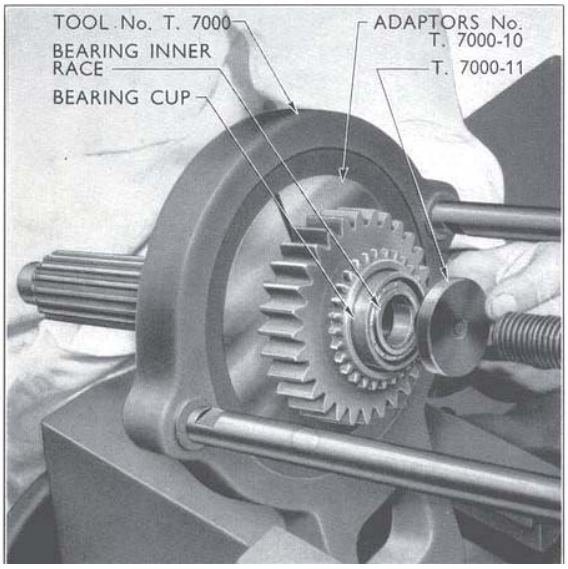

Fig. 21

Replacing Spigot Bearing Cup

Fit the circlip to retain the bearing. Replace the circlip against which the connector locates and replace the connector.

On tractors produced before Serial No. 957E–63953, replace the spacer to locate against the ball bearing, fit the connector and secure to the mainshaft by means of the appropriate circlip.

(iii) *If it is found necessary to remove the spigot bearing cup at the gear end of the shaft, the ball bearing should first be removed when it will be noted that two holes are provided in the gear to enable a suitable pin punch to be inserted and the cup driven out. The cup and its corresponding inner race (on the secondary output shaft) must be serviced as a matched pair (see 'To Overhaul the Secondary Transmission Output Shaft Assembly').*

(iv) *To replace the bearing cup, refit the ball bearing as previously described, assemble the inner race to the cup and locate the complete bearing in the counterbore at the rear of the main shaft. With the main shaft assembly in Tool No. T.7000 and split adaptors T.7000–10 around the ball bearing, locate thrust pad T.7000–11 in the inner race (see Fig. 21). Press the bearing into position until the cup seats firmly in the bottom of the counterbore. Remove the inner race and assemble to the secondary transmission output shaft as previously described.*

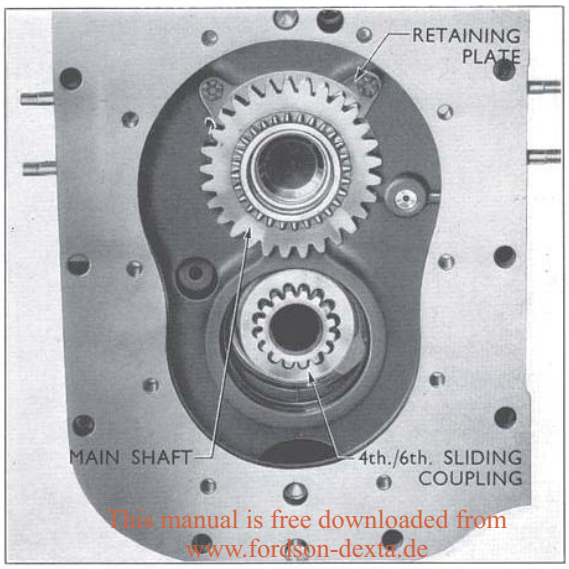

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Fig. 22

Main Shaft Retaining Plate

To Replace the Transmission Main Shaft Assembly

1. Hold the reverse fork and sliding coupling as close as possible to the main shaft rear bearing bore, and fit the main shaft assembly, picking up the internal splines of the sliding coupling on the external splines of the reverse connector and seating the main shaft ball bearing in the upper bore in the front wall of the gearbox rear compartment.

Note.—The reverse connector and sliding coupling are serviced as a matched assembly, the faces of the splines being marked to indicate their

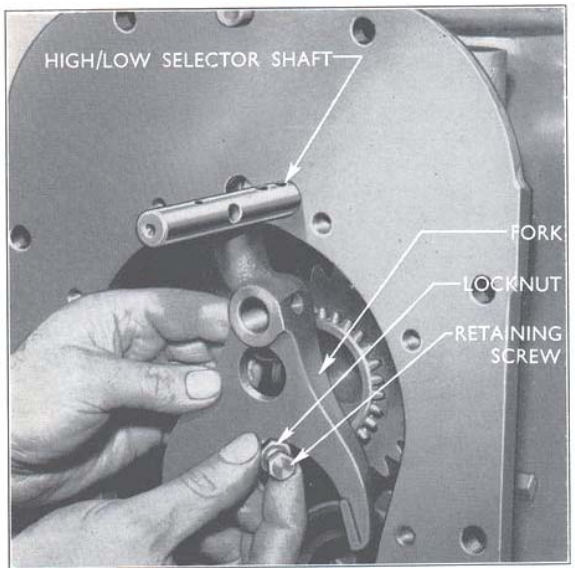

Fig. 23
Replacing High/Low Selector Fork and Rail

relative radial assembled position. These marks must coincide when the main shaft assembly is completed.

2. Position the bearing retaining plate against the rear of the bearing and secure to the gearbox with two self-locking screws (see Fig. 22). Tighten the self-locking screws to 23 lb. ft. torque.

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Fig. 24
Gear Selector Balls, Springs and Plungers

3. Position the high/low speed fork, in the rear compartment of the gearbox. The fork must be assembled with the hollow boss (for the selector lever) facing towards the left-hand side of the gearbox (see Fig. 23). Assemble the corresponding selector rail picking up the fork and insert the fork to rail securing screw ensuring that the screw locates firmly in the depression in the selector rail before tightening the locknut.

4. Replace the centre and left-hand selector springs and plungers followed by the right-hand (high/low) selector ball, plunger and spring (see Fig. 24).

5. Refit the selector lever and housing assembly engaging the levers with the selector rail gates and the high/low selector fork.

Use a new gasket between the selector housing and the gearbox housing, fit the retaining screws and lockwashers and tighten securely.

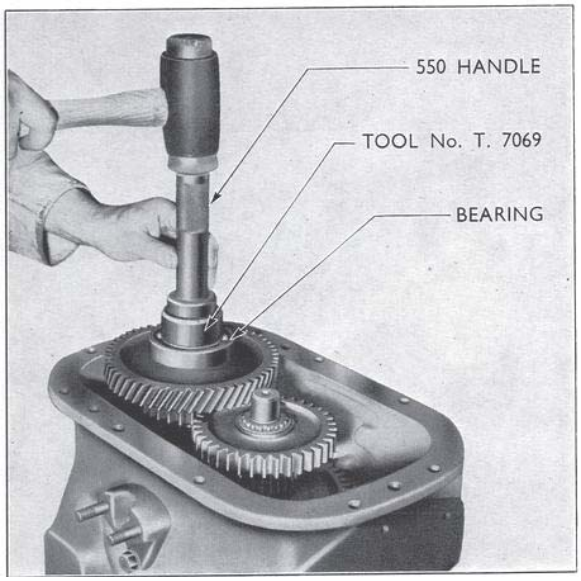

Fig. 25
Fitting Main Countershaft Front Bearing

6. Turn the gearbox onto its rear face and fit the thrust washer, reverse driven gear and second thrust washer to the mainshaft.

Note that on tractors produced before Serial No. 957E–63953 these thrust washers are not fitted.

7. Turn the main transmission countershaft so that the machined flat on the tapered portion of the shaft is facing towards the mainshaft. Replace the first/third gear with the dog teeth facing outwards.

8. Assemble the first/third/second/fifth speed connector. This is a close sliding fit on the splines of the main shaft and it may be necessary to try several positions in order to obtain the best fit.

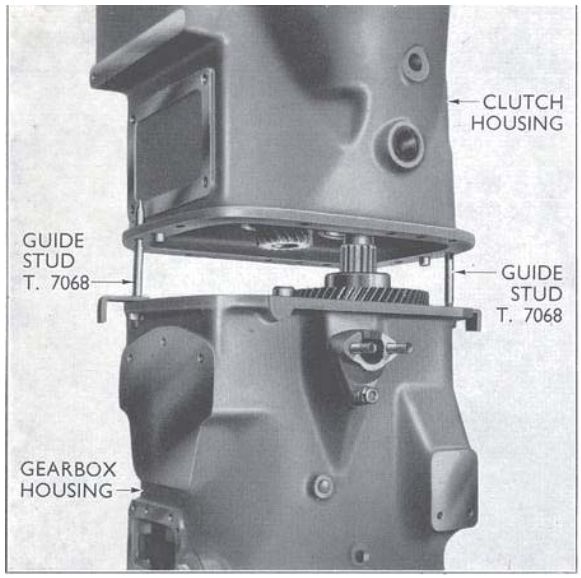

Fig. 26
Assembling Clutch Housing to Gearbox

9. Place the corresponding sliding coupling within the jaws of the first/third/second/fifth speed selector fork and assemble the fork to the appropriate selector rail, at the same time picking up the splines of the connector on the sliding coupling.

Note.—The connector and sliding coupling are serviced as a matched assembly, the faces of the splines being marked to indicate their relative radial position when assembled (see Fig. 18).

Secure the fork to the rail with a retaining screw and tighten the locknut.

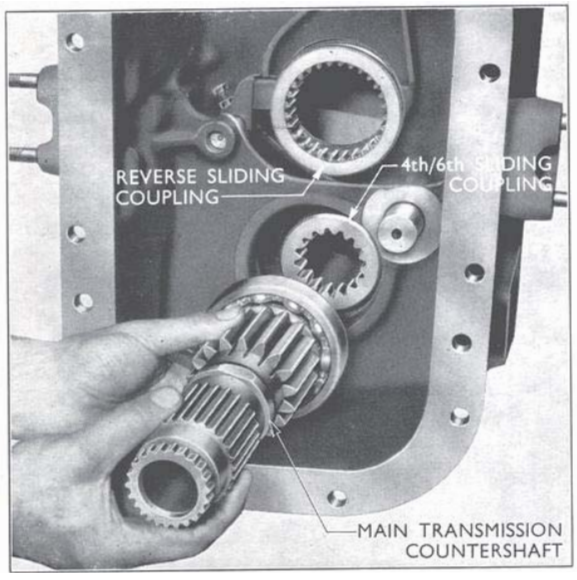

Fig. 27
Withdraw Main Countershaft

10. Assemble the second/fifth gear to the main shaft (dog teeth inwards) followed by the thrust washer and fit a circlip to retain the assembly to the main shaft.

11. Fit the main transmission countershaft cluster gear with the smaller gear facing inwards and install the front bearing using Tool No. T.7069 with 550 handle (see Fig. 25).

11a. Using guide studs T.7068, join the clutch housing to the gearbox (see Fig. 26).

12. Turn the assembly onto its base, insert the high/low sliding coupling within the jaws of the corresponding selector fork and complete the assembly by following the operations listed under sub-section headed 'To Replace the Secondary Transmission'.

12a. Turn the assembly onto its base, insert the high/low sliding coupling within the jaws of the corresponding selector fork and follow operations 1 to 13 of sub-section headed 'To Replace the Secondary Transmission' then carry out operations 2c to 7a of sub-section headed 'To Replace the Main Drive Shaft'.

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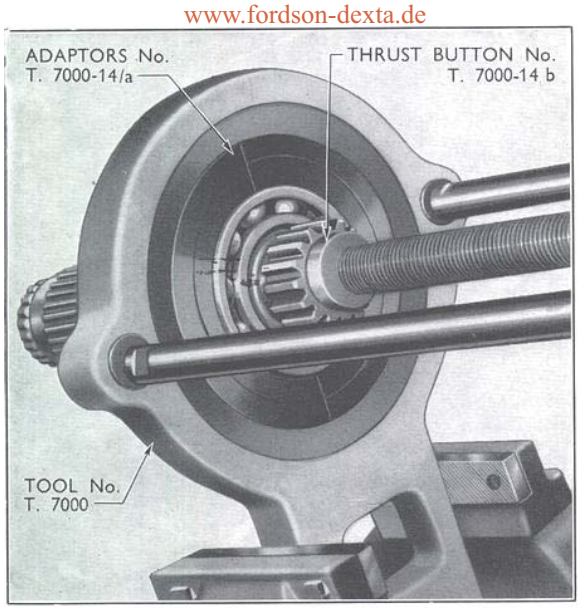

Fig. 28
Removing Main Countershaft Rear Bearing

12b. Refill the rear transmission with a similar grade of oil as was used in the gearbox.

To Completely Dismantle the Gearbox

1. Remove the main shaft as described in the previous sub-section.

2. Remove the reverse idler retaining bolt and washer and withdraw the reverse idler gear from the front compartment of the gearbox.

On tractors produced before Serial No. 957E–63953, on which the reverse idler gear is retained by a long bolt passing through the idler shaft, remove the self-locking nut and plain washer (located in the gearbox rear compartment) from the retaining bolt and extract the reverse idler gear, retaining bolt and washer from the front compartment of the gearbox.

3. Withdraw the main transmission countershaft and rear bearing assembly (see Fig. 27).

If so desired, the rear bearing may be withdrawn from the countershaft using adaptors T.7000–14/a and thrust pad T.7000–14/b in Tool No. T.7000 as illustrated in Fig. 28.

The same adaptors may be used to effect replacement of the bearing on the shaft by reversing the dismantling procedure.

4. Loosen the locknuts on the two selector rail gate retaining screws and remove the screws and gates.

5. Remove the reverse sliding coupling, loosen the reverse fork retaining screw and slide the selector rail from the gearbox followed by the selector fork.

The selector ball will drop when the shaft is removed and should be placed with the selector springs and plungers removed earlier in the dismantling sequence.

6. Remove the first/third/second/fifth gear selector rail and collect the selector ball which will drop when the rail is removed.

7. If necessary remove the expansion plug located on the left-hand side of the gearbox (in the cross-drilling between the selector rails at the selector rail front support) and extract the selector rail interlock.

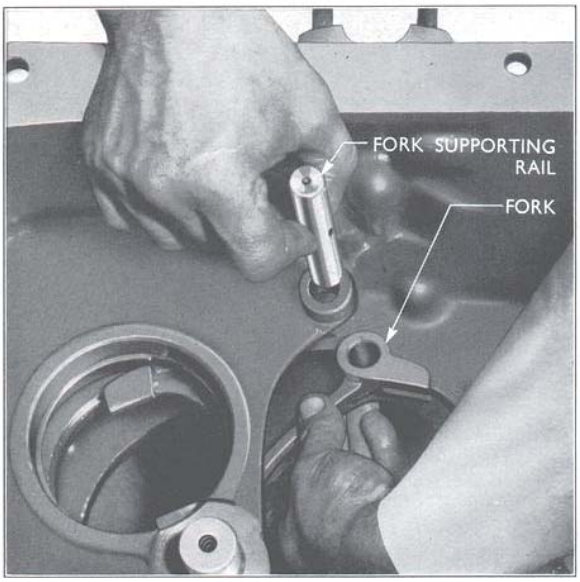

Fig. 29
Replacing 4th/6th Selector Fork

8. Loosen the locknut and remove the fourth/sixth gear selector fork screw, withdraw the selector fork supporting rail followed by the fork and remove the sliding coupling from the gearbox.

9. If necessary, remove the circlips retaining the main transmission countershaft rear bearing and the secondary transmission countershaft front bearing to their respective bores in the gearbox.

Fig. 30
Checking Reverse Idler Gear End-float

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10. Drive out the reverse idler shaft if it is necessary to effect a replacement.

To Rebuild the Gearbox/Clutch Unit

1. Replace the circlips retaining the main transmission countershaft rear bearing and secondary countershaft front bearing to the gearbox. The bearings will already be assembled to their respective shafts and will be fitted to the gearbox as built up assemblies later in the sequence.

2. Place the gearbox on to its rear face using suitable packing to protect the rear flange. If the reverse idler gear shaft has been removed, it should now be replaced and driven into position so that it protrudes between 1·30 to 1·31 in. (33·02 to 33·27 mm.) forward of the front face on the counterbore in the gearbox wall with the tapped hole towards the front.

3. Assemble the fourth/sixth gear selector fork supporting rail, picking up the selector fork as the rail is moved into position (see Fig. 29). The slot in the selector fork boss should incline towards the centre of the gearbox so that it can be linked with the reverse selector fork.

Insert the retaining screw ensuring that the tapered end of the screw enters the depression in the selector fork supporting rail and tighten the locknut.

4. Position the reverse fork in the gearbox with the slot in the fork linked with the tongue on the fourth/sixth gear fork. Insert the reverse selector rail picking up the corresponding fork. Make the assembly from the front of the gearbox and ensure that the three closely spaced notches in the rail face upwards and to the rear. Ensure that the fork to rail securing screw enters the depression in the rail and tighten the locknut.

5. Replace the selector gate on the rear end of the reverse selector rail (in the rear compartment of the gearbox) with the open side of the gate slot facing the left-hand of the gearbox. Tighten the retaining screw ensuring that the tapered end of the screw enters the depression in the rail and securely tighten the locknut.

6. Replace the interlock in the cross-drilling in the selector rail front support and insert the first/third/second/fifth speed selector rail picking up the corresponding selector gate in the rear compartment of the gearbox. The three closely spaced notches on the rail go to the rear and face upwards, and the slot in the gate faces the corresponding slot in the adjacent selector gate. Tighten the selector gate retaining screw ensuring that the tapered end of the screw locates correctly in the depression in the rear end of the shaft and then securely tighten the locknut. Install the interlock bore sealing cap.

7. Insert the reverse sliding coupling within the jaws of the reverse selector fork and then place the fourth/sixth sliding coupling within the jaws of the fourth/sixth selector fork.

8. Move the fourth/sixth fork and coupling as close as possible to the front wall of the gearbox. This will facilitate replacement of the main transmission countershaft and bearing assembly which should now be fitted. The dog teeth on the countershaft must pick up the internal splines of the sliding coupling as the bearing is assembled to the housing.

Note.—The outside diameter of this coupling is less than that of the other three couplings which are used on this gearbox.

9. Turn the gearbox onto its base and install the reverse idler gear (boss on gear facing inwards). Secure the gear to the shaft by means of the self locking bolt screwed into front end of the shaft.

On tractors produced before Serial No. 957E—63953, insert the long retaining bolt and washer, making the assembly from the front of the gearbox. Fit the plain washer and self-locking nut to the end of the retaining bolt which protrudes into the rear compartment of the gearbox.

Check that the end-float of the gear is between ·010 and ·025 in. (·25 and ·63 mm.). A small breakout of the counterbore enables a feeler to be inserted between the back face of the gear and the machined face of the wall separating the front and rear gearbox compartments (see Fig. 30).

10. Refit the main shaft and complete the assembly as outlined under sub-section headed 'To Replace the Transmission Main Shaft Assembly'.

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GEARBOX SPECIFICATIONS

Gear Ratios and Road Speeds (10 × 28 Rear Tyres)

Gear	*Ratio*	*Final Ratio*	800 *r.p.m.*		1500 *r.p.m.*		1800 *r.p.m.*		2000 *r.p.m.*	
			MPH	*KPH*	*MPH*	*KPH*	*MPH*	*KPH*	*MPH*	*KPH*
1st	30.5	204	.51	.82	.96	1.54	1.16	1.86	1.27	2.04
2nd	17.0	113.5	.92	1.48	1.72	2.77	2.08	3.35	2.30	3.70
3rd	10.28	68.6	1.53	2.46	2.87	4.62	3.43	5.54	3.82	6.15
4th	7.55	50.2	2.08	3.35	3.90	6.28	4.68	7.54	5.20	8.38
5th	5.73	38.2	2.74	4.41	5.14	8.27	6.16	9.92	6.85	11.03
6th	2.53	16.8	6.18	9.96	11.59	18.67	13.92	22.42	15.45	24.88
Low Reverse	18.70	124.2	.84	1.35	1.57	2.53	1.89	3.04	2.10	3.38
High „	6.30	42.0	2.49	4.01	4.67	7.52	5.60	9.01	6.22	10.01
P.T.O. Standard and "Live"	3.333	—	*P.T.O. Revs. per minute at above engine speed*							
			240		450		540		600	

	Inches	*Millimetres*
Main Drive Shaft Needle Roller Bearing		
Rear face of shaft to rear face of bearing	0.09	2.29
"Live" P.T.O. Input Shaft Needle Roller Bearing		
Front face of shaft to front face of bearing	1.01	25.65
Reverse Idler Shaft		
Protrusion into gearbox front compartment	1.30 to 1.31	33.02 to 33.27
Reverse Idler Gear		
End-float	.010 to .025	.25 to .64

Lubricant .. .. Above 20°F. (—7°C.) S.A.E. 30 H.D. } or 20W/30 H.D
Below 20°F. (—7°C.) S.A.E. 20 H.D. }

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Tightening Torque Figures	*lb. ft.*	*kg.m.*
Gearbox housing to clutch housing	35	4.84
Oil seal retainer to front cover plate	40	5.53
Front cover plate to clutch housing	40	5.53
Rear cover plate to gearbox	40	5.53
Main shaft retaining plate screws	23	3.18

	Inches	*Millimetres*
Main Drive Shaft Needle Roller Bearing		
Rear face of shaft to rear face of bearing	0.09	2.29
" Live " P.T.O. Input Shaft Needle Roller Bearing		
Front face of shaft to front face of bearing	1.01	25.65
1st/3rd, 2nd/5th Main Shaft Gears and Reverse Driven Gear		
Inside diameter	1.801 to 1.802	45.746 to 45.771
Main Shaft Spline		
Outside diameter	1.7994 to 1.7999	45.705 to 45.718
Clearance	.0011 to .0026	.028 to .0660
Reverse Idler Shaft		
Outside diameter	1.122 to 1.123	28.449 to 28.524
Reverse Idler Gear		
Bore diameter (Bush)	1.1245 to 1.1255	28.562 to 28.588
Clearance	.0015 to .0035	.038 to .089
Reverse Idler Shaft		
Protrusion into gearbox front compartment	1.30 to 1.31	33.02 to 33.27
Reverse Idler Gear		
End-float	.010 to .025	.25 to .64
P.T.O. Countershaft		
Rear bush—internal diameter (finished size)	.502 to .503	12.75 to 12.78
Rear end of bush to rear end of countershaft	.10	2.54
Secondary Output Shaft		
Diameter at oil seal sleeve	1.5001 to 1.5006	38.102 to 38.115
Oil seal sleeve internal diameter	1.498 to 1.499	38.049 to 38.075
Interference	.001 to .0026	.027 to .067
Secondary Output Shaft		
Diameter at gear location	1.873 to 1.874	47.574 to 47.600
Secondary output shaft gear internal diameter (bush)	1.875 to 1.876	47.625 to 47.651
Clearance	.001 to .003	.025 to .077

Tightening Torque Figures	*lbs. ft.*	*kg.m.*
Gearbox housing to clutch housing	35	4.84
Oil seal retainer to front cover plate	40	5.53
Front cover plate to clutch housing	40	5.53
Rear cover plate to gearbox	40	5.53
Main shaft retaining plate screws	23	3.18

Lubricant .. .. Above 20°F. (—7°C.) S.A.E. 30 H.D. } or 20W/30 H.D.
Below 20°F. (—7°C.) S.A.E. 20 H.D. }

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SUPER DEXTA GEARBOX

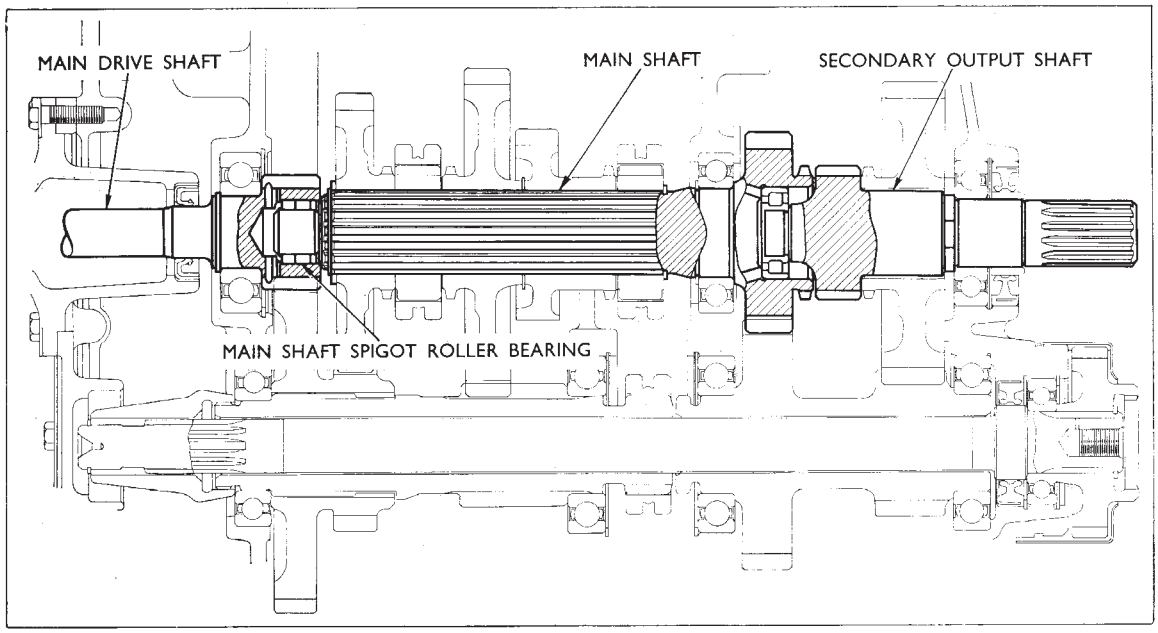

Fig. 31
Special Super Dexta Gearbox Components

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Whilst the gearbox assembly fitted to the Super Dexta gives the same overall gear ratios and is basically the same as that used on the standard Dexta, some of the Super Dexta gearbox components have increased strength in order to transmit the greater power available from the Super Dexta engine.

Fig. 1 illustrates four of the parts which are affected and the differences are described in detail in this section.

Main Shaft Spigot Bearing

The " Torrington " type main shaft spigot roller bearing, which is a press fit in the main drive shaft of the standard Fordson Dexta gearbox, is not suitable for use in the Super Dexta gearbox.

A " Hoffmann " type, fully floating, roller bearing (see Fig. 32) is fitted to the Super Dexta gearbox. No special service tools are required for assembly purposes as is necessary with the " Torrington " type bearing (see page 6) but it is important that the correct main drive shaft is used.

Main Drive Shaft

The spigot roller bearing bore in the Super Dexta main drive shaft differs in size from that in the standard Dexta shaft and it has four lubrication holes drilled between the gear teeth into the bore (see Fig. 33) as against one hole in the current standard Dexta shaft. To provide further identification the shafts are marked with different colour paint spots—see Identification Chart.

Main Shaft

The spigot journal of the main shaft used in the Super Dexta gearbox has a diameter of 0.9968 to 0.9973 in. (25.318 to 25.331 mm.) whereas that of the standard Dexta shaft has a diameter of 1.225 to 1.1230 ins. (28.511 to 28.524 mm.).

These shafts are also marked with different colour paint spots for identification purposes—see Identification Chart.

Secondary Output Shaft

The splined end of the Super Dexta secondary output shaft is larger in diameter than the equivalent portion of the standard Dexta shaft. In addition the Super Dexta shaft has 14 splines whereas the standard shaft has 10 splines.

Reverse Idler Shaft

In addition to the parts mentioned above the reverse idler shaft used on the Super Dexta differs from that fitted to previous Dexta models. The current shaft completely replaces all previous shafts for service on all Dexta tractors and it may be identified by its length, 4.18 ins. (106.17 mm.), and the presence of a threaded hole in the inner end. Very early Dexta shafts also had a length of 4.18 ins. (106.17 mm.) but did not have a threaded hole in the end.

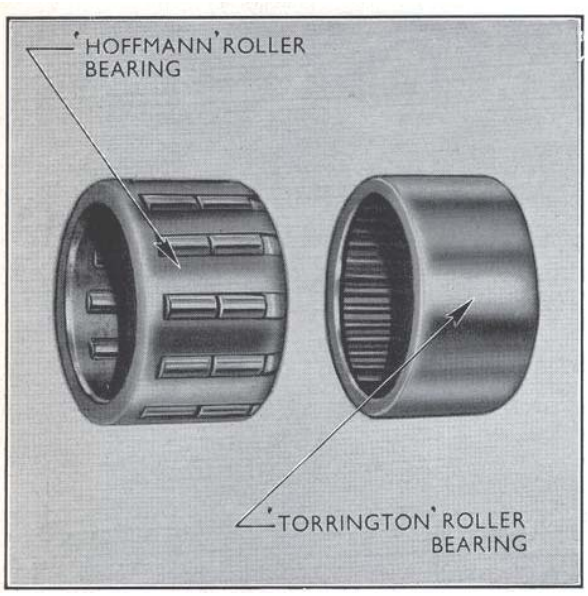

Fig. 32
Main Shaft Spigot Bearings

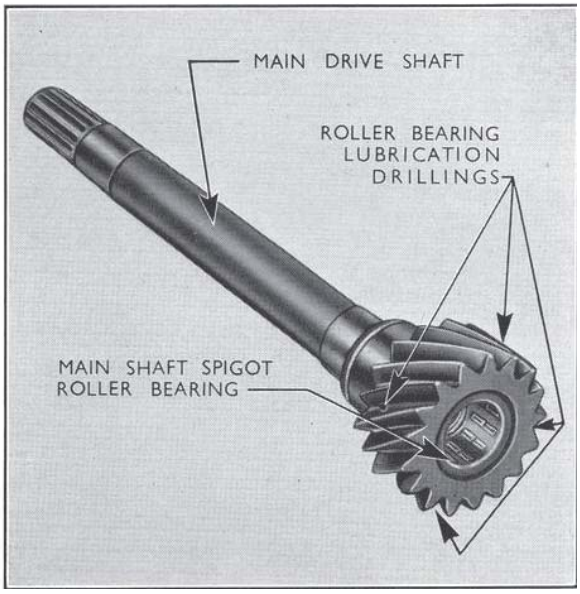

Fig. 33
Main Drive Shaft and Bearing Assy.
(*Super Dexta*)

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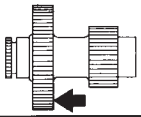
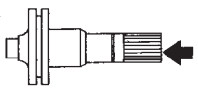
Special ratio gearboxes are fitted to both Standard and Super Dexta tractors for certain Export territories to meet legal requirements in respect of speed. The gears which differ from standard are also shown in the following chart.

IDENTIFICATION CHART

ITEM	PAINT MARKING			
	STANDARD DEXTA		SUPER DEXTA	
	Standard Ratio	*Special Ratio*	*Standard Ratio*	*Special Ratio*
MAIN DRIVE SHAFT 	YELLOW No. of teeth 17	YELLOW No. of teeth 17	WHITE No. of teeth 17	WHITE No. of teeth 17
SECONDARY COUNTERSHAFT 	YELLOW No. of teeth 37/20	RED No. of teeth 33/18	YELLOW No. of teeth 37/20	RED No. of teeth 33/18
MAINSHAFT 	YELLOW No. of teeth 28	LIGHT BLUE No. of teeth 32	WHITE No. of teeth 28	RED No. of teeth 32
SECONDARY OUTPUT SHAFT 	YELLOW No. of splines 10	YELLOW No. of splines 10	WHITE No. of splines 14	WHITE No. of splines 14
SECONDARY OUTPUT SHAFT GEAR 	YELLOW No. of teeth 45	RED No. of teeth 47	YELLOW No. of teeth 45	RED No. of teeth 47

THE REAR AXLE

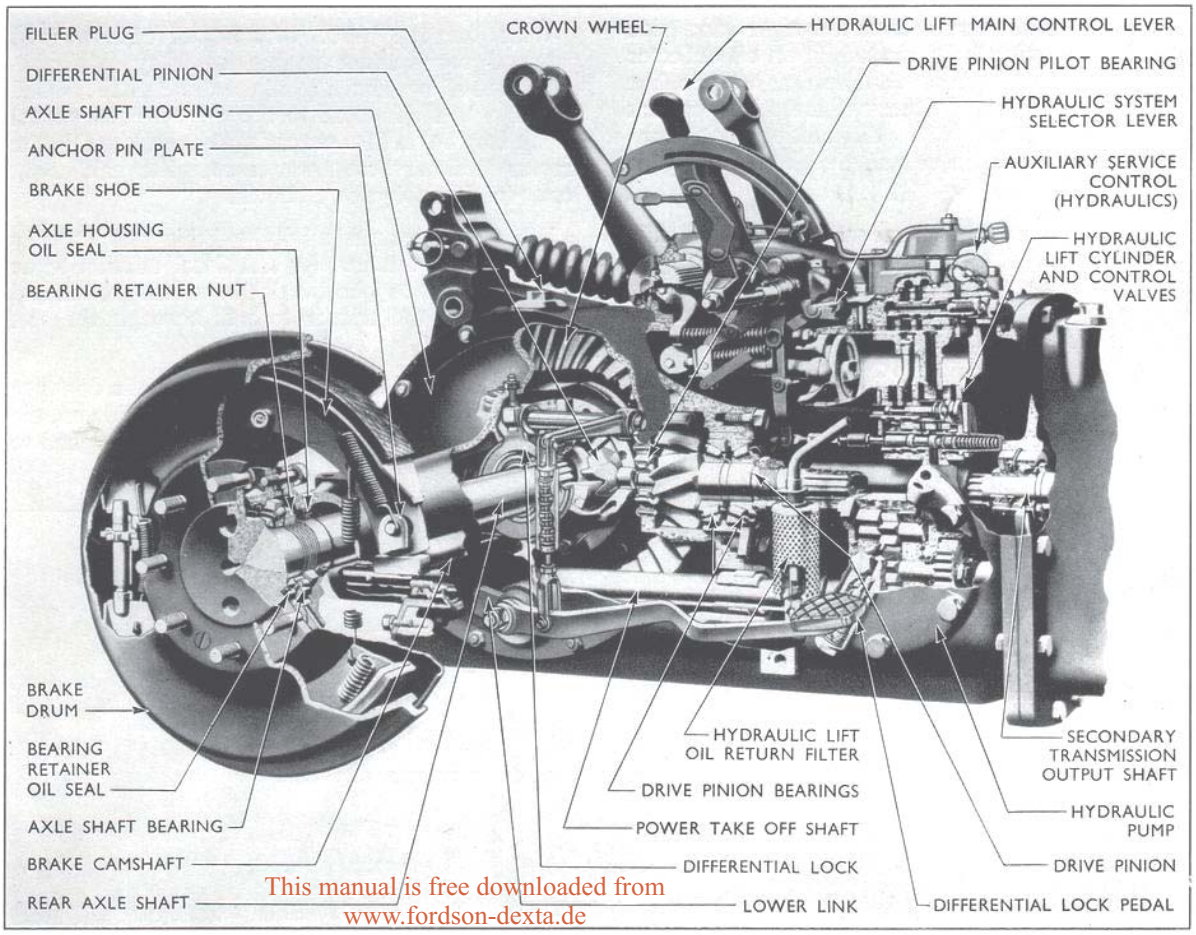


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Fig. 1
Sectioned View of Rear Axle and Hydraulics

Description

The drive from the gearbox output shaft is transmitted through a sleeve type coupling to a spiral bevel pinion mounted on taper roller bearings in the rear transmission centre housing. The pinion meshes with a crown wheel which is attached to the casing of a four pinion differential assembly, the whole being straddle mounted on taper roller bearings. The cups of the bearings locate in axle shaft housings which are attached to each side of the centre housing.

On tractors produced since November 1961, a differential locking device has been incorporated consisting essentially of a sliding coupling which is mounted on the right-hand differential side gear and connected through suitable linkage with a foot pedal, the operation of which locks this side gear to the differential casing.

Each axle shaft is supported at its outer end by a single taper roller bearing and the inner ends of the two shafts are in direct contact at the centre of the differential assembly, so that an inward loading on one axle shaft will be transferred to the opposite axle shaft and bearing. Each axle shaft bearing will therefore withstand the vertical loading of the wheel it supports and any outward thrust imposed on the wheel, while any inward thrust will be transmitted through the axle shafts to the opposite bearing.

The rear transmission housing extends forward forming a compartment which houses the hydraulic power lift pump and ram cylinder. A common supply

of oil is used for lubricating the rear transmission and operating the hydraulic power lift. The crown wheel and differential assembly is partly immersed in oil and an oil trough cast integral with the crown wheel thrust block collects oil from the crown wheel and conveys it to the drive pinion bearings and the left-hand side differential bearing. On early tractors not fitted with a differential lock the right-hand side differential bearing is lubricated by an oil deflector plate riveted to the pinion pilot bearing housing, but the larger right-hand bearing fitted to current production tractors with differential lock runs partially submerged in oil and the deflector plate is not required.

The oil is filtered by a gauze screen at the hydraulic pump inlet and also by a partial flow paper element type filter at the outlet. In addition a magnetic plug is fitted at the pump inlet to remove any metallic particles from circulation.

The power take-off drive is engaged by a lever at the left-hand side of the rear transmission housing which moves a splined coupling forward to engage with the hydraulic pump drive gear. The drive is then taken rearwards by a shaft which emerges at the rear of the tractor. The P.T.O. shaft is supported at its mid-length by a bronze bush and at its rear end by a roller bearing.

Differential Lock Operation

When one rear wheel of a tractor strikes a soft patch of ground and spins, the normal type differential action allows virtually all the drive to be applied to this wheel and little to the opposite rear wheel which may be on firm ground. The result is that the tractor is either brought to a complete halt or, at least, considerably slowed down.

When a differential lock is fitted this disability may be overcome as it enables additional traction to be obtained from the wheel which is on firm ground and thus enables the tractor to pull through the soft patch.

Basically, this locking device consists of a dog type coupling which is splined to, but free to slide on, the right-hand differential side gear, and is designed to

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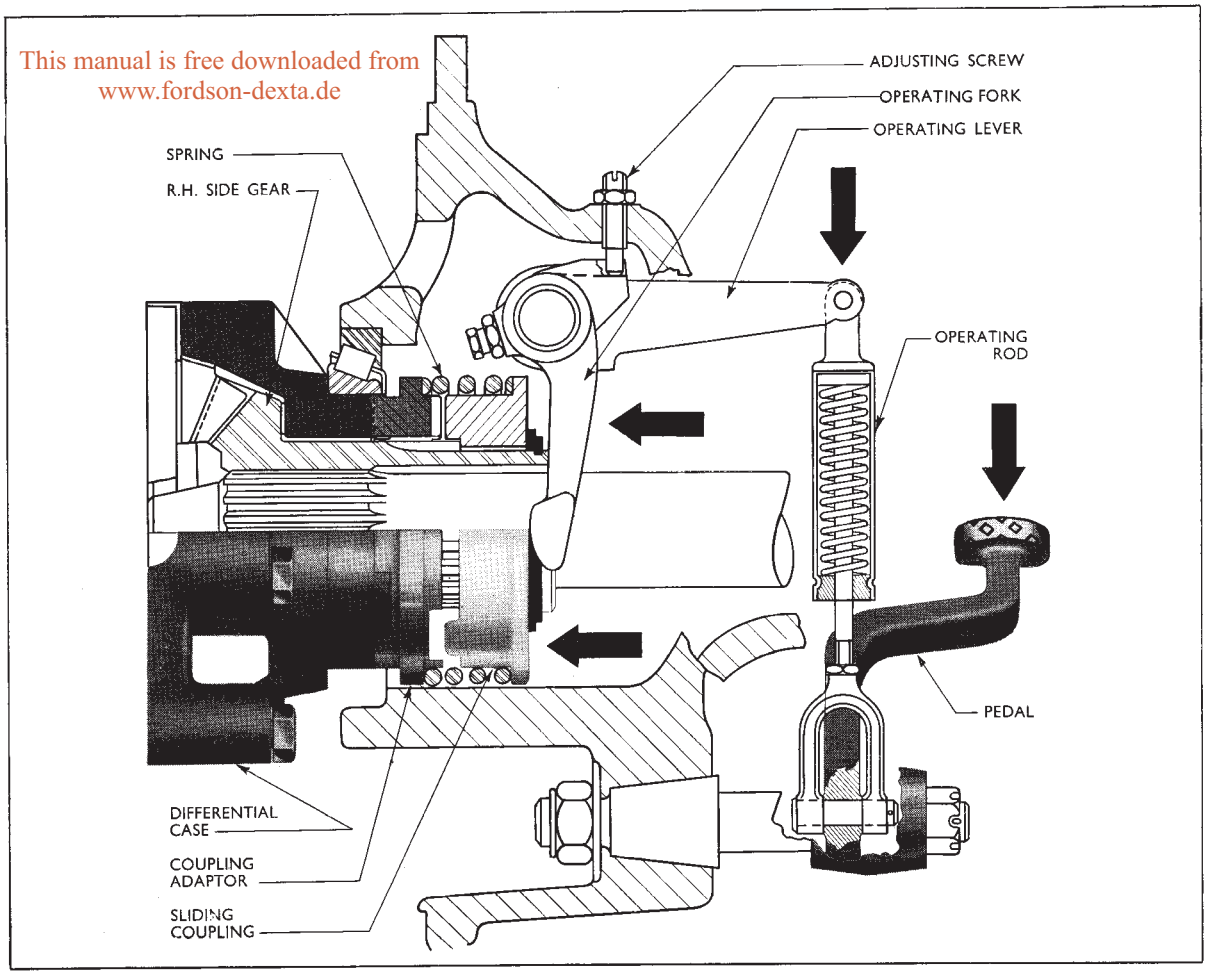

Fig. 2
The Differential Lock

positively lock the differential side gear to the differential case. The connection is made through a coupling adaptor which has dog teeth on both sides faces, those on the inside engaging with dogs machined on the differential case and those on the outside with the sliding coupling (see Fig. 2).

The sliding coupling is connected via a fork, operating lever and spring loaded operating rod assembly to a foot pedal situated above the right-hand footplate.

In operation, depression of the foot pedal will first move the sliding coupling into contact with the fixed adaptor and then compress the spring in the operating rod assembly. As the dogs of the sliding coupling come into alignment with the tooth spaces in the fixed coupling adaptor the operating rod spring tension will move the sliding coupling into engagement with the coupling adaptor. The fact that the spring supplies the final operating force obviates the possibility of damage should excessive force be applied to the foot pedal.

Once full engagement has taken place the foot pedal should be released as the sliding coupling will be held in engagement by the side loading on the splines until such time as equal traction is obtained from both wheels. When this condition is reached the side loading is released from the splines and a coil spring, fitted between the sliding coupling and the fixed coupling adaptor automatically disengages the lock.

ROUTINE MAINTENANCE, MINOR ADJUSTMENTS AND REPAIR

Check the transmission oil level every 50 operating hours and if necessary, top-up to the level plug hole with lubricant of the correct grade. Remember, that if a number of auxiliaries are being operated from the tractor hydraulics it represents a loss to the transmission lubricant and an equivalent amount should be added to make up the quantity used for this purpose.

Every 12 months drain and discard the rear transmission lubricant and refill with new oil of the correct grade—approximately 34 pints (19.32 litres) will be required on a standard tractor without auxiliary hydraulic equipment.

Oil should be of good quality with the following S.A.E. viscosity number :

Above 20°F (—7°C)	30 H.D. or 20W/30 H.D.
Below 20°F (—7°C)	20 H.D. or 20W/30 H.D.

Every 50 operating hours a grease gun should be applied to the differential lock operating pedal lubricator, at the same time apply a little oil to the upper and lower clevis pins of the spring-loaded differential lock operating rod to ensure free operation of the linkage.

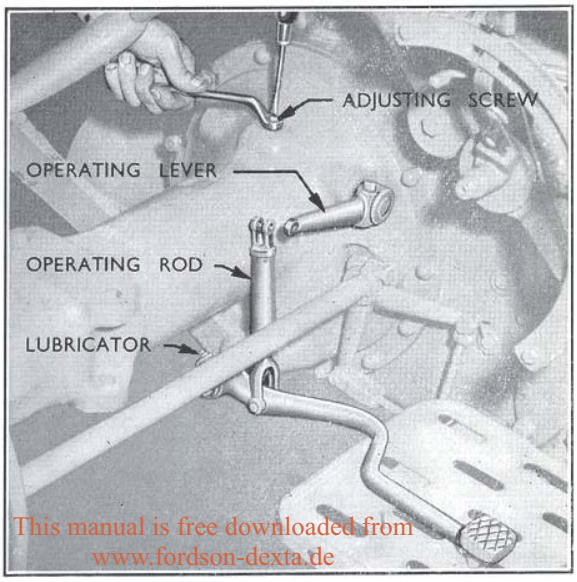

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Fig. 3
Adjusting the Differential Lock

Adjusting the Differential Lock

It is important that sufficient clearance exists between the differential lock pedal and the footplate to ensure full engagement of the lock. Should there be any doubt that full engagement is not taking place the following adjustment checks should be made :

1. Remove the split pin and clevis pin securing the operating lever to the spring-loaded operating rod and depress the operating lever until the operating fork is felt to just contact the differential lock sliding coupling.

2. Slacken off the locknut and screw down the adjusting screw until it contacts the bottom of the slot in the operating fork (see Fig. 3). The point of contact is determined by observing the operating lever which will begin to move immediately the screw reaches the bottom of the slot.

NOTE.—It is most important that the adjusting screw is not turned down past this point.

3. Turn back the adjusting screw one-quarter of a turn and tighten the locknut.

4. Allow the foot pedal to rest on the footplate, ensuring that there is no dirt or grit under the pedal. Push down the operating lever until the differential coupling is fully engaged, and, without compressing the spring in the operating rod, slacken the locknut and adjust the length of the operating rod until the clevis pin can just be inserted to connect the operating rod clevis to the lever (see Fig. 4).

5. Remove the clevis pin and shorten the operating rod assembly by one to two turns on the clevis then re-insert the clevis pin.

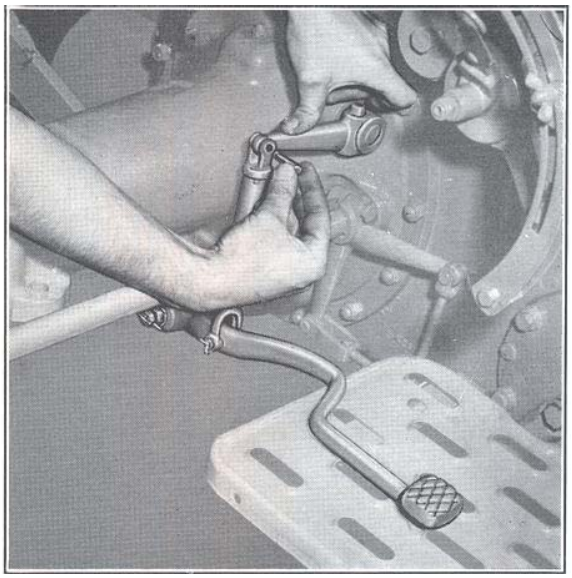

Fig. 4
Adjusting the Differential Lock Linkage

6. Tighten the clevis locknut and observe the last $\frac{1}{4}$ in. (6.35 mm.) of pedal movement until it strikes the footplate. If adjusted correctly this final pedal movement should result in approximately 0.04 in. (1.02 mm.) compression of the spring inside the operating rod tube without movement of the operating lever, i.e. the operating rod will move this extra amount out of the tube after all movement of the operating lever has ceased.

7. Secure the operating rod to operating clevis pin with the appropriate split pin.

Differential Lock Operating Pedal and Linkage

To Remove

1. Remove the split pins and clevis pins securing the operating rod assembly to the pedal and to the operating lever and remove the rod.

2. Remove the split pin, castellated nut and thrust washer securing the operating pedal and slide the pedal, sleeve and inner thrust washer from the pedal support.

If it is necessary to replace the pedal bush, knock out the old bush with a suitable drift. Replace the bush, using Tool No. T.4093 with the 550 handle, ensuring the lubrication hole in the bush is lined up with the grease nipple hole in the pedal.

To Replace

1. Replace the inner-thrust washer, pedal sleeve, pedal and the outer thrust washer on the pedal support shaft and secure with the castellated nut and split pin.

2. Connect the operating rod to the operating lever and to the pedal with the appropriate clevis pins.

3. Operate the pedal to ensure free movement and, if necessary, adjust the differential lock as previously described.

4. Secure the clevis pins with appropriate split pins.

OVERHAULING THE REAR AXLE

Before undertaking major repairs to the rear transmission the following points should be noted :—

With the introduction of a differential lock in November 1961, changes were made to the right-hand half of the differential case, the right-hand side gear of the differential, the differential right-hand bearing and the right-hand axle shaft housing. None of these parts are interchangeable with those previously used.

The Super Dexta rear transmission whilst basically the same as that used on the current standard type Fordson Dexta is fitted with a number of different detail parts and care must be taken to select the correct parts when carrying out replacement.

The crown wheel and pinion ratio of the standard type Dexta is 6.66 to 1 whereas that of the Super Dexta is 6.166 to 1. The number of pinion teeth is the same on both models but the standard type Dexta crown wheel has 40 teeth whilst the Super Dexta has 37.

The driving pinion and pinion coupling used on the standard type Dexta have 10 splines whilst those used on the Super Dexta have 14.

The driving pinion pilot bearing used on the Super Dexta has a larger internal bore diameter and a greater width than the bearing fitted to the standard type Dexta.

The driving pinion taper roller bearings fitted to the Super Dexta and to the current standard type Dexta are slightly wider and the rollers lie at a shallower angle from those fitted to Dexta tractors built before the introduction of the Super Dexta. These bearings may, however, be fitted as direct replacements for those originally fitted to early Dexta tractors providing the cup and cone are of the same type. The Super Dexta bearing locknuts, tab washer and thrust washer differ in size from those used on the standard type Dexta and these parts are not interchangeable.

To provide clearance for the Super Dexta drive pinion pilot bearing a shallow recess is machined around the periphery of the differential case at the joint line of the two halves. This differential case may be fitted to any Dexta with differential lock. The case used on early tractors without differential lock is not suitable for tractors with differential lock. The case used on standard type Dexta tractors with differential lock prior to the introduction of the Super Dexta did not incorporate the recess at the joint line and is therefore not suitable for use on the Super Dexta.

Rear axle shafts fitted to the Super Dexta and also the current standard type Dexta are threaded to

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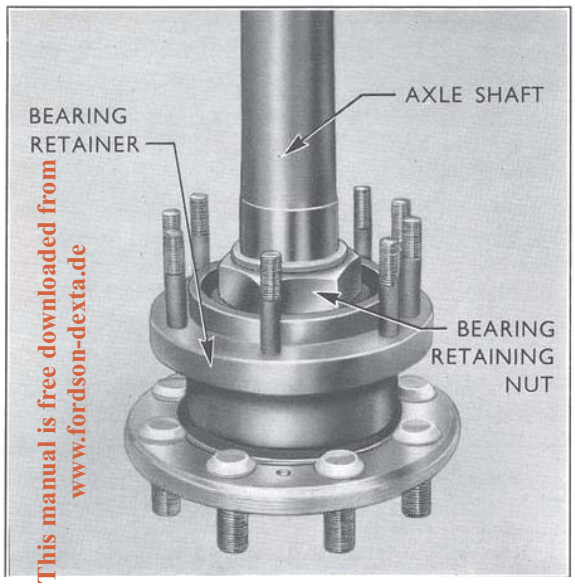

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Fig. 5
Axle Shaft Bearing Retaining Nut

accept a self-locking nut for retaining the axle shaft bearing. The same bearing is retained by a shrunk-on collar to the early Fordson Dexta axle shaft and the latter is not suitable for use on current production tractors.

TO SEPARATE THE REAR TRANSMISSION FROM THE GEARBOX

The following sequence is necessary when separating the tractor in order to carry out a rear axle overhaul.

1. Unscrew the rear axle drain plug and remove the oil. The oil should not be re-used if there is the possibility of metallic particles being present in the oil.

2. Disconnect the brake and clutch operating rods at their rear ends by removing the split pins and clevis pins.

3. Remove the two control panel side plates by unscrewing the four self-tapping screws in each, and disconnect the rear lamp connections from the main wiring loom. Release the wiring from the clips on the gearbox housing and pull the wiring through the holes in the housing flanges.

4. Unscrew the bolts and disconnect the footplate brackets from each side of the gearbox. Suitably support the gearbox and rear transmission and unscrew the flange bolts when the tractor may be separated at this point. A certain amount of oil may be expected to run from the housings when separated and a container should accordingly be placed in position.

To Reassemble the Rear Transmission to the Gearbox

1. Ensure that the gearbox and rear transmission housing flanges are clean, and use a new gasket for the joint.

2. Install guide studs, Tool No. T.7068, at diametrically opposite points on the gearbox housings flange and join the rear transmission to the gearbox. Ensure that the rear transmission is located on the dowels on the gearbox flange and fit the flange bolts and nuts. Remove the guide studs and tighten the flange bolts and nuts securely.

3. Remove the gearbox support and reconnect the footplate brackets to the gearbox.

4. Re-locate the rear lamp wiring through the housing flanges and the clips on the gearbox. Reconnect the wiring snap connectors and replace the control panel side plates.

5. Reconnect the brake and clutch operating rods replacing the clevis and split pins.

6. Refill the rear transmission with 34 pints of the correct grade of oil.

TRANSMISSION TO PINION COUPLING

In order to replace this coupling it is necessary to separate the rear transmission from the gearbox as previously described. After replacing the coupling on the drive pinion shaft fit a new gasket and reassemble the transmission to the gearbox as described under ' To Reassemble the Rear Transmission to Gearbox.'

If fitting a new coupling note that the correct coupling for a standard type Dexta has 10 splines, whilst that for a Super Dexta has 14.

REAR AXLE SHAFTS, BEARINGS AND OIL SEALS

To Remove

1. Jack up the tractor under the rear axle housings and remove the wheel weights (if fitted), the wheel, and the brake drum which is secured by two countersunk screws. The brake adjuster should be slackened back if necessary to retract the brake shoes before the drum is removed.

2. Disconnect the footbrake and handbrake operating rods from the foot and handbrake camshaft levers by removing the split pins and clevis pins.

3. The following operation is not necessary when removing a right-hand axle shaft, or a left-hand axle shaft when a handbrake is not fitted.

When a handbrake is fitted, disconnect the rear lamp conduit from the retaining clips on the fender and foot-plate, unscrew the three bolts securing the fender to the foot-plate and the two bolts securing the fender to the rear axle housing. Swing the fender to one side taking care to place no undue strain on the rear lamp wiring.

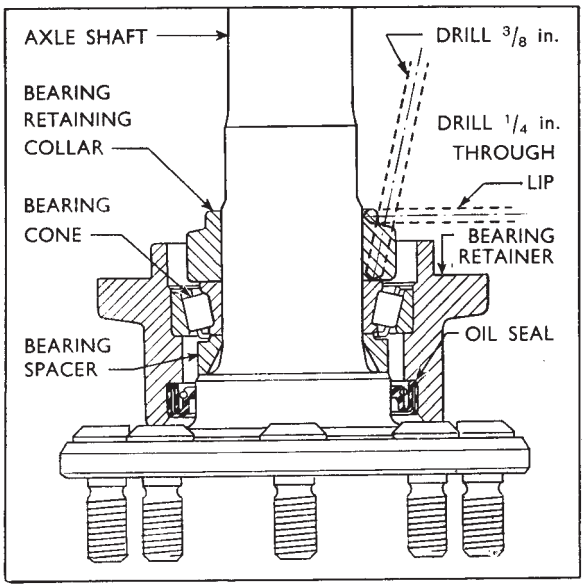

Fig. 6
Drilling Procedure for Axle Shaft Bearing Collar

4. Unscrew the ten bearing retainer to axle shaft housing nuts and remove the axle shaft, bearing retainer, brake shoes and back-plate, brake camshaft, and handbrake lever and tube (where fitted) as an assembly. Support the axle shaft carefully when withdrawing to prevent damage to the axle housing oil seal. Also support the brake camshaft as it will tend to drop when it is withdrawn from the bush in the axle housing.

5. Withdraw the axle shaft and bearing retainer assembly from the brake back-plate and shoe assembly.

6. Where a current type tractor is being handled, remove the nut retaining the axle shaft bearing using wrench Tool No. T.4095.

On tractors produced before the introduction of the Super Dexta the bearing retainer was secured to the axle shaft by a shrunk-on collar. In order to remove the bearing retainer it will be necessary to drill and crack the bearing retainer collar as described below.

(i) Place the shaft horizontally with two of the wheel studs resting on a wood block to prevent the shaft rotating. Centre punch and drill vertically through the lip of the collar, using a $\frac{1}{8}$ in. pilot drill and a $\frac{1}{4}$ in. drill (see Fig. 6). Drill carefully and stop when the drill contacts the hardened surface of the shaft as indicated when the drill speed increases.

(ii) Stand the shaft vertically on a wood block or similar surface and again centre punch and drill the collar at the same point as previously, using a $\frac{3}{8}$ in. drill and holding the drill as near to the vertical as possible to ensure it can pass the full length of the collar without contacting the shaft. The drill speed will again increase when it contacts the hardened face of the bearing cone.

(iii) Insert the point of a suitable chisel in the hole and drive in with a sharp blow to split the collar. The collar may then be lifted off the shaft.

7. Remove the bearing retainer by clamping Tool No. T.4069 in a vice as shown in Fig. 7, fit the axle shaft inside the tool and secure the bearing retainer to the tool flange using the bearing retainer nuts.

8. Use the large wrench to turn the centre screw and withdraw the bearing retainer assembly (see Fig. 7). The bearing spacer may then be removed from the shaft and the bearing cone from the retainer.

9. Using main Tool No. T.4060 with adaptors T.4060–4, place the adaptor plate over the bearing retainer studs, fit the split adaptors to engage with the bearing cup and the centre button on the tool, and tighten the large wing nut to pull the bearing cup from its location in the retainers.

To fit the new cup it is necessary only to reverse the position of the adaptor plate and pass the tool shaft through the centre of the bearing retainer. The bearing cup may then be drawn into position.

10. The oil seal may be removed without removing the bearing cup by driving the seal out of its location in the retainer.

To Reassemble

Clean all parts, inspect and renew as necessary.

It is advisable always to renew the bearing cup, seal and bearing cone if there is any possibility of them being damaged during removal.

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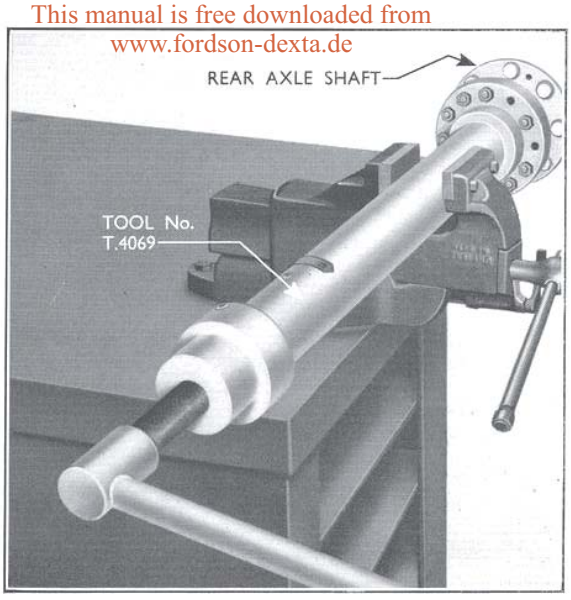

Fig. 7
Removing the Axle Shaft Bearing

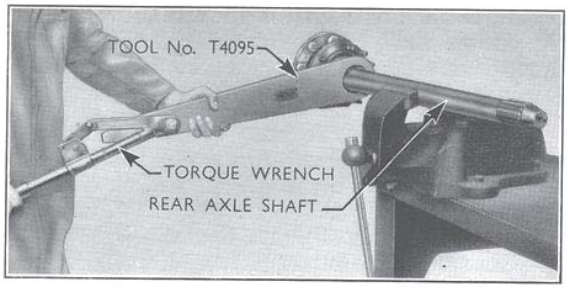

Fig. 8
Tightening the Axle Shaft Bearing Retaining Nut

1. To fit a new seal use adaptors Tool No. T.4070 with the 550 handle, ensuring that the lip of the seal faces inwards.

2. Stand the axle shaft vertical on a wood block surface to prevent damage to the stud threads and fit the bearing spacer over the shaft with the tapered inside edge downwards.

3. Fit the bearing retainer over the shaft, ensuring the oil seal lip seats correctly, and pack the retainer with grease.

4. Bolt adaptor, Tool No. T.4069–1, onto the remover tool and use as a driver to locate the bearing cone on the shaft. The bearing should be fitted with the cone facing downwards and the central screw of the tool should be screwed well back to ensure that it does not contact the end of the axle shaft.

5. If a current type tractor is being handled, secure the bearing to the axle shaft with a new self-locking nut and tighten to a torque of 230 to 250 lb. ft. (31.78 to 34.55 kg.m.). This torque can be achieved by using Tool No. T.4095 with a standard torque wrench set to 100 lb. ft. (13.82 kg.m.) (see Fig. 8). The tool is designed to multiply the torque to the 230/250 lb. ft. (31.78/34.55 kg.m.) required.

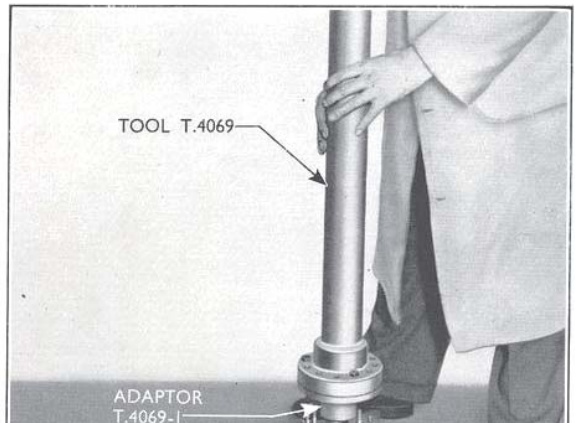

Fig. 9
Replacing an Axle Shaft Bearing Collar

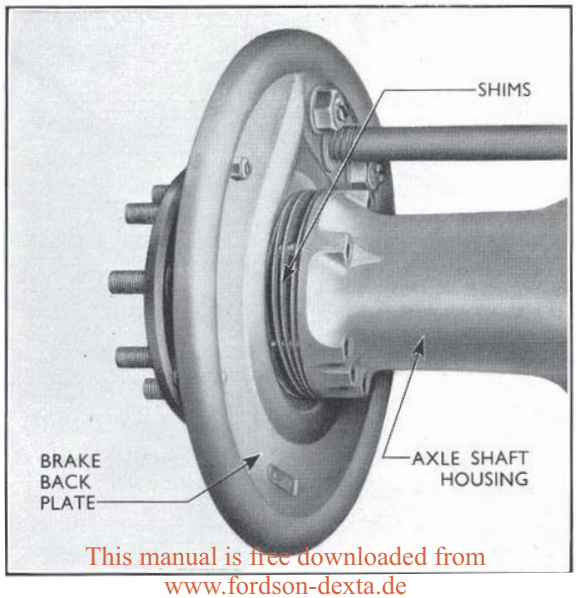

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Fig. 10
Location of Axle Shaft Bearing Shims

If an early type Dexta is being handled where a collar is used to retain the bearing, heat the collar with a gas torch to a temperature of 700 to 800° F (371 to 427°C). Apply the flame evenly around the outside of the collar noting the temper colours on the inside face. When the colour becomes dark blue the temperature will be correct for assembly. Drop the collar over the end of the shaft, lip uppermost, and drive it into position using adaptor T.4069–1 on the remover tool as detailed in operation 4 and illustrated in Fig. 9.

6. Fit the brake back-plate and shoe assembly together with the brake camshaft and handbrake lever and tube assembly (if fitted) onto the bearing retainer studs.

7. An end-float of 0.004 to 0.012 in. (0.10 to 0.30 mm.) is specified for the axle shafts and this need only be measured at one side of the axle. It is essential, however, that when the end-float is being measured on one shaft (normally the left-hand side shaft) the opposite shaft and bearing retainer assembly is correctly installed, the retainer bolts tightened and the shaft held securely outwards so that the bearing cone is fully seated in its cup.

The adjustment for axle shaft end-float is provided by means of shims between each brake back-plate and the axle shaft housings (see Fig. 10). The shims

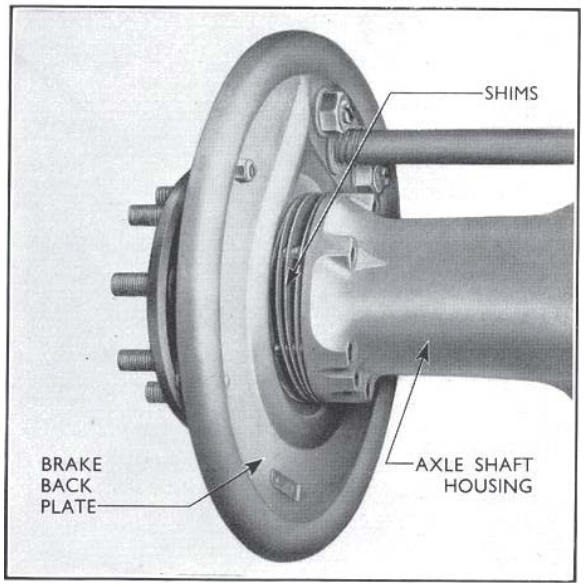

Fig. 11
Wedging an Axle Shaft Outwards Prior to Adjusting End-float

are available in thicknesses of 0.016, 0.021, 0.031, 0.050 and 0.057 in. (0.41, 0.53, 0.79, 1.27 and 1.45 mm.) and they should be divided equally between each side of the axle. If only one side has been dismantled it may be assumed that there will be approximately 0.060 in. (1.5 mm.) of shim thickness on the opposite side.

Fit a similar thickness of shim to the bearing retainer studs of the side being handled.

8. Pack the end of the axle shaft housing with grease and enter the axle shaft into the housing, carefully engaging the shaft with the differential side gear splines and at the same time locating the brake camshaft in its support bush. Fully assemble the shaft so that the bearing retainer studs locate in the corresponding holes in the axle shaft housing, fit nuts to four of the studs equally spaced around the bearing retainer and tighten to a torque of 40 to 45 lb. ft. (5.528 to 6.219 kg.m.).

9. Ensure that the opposite axle shaft and bearing retainer are securely installed and wedge the axle axle shaft outward (see Fig. 11). Turn the axle shaft flange through a small angle as the wedge is inserted to ensure that the bearing cone seats fully in its cup.

10. Insert a long $\frac{3}{8}$ in. 16 UNC bolt into one of the brake drum retainer screw holes of the shaft being replaced and screw it in until it just touches the bearing retainer. A locknut should be used, if necessary, to hold the screw steady.

If necessary, use a file to smooth down the bearing retainer at the point where it is contacted by the bolt. Ensure that the axle shaft is abutted firmly against the wedged shaft by tapping the end of the shaft flange with a mallet, moving the bolt in or out so that it just touches the bearing retainer.

11. Next pull the shaft firmly outwards and rotate the flange to seat the bearing in its cup and measure the clearance between the end of the bolt and the same point on the retainer (see Fig. 12). This gap, representing the axle shaft end-float should be 0.004 to 0.012 in. (0.10 to 0.30 mm.) and if outside these limits, the axle shaft should be removed and shims added to, or removed from, the retainer studs to increase or decrease the end-float respectively.

12. When the correct adjustment has been obtained fit the 10 nuts and spring washers on each retainer and tighten to a torque of 40 to 45 lb. ft. (5.528 to 6.219 kg.m.).

13. Where removed, replace the left-hand fender to the axle shaft housing and footplate and re-locate the rear lamp wiring conduit in the clips on the footplate and fender.

14. Reconnect the footbrake rod to the brake camshaft lever and the handbrake lever to the handbrake camshaft lever by inserting the clevis pins and split pins.

15. Refit the brake drum, securing in position with the countersunk screws.

16. Adjust the brake shoes and handbrake, and replace the wheel and wheel weights (if fitted) taking care not to damage the wheel stud threads. The wheel nuts should be tightened securely and re-checked after 50 working hours.

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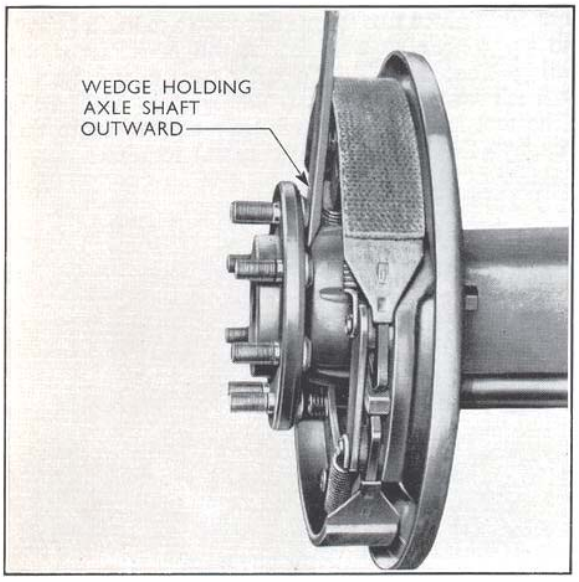

Fig. 12
Measuring Axle Shaft End-float

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REAR AXLE SHAFT HOUSING OIL SEAL

1. Remove the rear axle shaft, brake shoe and back-plate, brake camshaft and handbrake lever and tube (where fitted) as an assembly—see operations 1 to 4 of section headed " Rear Axle Shafts, Bearings and Oil Seals—To Remove."

2. Lever out the old seal and fit a new seal, lip facing inwards, using adaptor T.4071 with the 550 Handle.

3. Refit the rear axle shaft, brake shoe and back-plate, brake camshaft and handbrake lever and tube (where fitted), as an assembly taking care to ensure that the same thickness of shim as was originally fitted, is placed between the brake back-plate and the axle shaft housing—see operations 13 to 16 of section headed " Rear Axle Shafts, Bearings and Oil Seals—To Reassemble."

AXLE SHAFT HOUSINGS

If both axle housings are to be removed during an overhaul the left-hand housing and the differential assembly should be removed first, and replaced only after the right-hand housing has been replaced.

It is possible to remove an axle shaft and housing as an assembly, providing means are available for supporting their combined weight.

To Remove an Axle Shaft Housing

1. Remove the two control panel side plates by unscrewing the four self-tapping screws in each and disconnect the rear lamp connections from the main loom. Release the wiring from the gearbox housing clips and pull the wiring through the holes in the housing flanges.

2. Remove the mudguard and foot plate as an assembly from the foot plate support brackets and the axle shaft housings.

3. Drain the oil from the rear transmission housing and remove the axle shaft complete with brake shoe assembly, brake camshaft and handbrake lever and tube assembly (where hand brake is fitted) as previously described.

4. Remove the split pin and castellated nut on the lower link pivot support pin and remove the lower link.

When removing the right-hand axle shaft housing disconnect the differential lock operating linkage and remove the pedal from the lower link pivot pin.

5. Unscrew the axle housing to transmission stud nuts and lift the axle shaft housing away from the studs.

6. Note that a number of gaskets are fitted between the left-hand axle shaft housing and the centre housing. These gaskets provide the adjustment for differential bearing pre-load and the same number should be used on reassembly. If new parts are fitted it may be necessary to reset the pre-load as detailed in sub-section headed " Differential Bearing Pre-Load."

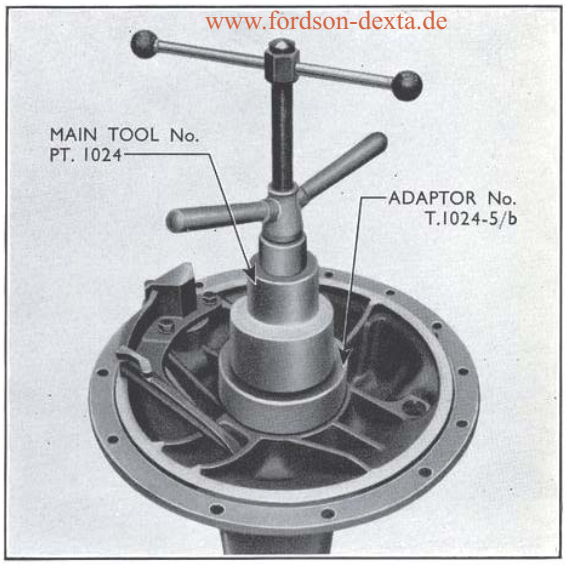

Fig. 13
Removing a Differential Bearing Cup

To Overhaul a Left-Hand Axle Shaft Housing

Prior to the introduction of the differential lock the differential bearings were identical on right- and left-hand sides of the tractor and the same procedure could be adopted for removing and replacing the bearing cup in the axle shaft housing. The right-hand bearing used when a differential lock is fitted, is however, larger than that previously used and different tools are required to effect removal.

1. To remove the left-hand differential bearing cup use Main Tool No. PT.1024 with adaptor ring T.1024–5/b and split adaptors T.1024–5/a. Engage the split adaptors with the bearing cup and the centre button on the tool shaft, and tighten the large wing nut to pull the cup from the housing (see Fig. 13).

2. The bearing cup may be replaced either by tapping into position or by using main Tool No. T.4055 with adaptors T.4055–1.

3. If it is necessary to renew the axle shaft housing oil seal, lever the old seal out of its location and fit the new seal, with the lip facing inwards, using adaptor T.4071 and the 550 handle.

To Overhaul a Right-Hand Axle Shaft Housing

If the tractor is not fitted with a differential lock the procedure is identical to that detailed above for a left-hand housing. If a differential lock is fitted adopt the following procedure :—

1. To remove the right-hand differential bearing cup from the housing use Tool No. T.4060 and adaptor Tool No. T.4060–5. Fit the adaptor T.4060–5 to the centre screw of the main Tool No. T.4060, tilt the tool at an angle and enter the remover

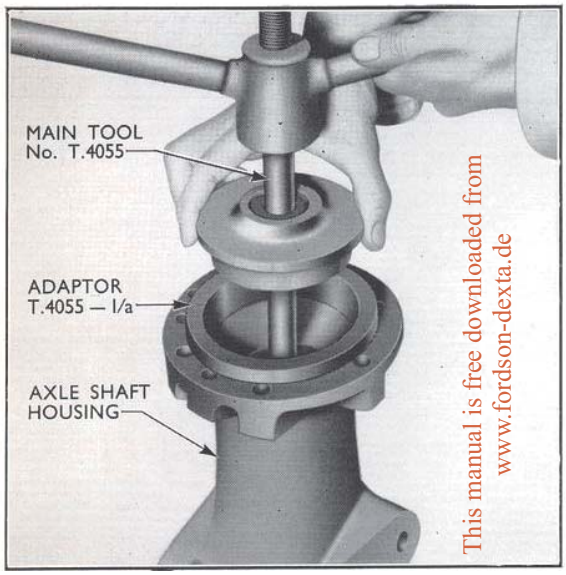

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Fig. 14
Replacing a Differential Bearing Cup

adaptor behind the bearing cup. Straighten up the tool and turn the large wing nut to pull the cup from the housing.

2. A new cup can be fitted quite easily without special tools by tapping it into its location in the housing.

3. As with the left-hand housing a new axle shaft housing oil seal may be fitted, after levering out the old seal, using adaptor T.4071 with the 550 handle.

4. To overhaul the differential lock operating fork and cross-shaft or the cross-shaft oil seal :

(i) Release the differential lock operating fork to cross-shaft locknut and screw (see Fig. 15) and withdraw the cross-shaft from the housing at the same time sliding the operating fork from the shaft.

(ii) Knock out the cotter, securing the differential lock operating lever to the cross-shaft and slide off the operating lever.

(iii) If necessary, remove the cross-shaft oil seal from the axle shaft housing.

(iv) Replace the cross-shaft oil seal in the axle housing with the lip of the seal facing inwards.

(v) Position the differential lock operating lever on the cross-shaft and drive the cotter firmly into position.

(vi) Enter the cross-shaft in the housing at the same time sliding the fork into position on the shaft. Assemble the locking screw to the fork ensuring that the end of the locking screw enters the hole in the cross-shaft. Tighten both the locking screw and the locknut to a torque of 25 to 28 lb. ft. (3.46 to 3.87 kg.m.).

To Refit an Axle Shaft Housing

1. Position the axle shaft housing on the main transmission housing studs with the brake camshaft bush to the front and ensure, in the case of a right-hand housing, that the non-threaded portion of the differential lock adjusting screw has entered the slot in the operating fork. If the original axle shaft housing is being replaced use the same number of gaskets as were originally fitted. If a new housing is being fitted it will be necessary to select the thickness of gasket to obtain the correct differential bearing pre-load as detailed under heading " Differential Bearing Pre-load."

2. Fit the retaining nuts to the studs and tighten to a torque of 50 lb. ft. (6.91 kg.m.).

3. Refit the axle shaft assembly complete with brake shoes assembly, brake camshaft, handbrake lever and tube as previously described under heading " Rear Axle Shafts, Bearings and Oil Seals—To Re-assemble."

4. Replace the mudguard and foot plate assembly, locating the side lamp wiring between the inner edge of the foot plate and support brackets. Connect the side lamp wiring to the main loom and replace the control panel side plates.

5. Refit the lower link, screw on the castellated nut and retain with a split pin. When replacing the right-hand axle housing on a tractor fitted with a differential lock reconnect the differential lock linkage and replace the operating pedal on the lower link support.

6. Refill the rear transmission with 34 pints of lubricant of the correct grade (see " Rear Axle—Specifications ").

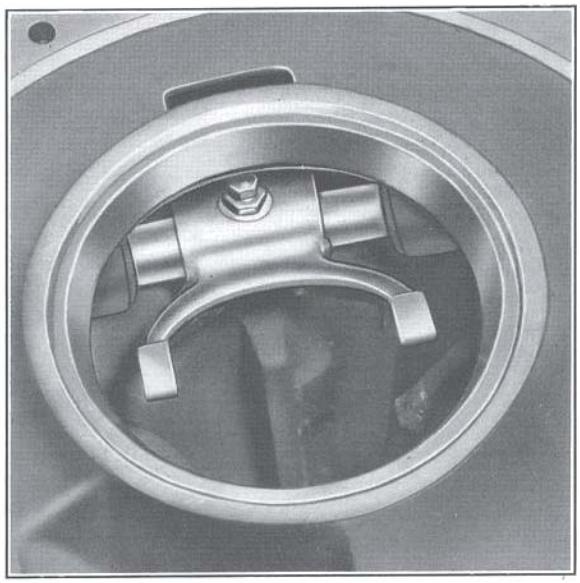

Fig. 15
Operating Shaft and Fork

DIFFERENTIAL AND DIFFERENTIAL LOCK

To Renew the Differential Lock Couplings

Access may be gained to the differential lock coupling adaptor, sliding coupling and spring by removing the right-hand axle shaft housing (see Fig. 16). To completely overhaul the differential case assembly it will, however, be necessary to remove the left-hand axle shaft housing in order to withdraw the complete assembly from the transmission housing, see " To Remove the Crown Wheel, Differential and Differential Lock Assembly."

If the differential couplings require attention proceed as follows :—

1. Remove the right-hand axle shaft housing as previously described.

2. Remove the circlip retaining the sliding coupling to the right-hand side gear and remove the thrust washer, return spring, and coupling adaptor (see Fig. 17).

3. Replace the differential lock coupling adaptor, return spring, sliding coupling and thrust washer and retain in position on the right-hand side gear with the appropriate circlip.

4. Reassemble the right-hand axle shaft housing as previously described.

Fig. 16
Differential Lock Coupling Assembly

To Remove the Crown Wheel, Differential and Differential Lock Assembly

1. Jack up the tractor and drain the oil from the rear transmission housing.

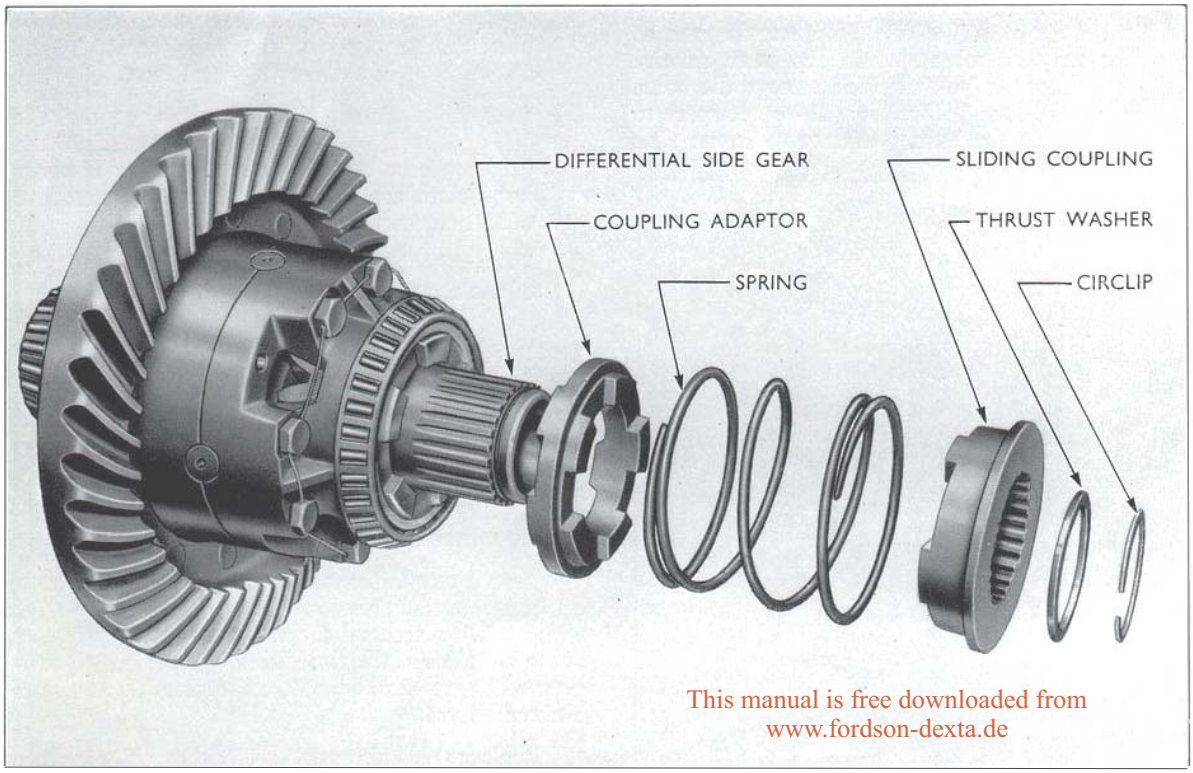

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Fig. 17
Exploded View of the Differential Lock

2. Remove the left-hand rear wheel and wheel weights where fitted.

3. Disconnect the rear lamp wiring conduit from the retaining clips on the fender and footplate, unscrew the three bolts securing the fender to the footplate and the two bolts securing the fender to the rear axle housing. Swing the fender to one side, taking care not to place undue strain on the rear lamp wiring.

4. Disconnect the left-hand foot brake rod from the brake camshaft lever.

5. Where a handbrake is fitted, disconnect the left-hand handbrake rod from the handbrake lever and tube assembly.

6. Remove the hydraulic lift left-hand lower link.

7. Remove the left-hand axle shaft housing to transmission housing nuts and remove the axle shaft housing, axle shaft, brake and handbrake (where fitted) as an assembly. Note the number of gaskets fitted between the axle shaft housing and the transmission housing so that the same thickness may be used on reassembly.

8. Carefully withdraw the crown wheel and differential assembly.

To Dismantle

1. If a differential lock is fitted, remove the circlip retaining the sliding coupling to the right-hand side gear. Remove the thrust washer, sliding coupling, coupling return spring and coupling adaptor (see Fig. 17).

2. Mark the two halves of the differential case so that they may be assembled in the same relative position, extract the lock wire and remove the bolts. If a differential lock is fitted it will be necessary to gradually release the bolts whilst at the same time lifting the right-hand half of the case. The bearing cone will prevent individual bolts from being removed.

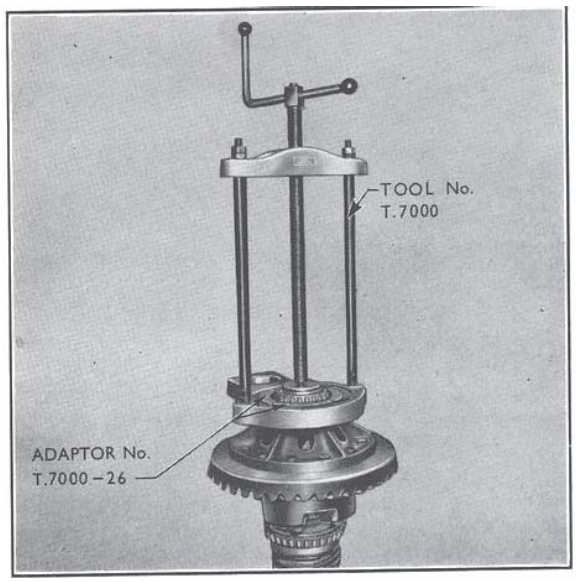

Fig. 18
Removing a Differential Bearing Cone

3. Remove the right-hand half of the case away from the rest of the assembly.

4. If it is necessary to remove the right-hand bearing cone on tractors fitted with a differential lock, existing Tool No. T.4056 and thrust pad T.4056/c will be suitable.

The left-hand bearing cone on all Dexta tractors and the right-hand cone on tractors without differential lock may be removed with Main Tool No. T.7000 and split adaptors T.7000–26.

If a bearing cone is renewed it is recommended that a new bearing cup of a corresponding manufacturing type is also fitted.

5. Remove the differential spider, pinions, side gears and thrust washer.

6. If necessary, remove the bushes from the differential case, using a suitable drift.

7. If a new differential case and/or crown wheel are to be fitted, remove the rivets retaining the crown wheel to the left-hand half of the differential case in the following manner :—

(*a*) Centre punch the upset end of each of the twelve retaining rivets, i.e. the end on the gear side of the crown wheel.

NOTE.—To ensure that the drill runs true to the rivet shank the centre punch should be placed in the centre of the circle formed by the counterbore in the crown wheel face.

(*b*) Drill $\frac{9}{16}$ in. diameter holes in the rivet until the end breaks free from the rivet shank. If the drill has been centred correctly, this will occur just before the drill reaches the hardened face of the crown wheel.

(*c*) Use a suitable size drift to remove the remainder of the rivet.

To Rebuild

The crown wheel and pinion are supplied through service as a matched assembly and no attempt should be made to renew one without the other.

Although the crown wheel is rivetted to the differential case in production, special bolts and self-locking nuts are available for service.

Where a new differential case is to be fitted to a Super Dexta tractor it must be of the latest type, i.e. with a shallow recess machined around the periphery at the joint line of the two halves. This case may also be used on standard type Dexta tractors fitted with a differential lock.

1. Replace the differential case bushes. These must be inserted from the inside of the differential case and located at a depth of 0.60 in. (1.53 mm.) from the inside face.

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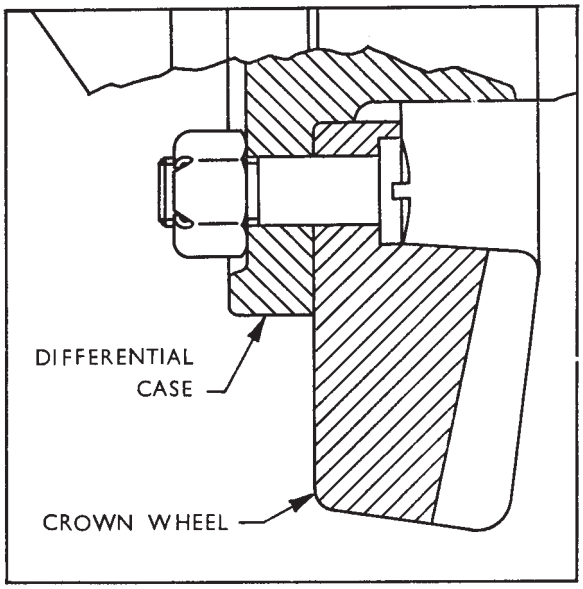

Fig. 19
Crown Wheel to Differential Case Securing

On tractors less differential lock, both left- and right-hand bushes may be assembled to the correct depth with Tool No. T.4073 and the 550 handle.

On tractors with differential lock, use Tool No. T.4073 and 550 handle to assemble the left-hand bush and Tool No. T.4087 with 550 handle to fit the right-hand bush.

2. If a new crown wheel and/or differential case is to be fitted, thoroughly clean the mating surfaces and ensure that the faces are free from burrs. Assemble the crown wheel to the left-hand half of the differential case using special bolts and locknuts as shown in Fig. 19. It will be noted that the slotted heads of the bolts locate in the counterbores of the holes in the gear side of the crown wheel. Tighten the locknuts to a torque of 50 to 60 lb. ft. (6.9 to 8.3 kg.m.).

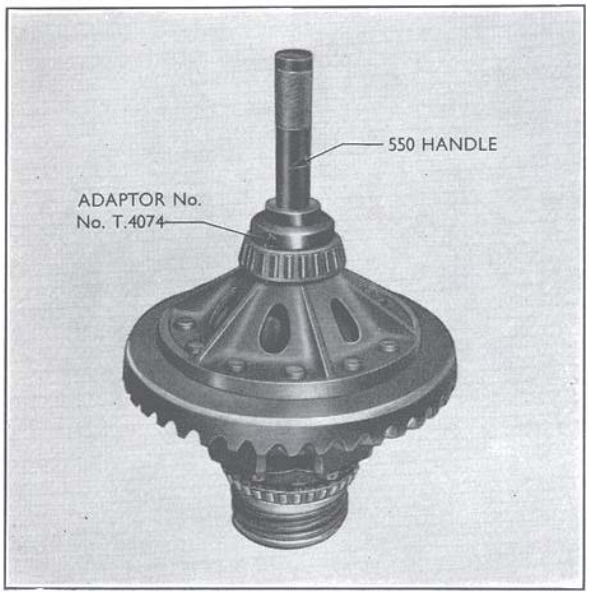

Fig. 20
Replacing a Differential Bearing Cone

3. Insert the eight retaining bolts in the holes in the right-hand half of the differential case then assemble the right-hand bearing cone.

Use Tool No. T.4074 with 550 handle for assembling the bearing cone on tractors less differential lock and Tool No. T.4088 with 550 handle on tractors with differential lock.

4. Assemble the left-hand bearing cone using Tool No. T.4074 with 550 handle.

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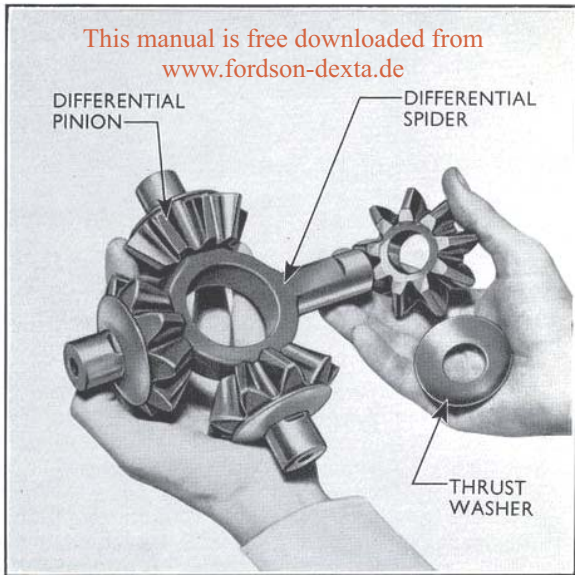

Fig. 21
Assembling the Differential Spider and Pinions

5. Place the left-hand half of the casing on the bench and install a side gear thrust washer and left-hand side gear. Assemble the pinions to the spider and locate in the left-hand differential case.

Locate the right-hand side gear and thrust washer on top of the assembly.

(NOTE.—The side gear used with a differential lock differs from that used when no differential lock is fitted.)

Lower the right-hand half of the differential case over the right-hand side gear and line up the mating marks, placed on left- and right-hand halves of the case before dismantling.

6. Tighten the retaining bolts to a torque of 70 lb. ft. (9.67 kg.m.). On assemblies with a differential lock a special adaptor, Tool No. T.4091,

Fig. 22
The Differential Assembly

is available to enable a torque wrench to be used. When using this adaptor, set the torque wrench to 62 lb. ft. (8.5 kg.m.) as this setting will be multiplied by the adaptor to give the specified 70 lb. ft. (9.67 kg.m.) at the bolt.

Lubricate the assembly and turn the gears to check freedom of movement. Lock the heads of the bolts with wire.

7. Replace the differential lock coupling adaptor, return spring, sliding coupling and thrust washer, and retain with the appropriate circlip.

To Refit the Crown Wheel, Differential and Differential Lock Assembly

1. Refit the assembly in the housing taking care to engage with the right-hand axle shaft splines.

2. Fit the axle shaft housing, axle shaft, and brake as an assembly to the rear transmission housing. If the differential casing and/or bearings have not been renewed, use the same number of gaskets as were originally used. If, however, a new differential casing or new bearings have been fitted it will be necessary to reset the bearing pre-load as outlined on page 16 under the heading " Differential Bearing Pre-Load."

3. Replace the hydraulic lift lower link.

4. Where a handbrake is fitted, reconnect the left-hand handbrake rod to the handbrake lever and tube assembly.

5. Reconnect the left-hand footbrake rod to the brake camshaft lever.

6. Replace the fender to the axle shaft housing and footplate and re-locate the rear lamp wiring conduit in the clips on the footplate and fender.

7. Replace the left-hand wheel.

8. Remove the jack and refill the rear transmission housing to the level plug hole with the correct grade of oil.

THE DRIVE PINION

The drive pinions used on both the Super Dexta and the standard type Dexta have six teeth but the pinions differ in tooth form, number of splines and size of thread. The taper roller bearings fitted to current production models are wider than those fitted prior to the introduction of the Super Dexta although they are used with the same bearing retainer housing and may therefore be fitted in service to early Fordson Dexta tractors. The early bearings must not be fitted to a Super Dexta.

It should also be noted that the pinion pilot bearing fitted to a Super Dexta is wider and has a larger internal diameter than that used on the standard type Dexta.

To Remove the Drive Pinion and Bearing Retainer Assembly

The drive pinion assembly cannot be removed with the differential in position as the crown wheel teeth prevent the pilot bearing from passing. It should also be noted that crown wheels and pinions are supplied as matched assemblies and one should not be renewed without the other.

1. Split the tractor at the rear transmission centre housing/gearbox flange as previously described.

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Fig. 23
Withdraw the Drive Pinion Assembly

2. Remove the left-hand axle shaft housing assembly followed by the differential assembly—see "To Remove the Crown Wheel Differential and Differential Lock Assembly."

3. Remove the hydraulic lift top cover assembly, hydraulic pump and hydraulic lift oil return filter.

4. Remove the driving pinion coupling then extract the bolts holding the pinion bearing retainer assembly to the rear transmission housing.

No special equipment will normally be necessary to draw the pinion bearing retainer assembly from the transmission housing but should a tight assembly be encountered which will not respond to gentle tapping, adaptors are available for use with existing main Tool No. CT.4014 to carry out this operation.

When using the tool on a standard type Dexta, adaptors CT.4014–1 will be required whilst on the Super Dexta, CT.4014–1 plus an alternative sleeve T.4014–5 will be necessary.

To use the tool refer to Fig. 23 and proceed as follows :—

(*a*) Straighten the tabs of the drive pinion lockwasher and remove the locknut and lockwasher. A pair of spanners to fit the standard type Dexta locknut and bearing adjusting nut is available under Tool No. CT.4050 and a similar pair to suit the Super Dexta under Tool No. T.4094.

(*b*) Locate the three tool adaptor studs CT.4014–1/c through equally spaced holes in the pinion bearing retainer flange and screw them into the threaded holes in the rear transmission housing.

(*c*) Fit the circular platform of adaptor set CT.4014–1 onto the studs.

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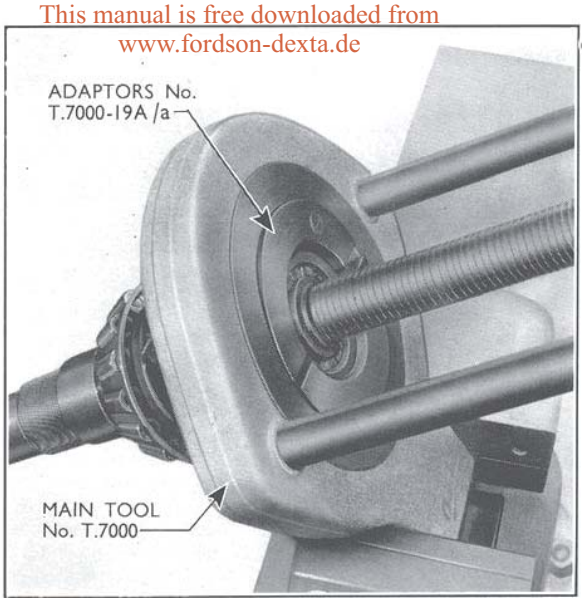

Fig. 24
Removing the Pinion Pilot Bearing

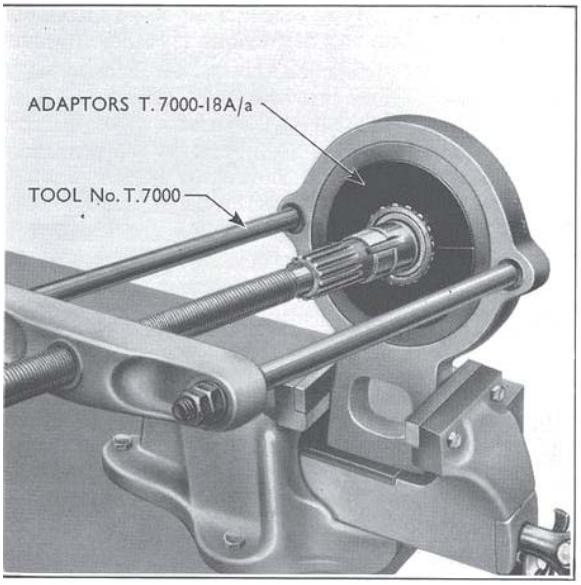

Fig. 25
Removing the Pinion Rear Bearing Cone

(*d*) Screw the threaded sleeve, Tool No. T.4014–1/a on a standard type Dexta or Tool No. T.4014–5 on a Super Dexta, onto the pinion then locate the body of the Main Tool No. CT.4014 on the circular platform.

(*e*) Fit the centre screw of the tool to the sleeve and then tighten the wing nut to withdraw the pinion and bearing retainer assembly from the housing.

To Overhaul the Drive Pinion and Bearing Retainer Assembly

1. If the drive pinion and bearing retainer has been removed complete without the use of special tools, straighten the lockwasher tabs and remove the locknut and lockwasher.

2. Remove the bearing adjusting nut and thrust washer and withdraw the pinion, rear bearing cone and pilot bearing assembly from the bearing retainer. Remove the front bearing cone.

3. To renew the drive pinion pilot bearing, first detach the locking ring, located in a groove in the pinion at the rear of the bearing, then use main Tool No. T.7000 with slave ring and split adaptors Tool No. T.7000–19A/a, to withdraw the bearing from the pinion. Fit a new bearing using the same adaptors with the addition of plate T.7000–19A/b, and retain on the pinion with a new locking ring which must be closed after locating in the pinion groove.

4. The rear bearing cone may be removed, using Main Tool No. T.7000 with adaptor T.7000–18A/a. To fit a new cone use Main Tool No. T.7000 and adaptors T.7000–18A/a with the addition of adaptor ring T.7000–18A/b to locate the bearing inner race.

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NOTE.—Early type adaptors T.7000–18/a are only suitable for removing a previous type bearing cone.

5. To renew either of the pinion bearing cups, remove the original cup with main Tool No. T.4060, adaptor ring T.4060–3A/a and split adaptors T.4060–3A/b (see Fig. 26). Reverse the position of the adaptors and fit the new cup, tightening the large wing nut of the main tool to pull the cup into position.

6. Fit the pinion, rear bearing cone and pilot bearing assembly in the bearing retainer and cup assembly. Install the front bearing cone, thrust washer, bearing adjusting nut, lockwasher and locknut.

7. Tighten the inner nut to pre-load the bearings to 12 to 16 lb. ins. (0.138 to 0.184 kg.m.). Use Tool No. T.4062 with adaptor T.4062–1 to check the pre-load when adjusting the bearings on a standard type Dexta and with adaptor T.4062–2 when checking the bearing pre-load on a Super Dexta.

When making the adjustment tap the splined end of the shaft lightly with a soft mallet and rotate the shaft to seat the bearings in their cups.

8. Tighten the locknut then re-check the bearing pre-load, making further adjustments if necessary. Bend one of the tabs of the lockwasher onto a flat on the adjusting nut and the other tab onto a flat of the locknut.

To Refit the Drive Pinion

1. Fit the pinion and bearing retainer assembly to the rear transmission housing. Where available, the adaptor studs of the removing tool may be used to guide the assembly into position.

2. Ensure that the dowel in the retainer enters the dowel hole in the housing then fit and fully tighten the six bolts and spring washers to secure the bearing retainer.

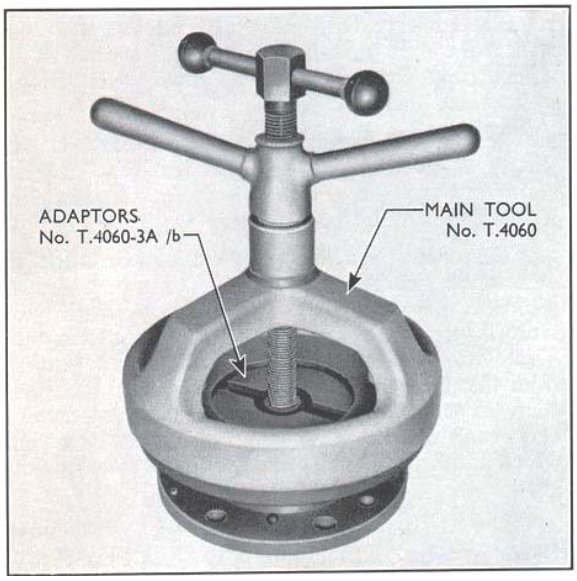

Fig. 26
Removing the Pinion Bearing Cup

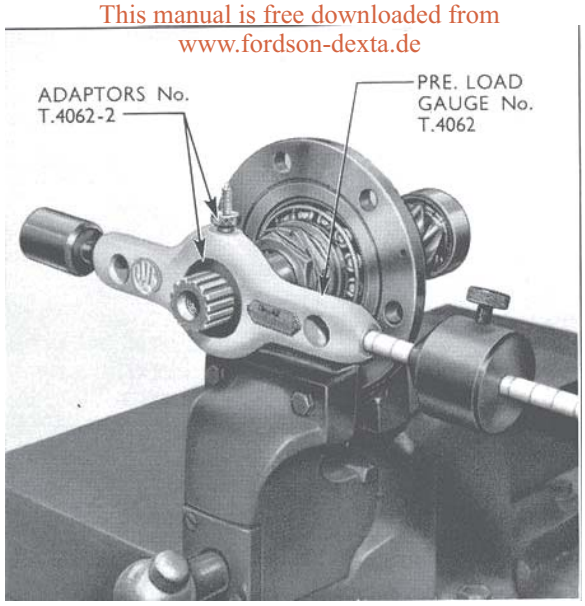

Fig. 27
Checking the Pinion Bearing Pre-load

3. Replace the differential assembly and the left-hand axle shaft housing including the fender and rear wheel—see "To Refit the Crown Wheel, Differential and Differential Lock Assembly."

4. Fit the pinion coupling, the hydraulic lift oil return filter and hydraulic pump.

5. Join the rear transmission to the gearbox as previously described under "To Reassemble the Rear Transmission to the Gearbox."

6. Replace the hydraulic lift top cover assembly and refill the rear transmission to the level plug hole with new lubricant of the correct grade.

DIFFERENTIAL BEARING PRE-LOAD

The number, and consequently the thickness, of gaskets fitted between the left-hand axle shaft housing and the main rear transmission housing determines the pre-load on the differential bearings.

To ensure that this pre-load is maintained the number of gaskets should be noted whenever an axle housing is removed and the same number used on reassembly.

If, however, a major overhaul is being carried out involving renewal of the differential housing, bearings or axle shaft housing it will be necessary to reset the bearing pre-load in the following manner :—

1. Fit a new gasket to the studs on the right-hand side of the main rear transmission housing. If a differential lock is fitted, ensure that the non-threaded portion of the differential lock adjusting screw has entered the slot in the operating fork then assemble the right-hand axle shaft housing to the

main rear transmission housing. Rotate the rear transmission housing until the right-hand axle shaft is pointing downward.

2. Locate the differential assembly in the cup of the right-hand axle shaft housing.

3. Position the left-hand side axle shaft housing correctly over the differential assembly and rotate the differential by hand to ensure that the bearing cones seat correctly.

4. Fit nuts to four studs positioned equally around the housing and screw down finger-tight.

5. With feeler gauges measure the gap between the axle housing ensuring that it is equal at all points around the circumference. Do not tighten the nuts beyond finger tightness.

6. Select a number of gaskets the compressed thickness of which will be equal to the gap measured. Each gasket supplied in service has a compressed thickness of 0.0065 in. (uncompressed thickness—0.009 to 0.012 in.).

7. Having determined the correct number of gaskets, remove the left-hand axle shaft housing and differential assembly and rebuild the axle as described under the appropriate heading.

NOTE.—Setting the differential bearing pre-load by the above method will ensure that the pre-load does not exceed 30 lb. ins. (0.345 kg.m.) at which loading the differential can be turned easily by hand.

Even if during an overhaul no parts are renewed which could directly affect the pre-load, it is advisable always to check on reassembly that the crown wheel can be turned easily by hand and is without perceptible side-float.

As an alternative method during overhaul the pre-load can be measured directly on the differential casing by means of a spring balance and a length of cord wound around the differential casing. Access to the differential may be gained through the P.T.O. aperture and the drive pinion should be removed before measurement to eliminate additional drag.

The maximum pre-load allowable would then be equivalent to a pull of 8½ lb. (3.76 kg.) on the spring balance. If gaskets are removed one at a time and the pre-load re-measured, then all the housing nuts should be tightened for each measurement, as the gaskets will then be compressed the correct amount.

POWER TAKE-OFF

The arrangement of the Power Take-Off and the method of engaging the drive is the same on all tractors with or without "Live" P.T.O. The shaft runs the full length of the rear transmission housing and emerges at the centre line of the tractor, the shaft being 1⅜ in. (34.9 mm.) diameter and having six splines. The shaft is supported at its rear end by a ball bearing and at its mid-length by a bronze bush in the housing.

At the front end a dog tooth gear and sleeve is splined to the shaft. When the P.T.O. shifter lever is pulled rearwards a cranked shaft and fork are moved forwards to slide the sleeve and gear into mesh with the internal dog teeth on the hydraulic pump drive gear at the rear of the P.T.O. counter shaft. Positive engagement is ensured by a spring-loaded ball locating in a recess in the shifter housing.

To Remove the P.T.O. Shaft Assembly

1. Drain off the rear axle oil. If the rear end of the tractor can be conveniently raised or the front

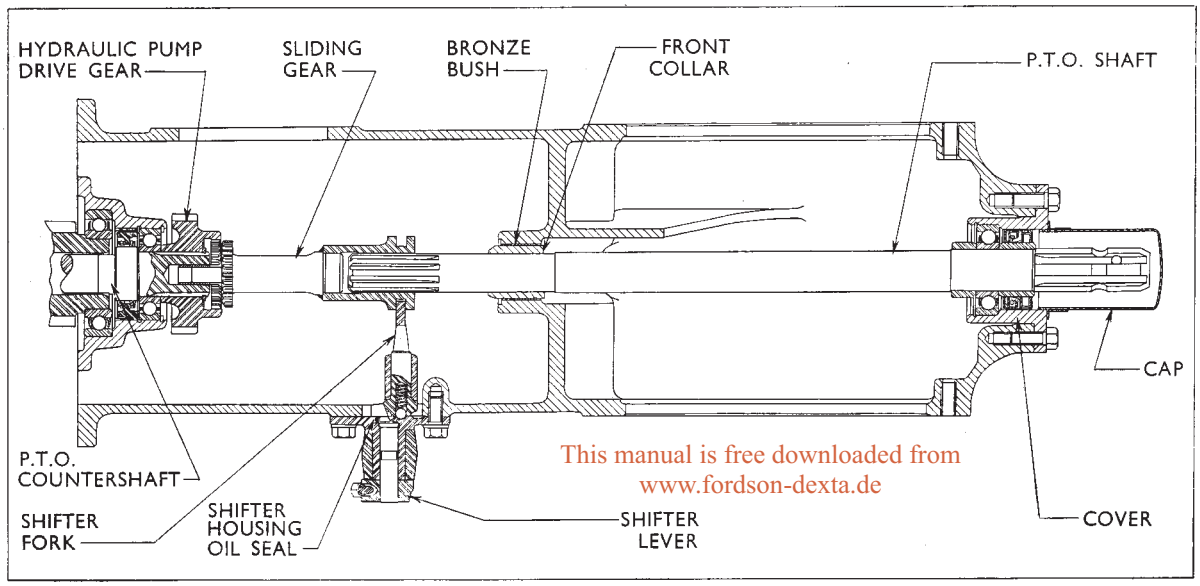

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Fig. 28
Sectioned Lay-out of the Power Take-Off

end lowered, then it will only be necessary to drain off a small quantity of oil.

2. Move the P.T.O. shifter lever rearward to the engaged position.

3. Remove the belt pulley and pulley guard (if fitted).

4. Unscrew the four P.T.O. shaft cover bolts and remove the P.T.O. cap and/or guard (if fitted). The P.T.O. cover and shaft may then be withdrawn as an assembly from the rear axle housing.

To Replace the P.T.O. Shaft

1. Ensure that the shaft is clean and that the splines at the front end are free from burrs. Fit a new gasket over the P.T.O. cover.

2. Install the shaft in the axle housing passing the end carefully through the bronze bush in the housing and engage the splines with the sliding gear.

3. Replace the rear cover bolts and fit the P.T.O. cap and/or guard or the belt pulley and guard as necessary.

TO RENEW THE P.T.O. OIL SEAL

1. Remove the P.T.O. shaft as detailed above.

2. Using a pair of circlip pliers remove the circlip retaining the P.T.O. bearing in the cover.

3. Tap the rear end of the shaft, using a mallet, to remove the shaft and bearing assembly from the cover.

4. Drive the seal out of its location in the cover.

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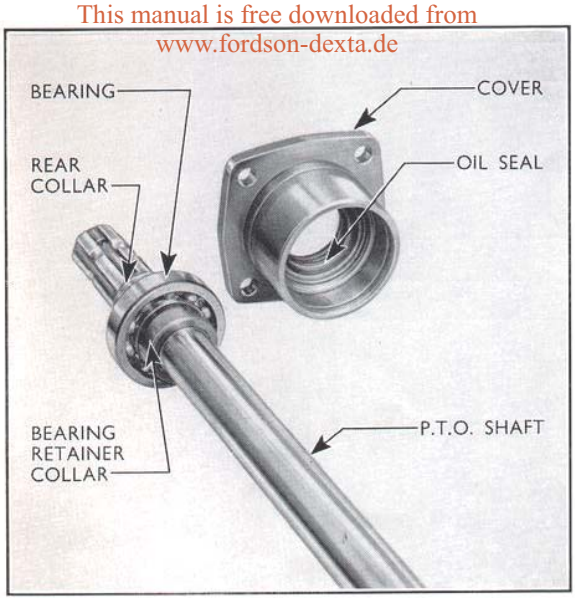

Fig. 29
P.T.O. Shaft and Cover

5. Use the adaptor No. T.7080 with the 550 handle to drive the new seal into the cover. With the cover placed flange downwards on the bench, position the seal so that the lip faces upwards (i.e. will face forwards when installed in the tractor). The use of the correct tool will ensure that the seal is positioned at the correct depth in the cover i.e. 0.12 in. (3.05 mm.) below the bearing locating shoulder.

6. Fit the tapered adaptor sleeve T.7081 over the rear end of the shaft and tap the shaft and bearing assembly into the cover. The use of the special tool will ensure that the lip of the oil seal is not damaged by the edge of the collar. Fit the bearing retaining circlip in the groove in the housing.

7. Install the P.T.O. shaft into the rear transmission housing as previously described.

TO RENEW THE P.T.O. SHAFT BEARING

To Dismantle

1. Remove the P.T.O. shaft as described on page 17.

2. Remove the circlip retaining the P.T.O. bearing in the cover and detach the cover (see Fig. 29).

3. Remove the shaft front collar. This collar runs in a bronze bush in the transmission housing and is a press fit on the shaft. To remove, suitably support the rear edge of the collar and press or drive the shaft through it. Take care not to burr the splines at the front end of the shaft.

4. Remove the bearing retainer collar. This collar is a shrink fit on the shaft and should be cracked by means of a chisel before removal.

5. Suitably support the bearing and press or drive the front end of the shaft through the bearing.

6. The rear collar on the shaft provides a bearing surface for the P.T.O. oil seal and should be renewed if worn or scored. It is a press fit and may be pressed or driven forwards off the shaft.

To Reassemble

1. Press the rear oil seal collar onto the shaft so that it contacts the ends of the P.T.O. splines.

2. Press the P.T.O. bearing onto the shaft, applying pressure to the inner race only, until it is in firm contact with the oil seal collar.

3. Heat the bearing retainer collar, applying the flame evenly until it reaches a dark blue temper colour. Drop it over the front end of the shaft and tap firmly home against the bearing.

4. Fit the front collar onto the shaft, with the chamfered outside edge facing forwards and press into position. This collar should be located with its rear edge 13.4 in. (340.4 mm.) from the front edge of the bearing retainer collar.

5. Replace the shaft and bearing assembly in the cover, retain with a circlip, and install in the rear transmission housing as previously described.

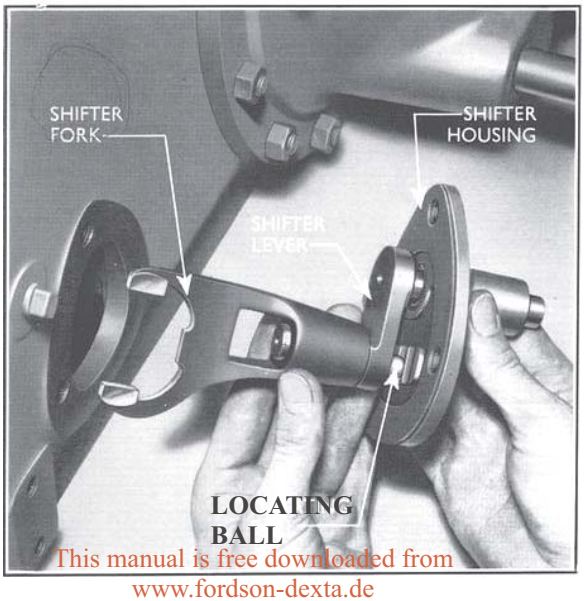

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Fig. 30

P.T.O. Selector

P.T.O. SHIFTER

To Remove

1. Remove the bolts securing the left-hand side foot plate to the mudguard and to the support brackets. Release the side lamp wiring clip at the rear of the foot plate, and remove the foot plate from the tractor.

2. Unscrew the rear axle drain plug and drain off approximately half of the axle oil.

3. Disconnect the clutch rod from the clutch pedal lever.

4. Move the P.T.O. shifter forward to the disengaged position.

5. Unscrew the three shifter housing securing bolts and remove the assembly from the transmission housing. Note that the front lower bolt is also used to retain the clutch pedal stop bracket (except on tractors with " Live " P.T.O.).

To Dismantle

1. Slide the shifter fork off the cranked end of the shaft (see Fig. 30).

2. Unscrew the nut on the shifter lever cotter bolt, drive out the cotter and remove the shifter lever. The clutch pedal may then be removed. Once the shifter lever has been released from the shaft the spring-loaded locating ball will tend to drop and care should be taken not to lose this.

To Reassemble

1. Clean and inspect all parts and renew as necessary, ensure that the shaft and the shifter housing joint face are free from burrs.

2. Prior to Tractor Serial No. 47875 a lip type of seal was fitted between the shifter shaft and the shifter shaft housing. After this number an " O " ring was fitted instead of the lip type seal and the shifter shaft housing modified to suit. The current type seal and housing are not individually interchangeable with those previously fitted. To renew the early lip type oil seal, lever the old oil seal out of its location and fit the new seal with the lip facing outwards (i.e. towards centre of tractor); press on the outer diameter of the seal and ensure that it enters squarely into the bore and abuts the locating shoulder.

3. Grease the shaft and slide it into the shifter housing taking care not to damage the oil seal.

4. Fit the locating ball spring into its bore in the shaft and install the locating ball to engage with the centre of the three grooves in the P.T.O. housing. Apply a light pressure to the shaft and housing to hold the ball in position. To prevent the ball dropping out of its location the clutch pedal and shifter lever should be installed at this stage and secured by means of the cotter bolt and nut. If, during a major overhaul, the hydraulic lift cover is removed, the shifter housing may be installed without the lever and clutch pedal, there being no danger of losing the locating ball.

5. Install the shifter fork on its shaft with the forked end offset downwards.

To Refit

1. Fit a new gasket to the joint face and install the housing, ensuring that the shifter fork engages correctly with the recess in the sliding gear. Fit and tighten the three shifter housing bolts. On tractors not fitted with " Live " P.T.O. the clutch pedal stop bracket should be fitted under the front lower bolt and positioned so as to contact the upper edge of the raised boss on the housing.

2. Fit the clutch pedal and shifter lever if not previously installed, replace the cotter bolt and tighten the nut securely.

3. Operate the shifter lever to ensure correct engagement and disengagement of the sliding gear.

4. Reconnect the clutch operating rod, securing the clevis pin with a new split pin.

5. Bolt the foot plate in position to the support brackets and the mudguard, and secure the side lamp wire in the clip at the rear of the foot plate. Also locate the wiring to run between the support brackets and the inner edge of the foot plate.

6. Refill the rear transmission with oil to the correct level.

P.T.O. SLIDING GEAR

The P.T.O. sliding gear is supported at its front end by a bush in the rear of the P.T.O. countershaft, and at the rear on the splined front end of the P.T.O. shaft. The gear can be moved into and out of engagement with the internal dog teeth on the hydraulic

pump drive gear by operating the P.T.O. shifter lever.

To remove the P.T.O. sliding gear it is necessary to split the tractor at the rear transmission/gearbox flange—see section headed " To Separate the Rear Transmission from the Gearbox "—and to remove the P.T.O. shifter assembly.

The P.T.O. sliding gear may then be withdrawn from the P.T.O. shaft.

P.T.O. SHAFT FRONT BUSH

This steel backed, bronze lined bush supports the front end of the P.T.O. shaft and is a press fit in the centre axle housing.

If a new bush is fitted it should be pressed into the bore from the front of the housing, to a depth of 0.22 in. (5.6 mm.), measured from the front of the boss.

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REAR AXLE — SPECIFICATIONS

	STANDARD TYPE DEXTA	SUPER DEXTA
Type	Semi-floating	Semi-floating
Axle ratio	6.66 : 1	6.16 : 1
THE DRIVE PINION		
Number of teeth	6	6
Number of splines	10	14
Pinion bearing pre-load	12.16 lb. in. (0.1401 kg.m.)	12.16 lb. in. (0.1401 kg.m.)
Pinion shaft diameter :		
at pilot bearing locations	0.9845 to 0.9850 in. (25.006 to 25.019 mm.)	1.1811 to 1.1816 in. (30.000 to 30.013 mm.)
at centre bearing locations	1.751 to 1.752 in. (44.476 to 44.501 mm.)	1.751 to 1.752 in. (44.476 to 44.501 mm.)
at front bearing locations	1.749 to 1.7495 in. (44.425 to 44.437 mm.)	1.749 to 1.7495 in. (44.425 to 44.437 mm.)
REAR AXLE SHAFTS		
Shaft diameter :		
at outer oil seal location	3.124 to 3.126 in. (79.350 to 79.401 mm.)	3.124 to 3.126 in. (79.350 to 79.401 mm.)
at inner oil seal location	2.124 to 2.126 in. (53.950 to 54.001 mm.)	2.124 to 2.126 in. (53.950 to 54.001 mm.)
at bearing location	2.2515 to 2.2525 in. (57.188 to 57.214 mm.)	2.2515 to 2.2525 in. (57.188 to 57.214 mm.)
*at retaining collar location	2.2515 to 2.2525 in. (57.188 to 57.214 mm.)	NOT APPLICABLE
*Bearing retaining collar I.D.	2.2445 to 2.2465 in. (57.011 to 57.061 mm.)	NOT APPLICABLE
Bearing retainer securing :	by nut/*by collar	by nut
Rear axle shaft end-float	0.004 to 0.012 in. (0.102 to 0.305 mm.)	0.004 to 0.012 in. (0.102 to 0.305 mm.)
Adjustment	By shimming the axle shaft retainers at both sides of axle	
Shims available	0.016, 0.021, 0.031, 0.050, 0.057 in. (all shims ±0.001 in.) (0.406, 0.533, 0.787, 1.270, 1.448 mm. (all shims ±0.025 mm.)	

** Applicable to tractors produced before the introduction of the Super Dexta*

REAR AXLE—SPECIFICATIONS (*continued*)

	STANDARD TYPE DEXTA	SUPER DEXTA
THE DIFFERENTIAL		
Differential spider journal diameter	0.9965 to 0.998 in. (25.273 to 25.349 mm.)	0.9965 to 0.998 in. (25.273 to 25.349 mm.)
Differential pinion bush bore	1.000 to 1.001 in. (25.400 to 25.426 mm.)	1.000 to 1.001 in. (25.400 to 25.426 mm.)
Differential casing bush bore L.H.	2.3735 to 2.3775 in. (60.287 to 60.389 mm.)	2.3735 to 2.3775 in. (60.287 to 60.389 mm.)
Differential casing bush bore R.H.	2.838 to 2.842 in. (72.085 to 72.187 mm.)	2.838 to 2.842 in. (72.085 to 72.187 mm.)
Differential casing bush bore	‡2.3735 to 2.3775 in. (60.287 to 60.389 mm.)	NOT APPLICABLE
Differential side gear journal L.H.	2.367 to 2.369 in. (60.122 to 60.173 mm.)	2.367 to 2.369 in. (60.122 to 60.173 mm.)
Differential side gear journal R.H.	2.8315 to 2.8335 in. (71.920 to 71.971 mm.)	2.8315 to 2.8335 in. (71.920 to 71.971 mm.)
Differential side gear journal	‡2.367 to 2.369 in. (60.122 to 60.173 mm.)	NOT APPLICABLE
Differential casing diameter at bearing location L.H.	2.626 to 2.627 in. (66.701 to 66.726 mm.)	2.626 to 2.627 in. (66.701 to 66.726 mm.)
Differential casing diameter at bearing location R.H.	4.252 to 4.253 in. (107.001 to 108.027 mm.)	4.252 to 4.253 in. (107.001 to 108.027 mm.)
Differential casing diameter at bearing location	‡2.626 to 2.627 in. (66.701 to 66.726 mm.)	NOT APPLICABLE
Differential side gear thrust washer thickness	0.058 to 0.062 in. (1.473 to 1.575 mm.)	0.058 to 0.062 in. (1.473 to 1.575 mm.)
Differential pinion thrust washer thickness	0.058 to 0.062 in. (1.473 to 1.575 mm.)	0.058 to 0.062 in. (1.473 to 1.575 mm.)
DIFFERENTIAL BEARING PRE-LOAD		
Setting	By fitting gaskets on left-hand axle shaft housing joint	
Maximum pre-load allowable	30 lb. in. (0.346 kg.m.)	30 lb. in. (0.346 kg.m.)
Maximum pre-load allowable in terms of pinch on housings	0.003 in. (0.076 mm.) pinch to 0.003 in. (0.076 mm.) end-float	
Gasket thickness	0.0055 to 0.0075 in. (0.140 to 0.191 mm.) compressed 0.009 to 0.012 in. (0.229 to 0.305 mm.) uncompressed	
REAR AXLE TORQUE TIGHTENING FIGURES		
Axle shaft bearing retainer to axle housing nuts	40 to 45 lb. ft. (5.53 to 6.22 kg.m.)	40 to 45 lb. ft. (5.53 to 6.22 kg.m.)
Axle shaft bearing retaining nut to axle shaft	230 to 250 lb. ft. (31.78 to 34.55 kg.m.)	230 to 250 lb. ft. (31.78 to 34.55 kg.m.)
Axle shaft housing to centre housing nuts	45 to 50 lb. ft. (6.22 to 6.92 kg.m.)	45 to 50 lb. ft. (6.22 to 6.92 kg.m.)
Differential casing bolts	65 to 75 lb. ft. (8.99 to 9.68 kg.m.)	65 to 75 lb. ft. (8.99 to 9.68 kg.m.)
REAR AXLE LUBRICATION		
Capacity	34 pints (19.312 litres)	34 pints (19.312 litres)
Lubricant grade	*Standard Type Dexta and Super Dexta* *Temperature Range* — *S.A.E. Viscosity No.* Above 20°F (—7°C) — 30 H.D. Below 20°F (—7°C) — 20 H.D. or 20W/30 H.D.	

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‡ *Applicable only to Dexta tractors produced prior to the introduction of Differential Lock*

REAR AXLE—SPECIFICATIONS (*continued*)

	STANDARD TYPE DEXTA	SUPER DEXTA
POWER TAKE-OFF		
Direction of rotation when viewed from rear	Clockwise	Clockwise
Engine/P.T.O. speed ratio	3.33 : 1	3.33 : 1
⌀Engine/P.T.O. speed ratio	2.895 : 1	NOT APPLICABLE
P.T.O. speed	540 r.p.m. at 1800 r.p.m. (engine)	540 r.p.m. at 1800 r.p.m. (engine)
⌀P.T.O. speed	536 r.p.m. at 1550 r.p.m. (engine)	NOT APPLICABLE
P.T.O. shaft :		
Height of shaft from ground—		
10—28 tyres	17.21 in. (437.1 mm.)	17.21 in. (437.1 mm.)
11—28 tyres	18.11 in. (460.0 mm.)	18.11 in. (460.0 mm.)
Number of splines	6	6
Spline diameter	1⅜ in. (34.93 mm.)	1⅜ in. (34.93 mm.)
Length of spline	2.7 in. (68.58 mm.)	2.7 in. (68.58 mm.)
Length of engagement	2.26 in. (57.40 mm.)	2.26 in. (57.40 mm.)
Diameter of shaft :		
Front collar location	1.2480 to 1.2485 in. (31.699 to 31.712 mm.)	1.2480 to 1.2485 in. (31.699 to 31.712 mm.)
Bearing retainer collar location	1.2501 to 1.2506 in. (31.753 to 31.765 mm.)	1.2501 to 1.2506 in. (31.753 to 31.765 mm.)
Rear collar location	1.2551 to 1.2556 in. (31.880 to 31.892 mm.)	1.2551 to 1.2556 in. (31.880 to 31.892 mm.)
Overall length of shaft	23.70 in. (602 mm.)	23.70 in. (602 mm.)
P.T.O. shaft front collar :		
Length	1.46 in. (37.08 mm.)	1.46 in. (37.08 mm.)
Internal diameter	1.2465 to 1.2475 in. (31.661 to 31.687 mm.)	1.2465 to 1.2475 in. (31.661 to 31.687 mm.)
Position of collar from bearing front retaining collar	13.39 to 13.42 in. (340.1 to 340.9 mm.)	13.39 to 13.42 in. (340.1 to 340.9 mm.)
Bearing retainer collar		
Length	0.75 in. (19.05 mm.)	0.75 in. (19.05 mm.)
Internal diameter	1.2441 to 1.2471 in. (31.600 to 31.676 mm.)	1.2441 to 1.2471 in. (31.600 to 31.676 mm.)
Oil seal collar :		
Length	1.085 to 1.095 in. (27.560 to 27.813 mm.)	1.085 to 1.095 in. (27.560 to 27.813 mm.)
Internal diameter	1.2538 to 1.2548 in. (31.847 to 31.872 mm.)	1.2538 to 1.2548 in. (31.847 to 31.872 mm.)
Outside diameter	1.615 to 1.620 in. (41.021 to 41.148 mm.)	1.615 to 1.620 in. (41.021 to 41.148 mm.)
Rear cover plate :		
Bearing bore diameter	2.7493 to 2.7499 in. (69.832 to 69.847 mm.)	2.7493 to 2.7499 in. (69.832 to 69.847 mm.)
Oil seal bore diameter	2.441 to 2.442 in. (62.001 to 62.027 mm.)	2.441 to 2.442 in. (62.001 to 62.027 mm.)
Oil seal position below bearing location shoulder	0.12 in. (3.05 mm.)	0.12 in. (3.05 mm.)

⌀ *Prior to Serial No. 957E–63953*

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HYDRAULIC SYSTEM

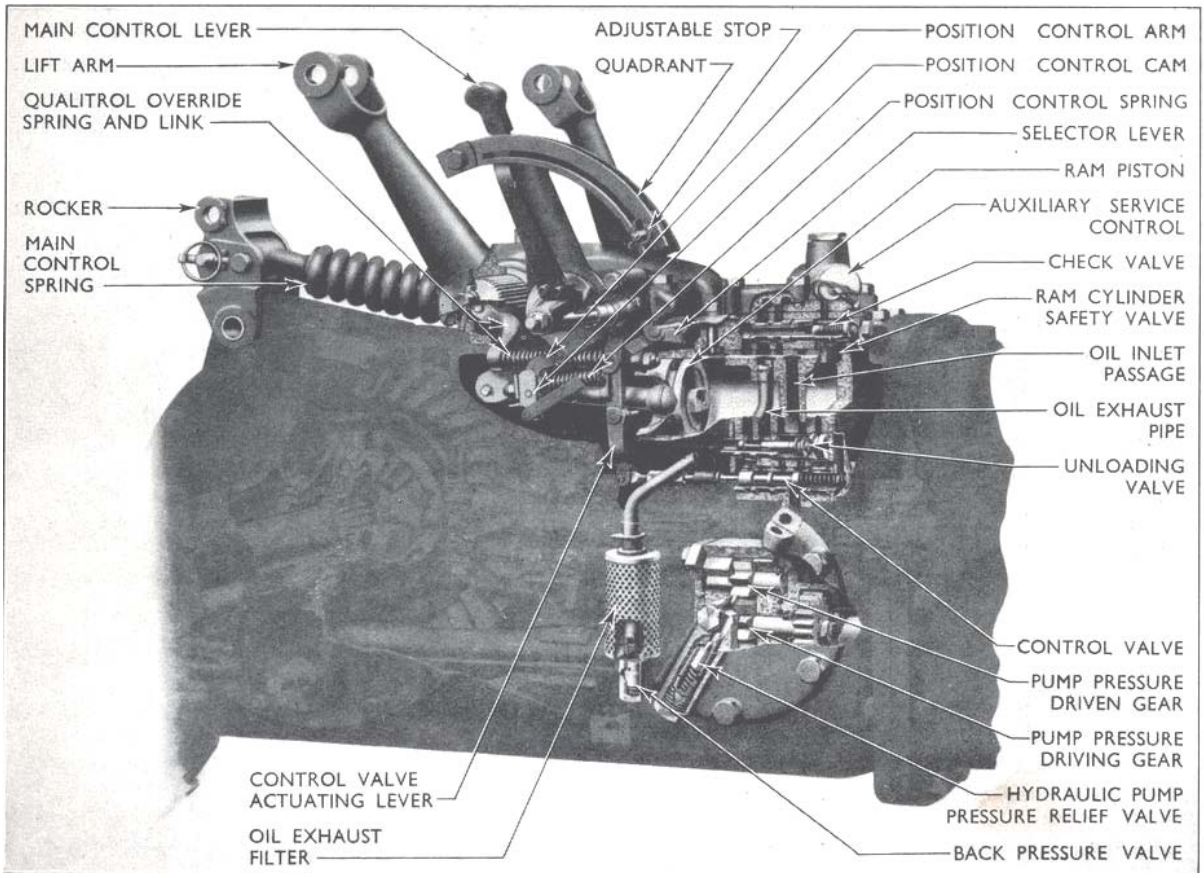

Fig. 1
Sectioned View of Hydraulic System

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HYDRAULIC POWER LIFT

General Description

The Hydraulic Power Lift offers a choice of operating control enabling either Qualitrol (constant draft) or Position Control (constant depth) to be selected according to the work being undertaken and the ground conditions encountered.

" Live " hydraulics are automatically available when a " Live " power take-off (optional equipment) is fitted, and gives the advantage that the tractor may be stopped or gear changes carried out without affecting the operation of the hydraulics.

Hydraulic Pump

A single stage gear type pump is flange-mounted in the front compartment of the rear transmission housing, and is driven by a gear attached to the power take-off countershaft (which runs through the gear-box). The oil supply is taken from the rear transmission lubricant and is drawn through a gauze type filter before entering the pump, which supplies it under pressure, to the lift top cover assembly.

Lift Top Cover Assembly

The top cover acts as a housing for the control linkage and has attached to it the lift cylinder assembly, which acts as a combination valve chest and ram cylinder housing. Attached also to the top cover is an auxiliary service plate, containing a special valve which enables the oil to be directed, as required, either to the ram cylinder (to operate the lift arms) or to a take-off point for hydraulically operated auxiliary equipment (see Fig. 2).

The cover also incorporates a check valve, the purpose of which is to stop the return of oil from the ram cylinder when the implement is in the transport position.

Lift Cylinder Assembly

The lift cylinder contains a piston which is connected, via a connecting rod and a lift ram arm, to the lift cross-shaft, the outer ends of which are splined to the lift arms. A safety valve is located in the front end of the cylinder to obviate damage should shock loads be imposed, as, for instance, when carrying heavy implements over rough ground.

Control, Unloading and Back Pressure Valves

The valve chest portion of the lift cylinder is suitably drilled to carry the oil to, and from, the ram cylinder as directed by two valves, the control and unloading valves, which work in conjunction with the control linkage in the lift cover.

The control valve is indirectly connected through an adjustable link and a valve actuating lever to a cross-shaft, to which is attached the main control lever. It is spring-loaded at its front end and is operated by the positioning of the main control lever within a fixed quadrant in conjunction with the balancing of spring pressures in the control linkage.

The unloading valve is a shuttle type of valve which is operated by oil pressure in accordance with the positioning of the control valve.

Under certain conditions of operation exhaust oil from the valve chest is directed through the lift cover and then via an exhaust pipe to a by-pass filter, which works in conjunction with a back pressure valve. (See Fig. 3.) The function of this valve is to maintain a slight pressure in the system at all times, so ensuring correct operation of the unloading valve; the filter gives additional protection to the system by ensuring that a proportion of the exhaust oil is filtered before rejoining the transmission lubricant.

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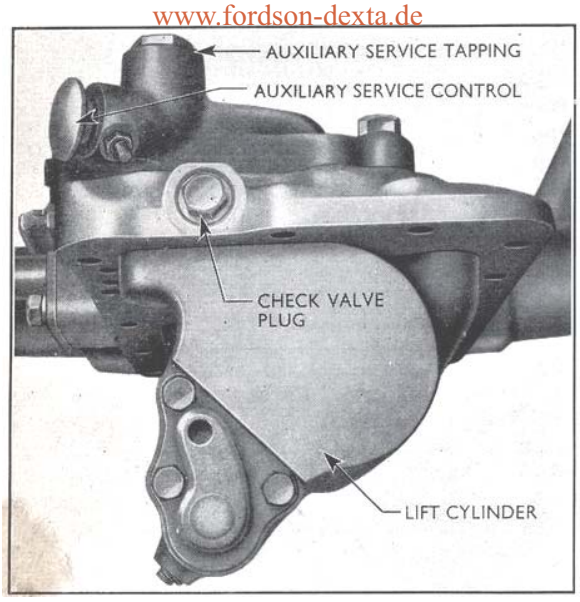

Fig. 2
Lift Cylinder and Auxiliary Service Control

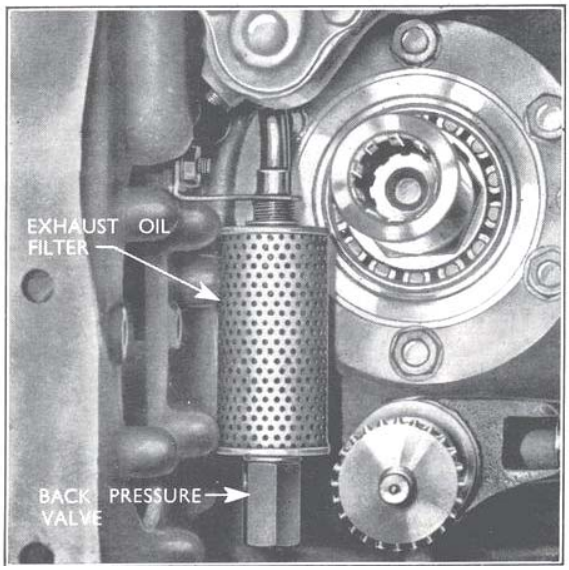

Fig. 3
Exhaust Oil Filter and Back Pressure Valve

Control Linkage

Operation of the lift in Qualitrol and Position Control is regulated by a variation of the pivot point for the control valve actuating lever.

Under Qualitrol a swivel fitted to the actuating lever becomes the pivot point, and also acts as a guide for a spring-loaded link rod, to which is attached the main control spring plunger. A main control spring is fitted over the plunger and is compressed between a spring seat, fixed to the rear end of the lift cover, and an adjustable yoke, which screws onto the rear end of the plunger. The yoke is also attached to a rocker, which is suitably designed to receive the normal upper link connection and pivots on the rear transmission housing.

Under Position Control the pivot point for the control valve actuating lever is a pad machined on the lever (immediately below the qualitrol swivel) against which operates the spring-loaded position control rod. This rod is supported in an arm which is a free fit on the control lever cross-shaft, and is part of an assembly which incorporates a cam, connected by a link and eccentric arm to a selector lever located immediately in front of the main control lever. With the selector lever in a horizontal position the lift operates under Position Control, but by moving the lever downwards the cam on the position control arm assembly withdraws the position control rod into the arm, moving it away from the control valve actuating lever and allowing the Qualitrol linkage to take over.

The position control arm carries a pin against which bears a servo cam machined on the lift ram arm. The latter, being splined to the lift cross-shaft, rotates as the lift arms rise or fall, so moving the position control arm and varying the force applied to the control valve actuating lever to operate the control valve and maintain the implement at a constant depth.

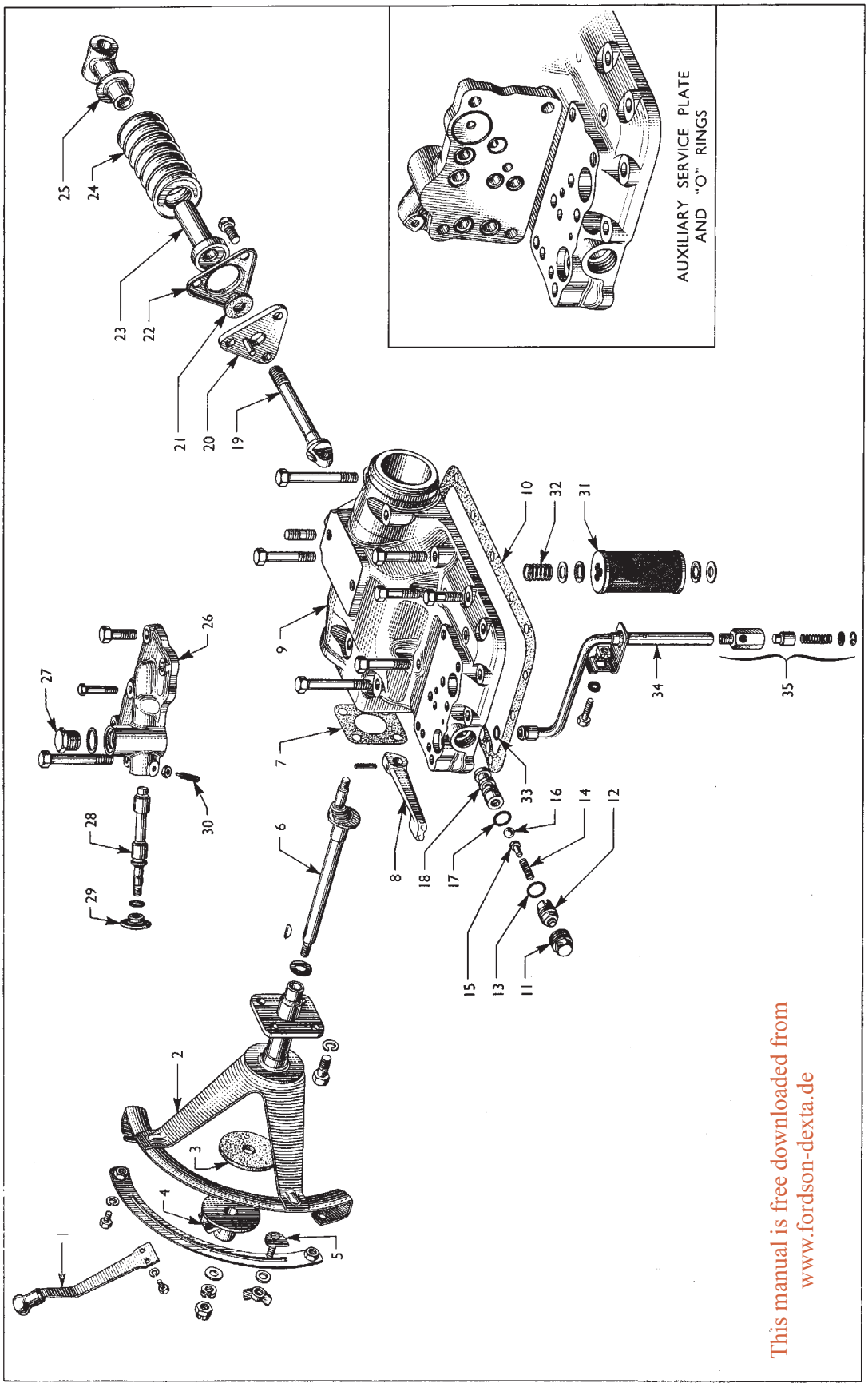

Fig. 4 Hydraulic Lift Cover Assembly, Auxiliary Service Control Assembly and Exhaust Filter Assembly

1 Main Control Lever
2 Quadrant Assembly
3 Friction Disc
4 Friction Plate
5 Control Lever Stop
6 Control Lever Shaft
7 Quadrant Gasket
8 Selector Lever
9 Lift Cover
10 Lift Cover Gasket
11 Check Valve Plug
12 Check Valve Pilot
13 "O" Ring
14 Check Valve Spring
15 Check Valve Ball and Spring Guide
16 7/16" Diameter Ball
17 "O" Ring
18 Check Valve Seat
19 Main Control Spring Plunger
20 Plunger Locking Plate
21 Felt Washer
22 Spring Seat Support
23 Spring Seat
24 Main Control Spring
25 Yoke
26 Auxiliary Service Control Valve Plate
27 Auxiliary Service Take-Off Plug
28 Auxiliary Service Control Valve Spool
29 Auxiliary Service Control Knob
30 Detent Spring and Plunger Assembly
31 Exhaust Oil Filter
32 Exhaust Oil Filter Spring
33 Exhaust Pipe "O" Ring
34 Exhaust Oil Pipe
35 Back Pressure Valve Assembly

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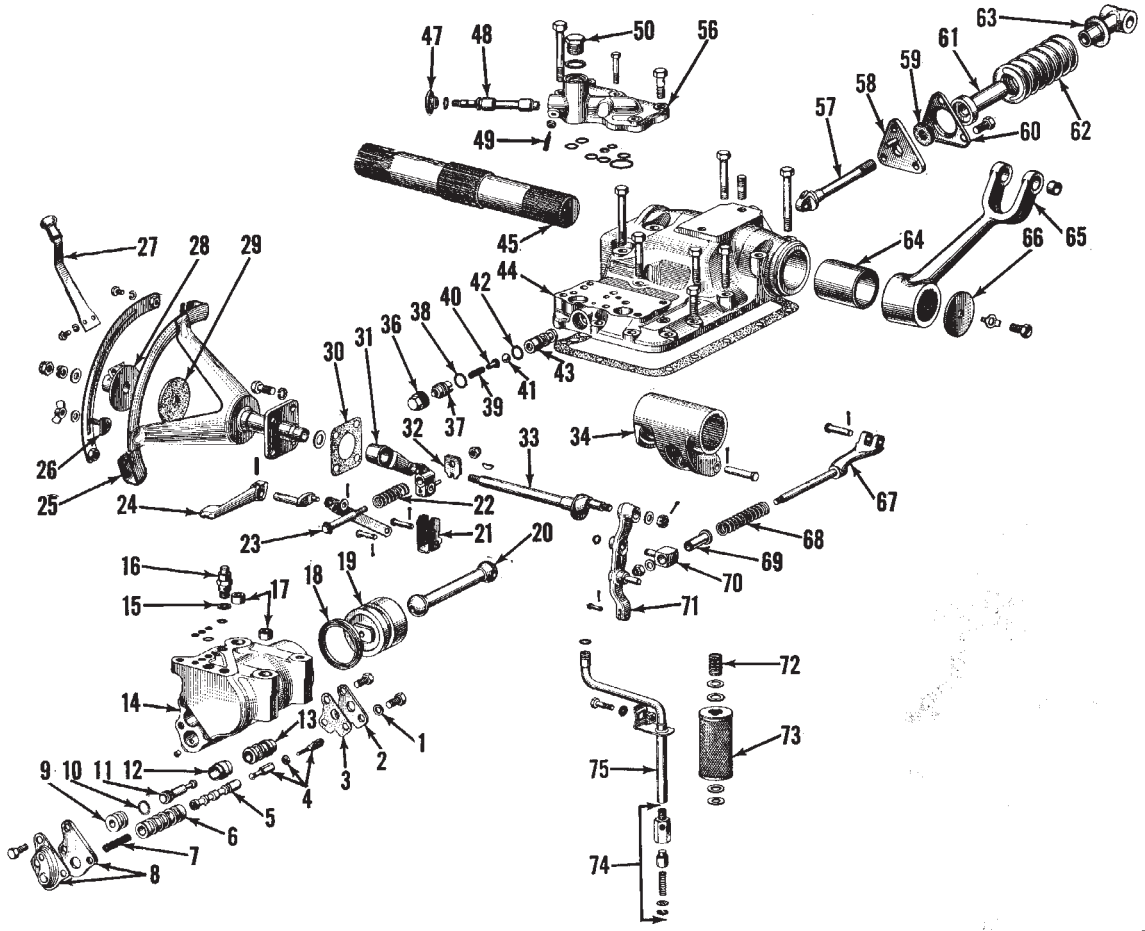

Fig. FO563 — Exploded view of early Fordson Dexta hydraulic lift cover, cylinder and linkage. Accessory plate (56) can be replaced with flow control valve (54—Fig. FO564) if complete valve and linkage are used. Although component parts are different, complete lift cylinder assembly (14) is interchangeable with later type complete lift cylinder assembly (14A — Fig. FO564).

1. Sealing washer
2. Rear cover
3. Gasket
4. Control valve link
5. Control valve
6. Control valve bushing
7. Control valve spring
8. Baffle plate
9. Unload valve plug
10. Unload valve "O" ring
11. Unload valve
12. Unload valve bushing (front)
13. Unload valve bushing (rear)
14. Lift cylinder
15. Copper gasket
16. Safety valve
17. Dowel pins
18. Piston seal
19. Piston
20. Piston rod
21. Control cam
22. Position control spring
23. Position control rod
24. Position control selector lever
25. Quadrant
26. Lever stop
27. Control lever
28. Friction plate
29. Friction disc
30. Gasket
31. Position control arm
32. Stamped adjusting nut
33. Control lever shaft
34. Ram lift arm
36. Check valve plug
37. Check valve pilot
38. "O" ring
39. Check valve spring
40. Check valve spring guide
41. Check valve
42. "O" ring
43. Check valve seat
44. Lift cover
45. Lift arm cross shaft
47. Remote cylinder selector knob
48. Selector valve spool
49. Detent assembly
50. Jack tapping plug
56. Accessory plate
57. Control spring plunger
58. Retaining plate
59. Felt seal
60. Seat support
61. Spring seat
62. Main control spring
63. Control spring yoke
64. Bushings (2)
65. Lift arm
66. Retaining washer
67. Draft control link
68. Over-ride spring
69. Bushing
70. Draft control swivel
71. Valve control lever
72. Spring
73. Oil filter element
74. Back pressure valve
75. Return tube

Two differant types of Auxily Service Control Valves were made. This page and the page before is taken from an I&T Shop Manual

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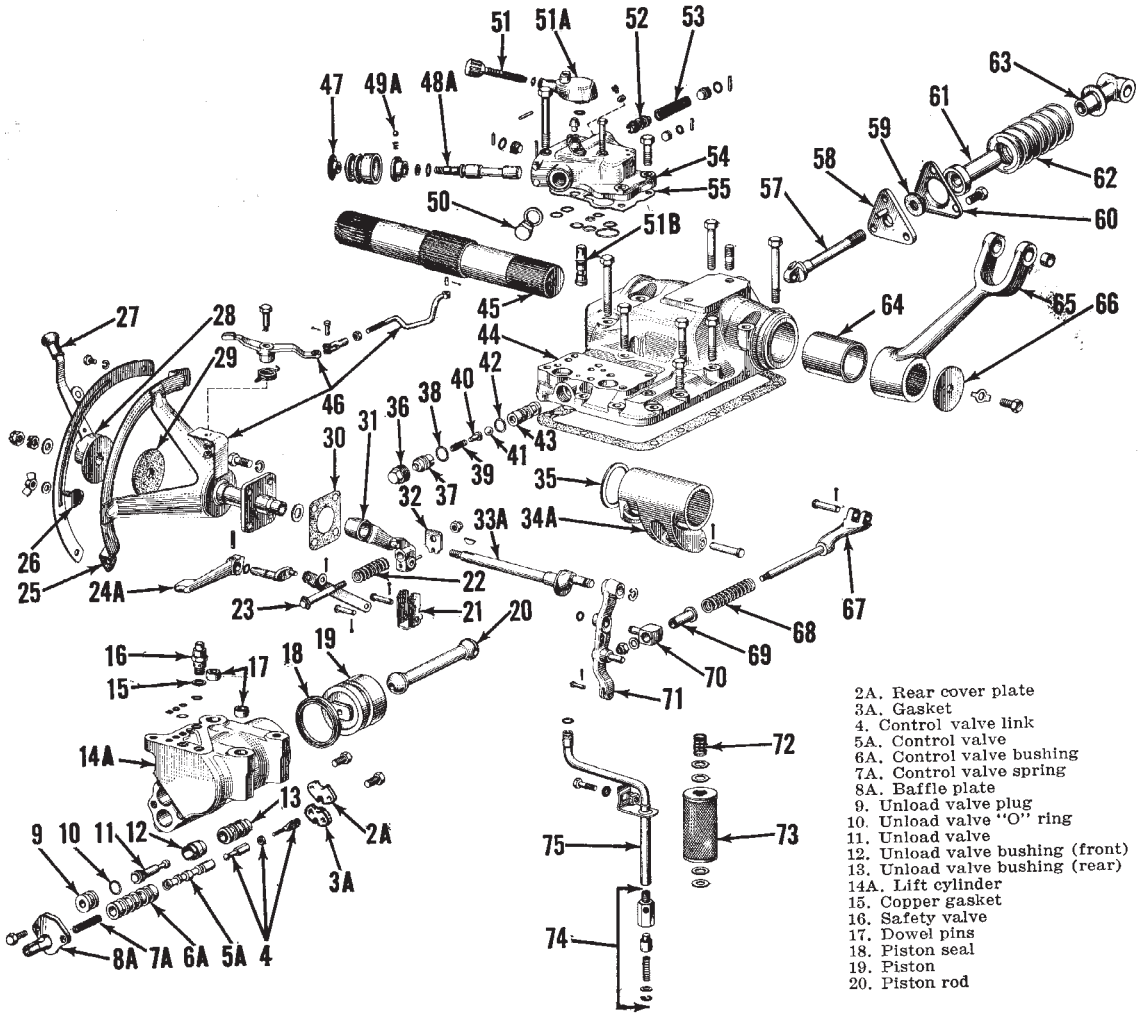

2A. Rear cover plate
3A. Gasket
4. Control valve link
5A. Control valve
6A. Control valve bushing
7A. Control valve spring
8A. Baffle plate
9. Unload valve plug
10. Unload valve "O" ring
11. Unload valve
12. Unload valve bushing (front)
13. Unload valve bushing (rear)
14A. Lift cylinder
15. Copper gasket
16. Safety valve
17. Dowel pins
18. Piston seal
19. Piston
20. Piston rod

Fig. FO564 — Exploded view of late hydraulic lift cover, cylinder and linkage. Ram lift arm (34A) and spacer (35) may be used to replace early production lift arm (34—Fig. FO563). Control lever shaft (33A) and snap ring may be used to replace early production shaft (33—Fig. FO564), washer and nut.

21. Control cam
22. Position control spring
23. Position control rod
24A. Position control selector lever
25. Quadrant
26. Lever stop
27. Control lever
28. Friction plate
29. Friction disc
30. Gasket
31. Position control arm
32. Stamped adjusting nut
33A. Control lever shaft
34A. Ram lift arm
35. Spacer washer
36. Check valve plug
37. Check valve pilot
38. "O" ring
39. Check valve spring
40. Check valve spring guide
41. Check valve
42. "O" ring
43. Check valve seat
44. Lift cover
45. Lift arm cross shaft
46. Flow control valve linkage
47. Remote cylinder selector knob
48A. Selector valve spool
49A. Detent assembly
50. Jack tapping plug
51. Restrictor adjusting knob
51A. Restrictor control lever
51B. Restrictor valve
52. Flow control valve spool
53. Flow control valve spring
54. Flow control valve housing
55. Gasket
57. Control spring plunger
58. Retaining plate
59. Felt seal
60. Seat Support
61. Spring seat
62. Main control spring
63. Control spring yoke
64. Bushing (2)
65. Lift arm
66. Retaining washer
67. Draft control link
68. Over-ride spring
69. Bushing
70. Draft control swivel
71. Valve control lever
72. Spring
73. Oil filter element
74. Back pressure valve
75. Return tube

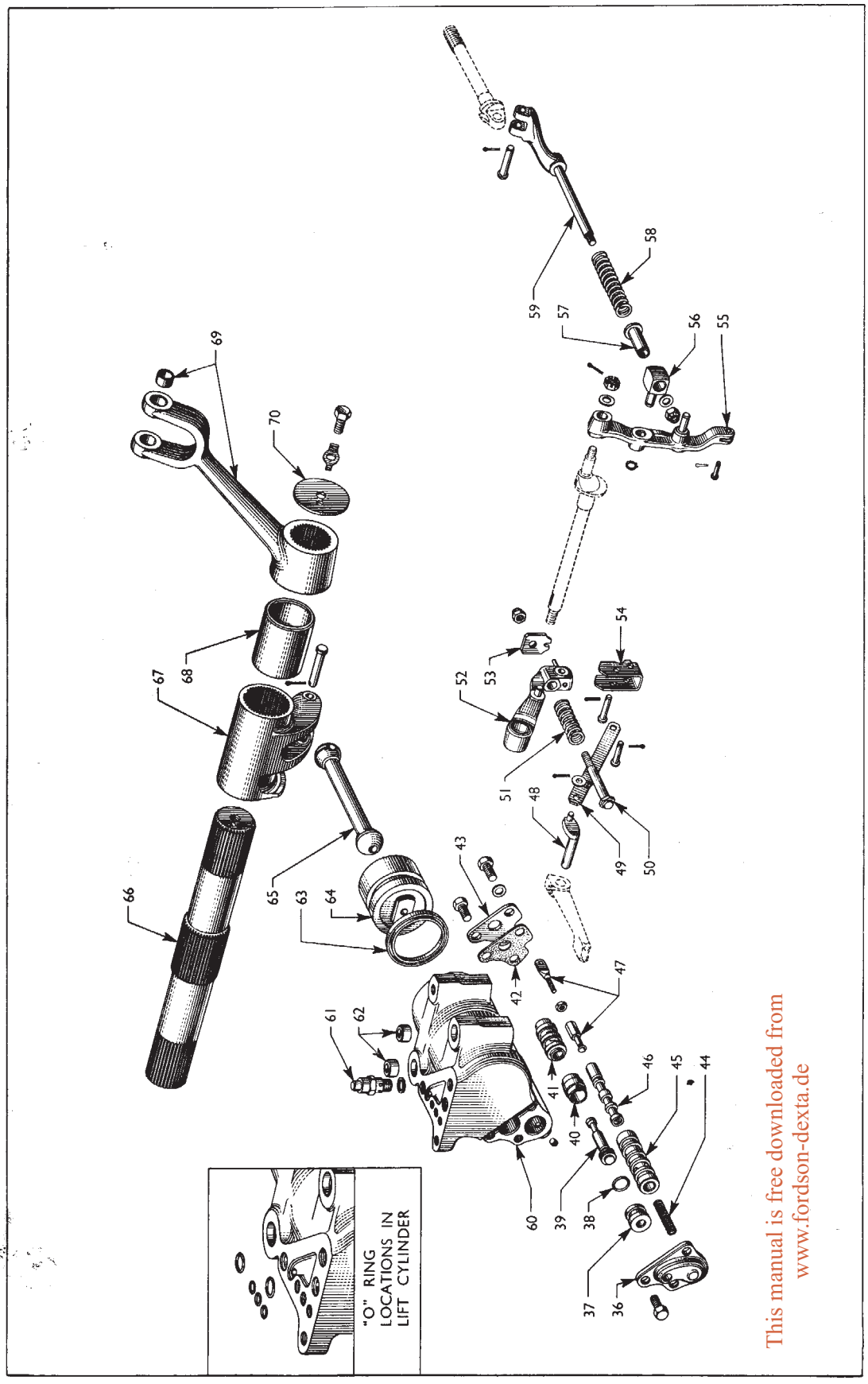

Fig. 5 Hydraulic Lift Cylinder Assembly, Linkage and Lift Arms

36 Cylinder Cover Plate (Front)
37 Unloading Valve Plug
38 Unloading Valve "O" Ring
39 Unloading Valve
40 Unloading Valve Bush (Front)
41 Unloading Valve Bush (Rear)
42 Gasket—Cylinder Cover Plate (Rear)
43 Cylinder Cover Plate
44 Control Valve Spring
45 Control Valve Bush
46 Control Valve
47 Turnbuckle and Link
48 Selector Control Arm
49 Selector Control Link
50 Position Control Rod
51 Position Control Spring
52 Position Control Arm
53 Position Control Drawbar Plate
54 Position Control Cam
55 Control Valve Actuating Lever
56 Qualitrol Swivel
57 Qualitrol Bush
58 Qualitrol Override Spring
59 Qualitrol Link
60 Lift Cylinder
61 Lift Cylinder Safety Valve
62 Lift Cylinder Dowels
63 Piston Gland
64 Ram Piston
65 Ram Piston Connecting Rod
66 Lift Cross-shaft
67 Ram Arm
68 Lift Cross-shaft Bushing
69 Lift Arm and Bush
70 Lift Cross-shaft Washer

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HYDRAULIC POWER LIFT FUNCTION

Raising or lowering of the lift arms is effected, in both Qualitrol and Position Control, by first ensuring that the auxiliary service control knob is pushed in, and then moving the main control level within its quadrant. Any required working depth for an implement has a corresponding position on the quadrant and, once this depth has been established, an adjustable stop on the quadrant may be set and the depth quickly regained, after a lifting cycle, by returning the control lever to the stop.

To operate auxiliary equipment, the auxiliary service control knob must first be pulled out, after which oil may be directed to and from the auxiliary equipment by movement of the main control lever.

When operating equipment from the auxiliary service under Qualitrol there is a short range of travel for the main control lever, near the top of the quadrant, within which the full range of control is available. By finding a neutral position within this range, and placing the adjustable stop at this point, the auxiliary equipment may be held at any required height merely by moving the main control lever against this stop.

It is important that the main control lever is in a neutral position before changing from lift arm to auxiliary service operation or vice versa.

NOTE.—If the lift arms are fully raised, the ram piston will hold the control valve in neutral and the " neutral " position for the main control lever will be against the *fixed* stop at the top of the quadrant (see " Raising under Qualitrol "). It will then be necessary to move the control lever past the fixed stop to raise auxiliary equipment.

LINKAGE OPERATION UNDER QUALITROL

Lowering under Qualitrol

Qualitrol is selected by placing the selector lever in the downward position.

Assuming the implement to be initially in the fully raised position, lowering may be effected by moving the main control lever down the quadrant. (See Fig. 6.) Such movement of the control lever moves the upper end of the control valve actuating lever forward and decreases the pressure applied by the qualitrol override spring to the actuating lever swivel. The control valve spring therefore moves the control valve rearwards to the lowering position, and oil is exhausted from the ram cylinder, allowing the lift arms to rotate and the implement to be lowered. Lowering will commence when the control lever is moved a short distance from the stop at the top of the quadrant and will continue until the implement touches the ground, or the control lever is moved back to within approximately 1 in. (25.4 mm.) of the stop at the top of the quadrant.

Immediately the tractor moves forward into work, the weight and suck of the implement tends to increase

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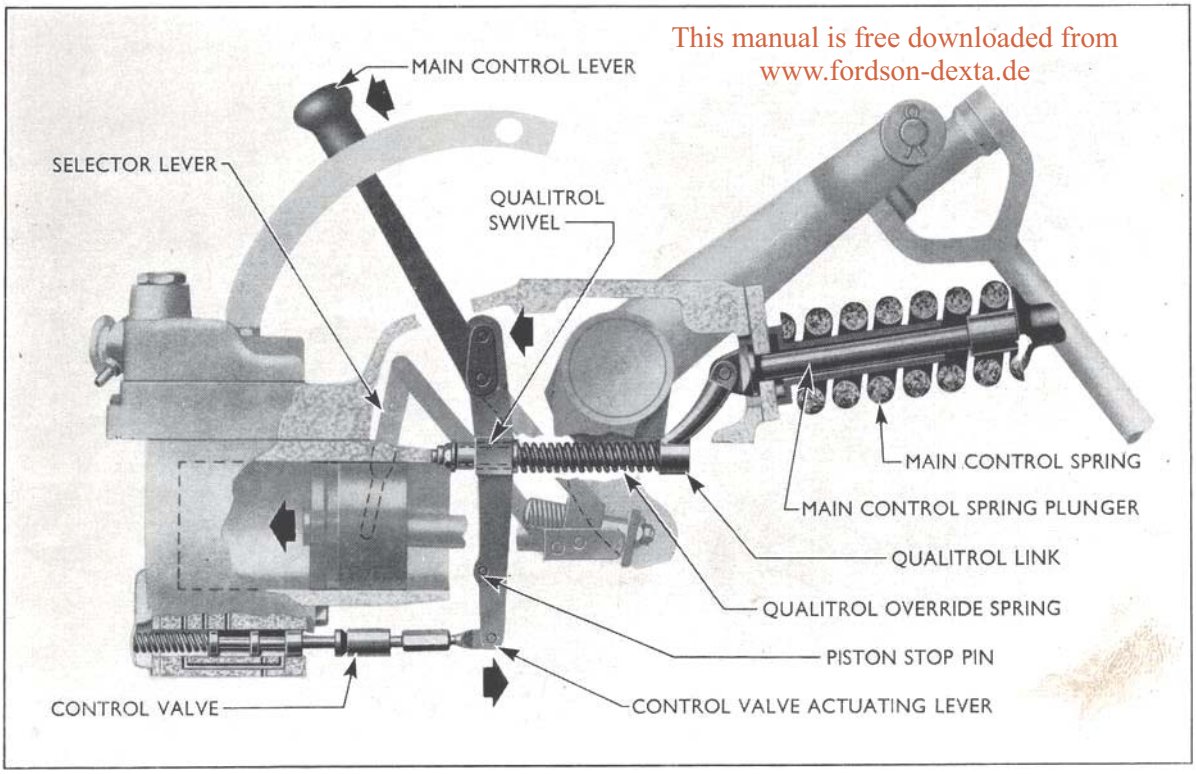

Fig. 6
Qualitrol Linkage - Lowering

the working depth and causes the implement to rotate about the lower link mounting pins, thereby applying a compressive force to the upper link. This force varies in accordance with the depth of work and the resistance of the soil to forward motion.

As the depth, and hence the compressive force on the upper link increases, a thrust is transferred through the rocker (pivoted to the rear transmission housing) to the main control spring plunger, compressing the main control spring and moving the plunger and qualitrol link forward. This movement of the qualitrol link within the actuating lever swivel compresses the qualitrol override spring and so applies a force to the swivel.

Positioning of the main control lever on the quadrant will establish a definite position for the upper end of the control valve actuating lever. When the implement reaches the required depth, the force applied to the swivel causes the actuating lever to pivot at its upper end and move the control valve forward, against the action of the control valve spring, to the neutral position, and lowering ceases.

It is, therefore, the balancing of compression of the qualitrol override spring and the control valve spring, together with the establishment of a pivot point for the actuating lever by the positioning of the main control lever on the quadrant, which governs movement of the control valve and establishes a neutral position.

Operation in work under Qualitrol

Assuming that the implement has now reached the required working depth, the main control spring will be partially compressed, and, as long as the implement draft remains constant, the control valve remains in neutral and no further changes in depth take place.

As soon as an increase in draft occurs a resultant increase in compression of the main control spring takes place, the effect of which is transferred through the qualitrol linkage to move the control valve into the raising position (see Fig. 7). Oil then flows to the ram cylinder and the implement rises until the draft decreases to the amount previously obtained, thus allowing the main control spring to expand to its former position and the control valve to be moved back to the neutral position.

Conversely, a decrease in draft allows the main control spring to expand and the control valve to move to the lowering position, whereupon the weight and suck of the implement carries it to a greater depth. The draft is thus increased to that previously obtained and the control valve again moves back to the neutral position.

By making these slight corrections, therefore, the hydraulic system automatically adjusts itself to maintain a constant draft at the implement.

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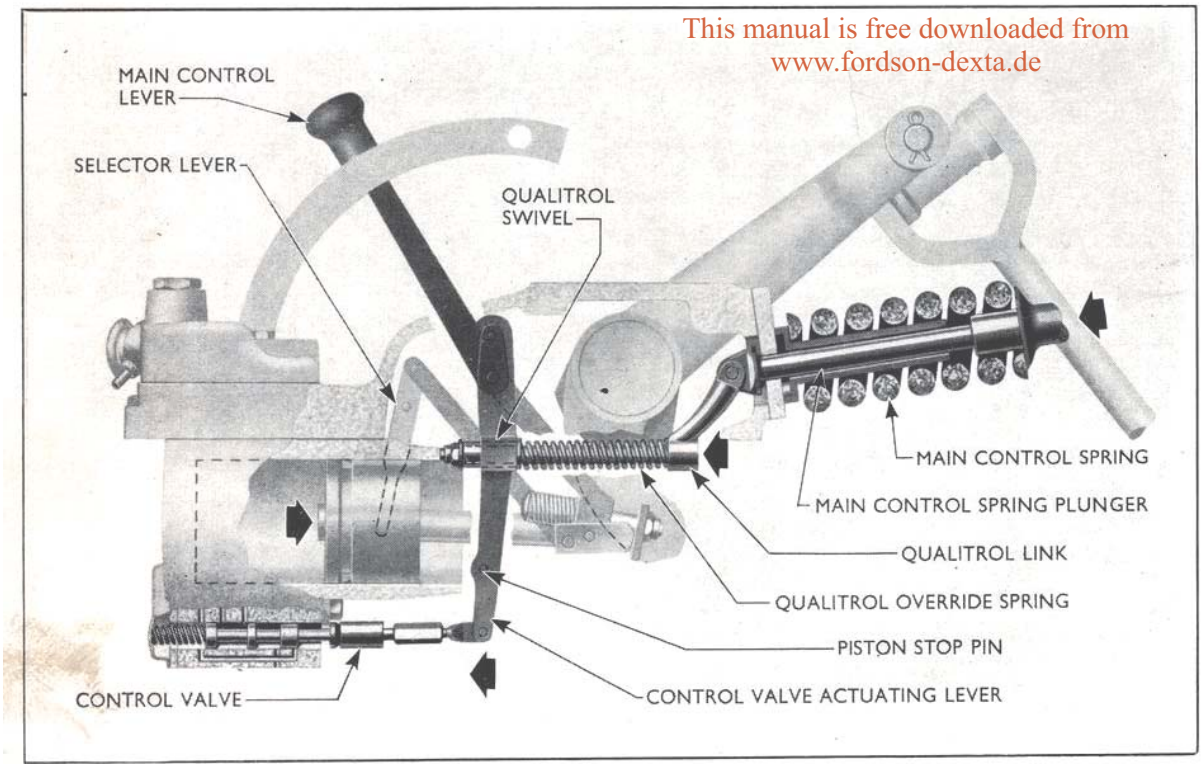

Fig. 7
Qualitrol Linkage - Raising in Work

Raising under Qualitrol

To raise the implement from its working position the main control lever should be moved up the quadrant, thus moving the upper end of the control valve actuating lever to the rear, causing it to pivot at the swivel and move the control valve forward, against the action of the control valve spring, into the raising position. As long as the implement remains in the ground, raising will be directly proportionate to the decrease in implement draft as established by the amount of upward movement given to the control lever, but to fully raise the implement to the transport position the control lever must be moved to the top of the quadrant (i.e. against or within 1 in. (25.4 mm.) approx. of the stop).

As the lift arms reach the fully raised position the ram piston will have moved out sufficiently for the rear edge of the piston to contact a pin on the control valve actuating lever, so forcing the lever to the rear and the control valve into a neutral position.

Raising may also be stopped, to establish an intermediate transport position, by moving the main control lever downwards again and allowing spring pressure to move the control valve into neutral.

LINKAGE OPERATION UNDER POSITION CONTROL

For work on fairly level ground with no wide variations in soil resistance, position control enables the working depth of the implement to be pre-set and for all practical purposes accurate work at constant depth can be achieved.

It is also suitable for operating implements which require to be worked at a set height from the ground, i.e. mowers, weeders, and steerage hoes.

To operate under position control the selector lever should be placed in a horizontal position, thus bringing into action the special linkage between the servo cam on the ram arm and the control valve actuating lever which overrides the qualitrol linkage.

The pivot point for the control valve actuating lever is now moved to the pad machined on the actuating lever immediately below the qualitrol swivel. In operation the pad on the actuating lever contacts the position control rod, compressing the position control rod spring and forcing the control arm pin against the servo cam on the ram arm, which acts as a stop.

As both the ram arm and the lift arms are splined to the lift cross-shaft, raising or lowering of the lift arms will cause the ram arm cam to rotate and so regulate movement of the control valve.

Lowering under Position Control

As with Qualitrol, lowering may be effected by moving the control lever down the quadrant. There is, however, one significant difference in that under Qualitrol the implement is lowered to the ground

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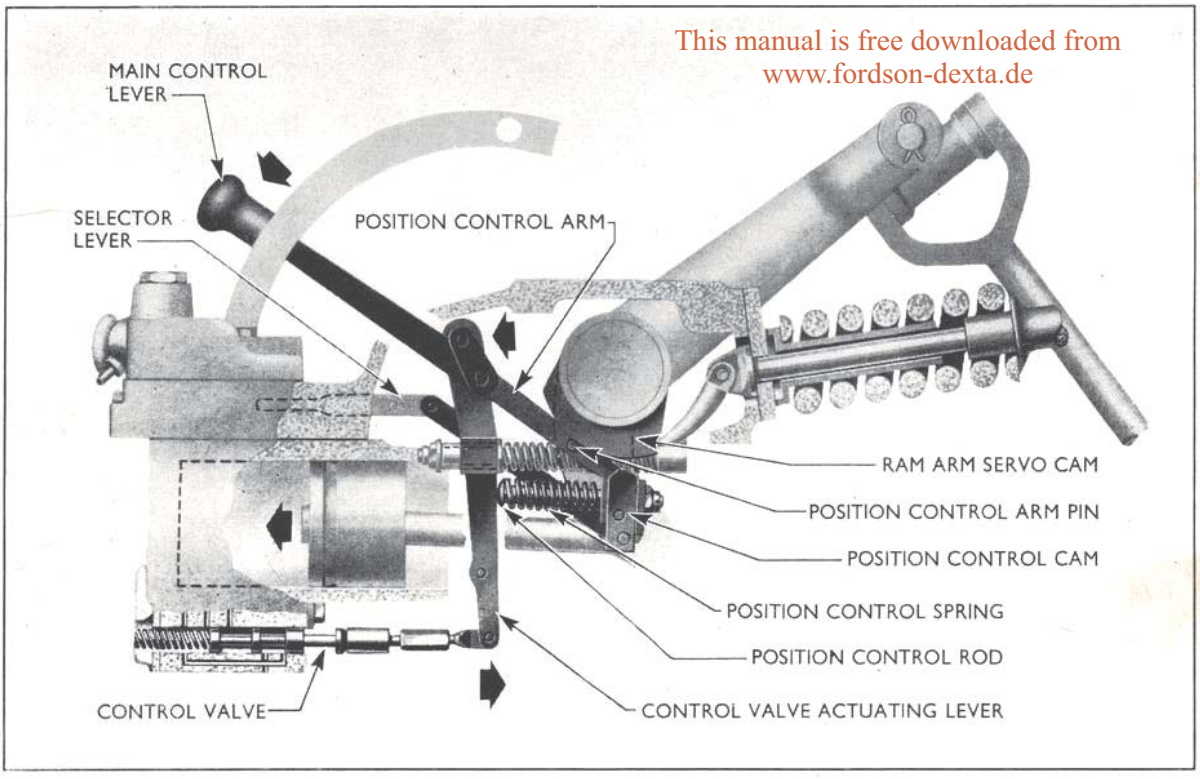

Fig. 8
Position Control Linkage - Lowering

almost immediately the control lever is moved away from the stop at the top of the quadrant (unless the control lever is moved back up the quadrant), whereas under position control the implement is lowered an amount directly proportionate to the amount of movement of the control lever.

As the control lever is moved down the quadrant the upper end of the actuating lever moves forward, away from the position control rod, thus relieving the compression on the position control spring and allowing the control valve spring to move the control valve into the lowering position. (See Fig. 8.) Oil is then exhausted from the ram cylinder and the lift arms drop under the weight of the implement.

As the lift arms drop, however, the cam on the ram arm forces the position control arm forward, gradually increasing the compression on the position control spring until the pressure exerted on the actuating lever by the control rod is sufficient to overcome the force applied by the control valve spring. When this condition is reached, the actuating lever pivots at its attachment to the control lever cross-shaft and moves the control valve into the neutral position.

The positioning of the main control lever on the quadrant establishes the point at which this neutral position is attained and sets the working depth of the implement.

Operation in work under Position Control

In operation, obstructions in the field may tend to force a soil engaging implement out of the ground, but the weight and suck of the implement will immediately return it to its pre-set depth.

Any leakage in the ram cylinder circuit will cause the lift arms to lower, but this will be compensated for by the ram arm cam forcing the position control arm forward, compressing the control valve spring, and thus applying a thrust to the control valve actuating lever to move the control valve into the raising position. The lift arms will then rise to their previous position and the ram arm cam will in consequence relieve the compression on the position control spring, thus allowing the control valve spring to return the control valve to the neutral position.

By making these slight corrections the hydraulic system is automatically adjusted to maintain the implement at a constant depth.

Raising under Position Control

To raise the implement, the control lever should be moved up the quadrant, thus pivoting the actuating lever on the position control rod and moving the control valve into the raising position. (See Fig. 9.) The lift arms will continue to rise until the ram arm servo cam permits the position control arm assembly to move rearward a sufficient amount to allow the control valve to be moved into the neutral position. Thus the nearer the control lever is moved towards the top of the quadrant, the higher the lift arms will be raised.

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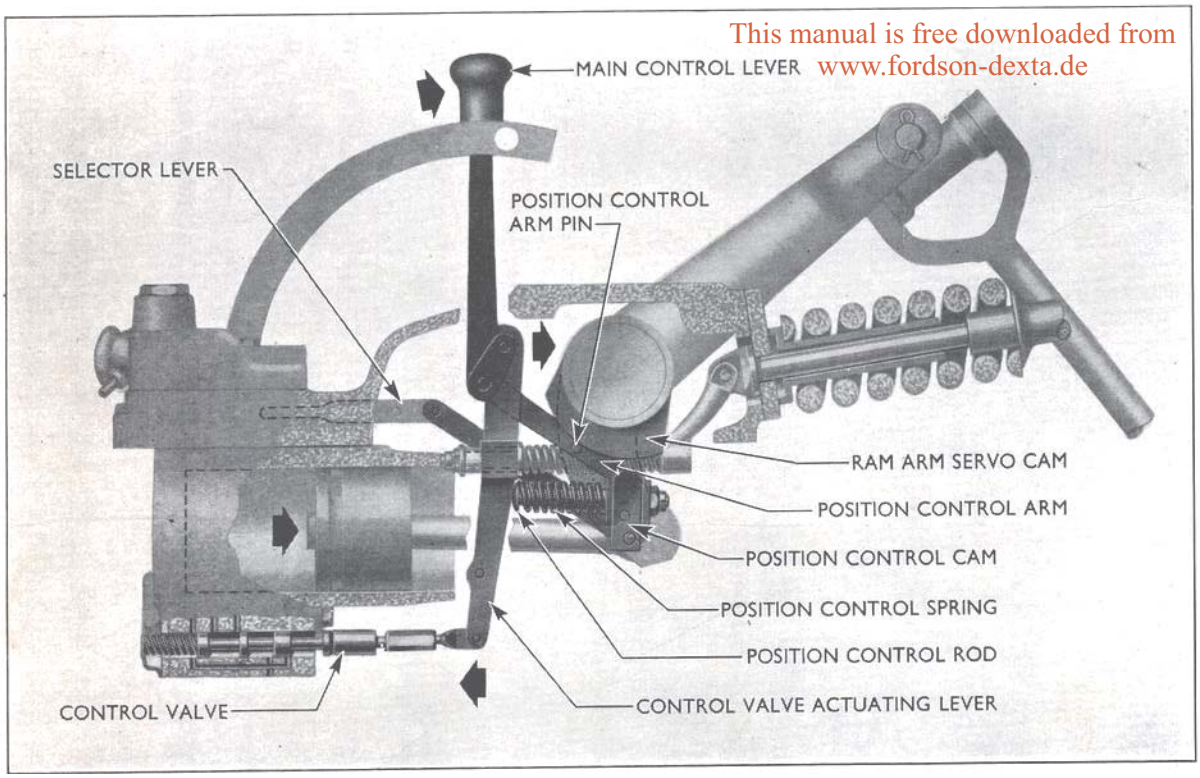

Fig. 9
Position Control Linkage - Raising

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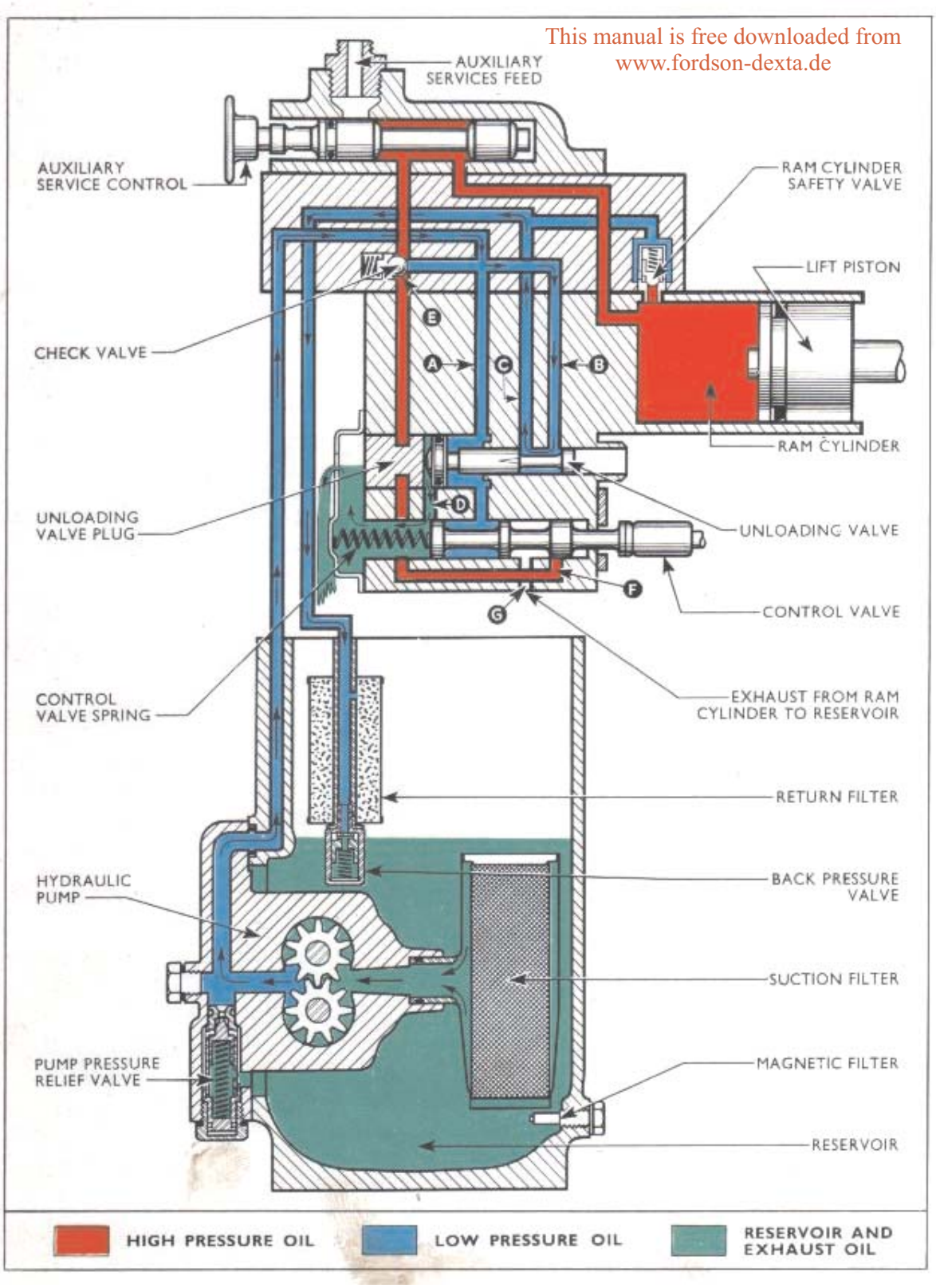

Fig. 10
Hydraulic Oil Flow - Neutral

HYDRAULIC LIFT OIL FLOW

Oil Flow in Neutral Position

The control valve is returned to the neutral position after the desired depth (or height) is reached, and also after each automatic correction is made to maintain draft (under Qualitrol) or position (under Position Control).

Figure 10 shows schematically the oil flow through the system when the control valve is in the neutral position, the flow being identical for both Qualitrol and Position Control.

The hydraulic pump supplies oil to the lift cover where it is passed to the check valve passage and enters the check valve seat. As the check valve ball is retained on its seat by a spring, the oil follows passages 'A' and ' B ' to the unloading valve bushes.

Oil from passage 'A' passes around an annular groove formed by the unloading valve forward bushing and enters the unloading valve chamber through a ' V '-shaped slot, where it works on the rear face of the unloading valve, moving it forward into the unload position.

Any oil in front of the unloading valve is forced, by the forward movement of the valve, into the control valve spring compartment and leaks away to the rear transmission housing through a hole in the top of the front cover plate.

Oil from passage ' B ' passes around, and into, the unloading valve rear bushing, where it is trapped until the unloading valve moves forward and opens up a passage for the oil to flow from passage ' B ' to passage ' C.' The oil now by-passes the check valve chamber and is directed to the auxiliary service plate, from where it is routed to the lift cover and then, via an exhaust pipe and filter, to mix again with the transmission lubricant.

Oil Flow in Raising Position

Oil is supplied by the pump to the check valve chamber as before, but as the control lever is moved to the raising position and the control valve moves forward, a passage ' D ' is opened leading from the control valve to the front of the unloading valve; at the same time the leak-off passage leading from the front of the unloading valve to the front cover plate is sealed off.

Oil flows from the check valve passage through drilling 'A' to the unloading valve bushing, some entering the bushing to operate on the rear face of the unloading valve and the rest continuing around the annular recess in the outside diameter of the bushing to the control valve, from where it is now free to pass to the front face of the unloading valve.

As the area in contact with the oil on the front face of the unloading valve is larger than that on the rear face, the total pressure exerted on the front of the valve exceeds the pressure applied to the rear, and in consequence the valve moves rearwards, thus stopping the oil flow between passages ' B ' and ' C.'

Pressure now builds up in the system until it reaches sufficient proportions to move the check valve ball from its seat, against the action of the spring, so allowing the oil to pass to the auxiliary service plate where it is directed, according to the positioning of the auxiliary service control valve, to either the ram cylinder or to auxiliary equipment. For the purposes of illustration, Fig. 11 shows the auxiliary service control valve in the inner position and oil pressure being applied to the ram cylinder piston to raise the lift arms to the height required (in accordance with the positioning of the main control lever).

Oil Flow in Lowering Position

When the control valve is moved to the lowering position, it closes the passage ' D ' from the control valve to the front of the unloading valve and opens up ports ' F ' and ' G.'

Oil from the pump therefore follows the usual channels to the check valve chamber and then through passage 'A' to enter the unloading valve bush, where it operates on the rear face of the unloading valve. As the passage to the front of the unloading valve is closed, no pressure is applied to the front face of the valve and it therefore moves forward, opening up a passage for the oil to flow from ' B ' to ' C ' and so back to the transmission housing (as in the neutral position). Oil remaining in front of the unloading valve is forced out through the control valve spring chamber and leaks off through the hole in the front cover plate.

No pressure build-up can therefore occur in the system and the check valve closes.

The weight of the implement now forces the piston forward and drives the oil from the ram cylinder through suitable passages in the lift cover to passage 'E,' which by-passes the check valve and connects with an annular groove in the unloading valve plug. A vertical drilling connects the annular groove in the plug with a longitudinal passage leading to port ' F.'

Oil, therefore, flows through port ' F ' into the control valve, from where it is exhausted through port ' G,' which is open to the rear transmission housing. (See Fig. 12.)

HYDRAULIC CONTROL ADJUSTMENTS

Adjustment of Main Control Lever

After an extensive period of operation, wear on the main control lever friction plate and friction disc may necessitate adjustment of the nut securing the friction plate to the quadrant. The nut should be tightened so that an effort of 4/5 lbs. (1.814/2.268 kg.), measured with a spring balance, at the top end of the main control lever, is required to move the lever within the quadrant.

Adjustment of Main Control Spring

The main control spring setting is correct for all normal operations when there is enough pre-

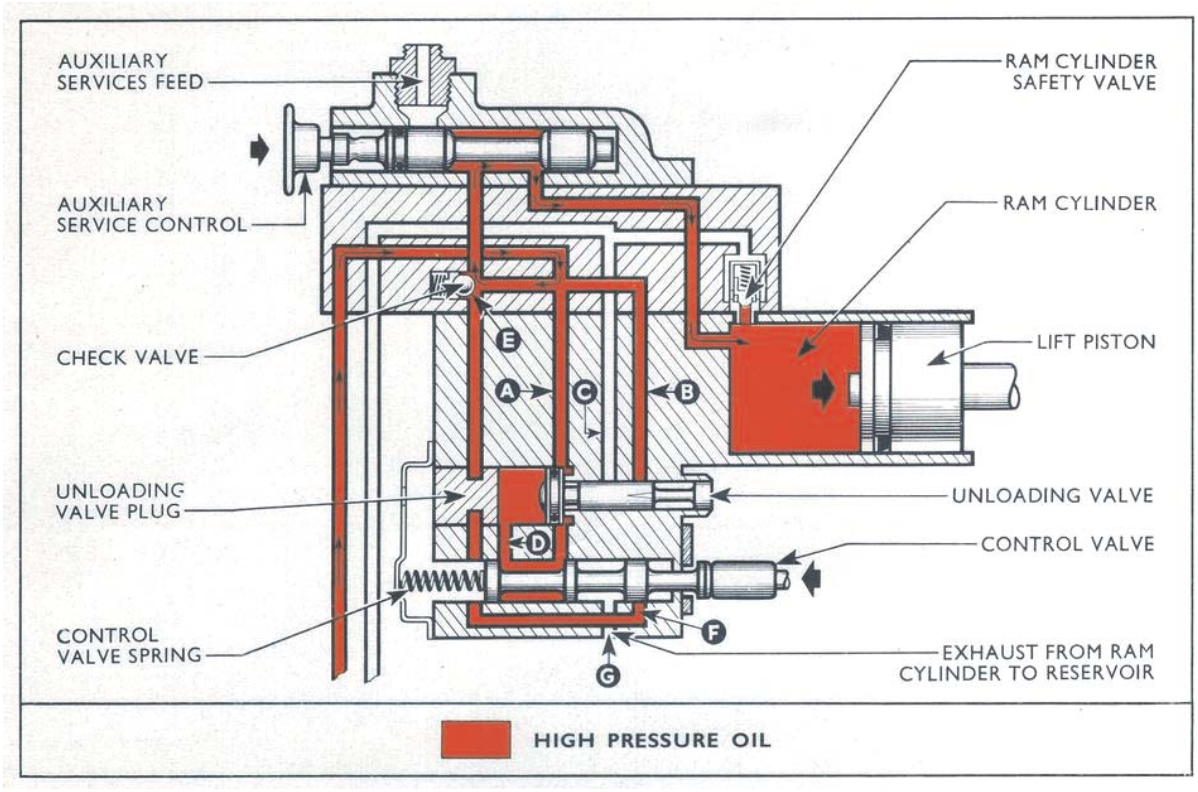

Fig. 11
Hydraulic Oil Flow - Raising

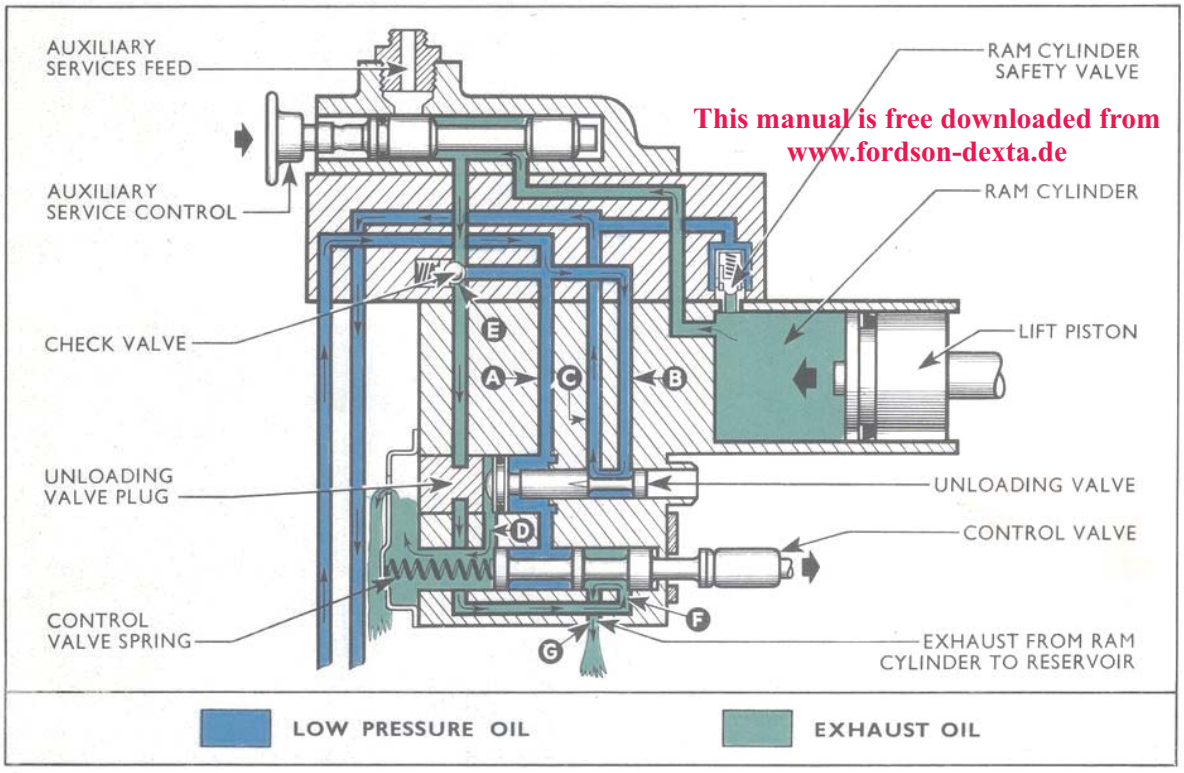

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Fig. 12
Hydraulic Oil Flow - Lowering

compression of the spring to just allow the spring to be rotated with the finger and thumb of one hand.

If it cannot be turned in this manner, or if the pre-compression is insufficient to meet the above requirement, the spring plunger yoke should be released from its connection to the rocker and turned in a clockwise direction to increase the loading on the spring, and vice versa to decrease the loading.

When operating under Qualitrol it may be advantageous, when undertaking certain operations, to increase the spring pre-compression beyond the normal setting, i.e. in order to obtain abnormal penetration from an earth moving implement. Before resorting to such a procedure, care must be taken to ensure that the implement itself is correctly set.

It must also be realised that with such settings the sensitivity of the Qualitrol will be reduced and care must be taken to correct the spring adjustment before resuming normal operations.

Qualitrol Linkage Adjustment

1. Remove the lift assembly from the tractor (see section headed " To Dismantle the Hydraulic Lift Assembly ") and place it in a soft jawed vice with the main control spring pointing upwards. (See Fig. 13.)

2. Before attempting any adjustment to the qualitrol linkage the main control spring must first be adjusted correctly and then tightened a further half turn.

3. Assemble locating arm T.8512/a to the underside of the lift cover flange, attaching it to the two rear holes on the right-hand side. Insert the locating pin T.8512/f through the arm and right-hand lift arm bush. (See Fig. 13.)

4. Place the selector lever in the downward position, i.e. at right angles to the lift cover.

5. Raise the main control lever to within .5 in. (12.7 mm.) of the stop formed by the upper hexagon nut on the quadrant. Slip gauge T.8512/g has a sideways dimension of exactly .5 in. (12.7 mm.) and this may be inserted between the quadrant stop and the lever so that the lever may be accurately positioned for adjustment (the gauge is shown dotted in Fig. 13).

6. Remove the slip gauge from the quadrant, loosen the control valve turnbuckle locknut and adjust the turnbuckle until the Qualitrol end of slip gauge T.8512/g can be just inserted between the control valve and the rear end of the control valve bush. After adjustment, tighten the turnbuckle locknut and recheck with the slip gauge.

7. Back off the main control spring yolk to obtain the correct operating adjustment of the main control spring before replacing the lift.

Position Control Adjustment

Before attempting to adjust this control the main control spring must be set correctly and the qualitrol linkage adjustment carried out ; then proceed with the following operations :—

1. Place the selector lever in a horizontal position, i.e. parallel with the lift cover.

2. Move the main control lever down the quadrant until it rests against the stop formed by the hexagon nut at the lower end of the quadrant.

3. Hold the position control rod locknut and turn the position control rod until the Position Control end of the slip gauge T.8512/g can be just inserted between the control valve and the rear end of the control valve bush. (See Fig. 14.)

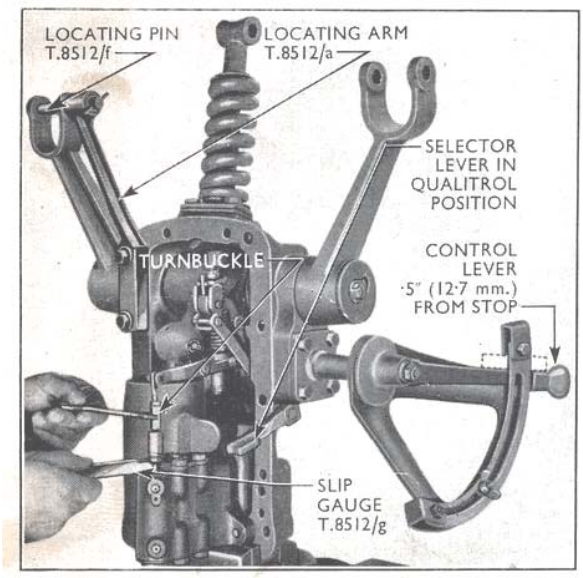

Fig. 13
Qualitrol Linkage Adjustment

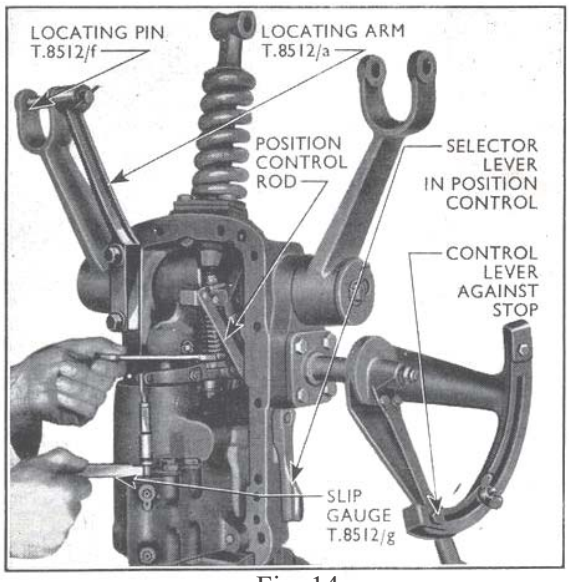

Fig. 14
Position Control Linkage Adjustment

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TO DISMANTLE THE HYDRAULIC LIFT ASSEMBLY

Absolute cleanliness is essential when undertaking repairs on the hydraulic lift and every precaution must be taken to see that all mud or dirt is removed before any attempt is made to disturb the lift or dismantle any of its components. It is recommended that suitable clean receptacles are provided for all small components and that parts with highly finished surfaces are carefully cleaned as they are removed, and placed on clean cloth to prevent damage.

To Remove the Auxiliary Service Control Plate Assembly

1. Remove the two nuts and spring washers retaining the driving seat spring to the studs located in the lift cover and remove the seat.

2. Extract the five set-screws retaining the auxiliary service control plate to the hydraulic lift top cover.

NOTE.—The two screws on the right-hand side of the plate are longer than the others and pass through both plate and cover into tapped holes in the wall of the rear transmission housing. The centre screw is the shortest of the five screws used.

To Dismantle the Auxiliary Service Control Plate Assembly

1. Remove the eight rubber ' O ' rings and discard them.

2. Remove the nut from the valve spool locking plunger assembly and extract the assembly from the plate.

3. Withdraw the valve spool complete with operating knob and remove the knob if necessary.

To Rebuild the Auxiliary Service Control Plate Assembly

1. Replace the valve spool in the plate. If it is necessary to fit a new spool it should be noted that it is a selective fit in the plate. (See Specification.) When making the assembly the largest valve should be fitted which will operate without binding in the housing. It is most important that great care is taken whilst handling the valve spools to obviate the possibility of burrs, distortion or bruising, otherwise it is possible to obtain a misleading impression as to the correct size of the valve required when making the assembly.

2. Assemble the locking plunger and spring assembly to the plate. Screw in the assembly until the plunger locates in the valve spool and adjust until the control knob can be operated without undue effort. Retain with a locking nut and operate the spool to ensure freedom of movement.

3. Fit a new set of rubber ' O ' rings in the various counterbores of the oil passages on the underside of the plate.

NOTE.—There are three different ' O ' ring sizes and the correct size of ring must be used in each passage (see Fig. 15).

See that the machined surface of the plate is carefully handled to avoid scoring or bruising which could give rise to an uneven surface and consequential oil leaks when the plate is reassembled to the cover.

To Replace the Auxiliary Service Control Plate Assembly

1. Ensure that the mating surfaces of the plate and the lift cover are clean and locate the plate on the cover.

2. Insert and fully tighten the retaining screws.

3. Replace the driving seat, adjust its position and securely tighten the retaining nuts.

To Remove the Lift Cover Assembly

1. Remove the seat and place the main control lever in the lowering position, thus allowing oil to be exhausted from the lift cylinder.

2. Remove the upper link and disconnect the right- and left-hand lifting rods from their respective lift arms.

3. Disconnect the main control spring plunger yoke from the rocker by removing the clevis pin. Swing the rocker away from the yoke.

4. Remove the two screws located on the right-hand side of the auxiliary service control plate, which pass through both the plate and the cover.

5. Remove the twelve remaining screws located around the periphery of the cover and retaining it to the rear transmission housing.

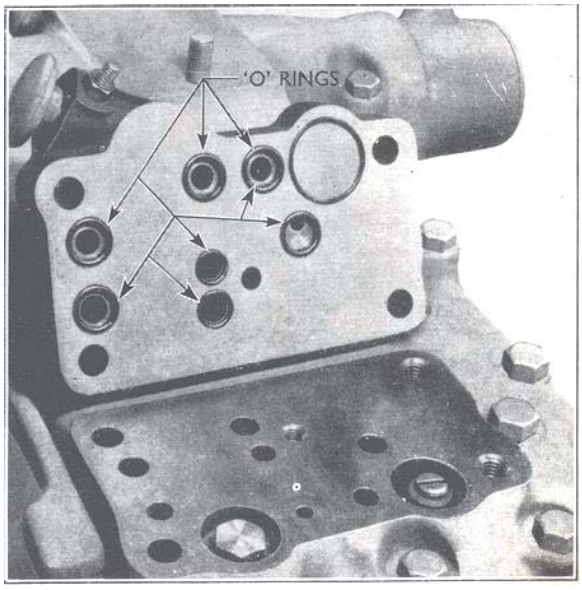

Fig. 15
Auxiliary Service Control Plate

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A note should be made of the positioning of each screw as, apart from the two which pass through both the auxiliary service control plate and the cover, there are five different length screws used at the various locations.

6. Remove the hydraulic lift cover assembly complete with lift cylinder and control linkage.

To Replace the Lift Cover Assembly

1. Fit new 'O' rings at the top of the inlet and exhaust passages in the wall of the rear transmission housing and locate a new gasket on the top surface of the housing. The gasket must be accurately located so that it does not restrict the flow of oil to and from the lift cover.

2. Replace the hydraulic lift cover assembly; insert and fully tighten the retaining screws.

3. Adjust the main control spring plunger yoke as described under "Adjustment of Main Control Spring" and connect the yoke to the rocker with the appropriate clevis pin.

4. Replace the upper link and connect up the lifting rods to the lift arms.

5. Replace the seat as previously described.

To Remove the Check Valve

1. Remove the lift cover assembly as previously described and place the lift cover on a bench suitably supported to protect the machined surface.

2. Unscrew the check valve plug and, using a pair of sharp nosed pliers, extract the valve pilot, spring, spring guide and ball, from the check valve passage in the cover. (See Fig. 16.)

3. The check valve seat is a press fit in the check valve passage in the cover but it is suitably threaded

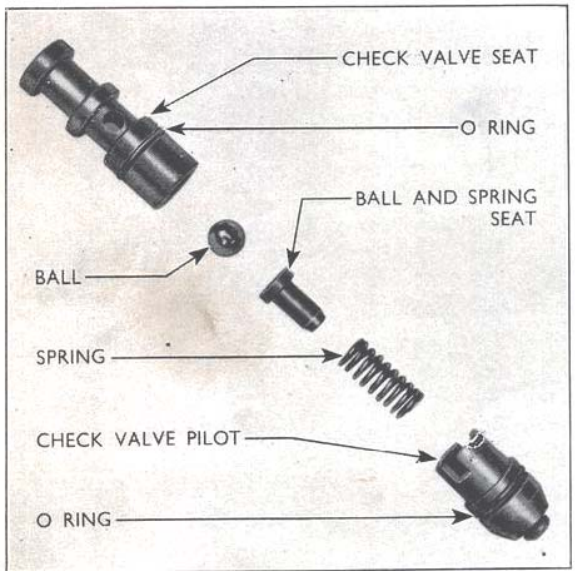

Fig. 16
Check Valve Assembly

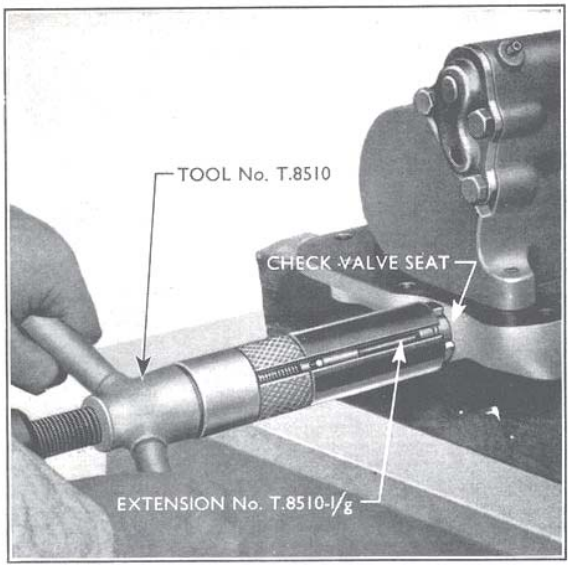

Fig. 17
Removing Check Valve Seat

at its forward end to accept the thread of the removal extension T.8510–1/g (used in conjunction with Tool No. T.8510). Screw the shorter threaded end of the extension into the centre of the tool and the long threaded end into the seat. Operate the wing nut on the tool and withdraw the seat (see Fig. 17).

NOTE.—It is most important that the hollow outer tube of the tool seats squarely against the end of the lift cover during the removal operation, as excessive misalignment may result in breakage of the seat which will then be extremely difficult to remove.

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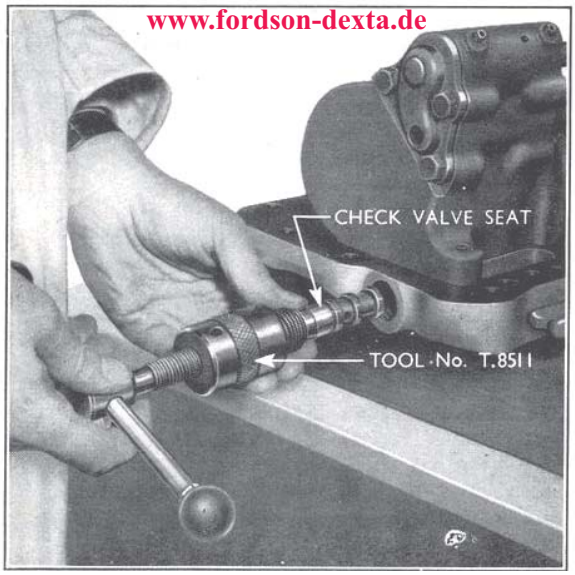

Fig. 18
Replacing Check Valve Seat

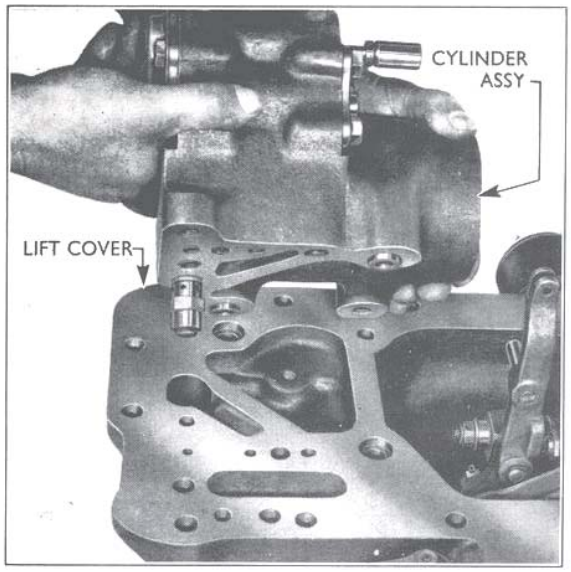

Fig. 19
Removing Lift Cylinder from Cover

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To Replace the Check Valve

1. Examine the seat and renew if scored or damaged on its outer surface or if the actual seat (for the ball) is chipped or damaged.

2. Fit a new ' O ' ring to the recess in the check valve seat and locate the seat on the pilot of Tool No. T.8511 (see Fig. 18). Enter the seat into the check valve passage and screw the body of the tool into the threaded outer end of the passage. Operate the centre screw of the tool and press the check valve seat into position.

3. Remove the tool and instal a new ' O ' ring on the check valve pilot. Assemble the check valve ball, spring guide, spring and pilot to the cover. Replace the check valve plug and tighten to 45/55 lbs. ft. (6.219/7.601 kg.m.) torque.

To Remove the Lift Cylinder Assembly

1. Remove the lift cover as previously described and withdraw the auxiliary service control plate.

2. Disconnect the control valve linkage, by removing the pin securing the turnbuckle assembly to the control valve actuating lever assembly, and remove the turnbuckle.

3. Move the lift arms to the raised position and swing the ram piston connecting rod away from the piston.

4. Remove the four set-screws securing the lift cylinder to the lift cover (one of these is recessed into the cover) and withdraw the cylinder from the cover (see Fig. 19). Pull the cylinder straight out from the cover to avoid damaging the safety valve.

To Dismantle the Lift Cylinder Assembly

1. Remove the cylinder safety valve by turning it anti-clockwise. Use a spanner on the hexagon body of the valve and do not attempt to remove the centre portion. The slot in the centre portion of the valve is for adjustment purposes when the valve is originally assembled. It is set to open at 2,400 lbs. per square inch (168.74 kg. per sq. cm.) and then sealed. No attempt should be made to break the seal, but if at any time the valve is suspected of being faulty it should be removed and replaced with a new assembly which is known to be correct.

2. If necessary remove the two dowel rings from the top face.

3. Discard the five ' O ' rings fitted in the counter-bores of the various oil passages.

4. Turn the cylinder onto its top face (or hold it in a soft jawed vice) and, to prevent damage to the machined surface, ensure that the bench top is smooth and clean.

5. Remove the three set-screws securing the front cover plate to the lift cylinder and remove the plate and control valve spring.

6. Remove the three set-screws securing the rear cover plate to the lift cylinder and remove the plate and gasket. It should be noted that a copper sealing washer is fitted under the head of the screw located between the control valve and the lift cylinder. (See Fig. 20). This particular screw fits into the threaded end of a longitudinal passage through which oil is exhausted from the ram cylinder. (Also in communication with this passage is a small vertical drilling located close to the rear blanking plug at the bottom of the cylinder.)

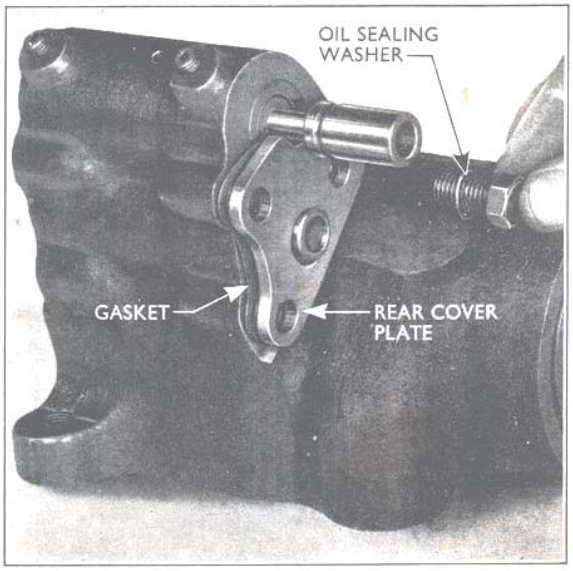

Fig. 20
Removing Rear Cover Plate from Cylinder

7. Remove the control valve, withdrawing it from the rear of the cylinder. Take great care in handling this valve to prevent damage or scoring of the lands, or distortion of the valve as a whole.

8. Attach removing adaptor T.8510–1/f to the main tool T.8510, screw the outer end of the adaptor into the unloading valve plug, at the front end of the unloading valve chamber, and withdraw the plug. (See Fig. 21.)

Note the annular recess in the plug which allows exhaust oil from the ram cylinder to by-pass the unloading valve. It is important that care is taken to avoid damage to the external surface of the plug as a leak past the plug will affect the operation of the lift. (See Fault Diagnosis.)

9. Remove the unloading valve from the front end of the cylinder and discard the ' O ' ring fitted to the large end of the valve.

10. Attach the short threaded end of extension T.8510–1/b to main tool T.8510 and pass the extension through the control valve bush so that the main tool remains at the front end of the cylinder. Screw the special nut T.8150–1/h onto the rear threaded end of the extension until it locates squarely on the rear face of the control valve bush, with the small taper on the front face of the nut located within the bush to centralise the tool. Operate the wing nut of the tool and withdraw the bush (see Fig. 22). Unscrew the special nut and remove the bush from the extension.

11. Pass the extension through the unloading valve bushes, attach the nut, locating it squarely against the rear end of the rear bush, and withdraw both bushes from the cylinder in one operation. (See Fig. 23.)

12. Remove the ram piston by applying air pressure through the safety valve hole whilst holding the thumb over the hole which is adjacent to it. (See Fig. 24.)

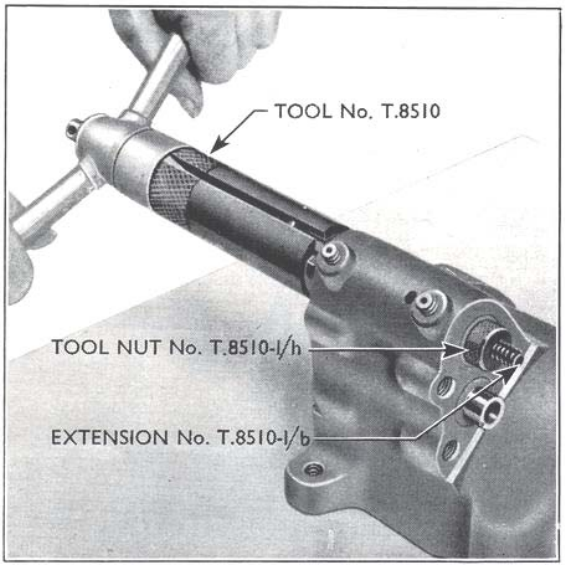

Fig. 22
Removing Control Valve Bush

CAUTION

Do not use excessive air pressure or the piston may fly out suddenly and cause injury or damage. Ordinary foot pump pressure is sufficient to move the piston.

13. Unless the piston gland is known to be giving an absolutely perfect seal it is recommended that the gland is discarded and a new one fitted on reassembly.

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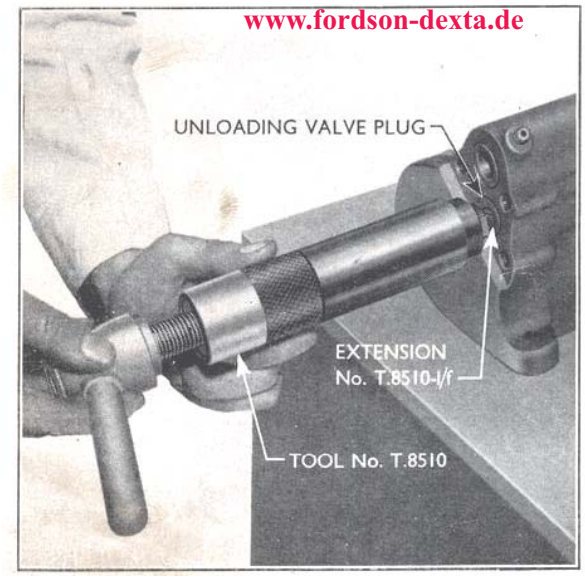

Fig. 21
Removing Unloading Valve Plug

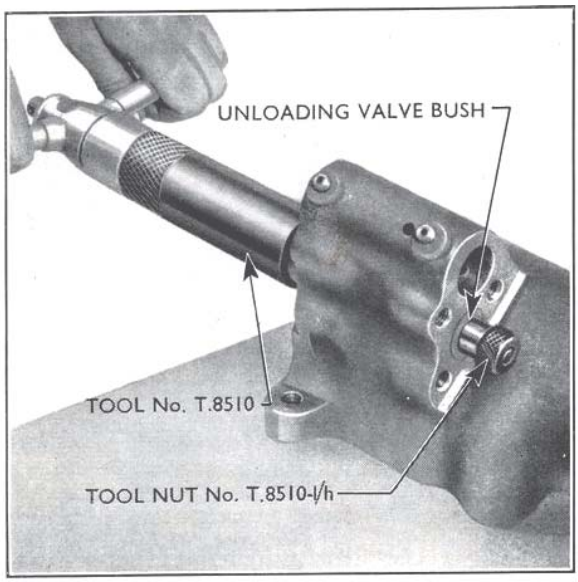

Fig. 23
Removing Unloading Valve Bush

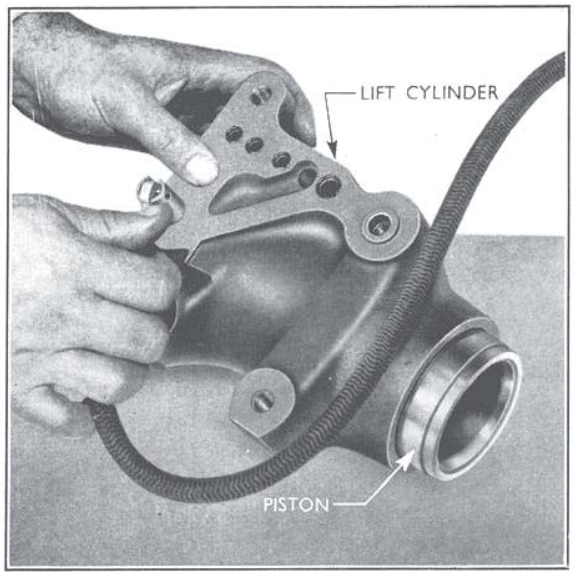

Fig. 24
Removing the Ram Piston

To Rebuild the Lift Cylinder Assembly

Owing to the extreme accuracy of the valves, bushings and sealing plugs used on the lift cylinder it is important that any part which is worn, scratched, distorted, or in fact damaged in any way, be discarded and only perfect parts fitted on reassembly. Each bush is a press fit in its respective bore in the cylinder and the control valve is a selective fit in its bush. All ' O ' rings and gaskets used for sealing purposes should be discarded and replaced by new parts on reassembly.

The outside of the lift cylinder bears colour spots (paint) at the front end of the cylinder, adjacent to the unloading valve and control valve bores, for identification of the bore size. The two unloading valve bushes and the control valve bush are similarly marked.

The colour spots should not be confused with a colour **streak** which is also placed adjacent to the control valve bore to indicate the **internal** diameter of the control valve bush. This streak is used to assist the original building of the unit during factory production and bears no relation to the size of a new bush when it is assembled in service.

1. Observe the colour spot on the outside of the cylinder adjacent to the front end of the unloading valve chamber and select a front and a rear unloading valve bush with corresponding colour markings.

Attach the short threaded end of extension T.8510–1/a to main tool T.8510 and, working from the front of the cylinder, pass the extension through the unloading valve bushing bore.

Place the unloading valve front bush over the extension and locate it at the entrance to the bore. The bush has a small single notch at one end, which should face into the bore, and two large notches at the opposite end, which must locate against the rear bush.

Place the unloading valve rear bush over the extension, making the assembly with the long spigot end facing away from the front bush.

Screw the special guide nut T.8510–1/e onto the extension and locate the adjacent spigot end of the rear bush in the counterbore in the nut. Lubricate the outside surfaces of both bushes and draw them into the bore (see Fig. 25) until the inner end of the spigot (i.e. the back face of the rear land) on the rear bush is flush with the rear face of the cylinder, i.e. the bushes are correctly located when the front face of the guide nut touches the rear face of the cylinder. The rear bush must be centralised correctly when making the assembly, otherwise difficulty may be experienced in obtaining entry into the bore.

NOTE.—It is important that the bushes are correctly located, i.e. neither under- nor over-flush with the rear face of the cylinder.

2. Release the special nut and withdraw the tool from the unloading valve bushes.

3. Observe the colour spot on the outside of the cylinder adjacent to the control valve bushing bore. Select a control valve bush with a similar colour marking. Insert guide and stop adaptor T.8510–1/k (spigot end foremost) into the front of the control valve bushing bore and, still working from the front of the cylinder, pass extension T.8510–1/a fitted to tool T.8510 through the guide. Locate the control valve bush over the extension. It will be noted that the lands of the bush vary in size and the assembly should be made with the widest land facing to the rear of the cylinder. (Counterbored end to front of cylinder.)

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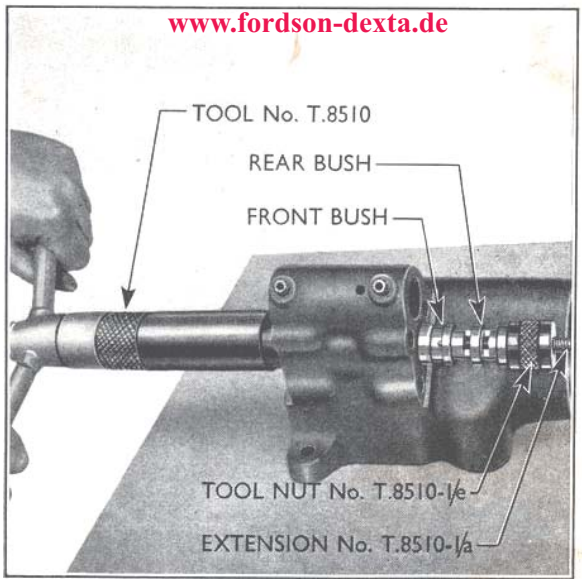

Fig. 25
Replacing the Unloading Valve Bushes

Lubricate the bush and, using nut T.8510–1/h to retain the bush and centralise the extension, pull the bush into the bore (see Fig. 26) until the front face of the bush meets the inner face of the guide.

Slacken the wing nut of the tool and reverse the guide, passing the spigot into the body of the tool so that the larger face of the guide is presented to the front face of the cylinder. Re-tighten the wing nut of the tool and draw the control valve bush fully into position to seat against the guide so that the front end of the bush is flush with the front face of the cylinder.

NOTE.—It is important that when finally positioned the front end of the bush is neither over- nor under-flush with the front face of the cylinder.

4. Instal a new ' O ' ring in the recess at the large end of the unloading valve, lubricate the valve and ' O ' ring and insert in the corresponding bushes in the lift cylinder. Make the assembly from the front of the cylinder with the large end of the valve facing towards the front.

5. The unloading valve plug is colour marked in the same manner as the unloading valve bush and a plug with a matching colour marking should be selected for assembly.

Fit the unloading valve plug to the front of the unloading valve chamber with the threaded central hole in the plug facing outwards.

Press the plug into the bore until the outer face is flush with the front face of the cylinder.

6. The control valve is colour marked to provide identification as to its diameter, but this should not be used as a means of selecting a valve to match the control valve bush. When the bush is pressed into its bore in the cylinder, the internal diameter becomes smaller in proportion to the amount of interference between bush and bore. When selecting a control valve, therefore, one should be chosen which, irrespective of colour markings, is the largest which will operate within the bush without binding. It is, therefore, extremely important that both the internal surface of the bush and the external surface of the valve lands are completely free from burrs and that care is taken when handling the valve to prevent distortion.

7. Having decided on a particular size of valve, it should be left in the bush and retained by replacement of the rear cover plate, using a new gasket and securing the plate to the rear face of the cylinder with three set-screws.

Fig. 27
Replacing Cylinder Front Cover Plate

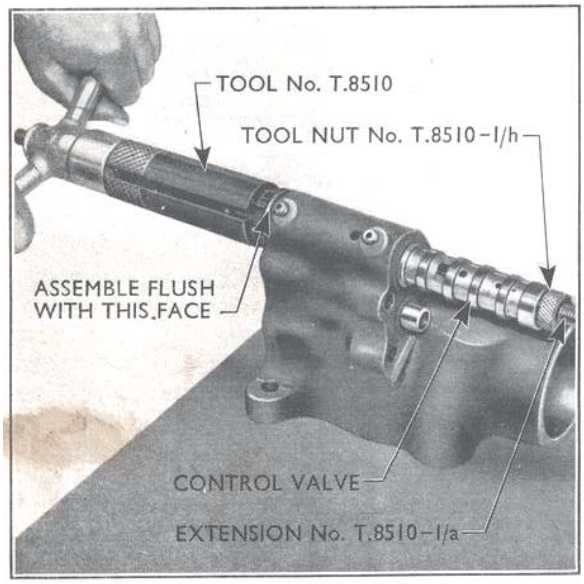

Fig. 26
Replacing the Control Valve Bush

Fig. 28
Replacing Ram Cylinder Safety Valve

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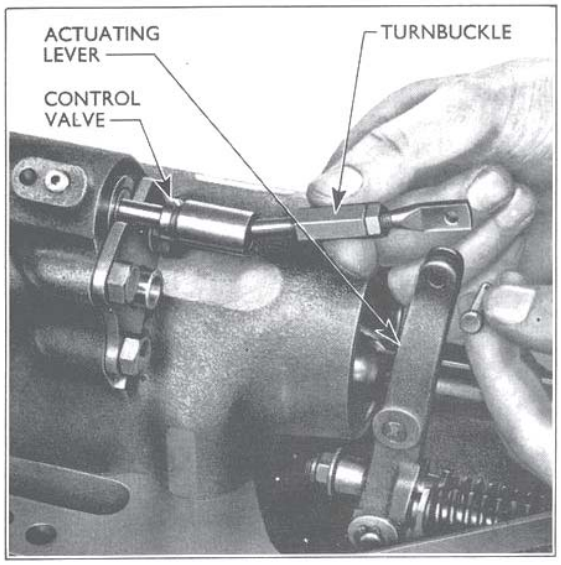

Fig. 29
Replacing Control Valve Turnbuckle

NOTE.—Remember that the set-screw located between the control valve and the ram cylinder fits into the end of a longitudinal exhaust passage in the cylinder. A copper sealing washer must therefore be fitted under the head of this particular screw to obviate oil leaks from the passage. (See Fig. 20.)

8. Replace the control valve spring in the recess in the front cover plate and reassemble the plate to the cylinder. (See Fig. 27.) Retain with three set-screws.

9. Turn the cylinder and assemble the two ring dowels (if they have been removed) in the diagonally opposing counterbored holes in the top face of the cylinder.

10. Fit a new gland to the ram piston, lubricate both gland and piston and assemble to the cylinder.

11. Replace the cylinder safety valve assembly, using a new gasket between the valve and the cylinder. (See Fig. 28.)

To Replace the Lift Cylinder

1. Ensure that the top surface of the cylinder and the mating face on the cover are clean and free from scores or burrs.

2. Fit new ' O ' rings in the counterbores of the oil passages, refit the cylinder to the cover and fully tighten the retaining screws.

3. Replace the control valve turnbuckle assembly securing the rear end to the control valve actuating lever with the appropriate cotter pin and split pin (see Fig. 29). Insert the forward end of the ram piston connecting rod within the piston and carry out the qualitrol linkage and position control adjustment as previously described.

Refit the auxiliary service plate, assemble lift cover assembly to the tractor and replace the driver's seat as previously described.

To Dismantle the Lift Cover Assembly

1. Remove the lift cylinder assembly from the cover, as previously described, and disconnect the ram piston connecting rod from the lift ram arm.

2. Remove the lift cover from the vice and place it on the bench so that it rests on its top face, suitably supported to protect the machined surfaces.

3. Unscrew the main control spring plunger yoke and remove the main control spring.

4. Remove the three set-screws retaining the main control spring seat support to the rear of the lift cover and withdraw the seat, seat support, felt ring and plunger locking plate.

5. Straighten the lock washer tab and remove the screw and flat washer retaining each lift arm to the lift cross-shaft.

6. Remove the two lift cross-shaft bushes and withdraw the cross-shaft from the lift cover leaving the ram arm in the cover.

7. Pull the control valve actuating lever towards the rear of the lift cover, so compressing the qualitrol override spring. Remove the self-locking nut and flat washer retaining the qualitrol bushing to the qualitrol link rod.

8. Remove the main control lever from the friction plate after extracting the two securing screws.

9. Remove the self-locking nut, double coil spring washer and flat washer securing the friction plate to the lift control lever shaft, and withdraw the friction plate, woodruff key and cork friction disc.

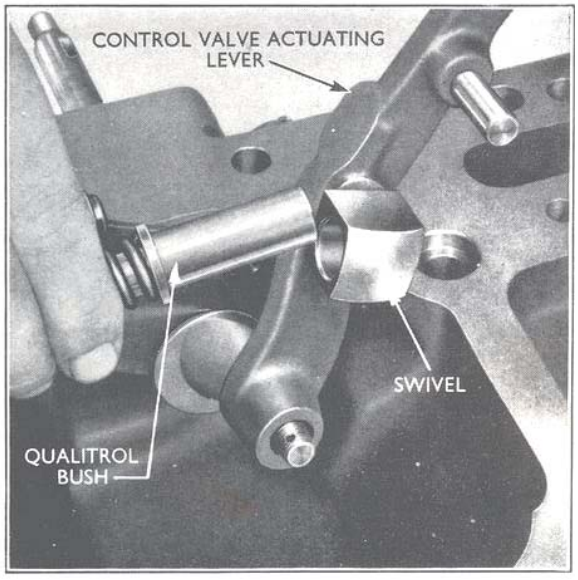

Fig. 30
Removing Control Valve Actuating Lever

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10. Remove the four screws and spring washers that secure the quadrant assembly to the lift cover and slide the quadrant assembly from the lift control lever shaft. Remove the flat washer fitted between the inner end of the quadrant and the position control arm.

11. Remove the split pin, nut and flat washer securing the control valve actuating lever assembly to the lift control lever shaft and slide the actuating lever and swivel assembly forward off the qualitrol bush (see Fig. 30). Withdraw the actuating lever from the lift control lever shaft and remove it from the lift cover. If necessary, remove the swivel from the actuating lever after extracting the special snap ring.

12. Remove the qualitrol bush and override spring from the qualitrol link rod.

13. Rotate the lift ram arm to its most forward position and remove the qualitrol link and main control spring plunger assembly from the cover. Dismantle this assembly by removing the split pin and cotter pin securing the link rod to the plunger.

14. Remove the split pin and washer that retain the selector control link to the selector control arm.

15. Remove the position control assembly and the lift control lever shaft from the lift cover and slide the shaft from the position control arm.

To Dismantle the Position Control Linkage Assembly

(i) Remove the split pin and cotter pin retaining the selector control link to the position control cam and remove the link.

(ii) Remove the split pin and cotter pin securing the position control arm to the position control cam and remove the cam.

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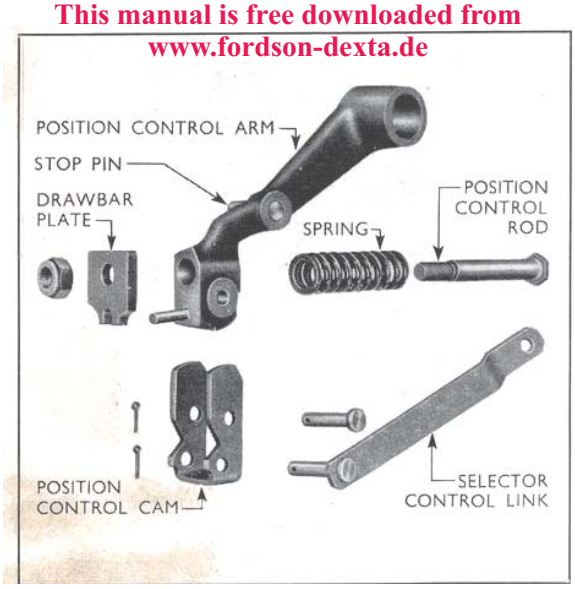

Fig. 31
Position Control Linkage Assembly

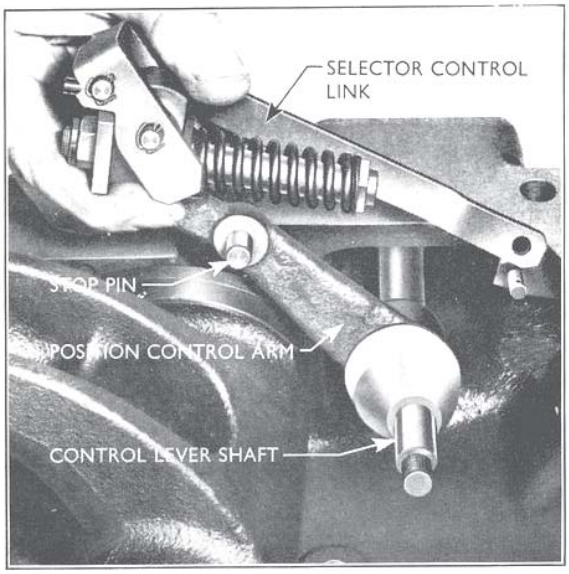

Fig. 32
Assembly of Position Control Linkage to Cover

(iii) Release the position control rod, spring and drawbar plate from the position control arm by removing the self-locking nut.

To Rebuild the Position Control Linkage Assembly

(i) Assemble the position control spring to the rod and insert in the position control arm, making the assembly from the opposite side to the drawbar plate guide pin.

(ii) Assemble the drawbar plate (non-cambered face inwards) to the threaded end of the rod with the slot in the plate engaging with the drawbar plate guide pin in the control arm. Retain with a new self-locking nut.

(iii) Locate the position control cam on the arm, with the straight side of the cam facing away from the drawbar plate guide pin, and insert a cotter pin through the holes nearest the open end of the cam and the corresponding hole in the control arm. Secure with a split pin.

(iv) Secure the selector link to the cam with a cotter pin and split pin. Make the assembly with the longer straight end to the cam and the crank in the link facing inwards, the link to be on the outside of the cam on the opposite side to the stop pin in the arm. (See Fig. 31.)

16. Remove the ram arm from the lift cover.

17. Remove the pin securing the selector lever to the selector control arm and remove the selector control arm from its location in the lift cover.

To Rebuild the Lift Cover Assembly

1. Instal the selector control arm in its appropriate bore in the lift cover and fit the selector lever to the arm, securing it with the special split retaining pin.

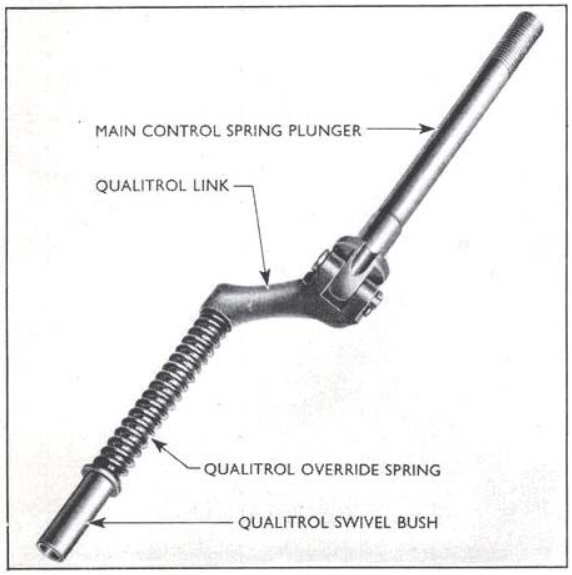

Fig. 33
Qualitrol Link and Control Spring Plunger Assembly

2. Place the ram arm in the cover with the machined cam on the same side as the selector control arm.

3. Assemble the lift control lever shaft to the position control assembly with the eccentric on the shaft on the same side as the large stop pin on the position control arm.

4. Place this assembly in the lift cover with the eccentric on the shaft facing inwards (see Fig. 32) and connect the selector control link to the selector control arm. Secure with a flat washer and split pin.

5. Assemble the main control spring plunger to the qualitrol link with the slot in the plunger facing away from the fork in the link and secure with a clevis pin and split pin. Assemble the qualitrol override spring and bush to the qualitrol link assembly with the flange on the bush adjacent to the spring. (See Fig. 33.)

6. Fit the qualitrol swivel to the control valve actuating lever, with the swivel on the same side as the piston stop pin. Secure with the special snap ring.

7. Fit the qualitrol link assembly to the control valve actuating lever assembly, passing the qualitrol bushing through the swivel so that the machined pad on the rear side of the lever faces towards the qualitrol override spring.

8. Position the resulting assembly in the lift cover so that the main control spring plunger protrudes through the rear of the cover and the qualitrol swivel faces the centre of the housing. (See Fig. 34.)

9. Rotate the lift ram arm to its most rearward position and connect the inner end of the control valve actuating lever to the main control lever shaft, securing it with a flat washer, castellated nut and split pin.

10. Replace the quadrant assembly with the appropriate washer between the inner end of the quadrant and the position control arm. Use a new gasket between cover and quadrant and secure with four screws and spring washers.

11. Compress the qualitrol override spring by pulling the control valve actuating lever towards the rear of the lift cover and fit the flat washer and self-locking nut to the end of the qualitrol link. Tighten the nut until it seats securely against the shoulder on the link. (See Fig. 35.)

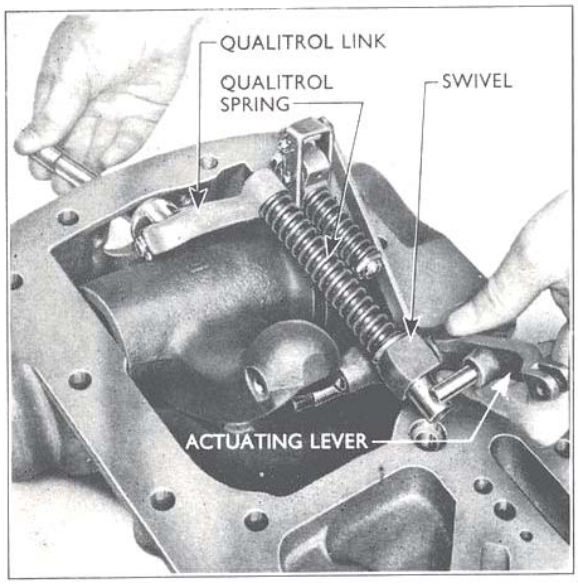

Fig. 34
Assembly of Qualitrol Linkage to Cover

Fig. 35
Retention of Qualitrol Link to Swivel

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12. Instal the lift cross-shaft, picking up the master spline in the ram arm on the corresponding master spline on the centre of the shaft. (See Fig. 36.)

13. Assemble the cross-shaft bushes, one on either side of the shaft, and position them flush with the side of the cover.

14. Fit the lift arms to the lift cross-shaft, picking up the master splines at the outer ends of the shaft. Fit a retaining washer, locking tab and retaining set-screw to each end of the shaft. Tighten the screws until the lift arms just drop under their own weight with no end play between the arms and the housing. Secure in this position by bending the locking tabs against the heads of the screws.

NOTE.—Over-tightening the screws will cause the lift arms to " bind " and adversely affect the operation of the lift.

15. Fit the cork friction disc and woodruff key to the main control lever shaft.

16. Assemble the friction plate over the woodruff key and retain on the control lever shaft with a flat washer, double coil spring lockwasher and self-locking nut. Do not fully tighten the nut.

17. Secure the main control lever to the friction plate with two set-screws and spring washers.

18. Tighten the self-locking nut on the control lever shaft to give a resistance of 4 to 5 lbs. (1.814 to 2.268 kg.) at the ball end of the main control lever.

19. Instal new " O " rings in the cylinder assembly and assemble the cylinder to the cover. Attach the control valve turnbuckle to the control valve actuating lever as previously described.

20. Attach the ram piston connecting rod to the ram arm, using the appropriate cotter pin and split pin, and place the forward end of the rod within the piston.

Fig. 37
Assembly of Main Control Spring Plunger Locking Plate

21. Fit the main control spring plunger locking plate so that the pin on the plate registers with the slot in the forward end of the plunger. (See Fig. 37.)

22. Fit a new felt seal in the counterbore in the front end of the main control spring seat and place this assembly over the main control spring plunger to locate against the rear face of the locking plate. Locate the spring seat support over the seat and

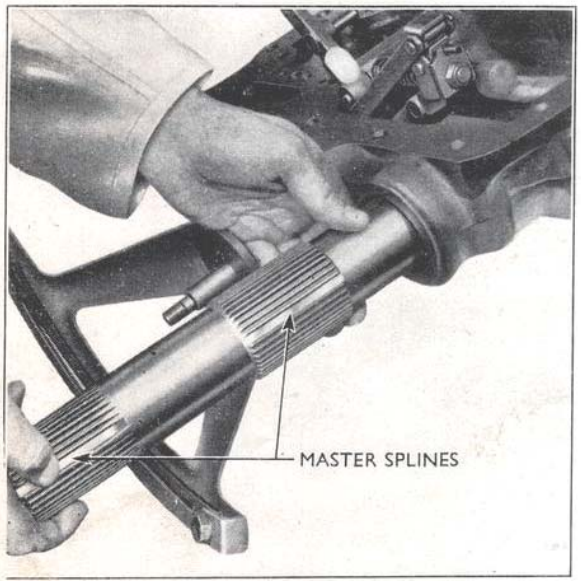

Fig. 36
Assembly of Lift Cross-shaft to Cover

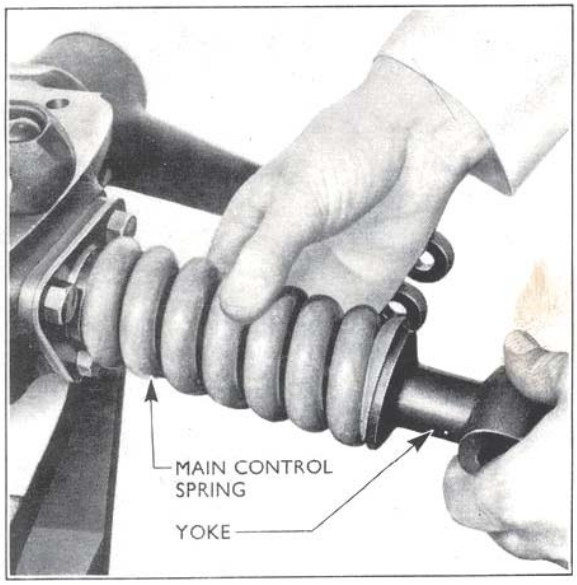

Fig. 38
Main Control Spring Adjustment

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plunger locking plate, and secure to the rear of the lift cover with three set-screws.

23. Position the main control spring on the spring seat and screw the yoke onto the plunger. Tighten the yoke until the main control spring may be just rotated with the finger and thumb of one hand. (See Fig. 38.)

24. Carry out the adjustments to the main control spring, qualitrol linkage and position control linkage, as previously described.

25. Instal new " O " rings in the auxiliary service control plate and fit the plate to the cover.

26. Replace the lift assembly on the rear transmission housing, as previously described, using a new gasket between the cover and the transmission housing and fitting new " O " rings at the inlet and outlet passages in the side of the rear transmission housing.

27. Connect the main control spring yoke to the rocker, attach the top link to the rocker and the lifting rods to the lift arms.

28. Refit the seat, attach an implement and test the lift for operation by raising and lowering the implement several times.

EXHAUST OIL FILTER AND BACK PRESSURE VALVE ASSEMBLY

To Remove

1. Remove the hydraulic lift cover assembly as previously described.

2. Remove the screw retaining the exhaust oil pipe to the right-hand side of the transmission housing. (See Fig. 39.)

3. Lower the assembly until the exhaust oil pipe is free from the passage in the transmission housing top flange and then withdraw the complete exhaust oil filter and back pressure valve assembly through the hydraulic lift cover aperture in the rear transmission housing.

To Replace

First discard the " O " sealing ring fitted to the upper end of the exhaust pipe, and also those fitted to the counterbores of the exhaust and inlet oil passages in the rear transmission housing top flange.

1. Enter the assembly to the rear transmission housing and push the exhaust filter pipe into the passage in the top flange of the housing until it protrudes from the top of the passage a sufficient amount to enable the new " O " sealing ring to be assembled to the groove in the upper end of the pipe.

2. Pull the assembly downwards to locate the " O " sealing ring and assemble the retaining screw in the side of the transmission housing picking up the captive nut in the exhaust oil pipe bracket.

3. Fit new " O " sealing rings to the counterbores of the inlet and exhaust oil passages in the top of the rear transmission housing flange and refit the hydraulic lift top cover assembly as previously described, using a new gasket between cover and rear transmission housing.

To Overhaul the Back Pressure Valve

1. Remove the complete exhaust oil filter and back pressure valve assembly as previously described.
2. Release the wire retainer from its groove in the internal bore of the back pressure valve body.
3. Remove the spring seating plate followed by the spring.
4. Extract the valve from the body.

Before rebuilding the valve assembly the surface of the valve and the internal bore of the body should be checked for damage or scoring. The valve should be perfectly free to slide in the body which should also be free from dirt or obstruction.

If necessary check the tension of the spring (see Specification). To rebuild the valve assembly, reverse the dismantling procedure and then replace the complete exhaust oil filter and pressure valve assembly in the rear transmission housing as previously described.

To Renew the Exhaust Oil Filter

Normally, this filter will not require replacing, excepting when major overhauls are being carried out on the hydraulic lift and rear transmission assemblies.

1. Remove the complete exhaust oil filter and back pressure valve assembly as previously described.
2. Unscrew the back pressure valve from the exhaust oil pipe.
3. Remove the plain washer and rubber washer from the base of the filter and withdraw the filter from the exhaust oil pipe.
4. Remove the rubber sealing washer, plain washer and spring from above the filter.

Renew the rubber sealing washers if they show signs of deterioration and refit the new filter by reversing the dismantling procedure.

Refit the complete exhaust oil filter and back pressure valve assembly to the rear transmission housing as previously described.

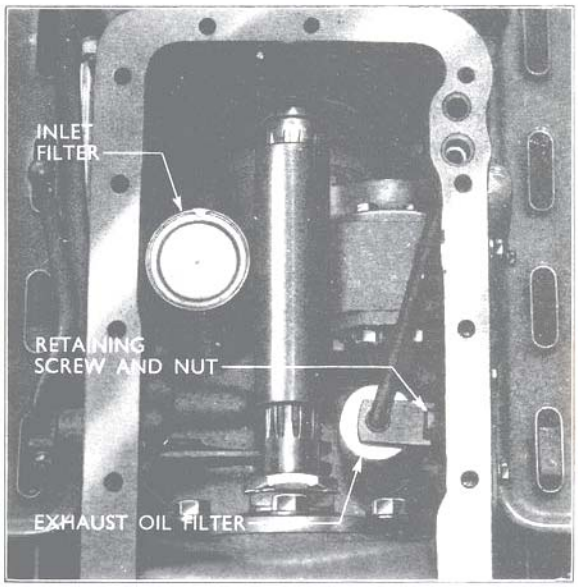

Fig. 39
Location of Exhaust Oil Filter Assembly

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FAULT DIAGNOSIS

A logical sequence of checks based on observation of symptoms provide the most rapid means of diagnosing faults in the hydraulic system. By carefully watching the operation of the hydraulic lift, conclusions may be quickly reached as to which of the conditions below are applicable and the remedies necessary to correct these faults.

The more likely causes are listed first, and, as these are eliminated, the more complex points are considered.

All external features affecting the operation of the lift, such as type and condition of implement, its setting, method of attachment and the ground conditions on which it is being operated, should be taken into consideration and any deviation from standard corrected before attempting to diagnose any particular fault on the hydraulic system.

1. Failure to Lift

(*a*) Check that the auxiliary service control knob is moved to its innermost position.

(*b*) Check that the transmission oil level is correct and that the correct grade of oil is being used.

(*c*) If the failure to lift occurs when the system is under Qualitrol, place the selector lever in Position Control and move the main control lever to the top of the quadrant to establish if the failure is confined to the Qualitrol system.

If the system fails to operate under Qualitrol only, remove the lift cover assembly and check the Qualitrol linkage adjustment as previously described.

(*d*) If the failure occurs on both Qualitrol and Position Control, check both the qualitrol and position control linkage adjustment. At the same time check over the linkage to see that there is no question of distortion or binding.

(*e*) If these adjustments are correct and there are no obvious signs of discrepancies in the linkage, check the ram piston gland and replace if it is not making a perfect seal.

(*f*) Check the lift cylinder safety valve and ensure that the sealing washer is in good condition and seating correctly. If necessary replace the safety valve with one which is known to be satisfactory. Attempts should not be made to dismantle this valve.

(*g*) Check the back pressure valve fitted to the exhaust filter, and the exhaust filter itself, as any failure to hold the back pressure in the system will result in faulty operation of the unloading valve.

(*h*) Check the inlet filter to the pump for blockage.

(*i*) If the trouble is still not located, replace the hydraulic lift cover assembly and either carry out a pressure test on the pump, or replace the pump with one which is known to be correct.

2. Rapid Corrections during Operation or in the Raised Position

As explained under the description of operation of the hydraulic system, any internal leakage of oil will be automatically corrected by the lift linkage moving the control valve into the " Raising " position. If the leak is substantial, " bobbing " of the implement will occur, caused by a continuous rise and fall of the lift arms.

The standard test for this condition is as follows :

1. Attach a weight of approximately 1,250 lbs (567 kg.) to the ends of the lower links or connect up a suitable implement.
2. Move the selector lever downwards to the Qualitrol position.
3. Move the main control lever to the top of the quadrant to a point .5 in. (12.7 mm.) from the stop.
4. Start the engine and observe the operation of the lift arms. The arms should move to the fully-raised position and remain there. During a period of two minutes, not more than three corrections of the linkage should occur.

If the rate of correction is in excess of the above figure, the lift cover assembly should be removed and the following points checked :—

(*a*) Remove the check valve and examine the check valve seat for chipping or scoring; examine the ball and replace if the surface is eroded or damaged; check the spring poundage (see specification).

(*b*) Remove the lift cylinder rear cover and examine the condition of the gasket; also that of the washer and the securing screw which fits into the longitudinal passage in the lift cylinder.

(*c*) Remove the control valve, check the surface of the lands for scoring or damage, and ensure that it fits correctly.

(*d*) Remove the unloading valve plug and check the fit in the forward end of the unloading valve chamber. Examine the surface of the plug and the chamber to ensure that a good seal is being obtained.

(*e*) Remove the unloading valve and check that the valve fits correctly and that the " O " ring is in good condition. It is recommended that this " O " ring is renewed irrespective of its apparent condition.

(*f*) Check that the " O " rings between the lift cylinder and the top cover, and also between

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the auxiliary service plate and the cover, are in good condition. No matter what their condition, it is recommended that new seals be fitted on reassembly. Examine the machined surfaces of the cylinder and plate and the mating surfaces of the top cover.

(*g*) Remove the ram piston and ensure that the piston gland is sealing correctly.

(*h*) Check the Qualitrol and Position Control adjustment, as previously described, before reassembling the lift cover to the tractor.

3. Erratic Action or Over-Correction

This will usually be indicative of an inoperative control valve, binding of the control valve linkage, or over-tightening of the lift arm securing screws.

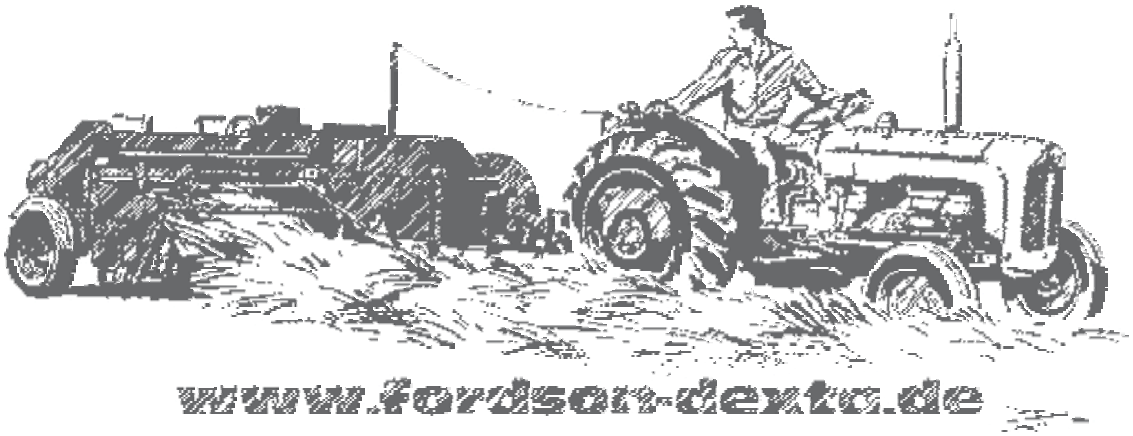
(*a*) Check the adjustment of the lift arm securing screws, which should be tightened until the lift arms will just drop under their own weight.

(*b*) Remove the lift cover assembly and check the control valve for freedom of movement.

(*c*) Check the main control spring plunger for freedom of movement; in particular, see that it is free to move on the locking pin in the rear plate.

(*d*) Check the qualitrol link for scoring or binding at the swivel bush.

(*e*) When installing the cover assembly, check that the main control spring yoke moves freely in the rocker.



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HYDRAULIC LIFT SPECIFICATIONS

Lift Cylinder

Ram cylinder diameter .. .. 2.9995 to 3.0010 ins. (76.19 to 76.23 mm.)
Ram piston diameter .. .. 2.998 to 2.999 ins. (76.15 to 76.18 mm.)

Control valve spring :
No. of coils 19
Length .. 1.45 ins. under load of 24.5 to 28.5 lb. (36.83 mm. under load of 11.11 to 12.93 kils.)

Cylinder safety valve :
Blow-off pressure .. .. 2,400 lb. per sq. in. (168.73 Kilogram per sq. cm.)

Control and Unloading Valve Bush Bores

Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
White	.9996 to .9998	25.390 to 25.395
Blue	over .9998 to 1.0000	25.395 to 25.400
Yellow	over 1.0000 to 1.0002	25.400 to 25.405
Green	over 1.0002 to 1.0004	25.405 to 25.410
Orange	over 1.0004 to 1.0006	25.410 to 25.415

Control and Unloading Valve Bushes and Unloading Valve Plug

Colour Marking	*Outside Diameter (ins.)*	*Outside Diameter (mm.)*
White	1.0002 to 1.0004	25.405 to 25.410
Blue	over 1.0004 to 1.0006	25.410 to 25.415
Yellow	over 1.0006 to 1.0008	25.415 to 25.420
Green	over 1.0008 to 1.0010	25.420 to 25.425
Orange	over 1.0010 to 1.0012	25.425 to 25.430

Control Valve

Colour Marking	*Outside Diameter (ins.)*	*Outside Diameter (mm.)*
White	.5917 to .5919	15.029 to 15.034
Blue	over .5919 to .5921	15.034 to 15.039
Yellow	over .5921 to .5923	15.039 to 15.044
Green	over .5925 to .5926	15.049 to 15.052
Orange	over .5927 to .5928	15.055 to 15.057

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Tightening Torque Figures	*lbs./ft.*	*kg./m.*
Lift top cover to transmission housing screws ..	30 to 35	4.15 to 4.84
Lift cylinder to top cover screws	40 to 45	5.53 to 6.22
Auxiliary service plate to top cover screws ..	30 to 35	4.15 to 4.84
Front cover plate to lift cylinder screws	17 to 22	2.35 to 3.04
Rear cover plate to lift cylinder screws	17 to 22	2.35 to 3.04
Hydraulic pump to transmission housing screws	30 to 35	4.15 to 4.84
Hydraulic pump through bolts	40 to 45	5.53 to 6.22
Control lever quadrant to shaft nut	4 to 5 lb*	1.814 to 2.268 kg.*
Check valve plug	45 to 55	6.22 to 7.60

* Measured at ball of main control lever

Back pressure valve :
- Blow-off pressure .. .. 23 to 26 lb/sq. in. (1.62 to 1.83 kg/sq.cm.)
- Spring length .. .74 in. under load of 2.28 to 2.52 lb. (18.8 mm. under load of 1.03 to 1.14 kg.)

Hydraulic Pump

Flow capacity .. .. 3.68 Imp. gal. (16.72 Litre) at 1,550 r.p.m.

Relief valve :
- Thickness of shim .. .. .010 in. (.254 mm.), .025 in. (.635 mm.)
- Blow-off pressure .. .. 2000 to 2200 lb. /sq.in. (140.6 to 154.7 kg./sq. cm.)

Relief valve :
- Maximum thickness permissible .. .. .080 in. (2.032 mm.)

Lift Cover

Check valve bore diameter .. .. .749 to .750 in. (19.025 to 19.05 mm.)

Check valve seat :
- Land diameter (Rear of " O " ring) .. .. .7510 to .7505 in. (19.08 to 19.06 mm.)

Cross-shaft journal diameter .. .. 1.998 to 1.996 in. (50.75 to 50.70 mm.)

Cross-shaft bush diameter :
- Outside diameter .. .. 2.370 to 2.372 in. (60.20 to 60.25 mm.)
- Inside diameter .. .. 2.001 to 2.003 in. (50.83 to 50.88 mm.)

Position control spring :
- No. of coils 10.7
- Length .. 1.96 ins. under load of 72 ± 6 lbs. (49.78 mm. under load of 32.66 ± 2.72 kg.)
  1.52 ins. under load of 152 ± 10 lbs. (38.61 mm. under load of 68.95 ± 4.54 kg.)

Check valve spring :
- No. of coils 9.5
- Length .. 0.70 in. under load of 10.2 to 12.2 lbs. (17.78 mm. under load of 4.65 to 5.53 kg.)

Qualitrol override spring :
- No. of coils 18
- Length .. 3.58 ins. under load of 105 ± 7 lbs. (90.93 mm. under load of 47.63 ± 3.18 kg.)
  3.21 ins. under load of 177 ± 10 lbs. (81.53 mm. under load of 80.29 ± 4.54 kg.)

Qualitrol swivel bore .. .. .631 to .633 in. (16.03 to 16.08 mm.)

Qualitrol swivel bush :
- Outside diameter .. .. .627 to .629 in. (15.93 to 15.98 mm.)
- Inside diameter .. .. .439 to .442 in. (11.15 to 11.23 mm.)

Auxiliary service tapping .. .. ½ in. B.S.P.

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Auxiliary Service Control Valve Bore in Plate		
Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
White	.7490 to .7493	19.025 to 19.032
Blue	over .7493 to .7496	over 19.032 to 19.040
Yellow	over .7496 to .7500	over 19.040 to 19.050

Auxiliary Service Control Valve		
Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
White	over .7485 to .7488	over 19.012 to 19.020
Blue	over .7488 to .7491	over 19.020 to 19.027
Yellow	over .7491 to .7494	over 19.027 to 19.035

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HYDRAULIC PUMP

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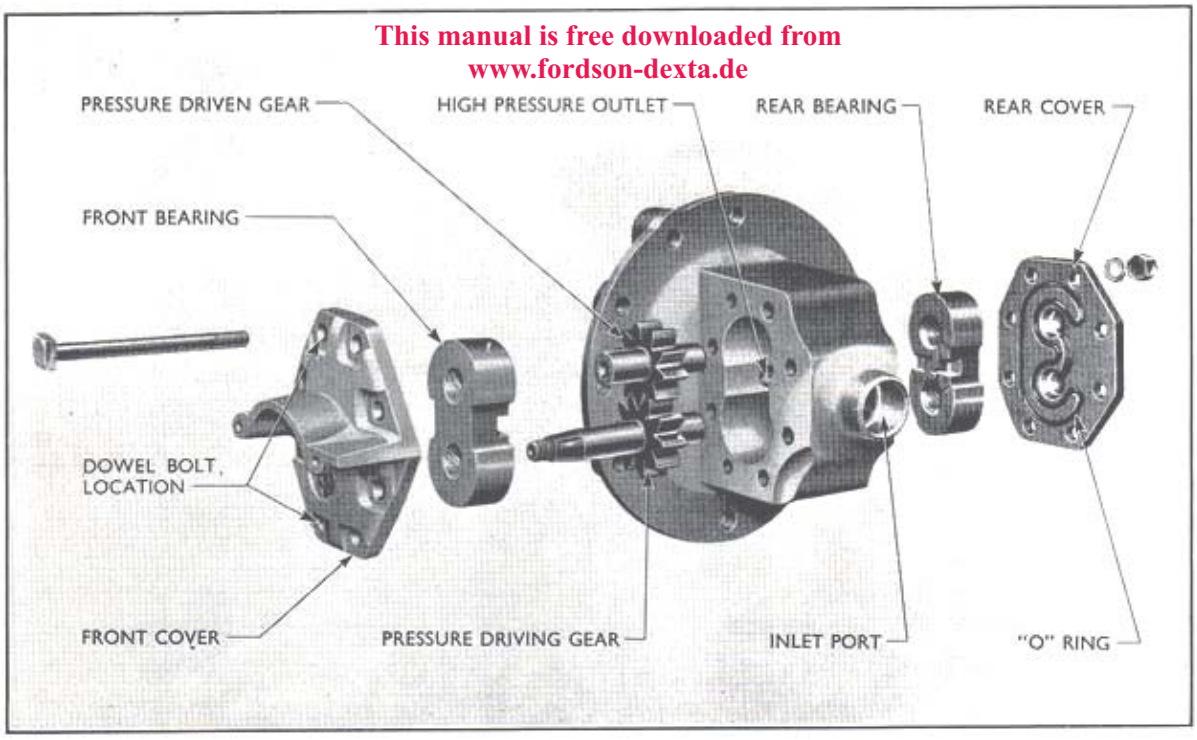

Fig. 40
Hydraulic Pump Assembly

General Description

The hydraulic pump is flange-mounted on the right-hand side of the rear transmission housing and is gear driven from the rear of the power take-off countershaft, which passes through the gearbox.

Two spur type gears, producing high pressure oil for operation of the hydraulic power lift, are mounted in specially designed bearing blocks, which are a precision fit in the pump housing. The pump pressure driving gear is integral with its shaft, the front of which protrudes through the pump front cover plate and is suitably tapered to accept an external gear which is keyed to the shaft. This external gear meshes with a driving gear which is splined to the power take-off countershaft. The hydraulic pump is, therefore, in constant operation whenever the engine is running in any gear, including neutral, provided the clutch is engaged.

Features of this arrangement are that—

(1) It is not necessary for the power take-off selector lever to be in the engaged position in order to operate the hydraulics, and

(2) When a " Live " power take-off is fitted the transmission clutch may be disengaged without affecting the drive to the pump.

Rotation of the pressure gears within the pump housing draws oil from the rear transmission housing, through a gauze type strainer into the inlet side of the pump. The strainer is directly mounted in the inlet port of the pump and incorporates a magnetic plug which collects any fine ferrous particles of metal which may be present in the oil.

On entering the pump the oil fills the gear tooth spaces and is carried around the housing, by the closely fitting gears, to the point where the teeth in the two gears come into mesh. The oil is then thrust out from between the teeth and delivered through an outlet port to a passage formed in the pump flange. This passage has a spring-loaded pressure relief valve fitted at its lower end, which is set to blow off at 2,100 to 2,300 lbs. per sq. inch and so prevent damage should the pump be overloaded. At its upper end the passage connects with a vertical drilling in the rear transmission casing which leads to the hydraulic lift.

An oil duct is incorporated on the high pressure side of the pump bearings to allow high pressure oil to be directed from the gears to the back faces of the bearings, where it is trapped between the bearings and their respective cover plates. An ' O ' ring is fitted in a specially shaped groove in each cover plate to ensure positive sealing between the bearing and

its corresponding cover plate. The effect of this design is to pressure load the bearings towards the gears, thus keeping end-float to a minimum, providing automatic compensation for wear, and ensuring maximum efficiency from the pump.

On the low pressure side of the pump a duct in each bearing, together with spiral grooves in the bearing bores and small reservoirs in the cover plates, ensure a continuous flow of low pressure oil to the bearing surfaces for lubrication purposes.

A special seal, fitted between the front cover and the pump drive gear, safeguards the pump by keeping out air should the operator inadvertently allow the oil level in the rear axle to drop below the safe level. This seal should always be fitted with the sealing edge (i.e. spring side of seal) facing outwards from the pump cover.

To Remove the Pump Pressure Relief Valve

For illustration purposes, the pump pressure relief valve assembly is shown " exploded " in Fig. 41, after the pump has been removed from the tractor, but it should be noted that servicing of this item may be accomplished whilst the pump is still mounted in the transmission housing.

1. Remove the plug and special sealing washer from the base of the relief valve chamber in the pump mounting flange.

2. Extract the relief valve and body assembly.

3. Remove the ' O ' sealing ring from the upper end of the valve body.

4. Hold the body, unscrew the spring retainer and extract the shims fitted between the end of the spring and the retainer. Make a note of the number of shims fitted, and of their thickness. These shims control the maximum working pressure of the pump and it is important that the correct thickness of shim is fitted when reassembling (see Specification).

5. Remove the relief valve plunger from the upper portion of the valve body.

To Reassemble the Pump Pressure Relief Valve

1. Examine the relief valve plunger for signs of scoring or wear. Similarly, examine the valve seat

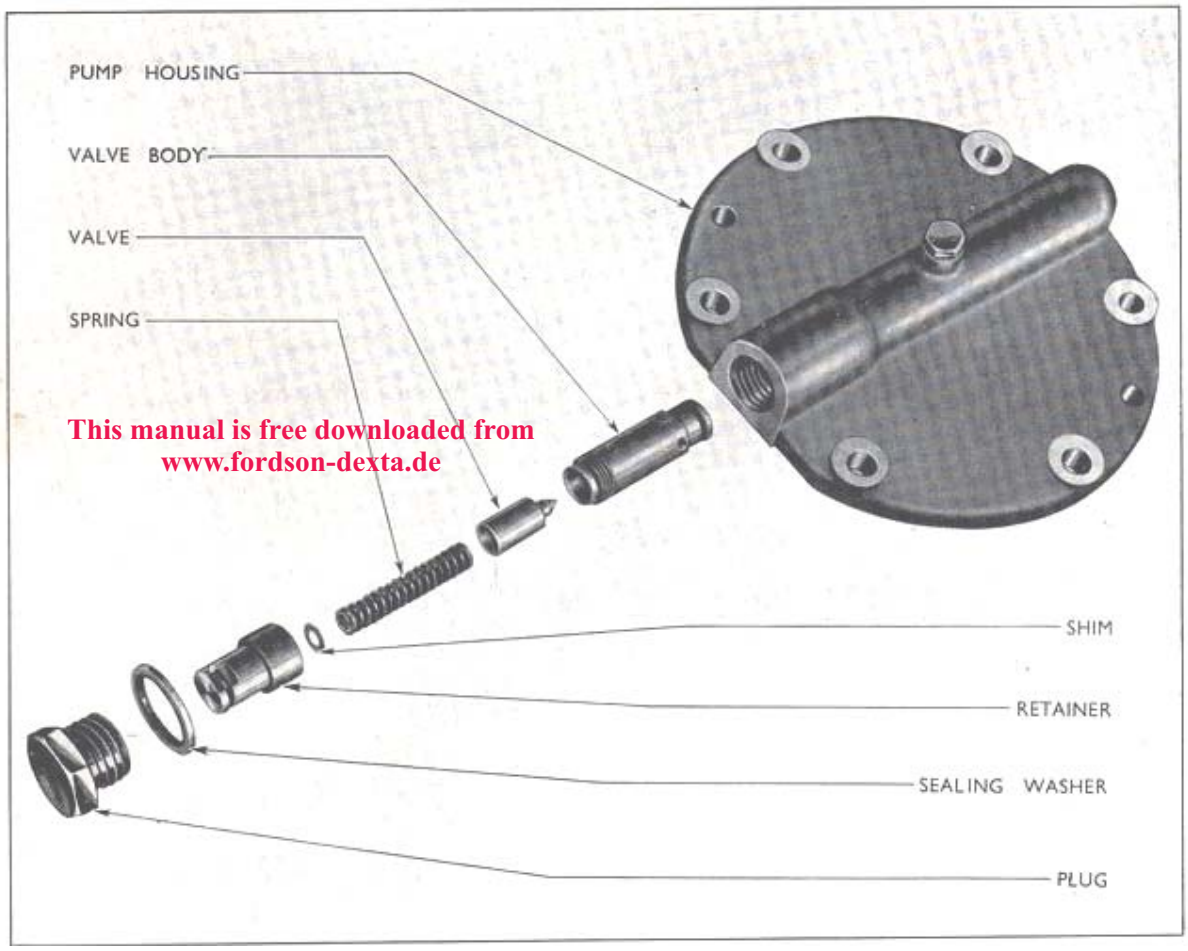

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Fig. 41
Hydraulic Pump Pressure Relief Valve Assembly

in the upper body and ensure that an even seat marking is being obtained.

2. Replace the shims in the bore of the spring retainer and install the spring. (See ' Testing the Hydraulic Pump ').

3. Assemble the retainer and spring assembly to the valve body and fully tighten the retainer.

4. Fit a new ' O ' sealing ring in the annular recess in the top of the valve body.

5. Replace the relief valve assembly in the pump, fit a new sealing washer to the end plug and replace the plug in the threaded end of the relief valve chamber. Securely tighten the plug.

To Remove the Hydraulic Lift Pump

1. Drain the oil from the rear transmission housing.

2. Remove the right-hand footplate and disconnect the right-hand brake operating rod.

3. Remove the hydraulic lift cover assembly as described on page 13.

NOTE.—It is possible to remove the pump without disturbing the hydraulic lift cover assembly but replacement is much easier if the cover is also removed. In addition, to service the pump inlet strainer necessitates either removal of the hydraulic lift top cover or splitting the rear axle away from the gearbox.

4. Extract the screws retaining the pump flange to the right-hand side of the rear transmission housing.

5. Remove the pump assembly and withdraw the inlet strainer through the hydraulic lift aperture in the top of the rear transmission housing. The inlet strainer should be withdrawn, examined and cleaned whenever the hydraulic pump is removed for servicing.

To Dismantle the Hydraulic Lift Pump

1. Remove the two screws and locking washers retaining the driving gear shroud to the pump front cover.

2. Straighten the locking tab and remove the nut retaining the external driven gear to the pump pressure driving gear shaft.

3. Using puller tool No. T.8514, draw the external driven gear from the shaft.

4. Remove the Woodruff key from the pump pressure driving gear shaft.

5. Remove the nuts, spring washers and through bolts retaining the two end covers. Note that the second bolts from the flange, top and bottom, are dowel bolts machined to very fine limits (see Fig. 40), and they should not be mixed with the other retaining bolts. These bolts are marked with letter ' D ' on their heads.

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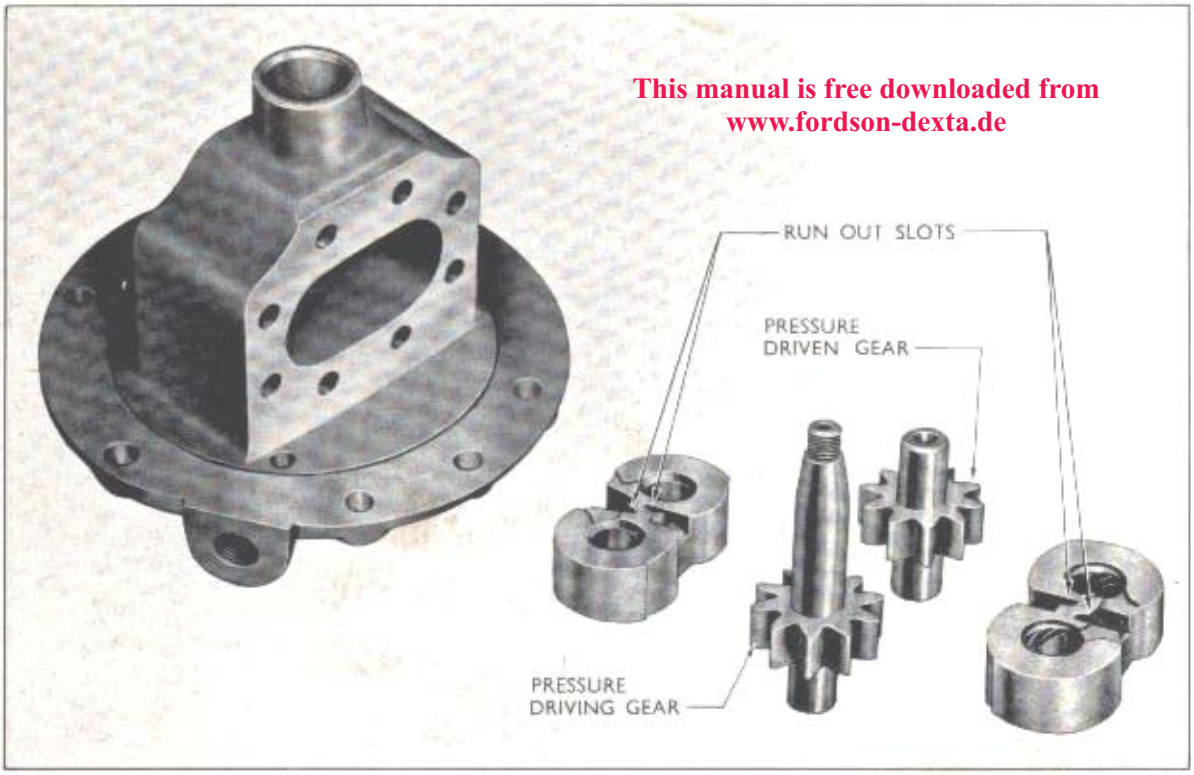

Fig. 42
Hydraulic Pump Body, Bearings and Gears

6. Remove the covers and extract the ' O ' sealing ring from the locating groove in each cover.

7. If necessary, extract the circlip retaining the pressure driving gear shaft seal to the front cover and remove the seal, using a drift of near size to the hole in the cover.

8. Slide the pump gears and bearings from the housing, if possible as one unit. No force should be applied to the gear shafts under any circumstances.

9. Examine the bearings for signs of seizure or scoring on the faces or journals. Light score marking may be removed by lapping on a surface plate, using ' O ' grade emery paper and paraffin. Any bearings showing excessive journal wear must be replaced. Bearings must always be fitted or replaced as pairs and must not be mixed.

10. Examine the body for wear in the gear running track. If the track is worn deeper than .0025 in. (.0635 mm.) on the pump inlet side, the body must be replaced.

11. Examine the gears for damage or excessive wear on journals, faces or teeth. The maximum run-out across the gear face to the tooth edge should not exceed .001 in. (.025 mm.). The gear journals may be lightly polished with ' O ' grade emery paper to remove wear marks. Similarly, the gear faces may be polished by sandwiching the emery paper between the gear face and a scrap bearing and rotating the gear. If new gears are fitted, the journal sizes on either side of each individual gear must be paired within .001 in. (.025 mm.) of each other. The face widths of each pair of gears must be held to within .001 in. (.025 mm.) of each other. This applies equally to the mixing of gears from different pumps or the replacement of single gears.

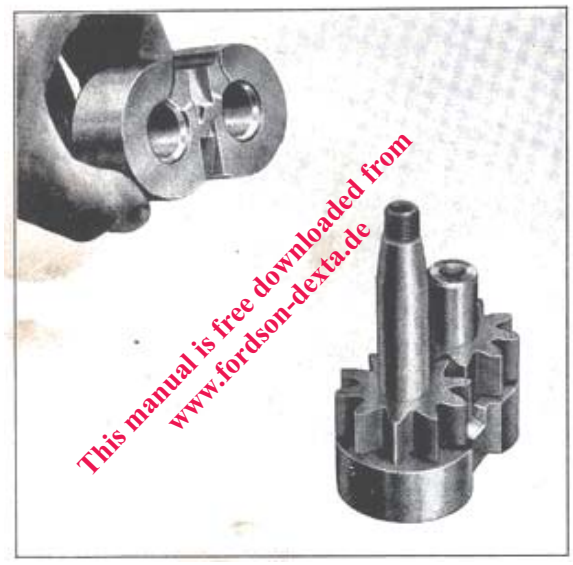
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Fig. 43
Assembling Gears and Bearings

12. All rubber seals, ' O ' rings, etc., should be replaced when servicing the pump.

To Assemble the Hydraulic Pump

It should be noted that the two bearings, although similar in appearance are **not** identical and they must be assembled in correct relationship to gears and housing. The pump main body should be placed on the bench, flange downwards, with the pressure relief valve chamber bore pointing towards the operator.

Arrange the bearings and gears as shown in Fig. 42. In this position the right-hand (rear) bearing will have the small run-out slots from the oil ducts, at the **upper** end of the **left**-hand (high pressure) duct and the **lower** end of the **right**-hand (low pressure) duct.

The left-hand (front) bearing will have the run-outs at the upper end of the **right**-hand (high pressure) duct and the **lower** end of the **left**-hand (low pressure) duct.

1. With the right-hand (rear) bearing in the position shown in Fig. 42, i.e. with the plain side of the bearing downwards and the run-out from the **bores** to the right (i.e. low pressure side of pump) assemble the pump pressure driven gear to the further bore of the bearing.

2. Assemble the pump pressure driving gear to the nearer bore of the bearing, threaded end of the shaft pointing upwards and teeth meshing with the pressure driven gear (see **Fig. 43**).

3. Turn the left-hand (front) bearing so that the plain face points upwards and assemble to the gears, so that the small relief on the outer diameter of each bearing (i.e. the high pressure side) is on the left-hand side of the assembly.

4. Install the bearing and gear assembly in the pump housing, with the threaded end of the pressure driving gear pointing to the left and the small reliefs on the outer diameter of the bearings facing the high pressure (flange) side of the pump (see **Fig. 44**).

5. Fit a new ' O ' sealing ring to each cover plate and assemble the plates to the pump, locating them so that the straight side of the ' O ' ring grooves are adjacent to the pump flange, and the oil channels in the covers curve upwards.

6. Lightly secure the end covers to the pump body with the two dowel bolts which must be correctly positioned, as described in paragraph 5, column 1 (see also Fig. 40). Fit the remaining six bolts together with the nuts and spring washers, taking care to locate the square bolt heads in the square recesses in the front cover. Tighten the nuts evenly to 40/45 lbs. ft. torque (5.528/6.219 kg.m.).

It is essential that this torque figure is not exceeded and an accurate torque wrench must be used on this operation.

7. Replace the Woodruff key in the pump pressure driving gear shaft and assemble the external gear to

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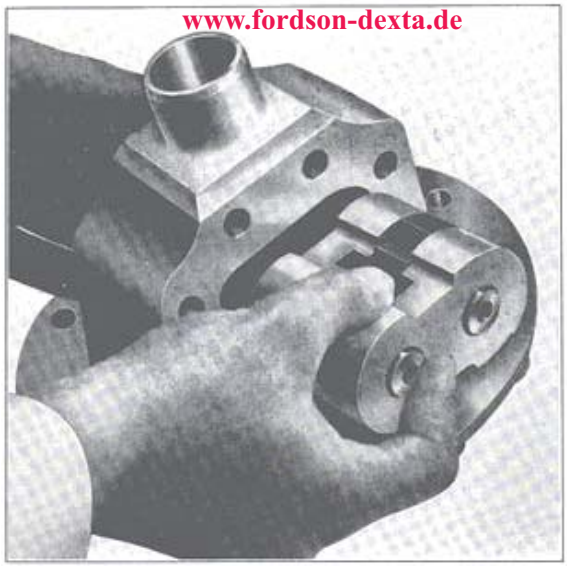

Fig. 44
Assembling Gears and Bearings to Pump Body

the shaft. Place a locking tab washer on the threaded end of the shaft, assemble and fully tighten the retaining nut, then turn the tab over to lock the nut in position.

8. Refit the driving gear shroud and retain to the pump front cover with the two screws and locking washers.

To Replace the Hydraulic Lift Pump

1. Fit a new ' O ' sealing ring on the side of the rear transmission housing adjacent to the delivery port in the pump flange. Fit a new ' O ' sealing ring on the outlet spigot of the inlet strainer casing (to the pump) and replace the strainer in the rear transmission housing ensuring the hole in the strainer bracket locates on the spigot screw in the side of the transmission housing.

3. Pour into the pump inlet plenty of clean new oil to lubricate the pump gears and bearings during start-up.

4. Replace the pump assembly using a new gasket between the pump flange and the rear transmission housing. As the pump is refitted the inlet port of the pump should be entered over the outlet spigot of the strainer casing. Ensure that the two dowels in the side of the rear transmission housing are correctly located in the corresponding holes in the pump flange and replace and tighten the pump to transmission housing securing screws to a torque of 30/35 lbs. ft. (4.15/4.84 kg.m.).

5. Replace the hydraulic lift top cover assembly as previously described.

6. Reconnect the right-hand brake operating rod and replace the right-hand footplate.

Testing the Hydraulic Pump

The pump is set to give the requisite delivery and pressure before leaving the factory and normally very little trouble may be anticipated in service. Should, however, the pump delivery pressure be suspect it may be checked by fitting a pressure gauge to the threaded hole provided for this purpose in the side of the pump relief valve chamber.

Immediately prior to making the test, however, the tractor should be operated to bring the transmission oil to its normal operating temperature.

Attach swivel adaptor T.8503–1/g to pressure gauge T.8503, remove the sealing plug and screw the swivel adaptor and gauge assembly into the threaded hole in the pump relief valve chamber.

Remove the jack tapping plug from auxiliary service control valve plate and the filler plug from the rear axle. Install pressure testing equipment T.8503–1, fitting the " T " adaptor T.8503–1/f to the jack tapping and the opposite end to the rear axle filler aperture. It will facilitate installation if the " T " adaptor is assembled first and the hose and shut-off valve assembly is then fitted to the " T " adaptor. Install the jack tapping plug in the upper end of the " T " adaptor.

Fully open the shut-off valve, start the engine and run at 1,550 r.p.m.

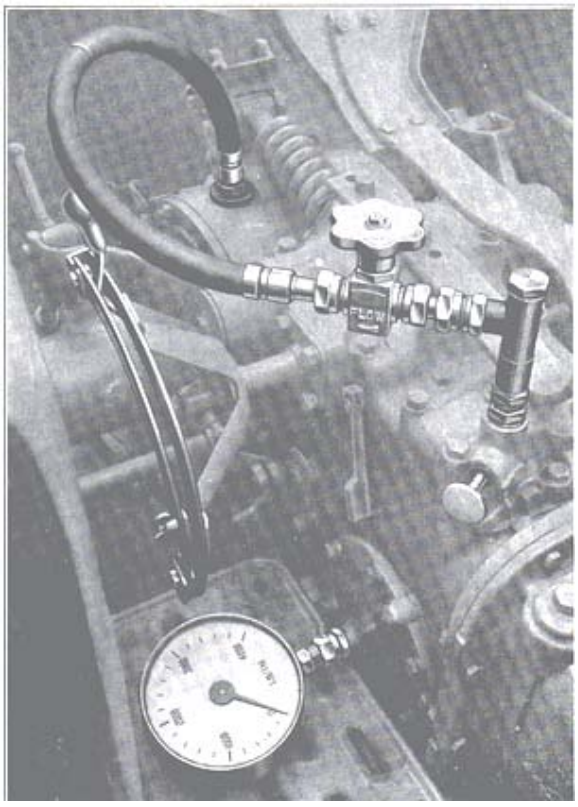

Fig. 45
Hydraulic Pump Test Equipment

Move the auxiliary service control knob to the outer position and place the hydraulic power lift control lever in the fully raised position.

Gradually close the shut-off valve and observe the reading on the pressure gauge which should show a steady increase in pressure up to 2,100 to 2,300 lbs/sq. in. (147.6 to 161.7 kg/sq. cm.). At this pressure the relief valve should blow off and the pressure should drop to approximately 600 lbs/sq. in. (42.18 kg/sq. cm.).

If the relief valve blows off at a pressure lower than that specified, it may be that insufficient shims have been fitted between the relief valve spring and the spring retainer (a faulty relief valve spring will also produce the same symptoms).

Shims are available in thicknesses of .005 in. (.127 mm.) .010 in. (.254 mm.), .015 in. (.381 mm.) and .025 in. (.635 mm.) and give an increase in operating pressure of approximately 10 lbs/sq. in. (.7031 kg/sq. cm.) for each .001 in. (.025 mm.) thickness of shim.

NOTE.—The maximum total thickness of shim permissible is .080 in. (2.032 mm.).

In the event of the relief valve not blowing off, either too many shims have been fitted in which case the gauge will read more than 2,300 lbs/sq. in. (161.7 kg/sq. cm.) or the pump itself may be at fault and the pressure will not reach the specified figures. If the latter is suspected the pump should either be replaced with one which is known to be correct, or dismantled to determine the cause.

HYDRAULIC PUMP SPECIFICATIONS

The following specification supersedes that quoted on page 27 of this section

Flow capacity	3.31 Imp. gall. (15.03 litre) per min. at 1,550 r.p.m. (engine)
Relief valve pressure	2,100 to 2,300 lb./sq. in. (147.6 to 161.7 kg./sq. cm.)
Thickness of shims available	.005 in. (.127 mm.), .010 in. (.254 mm.), .015 in. (.381 mm.), .025 in. (.635 mm.)
Maximum permissible total thickness of shim	.080 in. (2.032 mm.)

Tightening torque :—

Hydraulic pump through bolts	40 to 45 lbs. ft. (5.53 to 6.22 kg.m.)
Hydraulic pump to rear transmission housing screws	30 to 35 lbs. ft. (4.15 to 4.84 kg.m.)

DOUBLE-ACTING RAM VALVE

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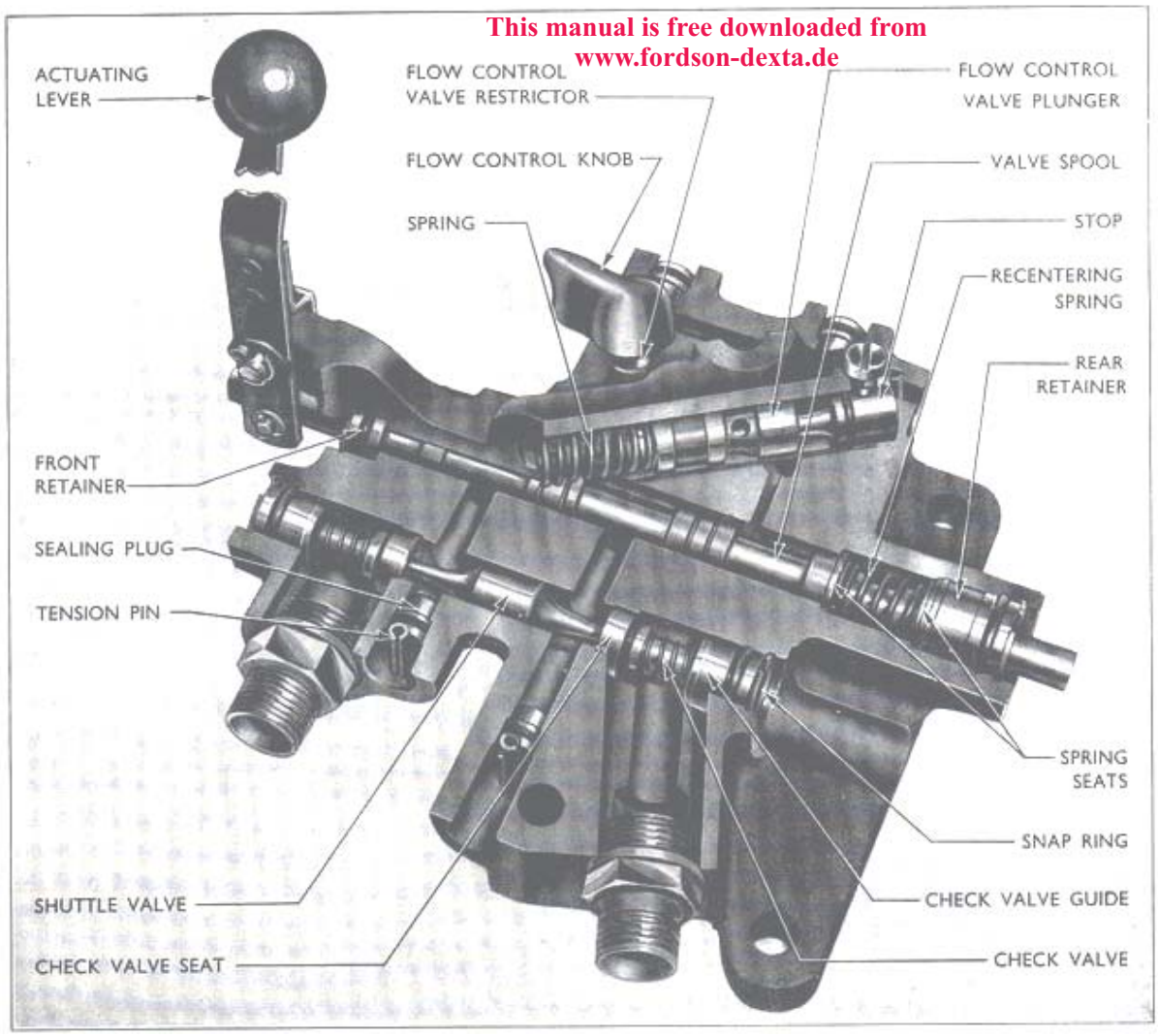

Fig. 46
Sectioned View of D.A.R. Valve

The double acting ram valve (D.A.R. valve) is fitted as a production option in place of the auxiliary service control valve on the hydraulic lift cover. It consists of two main components ; a control valve spool—operated by a hand controlled actuating lever, and a flow control device—adjusted by the flow control knob (see Fig. 47).

If required, two pipes may be fitted leading from the D.A.R. valve to a bracket mounted at the rear of the transmission housing, where the pipes connect with the male halves of two self-sealing couplings. In this position they are readily accessible for connecting up the coupling pipes to trailed or rear mounted equipment.

Using the D.A.R. valve it is possible to feed oil from the hydraulic pump on the tractor, to one side of an external double acting ram, and exhaust oil from the other side of the ram back into the rear transmission housing via the D.A.R. valve. By means of the flow control device it is also possible to control the rate of flow of oil to external equipment, which in turn governs the speed at which oil exhausts from the equipment.

The D.A.R. valve can be used to operate external single acting rams, but if such equipment is other than that officially approved by Ford Motor Co. Ltd., care must be taken to ensure that some form of restrictor is fitted between the ram and the D.A.R. valve to control the return flow of oil, particularly if the equipment is liable to drop quickly under gravitational pull, e.g., front end loader with a loaded bucket.

The actuating lever for the D.A.R. valve is spring-loaded in the neutral position and must be held forward or rearward as required to operate external equipment (see Fig. 47).

DESCRIPTION

The D.A.R. valve fits in the same location on the hydraulic lift cover as the auxiliary service control valve and is retained by four set-screws.

A vertical actuating lever which pivots on a pin in a fixed lug on the main body of the valve assembly is connected at its lower end to the D.A.R. valve spool. Fitted to the front and rear of the valve spool are retainers, on the inner and outer diameter of which are fitted rubber "O" rings. The retainers are held in position in the main body by snap rings.

On the rear of the valve spool is the recentering spring and seats. The spring and seats being held in position between a step in the valve body and a snap ring fitted in a groove on the valve spool.

To the right of the valve spool (when viewed from the driver's seat) is the flow control device. This consists of the flow control valve restrictor and the flow control valve plunger and spring.

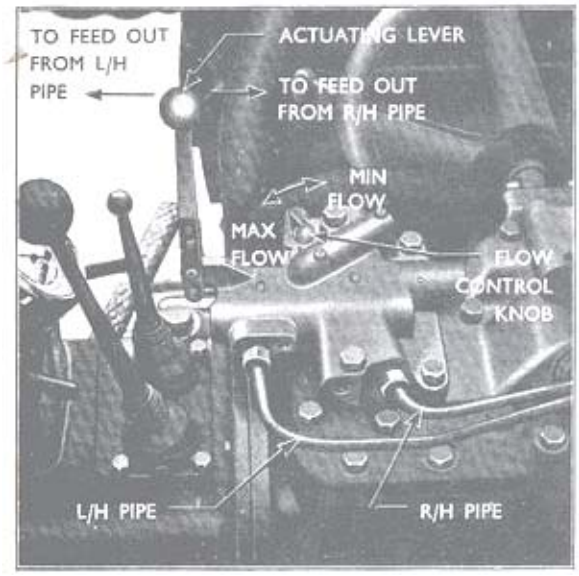

Fig. 47
Actuating Lever and Flow Control Knob

The flow control valve restrictor is located directly below, and connected to, the flow control knob. At the rear and slightly to the left of the flow control knob is a raised portion of the D.A.R. valve body in which the flow control valve plunger and spring are housed. They are retained in the housing by a stop which has a rubber " O " ring located in a groove on its outer diameter. The stop is secured by a pin screwed into the top of the housing.

To the left of the valve spool (when viewed from the driver's seat), and located in passages in the valve body is a shuttle valve on either side of which are the check valves. These locate in guides fitted at the front and rear of the body, and seat on renewable steel inserts which are an interference fit in the body.

All passages and drillings in the D.A.R. valve are sealed with plugs which have rubber " O " rings located in grooves on their outer diameter. These plugs are retained in position by either snap rings or tension pins.

The only oil passageway that leads directly into the D.A.R. valve is the oil feed from the hydraulic pump which flows through suitable passages to the valve spool and the flow control valve plunger.

The feed to the hydraulic ram cylinder and the exhaust from the hydraulic lift valve assembly pass through cast passages in the D.A.R. valve body but in no way affect the operation of the valve.

The exhaust from the D.A.R. valve is entirely separate from that of the ram cylinder or the hydraulic lift valve assembly, that is why it is necessary to ensure that a restrictor is fitted between the D.A.R. valve and the ram of certain types of equipment, to control the rate of flow of return oil from the equipment.

OPERATION

With the actuating lever in its neutral position (held in position by the recentering spring) normal operation of the hydraulic lift arms is possible, using the main control lever. Oil flow through the D.A.R. valve is shown in Fig. 48, and is indicated by the black arrows. Oil will also be present at the front and rear faces of the flow control valve plunger, but as there is no oil flow the pressure applied on each side will be equal, and the plunger will be held in the closed position by the spring.

If the actuating lever is moved from the neutral position, the hydraulic lift cylinder is isolated from the hydraulic pump, and oil is delivered under pressure to the external double acting ram. At the same time, the oil displaced from the opposite side of the ram piston is returned through the D.A.R. valve and exhausted into the rear transmission housing.

When the actuating lever is moved through neutral to the opposite position the oil flow is reversed ; and the passage previously used to supply oil under pressure to the double acting ram becomes the oil return passage, and vice-versa.

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Fig. 49 shows the oil flow through the D.A.R. valve when the actuating lever is in the forward position. As the valve spool is moved rearward by the actuating lever the passage " C " to the hydraulic lift cylinder is blocked off and a passage " E " leading to the front check valve is uncovered.

Oil pressure in the system will build up until it is sufficient to raise the front check valve off its seat ; it will also move the shuttle valve to the rear and lift the rear check valve off its seat. This will allow oil, under pressure, to flow to an external double acting ram via the front check valve and the drilling " G." In moving the double acting ram piston it will force oil from the other side of the piston into the valve body through the passage " H," past the rear check valve, around the valve spool and out of the valve body into the rear transmission case via the exhaust passage " J."

If the actuating lever is moved from the forward position through neutral to the rearward position (see Fig. 50), the valve spool is moved to the front and a passage " F " to the rear check valve is uncovered. Oil pressure in the system will build up until it is sufficient to raise the rear check valve off its seat ; it will also move the shuttle valve to the front and raise the front check valve off its seat. This will cause oil flow, to and from the double acting ram, to be reversed (out through passage " H " and in through passage " G ") and thus move the double acting ram piston in the opposite direction.

With the actuating lever in either its forward or rearward position no oil can flow to the hydraulic lift cylinder through passage " C," and therefore operation of the D.A.R. valve actuating lever overrides the hydraulic lift main control lever. The actuating lever can also be operated irrespective of the position of the main control lever in its quadrant.

FLOW CONTROL DEVICE

To adjust for slow or fast flow the control knob may be set in any position between the cast stops marked " F " and " S " on the D.A.R. valve body. The stop marked " F " indicates the maximum rate of flow position and " S " the minimum rate of flow position (see Fig. 47).

With the D.A.R. valve actuating lever in either its forward or rearward position, oil, under pressure, is passing through the flow control valve restrictor, around the valve spool and out to an external double acting ram (see Figs. 49 and 50). As the oil passes

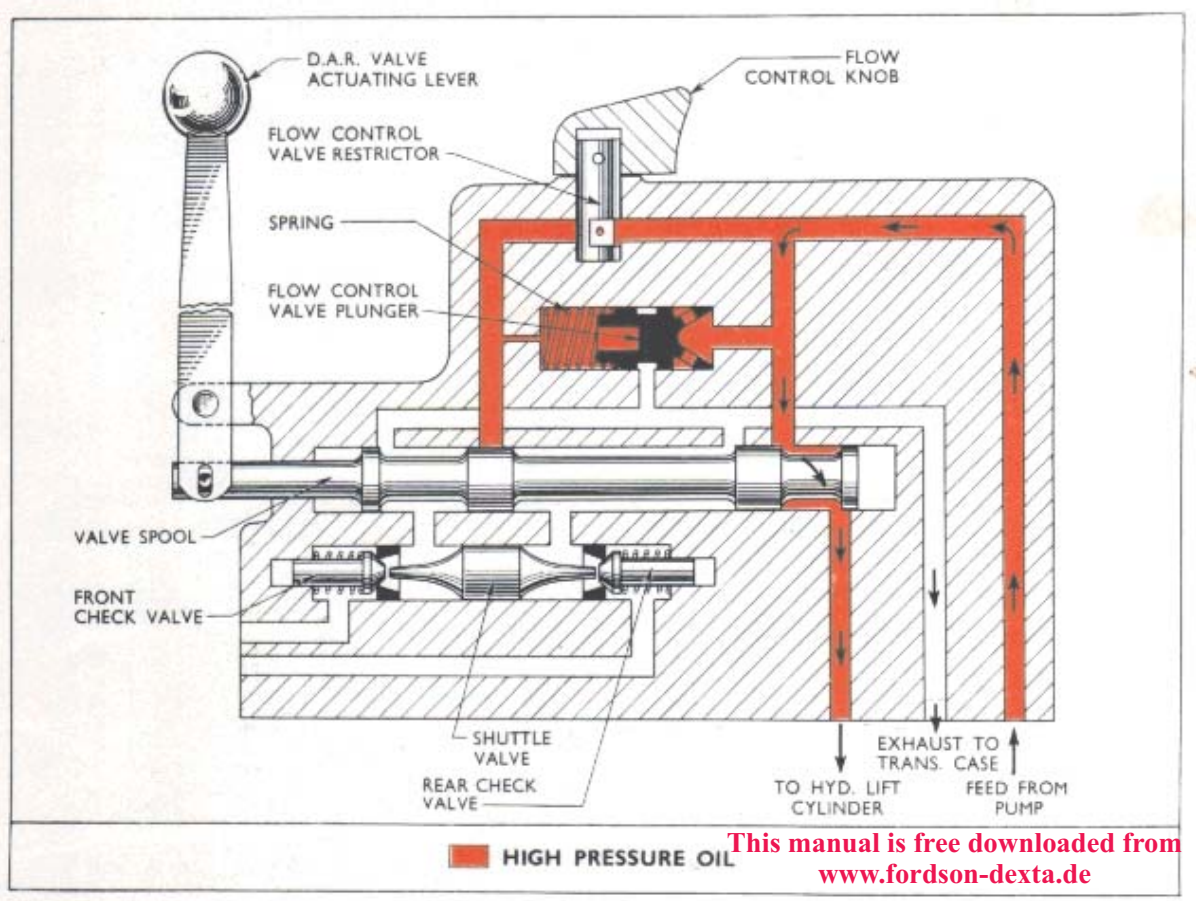

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Fig. 48
Oil Flow - Actuating Lever in Neutral Position

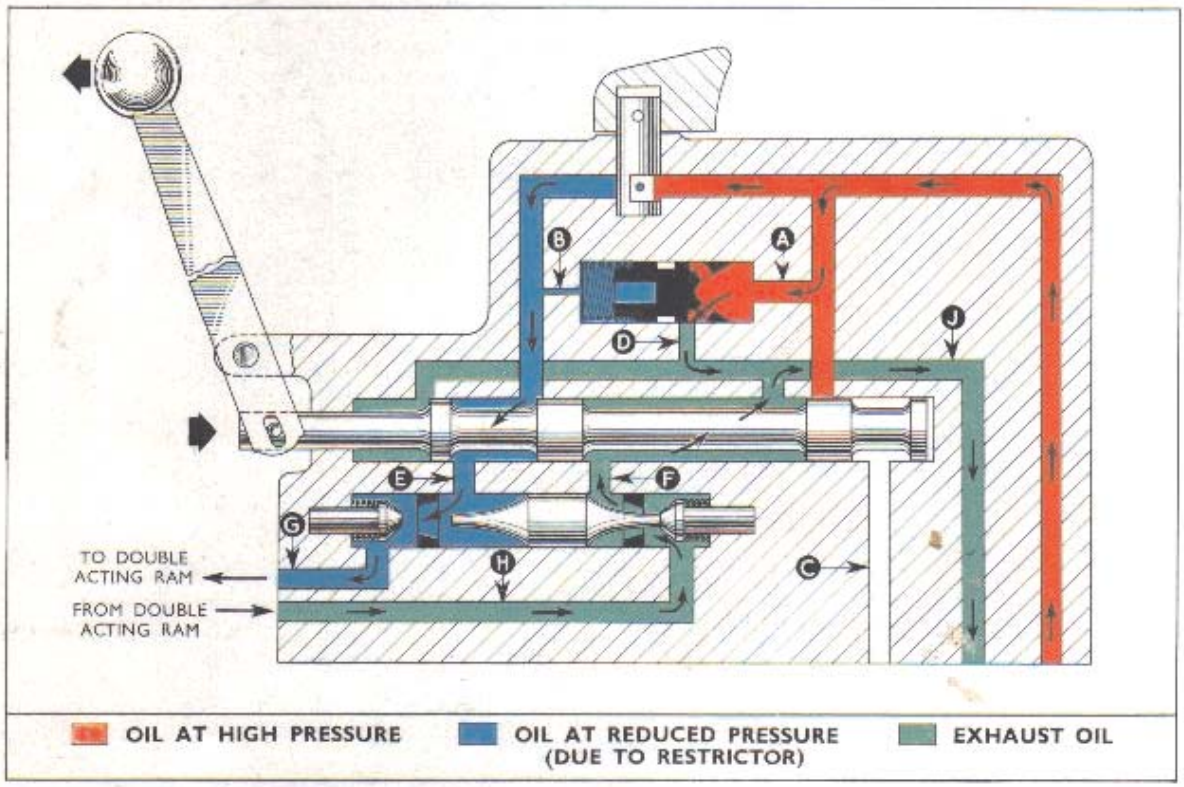

Fig. 49
Oil Flow—Actuating Lever in Forward Position

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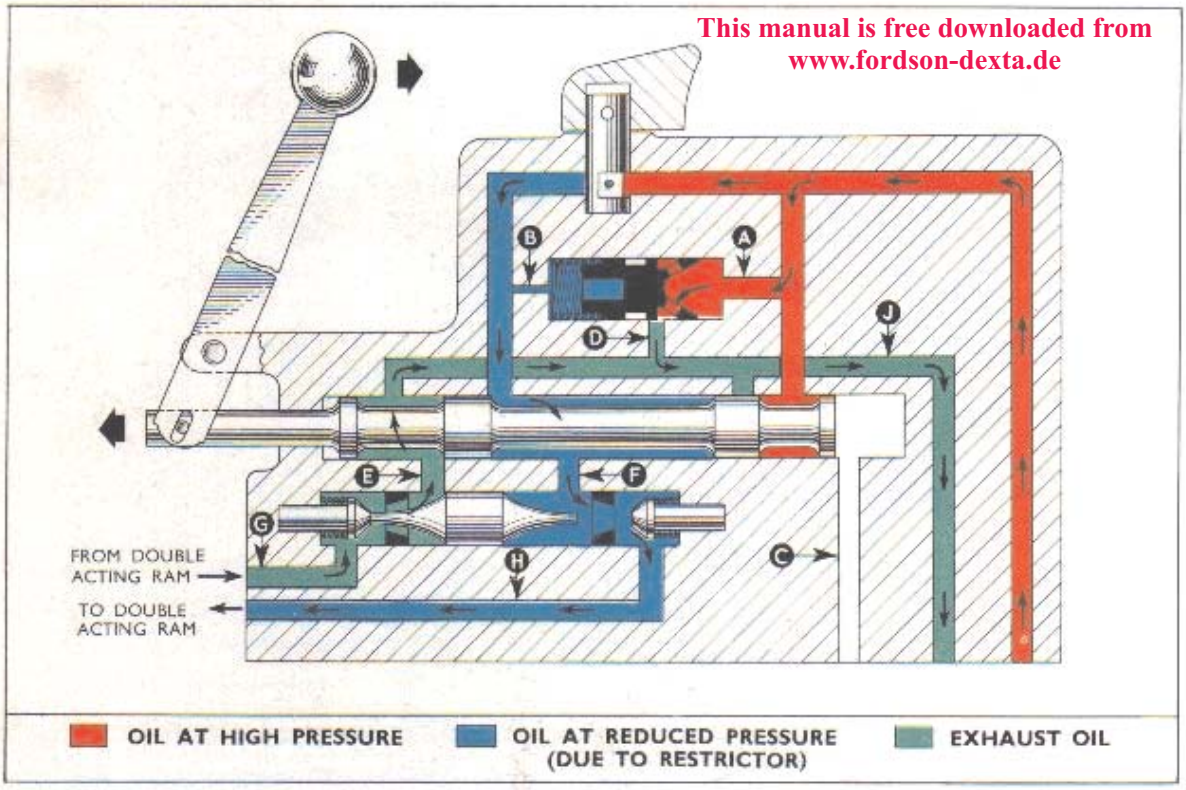

Fig. 50
Oil Flow - Actuating Lever in Rearward Position

the flow control valve restrictor it experiences a pressure drop due to the restriction to flow.

Therefore, oil under pressure, is being fed to the front of the flow control valve plunger through the drilling " A," and oil at decreased pressure (due to the pressure drop across the restrictor) to the rear of the plunger through the small drilling " B." If the pressure difference is sufficient to overcome the force of the flow control valve plunger spring it will move the flow control valve plunger and allow oil to exhaust to the rear transmission case through the drilling " D." The amount of oil " bled off " or exhausted will depend on the pressure difference between the front and rear of the flow control valve plunger ; this, in turn being determined by the amount of restriction to oil flow, i.e., the position of the restrictor (see Fig. 51).

Therefore, the rate of oil flow to an external double acting ram cylinder can be controlled at will by the operator, within the limiting design range of the flow control device, by merely setting the flow control valve restrictor in the desired position.

The correct rate of flow will depend on the weight and type of equipment being used, and will also be affected by the operating conditions and engine speed. Care should always be taken to ensure that the recommendations of the equipment manufacturer regarding speed of operation for the equipment are strictly observed.

TO OVERHAUL THE D.A.R. VALVE

To Remove

1. Unscrew the two retaining nuts and remove the driver's seat. If an extra comfort seat is fitted, swing it back into its most rearward position.

2. If the D.A.R. valve has feed pipes fitted, from the valve to the rear mounting bracket, disconnect the pipes from the D.A.R. valve by unscrewing the union nuts. Cover the ends of the pipes to protect them against the ingress of dirt.

3. Remove the four retaining set-screws and lift the D.A.R. valve from its location on the hydraulic lift cover. Suitably cover the top of the lift cover to stop the entry of dirt.

To Dismantle

1. Remove the retaining split pins and flat washers from the actuating lever clevis pins. Push the clevis pins out and remove the actuating lever.

2. Drive out the tension pin securing the flow control knob to the flow control valve restrictor, and remove the restrictor by pushing it downwards out from the underside of the valve housing.

3. Unscrew the flow control valve plunger stop retaining pin and remove the flow control valve plunger stop, plunger and spring.

4. Using a suitable pair of circlip or pointed nose pliers, remove the snap rings from the front and rear of the valve spool. Push the spool out from the rear of the housing complete with the rear seal retainer, recentering spring and spring seats.

To remove the recentering spring and seats, detach the small circlip from the valve spool.

5. Remove the valve spool front seal retainer from the valve housing taking care not to damage it.

6. Remove the snap rings from the check valve guides and remove the front check valve guide by inserting a suitable lever through the front jack tapping and levering the guide out. Remove the front check valve and spring.

7. Push on the front end of the shuttle valve to remove the rear check valve guide, check valve and spring. The check valve seats are an interference fit in the housing and they should only be removed if they need renewing or if the shuttle valve requires attention.

With one seat removed it is possible to slide the shuttle valve out of its bore.

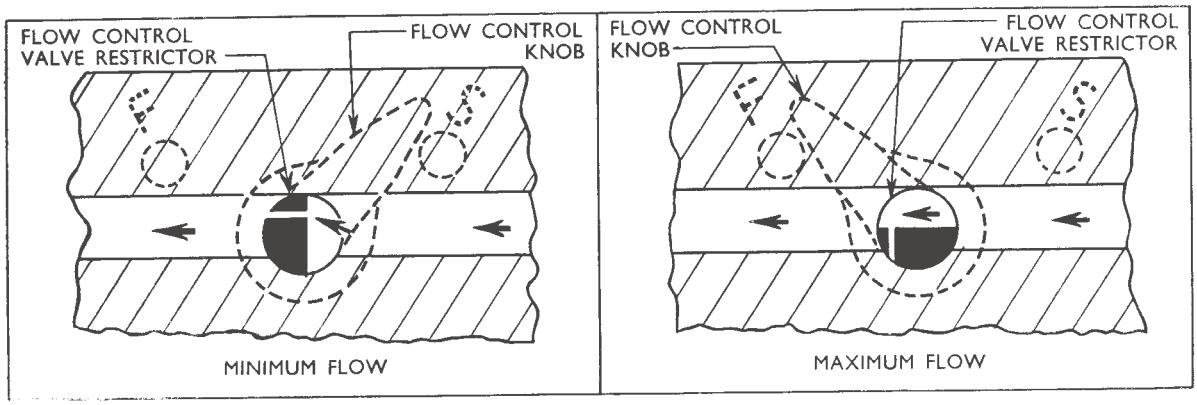

Fig. 51

Operation of the Flow Control Valve Restrictor

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8. It is not normally necessary to remove the sealing plugs from the passageways in the valve housing, although it is advisable if you require to give the housing a thorough clean out. There are six plugs in the housing—three retained by snap rings and three by tension pins. A pair of circlip or pointed nose pliers are required to remove the snap rings. The tension pins, however, can be driven out, using a small pin punch.

The sealing plugs are a press fit in the valve housing and to assist in their removal they have a tapped hole in them (No. 6–32–NC).

9. Remove and discard all rubber " O " rings. Thoroughly clean all components and inspect for damage or signs of wear. Renew any parts found defective, and **all " O " rings.**

NOTE.—The valve spool and the flow control valve plunger are selective fits in the D.A.R. valve housing. (See the Specification and Repair Data on page 41.) When selecting a new part the largest valve spool or flow control valve plunger should be fitted which will operate without binding in the housing.

It is most important that great care is taken whilst handling the valves to obviate the possibility of burrs, distortion or scratches, which could lead to a misleading impression as to the correct size of valve required.

To Reassemble

1. Replace one of the check valve seats, using the special tool No. T.8516, with the angled inner diameter of the seat facing inwards, until the seat contacts the shoulder in the bore. Care must be taken not to damage the seat, and it should have a firm, smooth outer edge to ensure a good seat for the check valve.

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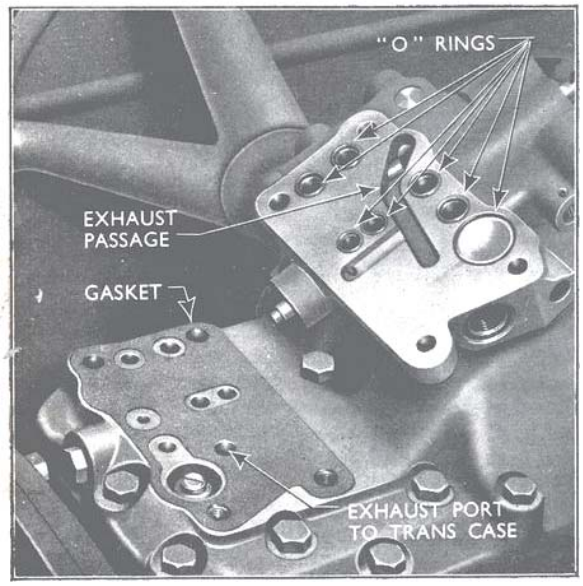

Fig. 52
"O" Ring Location

2. Lubricate the shuttle valve and replace it in the housing.

3. Replace the other check valve seat taking the precautions as described in paragraph 1.

4. Replace the check valves, springs and guides in the housing, and secure in position with two snap rings.

5. Refit the recentering spring and seats to the valve spool and secure in position with a circlip.

6. Lubricate the valve spool and replace it in the valve housing. Enter it from the rear with the recentering spring towards the rear.

7. Fit the front and rear seal retainers to the valve spool, taking care not to damage the " O " rings, and secure in position with two snap rings. The flat face of the rear retainer faces outwards.

8. Replace the flow control valve plunger and spring into the housing with the plain bore (parallel) of the plunger facing inwards. Fit the plunger stop and retain it in position with the threaded pin.

9. Push the flow control valve restrictor into its bore from the underside of the housing, taking care to see that the flat on the restrictor is facing to the right (when viewed from the rear of the body). **This is most important, otherwise incorrect operation of the restrictor will result.**

10. Fit the flow control knob to the restrictor and secure it in position with a tension pin.

11. Replace the actuating lever, fit the clevis pins and secure in position with two flat washers and split pins. The offset in the actuating lever must be to the right (when viewed from the rear of the D.A.R. valve).

To Replace

1. Ensure that the mating faces of the lift cover and D.A.R. valve are perfectly clean.

2. Fit new " O " rings into their appropriate locations on the D.A.R. valve and a new gasket (see Fig. 52).

3. Replace the D.A.R. valve on the lift cover and secure in position with four set-screws. The screws are all of different lengths and care should be taken to ensure that they are replaced in their correct positions, i.e., when viewed from the rear of the tractor the screws should be—front right 4.25 ins. (107.95 mm.) long ; rear right, 2.75 ins. (69.85 mm.) long ; front left, 2.125 ins. (53.975 mm.) long, and the rear left, 1.125 ins. (28.575 mm.) long.

4. Reconnect the feed pipes to their respective unions in the valve body, and tighten the union nuts securely.

5. Replace the driver's seat, and securely tighten the two retaining nuts.

SPECIFICATION AND REPAIR DATA—D.A.R. VALVE

Valve Spool

Diameter at each end .. .. .435 to .437 in. (11.049 to 11.100 mm.)

Diameter of lands :—

Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Red	.7435 to .7437	18.885 to 18.890
Yellow	.7437 to .7439	18.890 to 18.895
Blue	.7439 to .7441	18.895 to 18.900
Green	.7441 to .7443	18.900 to 18.905
White	.7443 to .7445	18.905 to 18.910

Diameter of bore in housing :—

Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Red	.7440 to .7442	18.898 to 18.903
Yellow	.7442 to .7444	18.903 to 18.908
Blue	.7444 to .7446	18.908 to 18.913
Green	.7446 to .7448	18.913 to 18.918
White	.7448 to .7450	18.918 to 18.923

Flow Control Valve Plunger

Outer diameter :—

Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Red	.6670 to .6672	16.942 to 16.947
Yellow	.6672 to .6674	16.947 to 16.952
Blue	.6674 to .6676	16.952 to 16.957
Green	.6676 to .6678	16.957 to 16.962
White	.6678 to .6680	16.962 to 16.967

Diameter of bore in housing :—

Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Red	.6675 to .6677	16.955 to 16.960
Yellow	.6677 to .6679	16.960 to 16.965
Blue	.6679 to .6681	16.965 to 16.970
Green	.6681 to .6683	16.970 to 16.975
White	.6683 to .6685	16.975 to 16.980

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Flow Control Valve Plunger Stop

Outer diameter .. .. .662 to .666 in. (16.815 to 16.916 mm.)

Thread size in extractor hole .. .. $\frac{1}{4}$ in.—28 U.N.F.

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Flow Control Valve Plunger Spring

No. of coils	13.5
Free length	2.80 ins. (71.12 mm.)
Length under load	1.31 ins. (33.27 mm.) under 11.9 lbs. (5.4 kgs.)

Shuttle Valve

Outer diameter	.6240 to .6245 in. (15.850 to 15.862 mm.)
Diameter of bore in housing	.6250 to .6255 in. (15.875 to 15.888 mm.)

Check Valve Seat

Inner diameter	.310 to .315 in. (7.874 to 8.001 mm.)
Outer diameter	.6880 to .6885 in. (17.475 to 17.488 mm.)
Diameter of bore in housing	.686 to .687 in. (17.424 to 17.450 mm.)

Check Valve and Guide

Diameter of check valve	.332 to .335 in. (8.433 to 8.509 mm.)
Angle of head	45°
Inner diameter of guide	.343 to .348 in. (8.712 to 8.839 mm.)
Outer diameter of guide	.745 to .748 in. (18.923 to 18.999 mm.)
Diameter of bore in housing	.750 to .754 in. (19.050 to 19.152 mm.)

Valve Spool Seal Retainers

Inner diameter	.441 to .443 in. (11.201 to 11.252 mm.)
Outer diameter	.996 to .998 in. (25.298 to 25.349 mm.)
Diameter of bore in housing	1.001 to 1.005 ins. (25.425 to 25.527 mm.)

Valve Spool Recentering Spring

No. of coils	7
Free length	1.42 ins. (36.07 mm.)
Length under load	.88 in. (22.35 mm.) at 11.75 lbs. (5.33 kg.)

Flow Control Restrictor

Outer diameter :—	
Above slot	.495 to .498 in. (12.573 to 12.649 mm.)
Below slot	.524 to .527 in. (13.310 to 13.386 mm.)
Base	.670 to .675 in. (17.018 to 17.145 mm.)

Sealing Plugs

Outer diameter	.527 to .529 in. (13.386 to 13.437 mm.)
Diameter of bore in housing	.530 to .532 in. (13.462 to 13.513 mm.)
Thread size in extractor hole	No. 6—32—N.C.

Thread size in jack tappings	½ in. B.S.P.
Tightening torque for D.A.R. valve retaining bolts	40 to 45 lb. ft. (5.53 to 6.22 kg.m.)

HYDRAULIC POWER LIFT

Since the introduction of the Fordson Dexta only minor modifications have been made to the hydraulic system and these changes have, where they affect servicing details or procedure, been covered through the medium of Service Letters. With the introduction of the Super Major certain components of the Dexta hydraulic system have been replaced or modified to allow the use of common parts or similar manufacturing methods on both tractors.

This supplement is intended to be used in addition to the information previously issued in the Fordson Dexta Workshop Manual and covers the latest parts, including the flow control valve, and information which has already been issued in the form of Service Letters to provide a complete supply of information covering the hydraulic system up to the current time.

It is not intended to repeat the repair procedure or the illustrations in the existing manual except where there is some definite variation in the procedure or appearance of the part. Many of the illustrations in the main section of the manual will therefore strictly apply only to the previous unit but where the parts and operations concerned are basically similar it has not been considered worthwhile making new illustrations.

The hydraulic oil flow as previously described in the Workshop Manual is basically correct with the exception that a flow control valve and restrictor are now incorporated in the auxiliary service control plate. The lowering cycle has been modified by the use of a new control valve and bush giving a simpler method of producing the lift cylinder. With the new control valve oil is passed in front of the control valve and exhausted through the spring chamber during lowering, also in the neutral cycle oil from in front of the unloading valve exhausts into the transmission through drillings in the control valve instead of passing the front of the valve. The oil flow in the neutral, raising and lowering cycles with the new parts is shown in Figs. 55, 56 and 57, and the operation of the flow control valve and restrictor are described fully later in this supplement.

Lift Cylinder Assembly

The lift cylinder is interchangeable as an assembly with the previous part but due to modifications to the oil drillings in the cylinder it is essential that the correct bushes, valves and retaining plates are used in sets on each cylinder.

The current and previous cylinders can be easily identified, the earlier cylinder having two blanking plugs and an exhaust port in the base of the valve portion, together with three screw fixings for the front and rear retaining plates whereas on the latest cylinder the exhaust ports and blanking plugs have been deleted and the retaining plates, which have been modified in shape, are now secured by two screws.

The method of removing and replacing the unloading valve plug and bushes is the same as previously described. There are, however, two types of unloading valve plug available in service with different size internal threads, adaptor T.8510–1/f is suitable for withdrawing the earlier plug while adaptor

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Fig. 53
Removing the Unloading Valve Plug

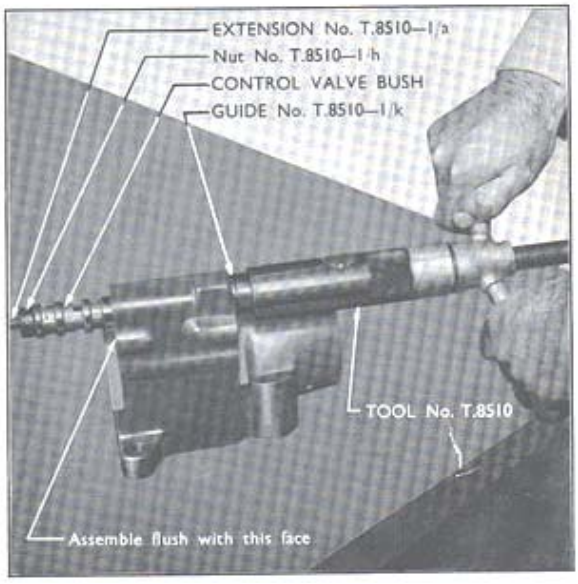

Fig. 54
Replacing the Control Valve Bush

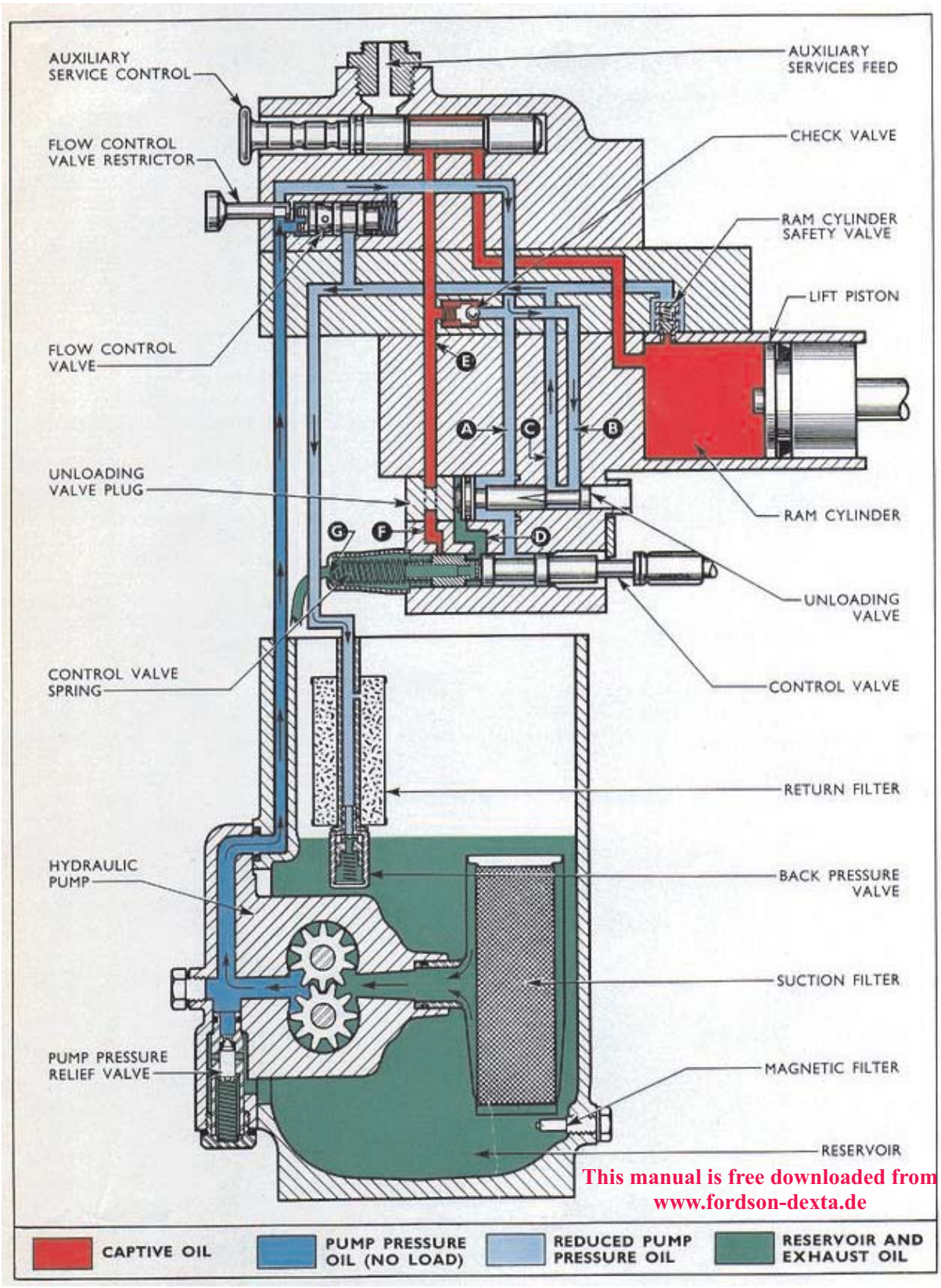

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Fig. 55
Hydraulic Oil Flow - Neutral

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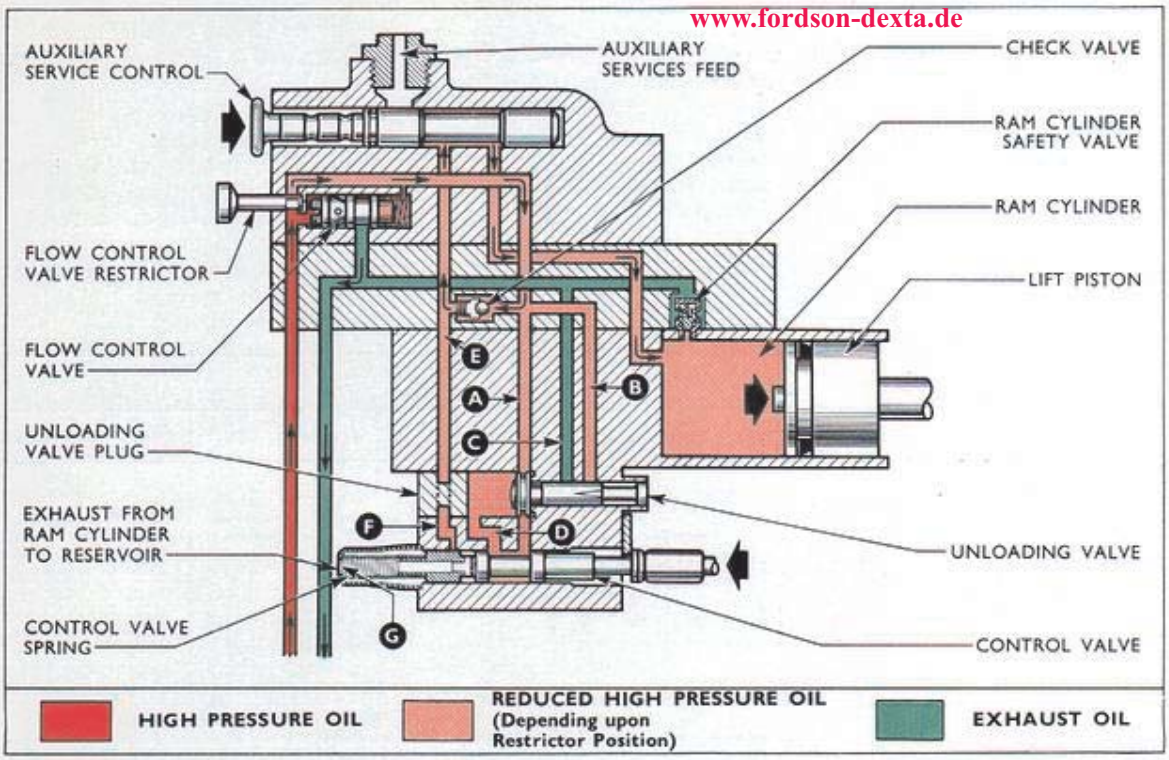

Fig. 56
Hydraulic Oil Flow—Raising

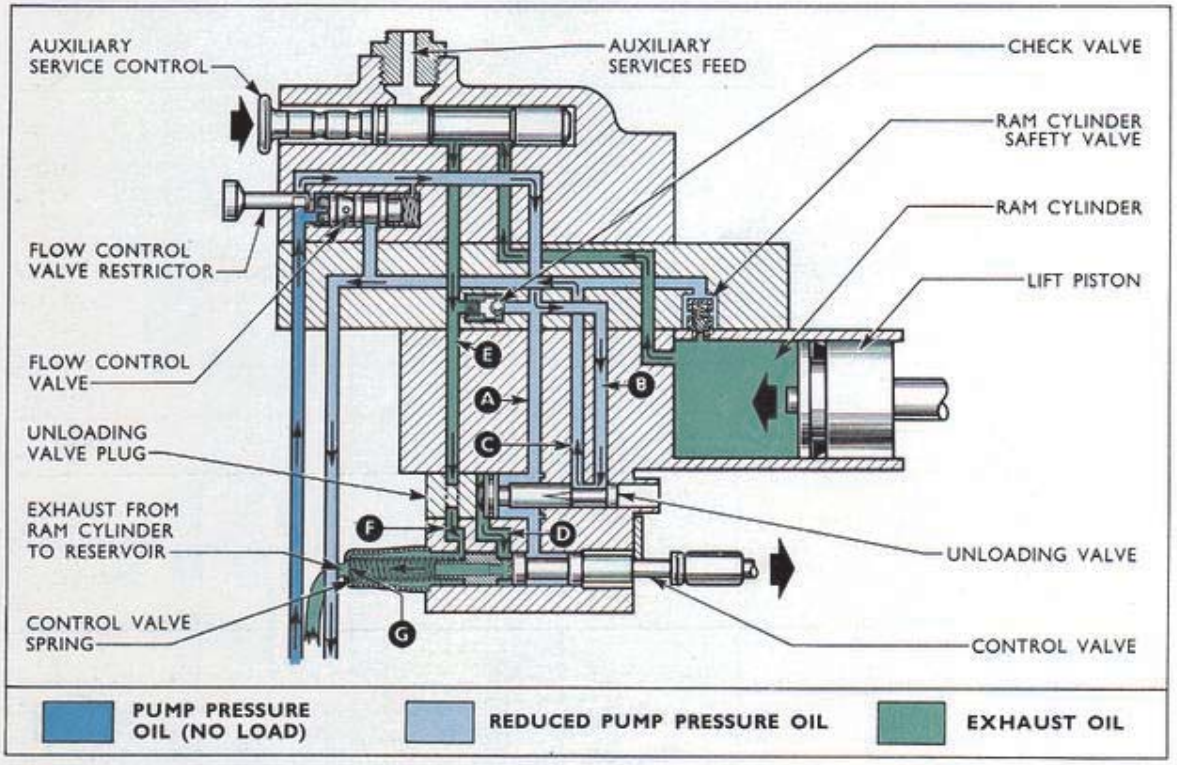

Fig. 57
Hydraulic Oil Flow - Lowering

T.8510–1/g is used for the current plug (see Fig. 53). The same tools as previously specified i.e. T.8510–1/a/h/k, are used for removal and replacement of the new control valve bush but when replacing the new bush it is recommended that the operation is carried out from the rear of the cylinder, pulling the bush in until it is flush with the front face of the cylinder (see Fig. 54). The bush should be located with the long annular recess to the rear of the cylinder.

The front and rear retaining plates are new parts, as is the control valve spring, and these parts must not be used on previous cylinders. It should be noted that the gasket and sealing washer fitted to the previous rear plate are no longer used. They must, however, continue to be fitted to the previous cylinder.

Since the Dexta was first introduced the size range for the control and unloading valve bushes and unloading valve plug has been extended. Also, with the introduction of the current valve chest, the Part Nos. of the control valve and bush have been changed and the following tables give the appropriate Part Nos., colour markings and dimensions of the various parts :

Unloading Valve Bushings and Plug

Colour Mark	*Rear Bush*	*Front Bush*	*Plug*	*Diameter (ins.)*	*Diameter (mm.)*
Blue/White	957E–482–F	957E–440–F	957E–916–F	1.0000–1.0002	25.400–25.405
White	957E–482–A	957E–440–A	957E–916–A	1.0002–1.0004	25.405–25.410
Blue	957E–482–B	957E–440–B	957E–916–B	1.0004–1.0006	25.410–25.415
Yellow	957E–482–C	957E–440–C	957E–916–C	1.0006–1.0008	25.415–25.420
Green	957E–482–D	957E–440–D	957E–916–D	1.0008–1.0010	25.420–25.425
Orange	957E–482–E	957E–440–E	957E–916–E	1.0010–1.0012	25.425–25.430
Green/White	957E–482–G	957E–440–G	957E–916–G	1.0012–1.0014	25.430–25.435
Red/White	957E–482–H	957E–440–H	957E–916–H	1.0014–1.0016	25.435–25.441

Control Valve Bushing

Colour Mark	*Prior to Serial No. 957E–68355*	*After Serial No. 957E–68355*	*Diameter (ins.)*	*Diameter (mm.)*
Blue/White	957E–481–F	E1ADDN–481–F	1.0000–1.0002	25.400–25.405
White	957E–481–A	E1ADDN–481–A	1.0002–1.0004	25.405–25.410
Blue	957E–481–B	E1ADDN–481–B	1.0004–1.0006	25.410–25.415
Yellow	957E–481–C	E1ADDN–481–C	1.0006–1.0008	25.415–25.420
Green	957E–481–D	E1ADDN–481–D	1.0008–1.0010	25.420–25.425
Orange	957E–481–E	E1ADDN–481–E	1.0010–1.0012	25.425–25.430
Green/White	957E–481–G	E1ADDN–481–G	1.0012–1.0014	25.430–25.435
Red/White	957E–481–H	E1ADDN–481–H	1.0014–1.0016	25.435–25.441

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Control Valve

Colour Mark	*Prior to Serial No. 957E–68355*	*Between Serial Nos. 957E–68355 and 957E–72408*	*After Serial No. 957E–72408*	*Diameter (ins.)*	*Diameter (mm.)*
White	957E–488–A	957E–488–L	957E–488–T	.5917–.5919	15.029–15.034
Blue	957E–488–B	957E–488–M	957E–488–U	.5919–.5921	15.034–15.039
Yellow	957E–488–C	957E–488–N	957E–488–V	.5921–.5923	15.039–15.044
Green	957E–488–D	957E–488–P	957E–488–W	.5925–.5926	15.049–15.052
Orange	957E–488–E	957E–488–R	957E–488–X	.5927–.5928	15.055–15.057

Main Control Lever Cross-Shaft

To enable parts common to both the Super Major and Dexta, and similar production methods to be used, the inner end of the control lever cross-shaft has been modified and the actuating lever is now retained by a snap ring instead of the flat washer, castellated nut and split pin previously used.

These two cross-shafts are completely interchangeable, providing that the correct hardware is used to secure the actuating lever. This change became effective in production at Tractor Serial No. 957E–74917.

Main Control Lever, Quadrant Assembly and Top Cover

With the introduction of the flow control valve, i.e. after Serial No. 957E–68355 the quadrant assembly was modified to incorporate a pivot point for the flow control valve linkage.

In addition the main control lever was modified and now carries a movable spacer which, when inserted between the lever and the flow control linkage, provides automatic fast operation of the hydraulics whenever the lever is moved to the " raise " position on the quadrant.

At Tractor Serial No. 957E–76093, changes were made to the fixing flange to enable the quadrant assembly to be retained by two screws instead of the four previously used.

To suit the two screw fixing arrangement a gasket with two holes for the fixing screws, instead of the previous four-hole type is used between the current type quadrant and the top cover.

In line with the changes to the quadrant the top cover has been modified and the latest cover has only two tapped holes for securing the quadrant.

Auxiliary Service Control Valve

The latest type auxiliary service control valve, incorporating a flow control device, is completely interchangeable as an assembly with the previous type, provided that a modified quadrant assembly and the necessary flow control valve linkage are also fitted.

The spool, retainer and housing are not interchangeable as separate items with previous production parts.

Operation of the Flow Control Valve

The flow control device, incorporated in the auxiliary service control valve plate, enables the driver to limit the rate of flow of oil to the ram cylinder or auxiliaries.

The rate of flow is adjusted by screwing the knob and spindle in or out of the control knob, moving the restrictor between the " F " (maximum flow) and " S " (minimum flow) marks cast in the housing. When the knob is screwed fully out, the restrictor will be in the minimum flow position, as the knob is screwed in the restrictor will be rotated until it reaches the maximum flow position. Regardless of the position at which the control knob is set, when the quadrant lever is raised to the top of the quadrant the flow control valve linkage will automatically move it to the fast position providing the quadrant spacer is moved into position between the control lever and the flow control linkage. When the implement is returned to work the flow control valve restrictor will automatically return to its pre-set position.

When the hydraulic system is in operation oil is being fed to the restrictor and the front face of the flow control valve at pump pressure, it then continues, via the restrictor, to the check valve passage and also via a small drilling to the rear face of the flow control valve.

Due to the obstruction to flow at the restrictor there will be a slight pressure drop at this point and the oil acting on the front and rear faces of the flow control valve will be at different pressures. The difference in these pressures will be in direct relation to the position of the restrictor, the further it is closed, the greater will be the difference. If sufficient difference exists, the high pressure oil will move the flow control valve against the pressure of the flow control valve spring and allow oil from the high pressure side to bleed off into the transmission housing.

The driver can thus, by altering the position of the restrictor, control the quantity of oil flowing to the ram cylinder or auxiliary circuit as required.

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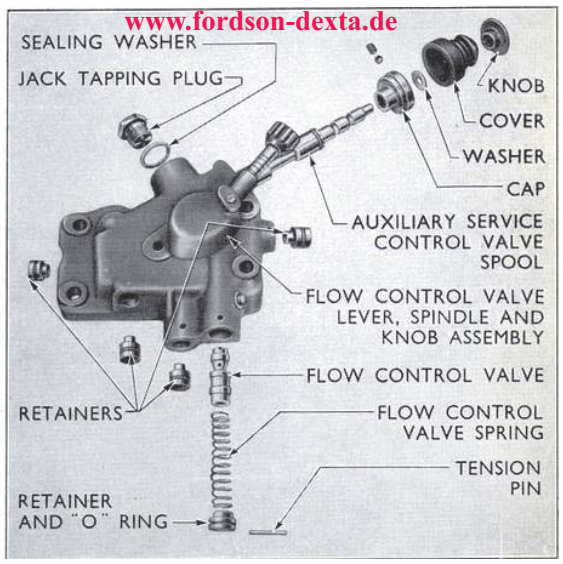

Fig. 58
Auxiliary Service Control Plate and Flow Control Valve

This is of particular benefit when operating in Qualitrol as it enables the operator to smooth out the reaction from the hydraulic system. When operating in undulating or rapidly varying soil conditions, there is a tendency for the implement to " bump " or over-correct and this can be overcome by setting the restrictor in the slow position. When operating under heavy conditions, where wheel slip is limiting traction, setting the restrictor in the fast position will allow corrections to take place at full speed. As the system causes a raising correction, weight will be transferred rapidly to the tractor assisting the tractor tyres to bite in and obtain a grip. A further advantage of the system is that when operating mounted equipment such as hedgers, setting the restrictor at " slow " will allow the operator to make small corrections to suit varying soil contours and will minimise the tendency to raise the implement too high which would occur on a system not equipped with flow control.

While the flow control valve has no control on the rate of lowering, the new control valve and bush mentioned previously are designed to allow a progressive rate of drop. The control valve bush now has three pairs of holes in it, each behind the other so that as the valve moves to the lowering position the holes will be progressively opened. Moving the valve a small amount means that the oil must exhaust through one pair of holes and gives a slow rate of drop, as the valve is moved further back the second and then the third pair of holes will be uncovered, increasing the rate of drop.

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To Remove and Dismantle the Flow Control Valve and Auxiliary Service Control Plate

1. Disconnect the flow control linkage from the knob by removing the clevis pin and split pin.

2. Remove the set screws securing the auxiliary service plate to the lift cover. Remove and discard the "O" rings fitted between the plate and the lift cover.

3. Drive out the tension pin securing the auxiliary service spool cap and withdraw the spool, cap and rubber cover. Unscrew the knob from the spool, remove the cover and flat washer and slide the cap off the spool, taking care not to lose the locating ball and spring from inside the cap. Remove and discard the "O" ring from the spool.

4. Drive out the pin securing the flow control knob to the restrictor, remove the knob and push the restrictor downwards out of the housing. Remove and discard the "O" ring fitted in the upper recess of the restrictor bore.

5. Drive out the pin in the end of the flow control valve chamber and withdraw the retainer, spring and valve plunger. Remove and discard the "O" ring fitted to the retainer.

6. Similarly, drive out the remaining four tension pins and remove the retainers and "O" rings fitted in the other oil passages in the housing.

To Reassemble the Auxiliary Service Control Plate and Flow Control Valve

1. Fit new "O" rings to the retainers, press into position in their bores and secure with tension pins.

2. Place the flow control valve plunger in its bore. This valve is a selective fit and the largest valve should be fitted which will operate without binding in the bore. Replace the flow control valve spring followed by the retainer, using a new "O" ring on the retainer, and secure by driving in the tension pin.

3. Insert the restrictor in its bore in the plate, keeping the large end to the lower face of the plate. Place a new "O" ring over the top of the restrictor and into the counterbore in the housing. Place the control knob in position over the restrictor and secure with a tension pin.

NOTE.—The holes in the restrictor and knob are drilled off-centre to ensure correct relationship between these parts.

4. Place the spring and ball in the internal recess of the auxiliary service spool cap. Depress the ball into the recess and slide the cap on to the spool. Place the flat washer on the end of the spool, followed by the rubber cover and operating knob.

5. Fit new "O" rings to the valve spool and fit the spool to the valve chest. The spool is a selective fit in its bore and the largest spool which will operate without binding should be fitted. Locate the cap in the entrance to the bore and secure with a tension pin.

6. Fit new "O" rings to the oil passages between the plate and the lift cover and fit the valve chest to the lift cover, using a new gasket.

Since the Dexta was introduced the range of auxiliary service spools has been increased to cover five bore and spool sizes. The colour markings of the bore and spool are shown in the tables below, together with the colour markings of the flow control valve and its bore. It should be remembered that the current spool, although having the same outside diameters as the previous type is not interchangeable. The table, however, is applicable to both types of spool.

Position Control/Qualitrol Selector Lever

Effective with approximate Tractor Serial No. 957E–53258 the position control selector arm was modified by the incorporation of an annular groove in the spindle section.

An "O" ring is now fitted at this location to improve oil sealing between the selector arm and lift cover. Whilst the selector arms are completely interchangeable, the "O" ring can only be fitted to the latest type arm.

Auxiliary Service Control Valve Bore		
Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Green	from .7487 to .7490	from 19.017 to 19.025
White	over .7490 to .7493	over 19.025 to 19.032
Blue	over .7493 to .7496	over 19.032 to 19.040
Yellow	over .7496 to .7500	over 19.040 to 19.050
Orange	over .7500 to .7503	over 19.050 to 19.058

Auxiliary Service Control Valve		
Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Green	from .7482 to .7485	from 19.005 to 19.013
White	over .7485 to .7488	over 19.013 to 19.020
Blue	over .7488 to .7491	over 19.020 to 19.028
Yellow	over .7491 to .7494	over 19.028 to 19.036
Orange	over .7494 to .7497	over 19.036 to 19.043

Flow Control Valve Plunger Bore		
Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Red	from .6675 to .6677	from 16.955 to 16.960
Yellow	over .6677 to .6679	over 16.960 to 16.965
Blue	over .6679 to .6681	over 16.965 to 16.970
Green	over .6681 to .6683	over 16.970 to 16.975
White	over .6683 to .6685	over 16.975 to 16.981

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Flow Control Valve Plunger		
Colour Marking	*Diameter (ins.)*	*Diameter (mm.)*
Red	from .6670 to .6672	from 16.942 to 16.948
Yellow	over .6672 to .6674	over 16.948 to 16.953
Blue	over .6674 to .6676	over 16.953 to 16.958
Green	over .6676 to .6678	over 16.958 to 16.963
White	over .6678 to .6680	over 16.963 to 16.968

Hydraulic Pump Pressure Relief Valve

Effective with approximate Tractor Serial No. 957E-49624 a new pressure relief valve was introduced to increase the operating efficiency of the hydraulic lift. The valve is completely interchangeable as an assembly with the previous valve but the details must not be mixed (see Fig. 6).

With the new unloading valve the maximum operating pressure of the system is raised to 2,450 to 2,500 lb/sq. in. (172.24 to 175.77 kg/sq. cm.), the valve will then blow off and remain off its seat until the pressure drops below 300 lb/sq. in. (21.09 kg/sq. cm.). The table below gives details of current and previous parts, the part number of the pump being changed due to the new valve incorporated in it.

With effect from approximate Tractor Serial No. 957E-56886 a further change was made to the unloading valve spring, this spring is interchangeable with the previous spring but must not be mixed with the earliest springs.

Description	*Part Nos.*	
	Current Type	*Previous Type*
Pump assembly—H.P.L.	957E-994630-B	957E-994630-A
Valve assembly—H.P.L. pump unloading	957E-638-B	957E-638-A
Plug—H.P.L. pump unloading valve	957E-679-B	957E-679-A
Seat—H.P.L. pump unloading valve spring	957E-906	—
Valve—H.P.L. pump unloading	957E-994601-B	957E-994601-A
Body—H.P.L. pump unloading valve	957E-994608-B	957E-994608-A
Shim—H.P.L. pump unloading valve (.010 in.)	957E-994613-E	957E-994613-A
Shim—H.P.L. pump unloading valve (.025 in.)	957E-994613-F	957E-994613-D
Shim—H.P.L. pump unloading valve (.005 in.)	—	957E-994613-C
Shim—H.P.L. pump unloading valve (.015 in.)	—	957E-994613-B
Spring—H.P.L. pump unloading valve	957E-994717-B	957E-994717-A
Cap—H.P.L. pump unloading valve	—	957E-931

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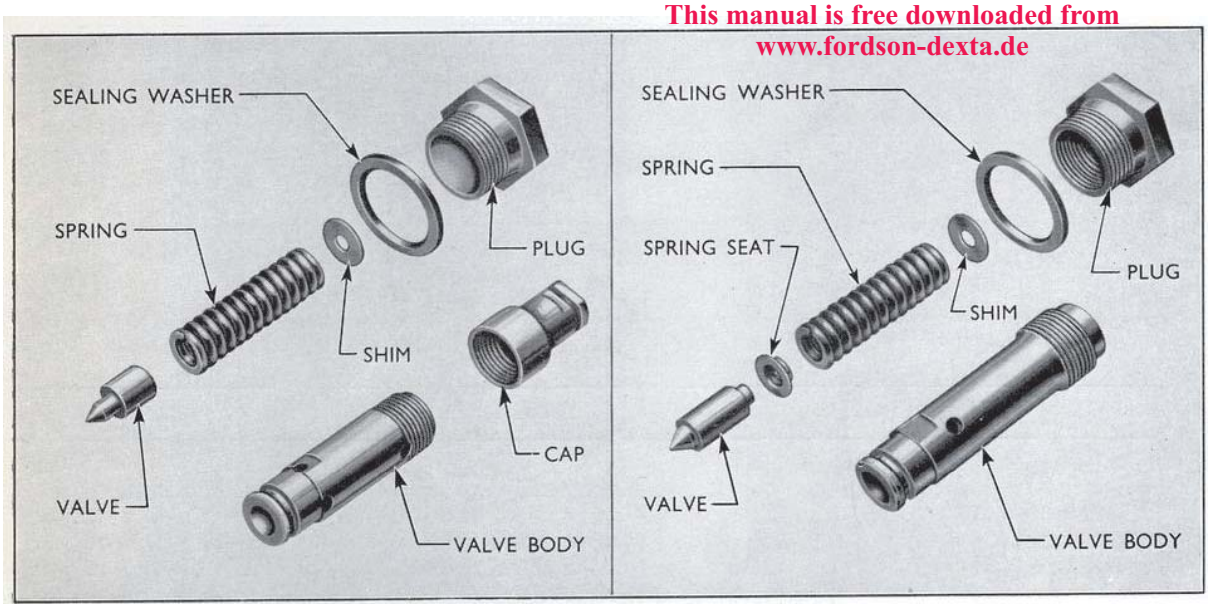

Previous type Current type

Fig. 59
Pressure Relief Valve Assemblies

Ram Cylinder Safety Valve

In line with the changes to the pump unloading valve the internal components of the ram cylinder safety valve were modified to raise the " blow-off " pressure to 2,750 to 2,850 lbs. per sq. in. (193.35 to 200.38 kg. per sq. cm.). This valve is fully interchangeable with the previous type and only the latest type is being supplied in service. As previously, this valve is a sealed unit and no attempt should be made to adjust it. If for any reason it is suspected to be faulty it should be removed and replaced with a new part.

This change became effective in production at Tractor Serial No. 957E–59444.

Ram Arm

All tractors after Serial No. 957E–19962 incorporate a thrust washer fitted between the right-hand side of the ram arm and the adjacent cross-shaft bush. To accommodate this washer the overall width of the ram arm has been reduced, the two arms are completely interchangeable and there is no change in part number. If, however, the narrower arm is fitted, the thrust washer must be fitted.

D.A.R. VALVE ASSEMBLY

Hydraulic Pump Relief Valve Pressure Testing

To facilitate checking the hydraulic pump pressure relief valve on " Fordson Dexta " tractors fitted with D.A.R. valve assemblies, the following procedure should be adopted, the equipment being assembled as shown in Fig. 7.

1. Operate the tractor to bring the transmission oil to normal operating temperature. While running the tractor operate the D.A.R. valve actuating lever to clear the D.A.R. valve left-hand feed pipe of high pressure oil, i.e. move the actuating lever to the rear to pressurise the right-hand feed pipe and thereby release oil from the left-hand pipe.

2. Disconnect the left-hand pipe at its forward end and remove the pipe adaptor from the jack-tapping in the D.A.R. valve housing.

3. Screw the " T "-piece (Tool No. T.8503–1/f) of the hydraulic test equipment (Tool No. T.8503–1) into the jack-tapping using a suitable sealing washer between the " T "-piece and D.A.R. valve housing. Fit a ½ in. B.S.P. plug and sealing washer in the outer end of the " T "-piece.

4. Remove the rear axle filler plug and install the transparent plastic hose and shut-off valve of the hydraulic test equipment between the " T "-piece and the rear axle filler plug hole, ensuring that the shut-off valve is assembled the correct way round, i.e. " FLOW " arrow on valve body pointing towards rear axle filler plug hole.

5. Attach the swivel adaptor (Tool No. T.8503–1/g) to the pressure gauge (Tool No. T.8503), remove the sealing plug from the hydraulic pump pressure relief valve chamber and screw the swivel adaptor and gauge assembly into the tapped hole.

6. Fully open the shut-off valve, start the engine and run at 1,550 r.p.m.

7. Move the D.A.R. valve flow control knob into the fast flow position (against stop marked " F " on valve body) and hold the D.A.R. valve actuating lever in the forward position.

8. Slowly close the shut-off valve and observe the reading on the pressure gauge which should show a steady increase in pressure up to 2,450 to 2,500 lbs/sq. in. (172.24 to 175.77 kg/sq. cm.). At this pressure the relief valve should open and the pressure should drop to approximately 300 lbs/sq. in. (21.09 kg/sq. cm).

If, after at least three consistent readings the relief valve is found to open at above or below the specified pressure, remove and dismantle the pump relief valve. Rinse thoroughly in cleaning fluid, reassemble while still wet and re-check the opening pressure. Only after this procedure has been followed should the number of shims be changed to increase or decrease the pressure to that specified, two thicknesses of shims, .010 in. (.254 mm.) and .025 in. (.635 mm.) are available for this adjustment.

9. Reassemble the relief valve, install in the pump and re-check the opening pressure.

In the event of the relief valve not blowing off, the pump itself may be at fault and the pressure will not reach the specified figures. If this is suspected, the pump should either be replaced with one which is known to be correct, or dismantled to determine the cause.

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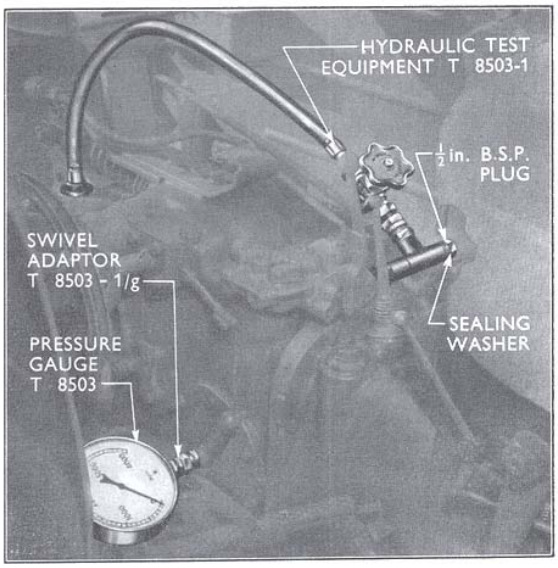

Fig. 60
Hydraulic Pump Test Equipment (With D.A.R. Valve)

NOTE.—Cleanliness is an absolute necessity when dealing with the hydraulic pump relief valve and when dismantling and reassembling the valve the parts should be rinsed in cleaning fluid to ensure that all traces of swarf and dirt are removed. Always reassemble the valve assembly while still wet.

10. When the relief valve pressure has been correctly set, release the pressurised oil from the left-hand feed pipe as described previously, remove the hydraulic test equipment and replace the pump relief valve chamber sealing plug, left-hand feed pipe adaptor, left-hand feed pipe and rear axle filler plug.

D.A.R. Valve Check Valve Testing

Whenever D.A.R. valve check valves and seats are renewed in service it will be necessary to test the sealing between the valve and seat to ensure satisfactory operation of the D.A.R. valve assembly (see Fig. 8).

A simple method of testing the sealing capabilities, using existing test equipment is outlined in the paragraphs below :—

1. Operate the tractor to bring the transmission oil up to normal operating temperature.

2. While the engine is running, release pressure oil from the feed line in which the check valve to be tested is situated, i.e. move the D.A.R. valve actuating lever rearward if the test is to be made on the front check valve and forward if the test is to be made on the rear check valve.

3. Disconnect the appropriate feed pipe at its front end and remove the pipe adaptor from the jack-tapping in the D.A.R. valve housing.

4. Screw the " T "-piece (Tool No. T.8503–1/f) of the hydraulic test equipment (Tool No. T.8503–1) into the jack-tapping, using a suitable sealing washer between the " T "-piece and the D.A.R. valve housing. Fit a ½ in. B.S.P. plug and sealing washer in the outer end of the " T "-piece.

5. Fit the hydraulic pressure gauge (Tool No. T.8503) into the top of the " T "-piece.

6. Run the engine at approximately 1,000 r.p.m., set the D.A.R. valve flow control knob in the slow flow position (against stop marked "S" on valve body), and move the actuating lever into the appropriate position to feed oil to the pressure gauge. Operate the lever approximately six times, raising the pressure on the gauge to maximum each time and then releasing it by moving the lever to feed oil to the other pipe. This sequence will allow the check valve to " bed " down on its seat.

7. Move the actuating lever into the appropriate position and raise the pressure on the gauge to above 2,000 lbs/sq. in. (140.6 kg/sq. cm.), release the actuating lever and check that the check valve and seat does not allow the pressure to drop below 1,250 lbs/sq. in. (87.9 kg/sq. cm.) in three minutes. Should the check valve and seat not pass this test they should be renewed.

8. Remove the hydraulic test equipment and replace the feed pipe adaptor and pipe.

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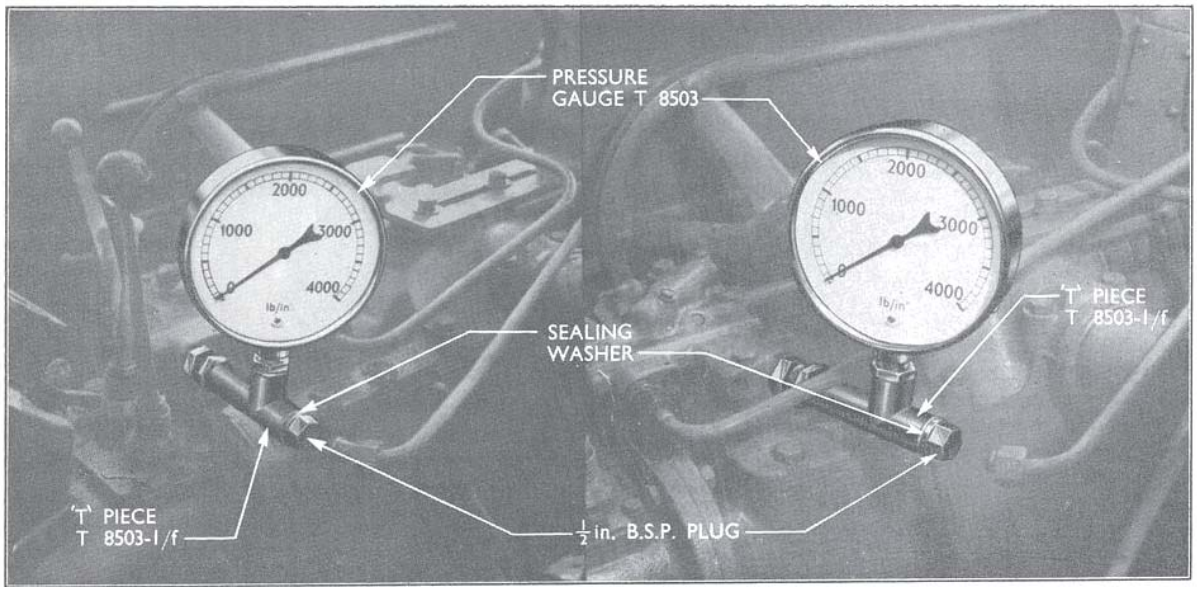

Fig. 61
D.A.R. Valve Check Valve Test

ELECTRICAL SYSTEM

The electrical system is of the 12 volt earth return type, the positive terminal of the battery being earthed.

THE BATTERY

The battery is supported in a suitable carrier behind the engine on the clutch housing. It is insulated from the engine by an asbestos bulkhead.

The battery has 9 plates per cell with a capacity of 80 ampere hours at the 10-hour rate, and depending on the territory concerned it is supplied in either a wet or dry (uncharged) state.

Provided the battery is properly maintained, it will function satisfactorily between the extreme temperatures of summer and winter.

If a dry battery is fitted, before putting the tractor into service the battery will require filling with electrolyte and charging as detailed under the heading " Dry Batteries."

Service replacement batteries are of the dry **charged** type and these only require a simple filling operation (see page 4) before the battery is put into service.

For certain export territories twin 6-volt batteries (129 ampere hour capacity at 10-hour rate) are provided, the extra battery being located on the left-hand foot plate.

The extra battery is fitted with a protection cover which will need to be removed when carrying out routine maintenance in order to gain access to the battery filler plugs.

MAINTENANCE

Cleanliness

Keep the battery and the surrounding area, particularly the tops of the cells, clean and dry and brush away any dirt or dust.

Keep the filler plugs tight and clean. Check the gas vents to ensure they are clear.

The terminals should be kept clean and coated with petroleum jelly (not grease).

If distilled water or electrolyte has been spilled on top of the battery, it should be cleaned off immediately, as even weak acid will quickly attack and corrode the cable connections, clamp frame and bolts. Use a rag soaked in a solution of hot water and weak ammonia to neutralise the effect of spilled electrolyte or acid.

Electrolyte Level

When topping up, use clean distilled water. Use only a clean lead, glass or earthenware container.

The correct working level of the electrolyte is shown in Table 3. It is good practice to top up the battery just prior to running the tractor, especially in cold weather, to ensure thorough mixing of the acid and the water and so prevent freezing.

If the battery is found to need an excessive amount of topping up, steps should be taken to determine the reason. For example, the battery may be receiving an excessive charge, in which case the regulator setting should be checked. If one cell in particular needs topping up more than another, it is likely that the case is cracked, in which event the battery must be replaced and the battery carrier cleaned and repainted if necessary.

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Specific Gravity

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The specific gravity of the electrolyte indicates the state of charge of the battery and should be checked with a hydrometer.

If the level of the electrolyte is so low that a hydrometer reading cannot be taken, no attempt should be made to take a reading after adding distilled water until the battery has been on charge for at least one hour.

Table 1 gives the specific gravity of the electrolyte at various acid temperatures when the battery is fully charged and the low limits of specific gravity when the battery is fully discharged at the normal rate.

Table 1

Temp °F	*Temp* °C	*Specific Gravity*	
		Fully Charged	*Fully Discharged*
110	43	1.264	1.094
100	38	1.268	1.098
80	26	1.276	1.106
70 (Normal)	21	1.280	1.110
60	16	1.284	1.114
40	4	1.292	1.122
20	—7	1.300	1.130
0	—18	1.308	1.138
—20	—29	1.315	1.146

Temperature Correction

Specific gravity varies with temperature and therefore the reading obtained on a hydrometer, at any acid temperature other than the standard of 70°F. (21°C.), must be corrected as follows :—

Add four points (0.004 specific gravity) for every 10°F. (5.5°C.) above 70°F. (21°C.)

Subtract four points (0.004 specific gravity) for every 10°F. (5.5°C.) below 70°F. (21°C.)

Example :—

Hydrometer reading at 80°F. (26°C.) = 1.276

1.276 + 0.004 = 1.280

Therefore battery is fully charged.

Variations in Cell Specific Gravity

When checking the specific gravity at least two readings should be taken of each cell. There should be little variation in the average specific gravity readings from cell to cell on any battery in reasonably good condition. If the variation is greater than 0.025, then the reason should be investigated.

When carrying out the specific gravity test the appearance of the electrolyte drawn into the hydrometer should be observed, if it is very cloudy or contains small particles in suspension, it is probable that the plates are in poor condition.

If acid has been spilled at any time or lost due to a leak, topping up the level with distilled water will lower the specific gravity.

This can be corrected when next charging the battery by adding a solution of sulphuric acid which has an approximate specific gravity of 1.350 or 37° Baumé (tropical batteries 1.245 ; 28.5° Baumé), until the specific gravity of the electrolyte is again standard.

Never use neat or strong acid for this purpose and when diluting always add the acid to the water.

A large variation, which is not the result of acid loss, is probably an indication of an internal short circuit and an early inspection of the battery is advisable.

Checking Battery Condition

There are three methods of checking battery condition ; open circuit voltage test, high rate discharge test and specific gravity test.

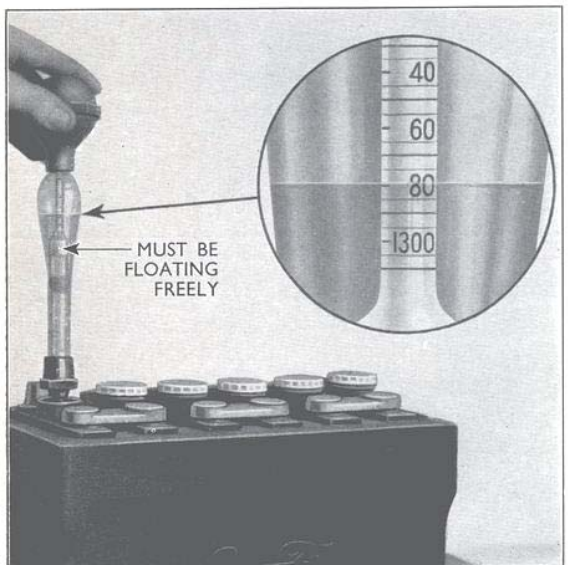

Fig. 1
Checking Battery Specific Gravity

Open Circuit Voltage Test

The open circuit voltage of a battery cell in good condition should be above 2.1 volts (12.6 volts total for a 12 volt battery).

Connect a suitable voltmeter across each cell and note the reading, ensuring that a good contact is made with the terminals.

However, the voltage reading on open circuit is liable to be misleading. If the voltage is low then the cell is definitely in poor condition, but a high voltage reading on open circuit does not necessarily indicate that the cell is in good condition.

High Rate Discharge Test

Never make a high rate discharge test on a battery known to be low in charge.

The high rate of discharge test gives an indication of the condition and capacity of the battery. On a Diagnosis Test Set high rate discharge test, a 12 volt battery should maintain 100 amp. flow for 10 seconds with no appreciable fall in voltage.

Where a hand instrument is used for checking the individual cells of a battery, the actual reading obtained will depend upon the type of instrument used, but the cell voltage on a 5 to 6 seconds test should remain steady between 1.2 and 1.7 volts.

Variations in individual cell readings can indicate faults, but if all cells in any one battery fall below standard, re-charge and again test before rejecting the battery.

Specific Gravity Test

The third method of checking the state of charge of the battery is by means of a specific gravity reading, taken on a suitable hydrometer (see Fig. 1). A fully charged battery should give specific gravity readings of 1.270 to 1.285 (31° to 32° Baumé) when checked with a hydrometer and corrected to 70°F. (21°C.) (see page 1).

General

Never bring a flame or spark near a battery at any time, particularly during or shortly after a charge, as the gases produced may be explosive.

Never add acid to the cells unless :—

1. The specific gravity and voltage at the end of the charge have remained constant over five successive hourly readings.

2. Gas is evolved freely from each cell.

3. The specific gravity is more than 0.010 (10 points) below 1.280 at 70°F. (21°C.), or as given in the fully charged specific gravity table (see page 1).

Never empty acid from a battery to refill with fresh acid unless the battery is fully charged.

Never leave a battery in a discharged condition. It should be recharged as soon as possible.

Avoid high temperatures above 110°F. (43°C.), as electrolyte temperatures above this tend to shorten the life of the battery.

WET BATTERIES

Wet batteries are no longer supplied in service, but if by chance they are removed from tractors and taken into stock it should be remembered that they will, with time, gradually deteriorate.

The actual loss of charge amounts to a fall in specific gravity of approximately 0.0015 in every 24 hours. This means that a fully charged battery having a specific gravity of 1.270 to 1.285 (corrected to 70°F. (21°C.) will, during one month, fall to approximately 1.230 (corrected to 70°F. (21°C.), which is an appreciable drop from the fully charged condition.

For this reason all wet batteries in stock, either on or off tractors, should be recharged at least once per month.

DRY BATTERIES

Dry batteries must not be allowed to stand in an unfilled state after the time period (approximately one year) stamped on the battery label has expired.

When preparing a dry battery for service the following instructions on filling and charging should be strictly adhered to :—

1. Fill each cell with electrolyte of the correct specific gravity (see Table 2) until the electrolyte is at the correct level (see Table 3), above the tops of the separators.

The electrolyte used should be dilute sulphuric acid sufficiently pure for storage battery use and at a temperature not exceeding 90°F. (32°C.).

2. The electrolyte level may fall due to absorption soon after filling, in this case it should be topped-up by adding acid of the correct specific gravity.

3. Replace the vent plugs and allow the battery to stand for 12 hours. If, after 12 hours, the level of the electrolyte has fallen, it should be restored to the correct level by adding further electrolyte.

	6-Volt	*12-Volt*
Normal charge rate and time (dry battery)	10 amps. for 48 hours	6 amps. for 48 hours
Normal charge rate (dry charged battery)	10 amps.	6 amps.
Electrolyte level above separators	$\frac{5}{8}$ in. (15.9 mm.)	$\frac{1}{4}$ in. (6.4 mm.)

Table 3

4. After connecting the positive terminal of the battery to the positive of the charging source and the negative of the battery to the negative of the charging source, charge at the specified rate (see Table 3) until the specific gravity and voltage stop rising.

If this rate of charge is maintained the charging time will be at least 48 hours.

The charge may be interrupted provided the charge periods are of at least eight hours duration and the rest periods do not exceed 16 hours. The battery cannot be considered fully charged until :—

(*a*) It has been charged at the specified rate (see Table 3) for 48 hours.

Should the temperature of the electrolyte reach the maximum figure given in Table 2, reduce the charge current and increase the time proportionately, or suspend the charge.

(*b*) The specific gravity and cell voltage in each cell show no further rise during five hours of continuous charging and all cells gas freely.

Should it be necessary to restore the electrolyte level during charge, top-up with distilled water.

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	Temperate Climates	*Tropical Climates*
Specific gravity of electrolyte for filling new batteries	1.260 (30° Baumé)	1.230 (27° Baumé)
Specific gravity of electrolyte at end of charge ..	1.270 to 1.285 (31° to 32° Baumé)	1.240 to 1.255 (28° to 29.5° Baumé)
Maximum permissible temperature of electrolyte during charge	110°F. (43.3°C.)	125°F. (51.7°C.)

Table 2

Specific Gravity of Electrolyte for Filling Dry and Dry Charged Batteries

5. On completion of the charge, the specific gravity should be within the limits shown in Table 2.

If the specific gravity is too low, adjust by removing some of the electrolyte and replace with an electrolyte of about 1.300 specific gravity. If the specific gravity is too high, remove some electrolyte and replace with distilled water.

After adjusting the specific gravity of the electrolyte continue charging until the electrolyte is thoroughly mixed. This may be determined by taking specific gravity readings at 10 minute intervals, and the charge should be continued until three successive readings are the same.

Always wash off any electrolyte that may have been spilled.

DRY CHARGED BATTERIES

The batteries supplied in service are of the dry charged type and may be identified by the part number embossed on the front side of the outer casing. A label is also attached to the battery, and on this label is printed complete filling instructions which must be adhered to when preparing the battery for service use.

At the time of manufacture of a dry charged battery, each battery cell is sealed and it is essential that these seals and the cell filler vent plugs are left in position and not removed in any circumstances, until the battery is to be prepared for actual use. Failure to observe this instruction may result in the battery losing its dry charged characteristics.

It is intended that batteries of this type should only remain in a dry condition for a period of up to six months, and a date by which the battery should be filled and put into use is stamped on the instruction label attached to the battery.

Filling a Dry Charged Battery

1. Remove and discard the seals from each cell filler vent plug.

2. Unscrew and remove each filler vent plug.

3. Fill each cell with electrolyte of the correct specific gravity (see Table 2) until the electrolyte is at the correct level (see Table 3) above the tops of the separators. The electrolyte should be at a temperature preferably between 70 and 90°F. (21 and 32°C.).

The level in each cell will fall rapidly during the first few minutes following filling, and thereafter progressively at a much lower rate.

Allow the battery to stand for approximately ten minutes, then add electrolyte to bring it up to the correct level.

4. Replace the filler vent plugs.

5. Approximately fifteen minutes after initial filling the battery should be ready for service.

Prolonged or unsuitable storage, also low ambient and battery temperatures may result in a longer standing period (up to two hours) being required to ensure sufficient output from the battery for starting a cold or stiff engine. Before installation and if the necessary time and facilities exist, it is beneficial to give a freshening charge for about four hours at the normal charging rate (see Table 3) and then check that all cells are gassing freely. The specific gravity should now approach that of a fully charged battery (see Table 2).

NOTE.—If the battery is put into service after the date shown on the label, it should be dealt with as in paragraphs 1, 2 and 3 above, but a special charge must then be given at the normal charging rate prior to installation in the tractor. This charge should be continued until the voltage and specific gravity of all cells remain constant for five successive hourly readings with all cells gassing freely. The specific gravity of a normal fully charged battery is shown in Table 2.

6. If, owing to unforeseen circumstances, the battery is not put into service immediately after filling, the battery should not be allowed to stand for more than two days before receiving a charge on or off a tractor. Before charging the battery check the electrolyte level in each cell.

7. The electrolyte levels and specific gravity should again be checked within a few days of going into service, and if necessary, the electrolyte levels topped-up.

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General

After dry charged batteries have been initially filled and charged, it is possible they may remain idle. If so, they should receive a bench charge, preferably once per month, especially in hot climates, as is the normal practice with wet batteries in store.

It is important that a battery which has been processed for fully dry charge shall be given a charge either on or off a tractor within two days after initial filling. Since there may be a delay in getting the battery into service after it has been filled with electrolyte, it is most desirable that the personnel responsible for filling arrange for the battery to be given a short charge of about four hours duration in every case before despatch, as indicated on the label attached to each battery.

The dry charged characteristics of batteries slowly fall off with time ; hence the limiting date stamped on the label. Such falling off in dry charge characteristics does not mean that the battery which has remained in stock after the expiry of the period given on the label will not have a perfectly normal life in service providing that it is given a sufficient charge before being fitted. It is, however, very much to the Dealer's advantage to see the dry charged batteries are taken from his stock in proper rotation, so that no batteries are kept in his stock for more than six months, and the need to give a lengthy charge before sending a battery out is avoided.

SPECIAL INSTRUCTIONS

Cold Climates

The freezing point of the battery electrolyte will depend upon its specific gravity and, therefore, upon its state of charge. This relationship is shown in the table below.

Sp. Gr. Corrected to 70°F. (21°C.)	*Freezing Point*	*Battery State of Charge*
1.100	18°F. (— 7.7°C.)	Fully discharged
1.150	4°F. (—15.3°C.)	25% charged
1.200	—18°F. (—27.8°C.)	50% charged
1.250	—60°F. (—51.1°C.)	75% charged
1.280	—90°F. (—67.8°C.)	Fully charged

If extreme cold is at all likely it is advisable to keep the battery at least 75 per cent. charged, since it is then extremely unlikely that the electrolyte will freeze.

Topping-up should only be carried out during charging and preferably when the cells are gassing freely, so that the water will mix with the electrolyte before it has time to freeze.

Tropical Climates

Wet batteries supplied with new tractors have an acid specific gravity of 1.270 to 1.285 (31° to 32° Baumé) when in a fully charged condition. These readings are corrected to 70°F. (21°C.).

The specific gravity of the electrolyte in batteries to be used under tropical conditions should, however, be between 1.240 and 1.255 (28° to 29.5° Baumé) on batteries with Porvic separators, when corrected to 70°F. (21°C.). It will, therefore, be necessary to adjust the specific gravity of all wet batteries supplied with new tractors on arrival at their destination.

Methods of Adjusting Specific Gravity in Tropical Climates

1. Immediately the tractor arrives at its destination, check and top up the battery electrolyte level with distilled water. Then place the battery on charge at its normal rate (see Table 3).

2. Continue the charge until the specific gravity has reached its maximum, i.e. until the gravity of each cell remains constant for a period from 2 to 5 hours and all cells are gassing freely.

3. Discontinue the charge, turn the battery upside down and allow it to drain for 10 to 15 minutes.

4. Turn the battery back to its normal upright position and clean the exterior surface of the casing thoroughly, using a cloth moistened with ammonia. This will counteract the effect of spilled acid.

5. With a minimum of delay, refill each cell with acid of 1.200 specific gravity (24° Baumé).

If the cells are not refilled directly after draining, the negative plates will tend to oxidise.

6. Again place the battery on charge at its normal rate and continue the charge for 4 to 6 hours.

7. If the acid specific gravity after the charge is above 1.255 (29½° Baumé) when corrected to 70°F. (21°C.), adjust by withdrawing acid from the cells with a squeezeball and restoring the level with distilled water.

If the specific gravity is below 1.240 (28° Baumé) adjust by adding acid of specific gravity greater than 1.250 (29° Baumé).

8. Following an adjustment to the electrolyte specific gravity, replace the battery on charge at the normal rate until the specific gravity of the acid in each cell has stabilised.

9. Before putting the battery into service, again check the acid levels, adjusting if necessary to the correct level above the separators. Remove acid if the levels are too high or add acid of 1.240 specific gravity (28° Baumé) if too low.

Always give idle batteries a freshening charge at least once a month.

BATTERY CONNECTIONS

If the battery connections are suspected of having a high resistance, the following tests should be applied.

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The Earth Strap

Using a 0–3 voltmeter or the leads V— and V+ on the Diagnosis Test Set, connect the negative lead to a good earth on the clutch housing near the battery earth strap.

Connect the positive lead to the positive terminal post (not the battery clamp) whilst the starter motor is cranking the engine with the stop control pulled out.

The reading should be less than 0.1 volts. If it is less than this reading, the connection from the battery to earth is in good condition.

If the reading is more than 0.1 volts, connect the negative lead to the clutch housing end of the earth strap. If the reading is now less than 0.1 volts, the resistance is at the earth strap connection on the clutch housing and the surrounding parts should be cleaned. If the reading is more than 0.1 volts the resistance is at the terminal on the battery which should be cleaned or replaced.

The Starter Motor Connections

Use a 0–15 voltmeter in parallel to the circuit to be tested (on the Diagnosis Test Set, use the leads V— and V+). Connect the negative lead to the battery negative post and clip the positive lead to the field terminal connection on the end of the starter motor, taking care not to touch the starter cable.

The meter should now read full battery voltage. Operate the starter motor with the stop control pulled out when the reading should be less than 0.5 volts.

If the reading is less than 0.5 volts, the connections at the battery, solenoid switch and starter motor are satisfactory.

Should a high reading exist, indicating a high resistance, the positive lead should be connected to the battery terminal of the solenoid switch. Operate the starter (stop control still out), when the reading should be less than 0.5 volts.

If the reading is more than 0.5 volts, connect the negative lead of the voltmeter to the battery negative cable clamp connection to the battery. If the reading is now less than 0.5 volts, the resistance is at the battery cable connection to the battery.

If the upper portion of the negative cable is in order, connect the positive lead to the field connection of the starter motor and the negative lead to the starter terminal of the solenoid. Keep the stop control pulled out and again operate the starter motor when the reading should be less than 0.5 volts. If both readings are less than 0.5 volts, there is a high resistance in the solenoid.

Having determined the location of the high resistance, the part should be cleaned or renewed as necessary.

THE GENERATOR

The generator is of the two-brush type with blade terminal connections and, is used in conjunction with a voltage control regulator mounted in the instrument box. The generator is driven at 1.5 times engine speed.

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Prior to tractor serial number 09B728446 a generator of the same overall dimensions but with screwed terminal posts and detail internal differences was used, and where such differences occur these are shown in the repair operations below.

Testing the Generator

Output Test

Disconnect the leads from the "D" and "F" terminals of the generator and join the terminals together with a short piece of wire. Connect a 0–30 voltmeter between this junction and earth. Run the engine at 1,000 r.p.m. when the voltage reading should rise rapidly without fluctuation above 24 volts. Do not increase the engine speed above 1,000 r.p.m. in an endeavour to obtain this voltage, as this will give a false reading.

If there is no reading, check the generator leads, brushes and brush connections. If the reading is very low, the field or armature windings may be suspected.

Motoring Test

If the output reading is incorrect, but does not indicate the cause of the trouble, remove the fan belt by slackening the generator mounting bolts and moving the generator in towards the engine. Connect a 0–30 ammeter between the joined terminals of the generator and the battery negative post.

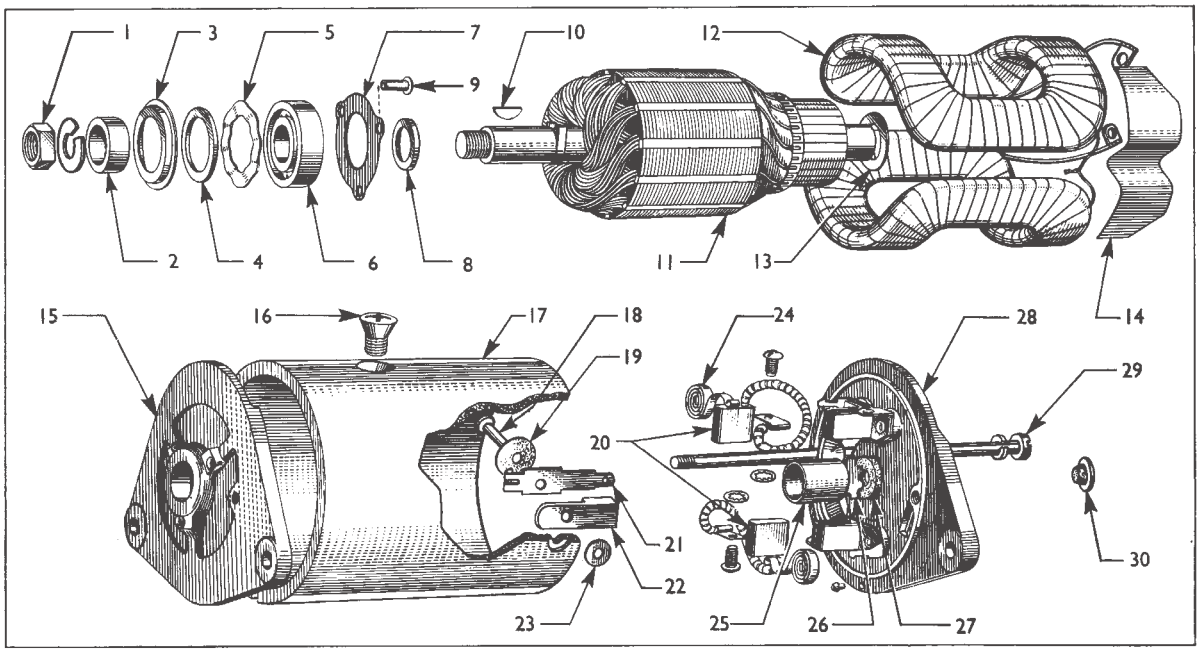

Fig. 2 **Exploded View of the Generator**

1 Nut
2 Collar
3 Retainer
4 Felt
5 Corrugated washer
6 Bearing
7 Retainer plate
8 Ring retainer
9 Rivet
10 Key
11 Armature
12 Field coils
13 Distance washer
14 Insulator
15 Drive end plate
16 Pole piece screw
17 Yoke
18 Rivet
19 Insulator
20 Brushes
21 Field terminal
22 Insulator
23 Insulator
24 Brush spring
25 Bush
26 Retainer
27 Felt
28 Commutator end plate
29 Through-bolt
30 Plug

The generator should now motor and the current consumption should be 4 to 6 amps.

(*a*) A high reading on the ammeter is an indication of tight generator bearings.

(*b*) An excessively high reading will indicate a short circuit.

(*c*) A low reading is a general indication of bad commutation.

Remove the joining wire between the " D " and " F " terminals and refit the fan belt.

Field Coil Resistance

The resistance of the field coils should be calculated by Ohm's law, after taking a reading of the current consumption.

The field coil current consumption should be checked with the generator " D " and " F " leads disconnected and an ammeter connected between the battery negative post and the " F " terminal of the generator.

For an accurate reading, the battery voltage applied to the generator for this test should be 13.5 volts. With this voltage applied, the current reading should be observed and the field coil resistance calculated from Ohm's law, viz. :—

$$R = \frac{E}{I}$$

where R = the field coil resistance in ohms.
E = the applied voltage.
I = the current reading on the ammeter.

The correct field coil resistance is 5.7 to 6.3 ohms at 68°F. (20°C.).

OVERHAULING THE GENERATOR

To Remove

1. Slacken the three securing bolts and move the generator in towards the engine so that the fan belt may be detached.

2. Disconnect the wiring connections from the generator terminals.

3. Remove the three securing nuts and bolts and lift the generator from its supports on the side of the cylinder block.

To Replace

1. Place the generator against its forward support bracket with the drive end plate in front of the support bracket leg and locate it with the three securing bolts. (It may be necessary to slacken the nut securing the generator adjusting strap to the cylinder block.)

2. Refit the fan belt over the generator pulley and move the generator away from the engine until there is 1 in. (25.4 mm.) free movement of the fan belt, measured midway between the generator and crankshaft pulleys. Tighten the adjustment bolt and generator mounting bolts securely.

3. Reconnect the leads to the terminals on the commutator end plate. The red/white tracer wire has the small blade connector which fits the " F " (smaller) terminal and the yellow/white tracer wire has the larger blade connector which fits the " D " terminal.

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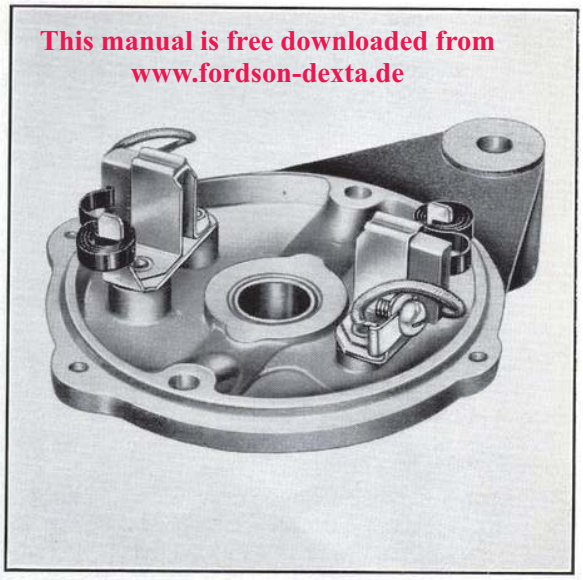

Fig. 3
Brushes Held in the Raised Position

Before Tractor Number 09B728446 :—

Reconnect the leads to the terminals on the commutator end plate. The red/white tracer wire to the " F " (smaller) terminal and the yellow/white tracer wire to the " D " terminal.

To Dismantle

1. Remove the generator as described above.

2. Secure the pulley and unscrew the pulley nut and spring washer. If the pulley is tight on the shaft, it may be removed, using the universal pulley puller CPT.6041. Detach the key and spacer.

3. Unscrew the two through bolts which hold the end plates together. The commutator end plate assembly is now free and can be removed from the yoke.

If it is a tight fit, it should be carefully levered off with a screwdriver.

Do not lose the distance washer on the commutator end of the armature shaft.

4. The drive end plate and armature may now be pulled from the generator yoke.

NOTE.—The drive end plate and armature should not be separated unless the front bearing requires attention.

To remove the field coils, refer to page 9.

To Reassemble

1. Replace the field coils as described on page 9.

2. Place the armature and drive end plate assembly in the generator yoke from the front end, so that the dowel on the bracket locates in the slot in the yoke end face.

3. Replace the distance washer on the commutator end of the armature shaft. Ensure that the insulator strip is fitted between the field coil connections and the generator yoke.

4. Check the brush gear as described under "Generator Brushes." Enter the brushes into their holders securing them in the raised position by locating the brush springs against the sides of the brushes (see Fig. 3).

5. Position the commutator end plate on the armature shaft until the brushes are partially entered over the commutator. Enter a thin screwdriver in the gap between the yoke and the commutator end plate and gently lever the brush springs away from the brushes to allow the brushes to lower fully on to the armature, then locate the spring ends correctly on the top of the brushes.

The commutator end plate may now be pushed home, making sure that the dowel engages in the slot of the yoke end face.

6. Replace the two through-bolts and spring washers from the commutator end, screwing them into the drive end plate. Make sure that the top bolt (looking from the commutator end with the generator positioned as on the tractor) passes between the insulator strip and the generator yoke, thus clearing the field coil bridge connection.

7. Locate the spacing collar on the front of the armature shaft and fit the key in the shaft key-way.

Align the key-way in the pulley with the key on the shaft and gently tap the pulley into position, using a hide mallet. Refit the generator pulley nut and lockwasher and tighten securely.

8. Refit the generator as described on page 7.

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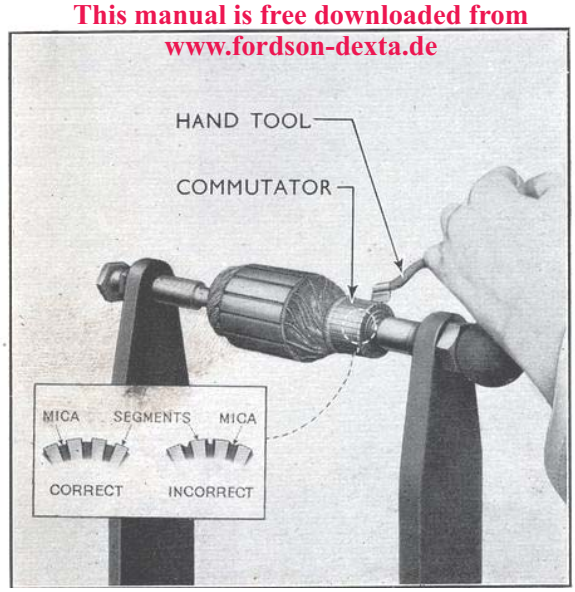

Fig. 4
Undercutting the Generator Commutator Segments

THE GENERATOR BRUSHES

To Remove

1. Remove the generator as described on page 7.

2. Unscrew the two through bolts which hold the end plates together. The commutator end plate assembly is now free and can be removed from the yoke.

3. Raise the brush springs and draw the brushes out of the brush holders.

4. If the brushes are sticking, clean with a petrol-moistened rag and, if necessary, ease the sides by polishing on a smooth file.

If the brushes are worn to 0.35 in. (8.89 mm.) in length or if the brush lead is exposed on the brush face, new brushes must be fitted.

5. Unscrew the brush terminal screw, holding the brush lead, taking care not to lose the lockwasher. The brush may now be removed.

6. Slide the loop on the brush spring off the post and remove the spring if necessary.

To Replace

The contact face of the brush is pre-formed so that bedding to the commutator is unnecessary.

If the original brushes are being replaced, refit in the same positions as removed to maintain correct brush contact with the commutator.

1. Replace the brush spring on the post and "wind-up" the spring until it exerts pressure on the top of the brush holder.

2. Raise the brush spring and locate the brush into the holder, ensuring that it is free to slide. Place the end of the brush spring on the top of the brush.

3. Connect the brush lead to the terminal on the holder and secure with a screw and lockwasher.

4. Refit the commutator end cover as previously described.

5. Replace the generator as previously described.

THE COMMUTATOR

The commutator should be inspected when the generator is dismantled. A commutator in good condition will be smooth and free from pits or burned spots.

Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish it with a strip of very fine glass paper, *not emery cloth*, while the armature is rotated.

If the commutator is badly worn or scored, mount the armature, with or without the drive end bracket, in a lathe, rotate at high speed and take a light cut with a very sharp tool, removing only the minimum of metal.

Polish the commutator with very fine glass paper. Undercut the mica insulation between the segments to a depth of $\frac{1}{32}$ in. (0,8 mm.) with a hacksaw blade

Fig. 5
Testing Field Coils for Continuity

ground down to the thickness of the mica (see Fig. 4), i.e. to the width of the spaces between the commutator segments, if the proper equipment is not available.

Finally, polish the commutator with fine glass paper and remove all copper dust. Check the armature for short circuits to the shaft or core.

THE ARMATURE

If the armature is suspected of being faulty and no signs of burning, arcing or broken connections are visible, it should be checked on suitable armature testing equipment or by substitution.

No attempt should be made to machine the armature core or true a distorted shaft.

GENERATOR FIELD COILS

To Test the Field Coils

To check field coils suspected of being faulty it is necessary to drill out the rivet securing the terminal post to the yoke in order to be able to isolate the two field coil tappings.

To ensure correct alignment of the post when refitting, the commutator end plate should be temporarily placed in position before final peening over the end of the rivet.

Continuity

Connect the prods of a suitable continuity tester between the two coil tappings. If the proper equipment is not available, use a 6 or 12 V. battery and voltmeter as shown in Fig. 5.

If the bulb lights or a reading is given on the meter, it indicates a complete circuit through the field coils.

Earth

Connect the test prods between one tapping and the generator yoke. If the bulb lights, the coils are earthing.

It is also advisable to examine the terminal post insulation for the possibility of earthing.

To Remove the Field Coils

1. Dismantle the generator as described on page 7.

2. Remove the insulation strip which prevents the junction of the field coils contacting the yoke and through-bolts.

3. Mark the yoke and pole pieces in order that they can be refitted in their original positions. Make the marks on each pole piece distinguishable from the others, so that they cannot be refitted in the wrong position and thus alter the residual magnetic polarity of the generator.

4. Carefully mark the two wires connected to the terminal post, as the wire nearest the yoke (red) is earthed while the other wire (yellow) is insulated.

Remove the terminal post and unsweat the terminals from the field coil wires.

5. To expand the pole pieces, use a pole piece expander. Locate the expander inside the yoke and tighten the end nut securely (see Fig. 6).

6. Mount the yoke and pole piece screwdriver CPT.9504 in a vice, as shown in Fig. 7, when the pole piece screws can be slackened off and finally removed.

7. Remove the pole piece expander, when the pole pieces and field coils can be withdrawn from the generator yoke.

To Replace

1. Place the new field coils over the pole pieces and position them in the generator yoke. The pole

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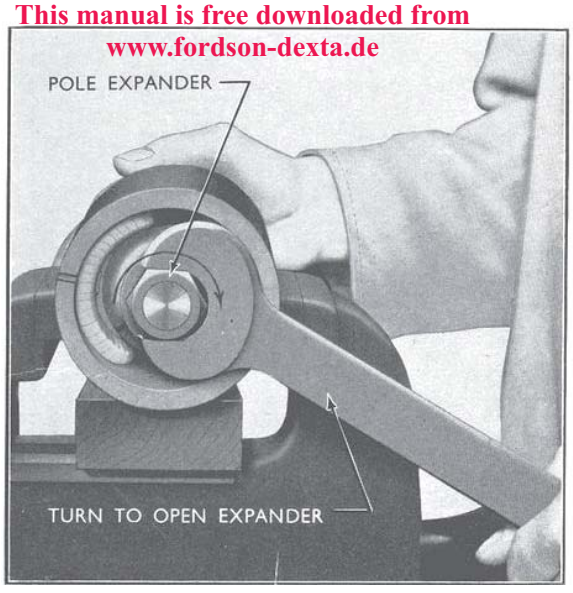

Fig. 6
Expanding the Pole Pieces

pieces must be refitted in the same position from which they were removed and the field coil wires must point towards the apertures in the yoke and be on the same side as the terminal post. Take care not to trap the wires between the pole pieces and the yoke.

2. Replace the pole piece screws, tightening them up to retain the field coils in position.

3. Insert the pole piece expander and open it up to its fullest extent, tightening the pole pieces as much as possible.

4. Mount the yoke and pole piece screwdriver in a vice, and tighten the screws fully.

5. Remove the pole piece expander.

6. Replace the insulator strip between the field coil connections and the yoke.

7. Re-solder the two field coil connections to their correct terminal tags ; refit the terminal post and secure with a new rivet.

8. Reassemble the generator as previously described.

NOTE.—It may be necessary to provide residual magnetism in the field coils after the generator has been replaced on the tractor.

Before Tractor serial number 957E–58225, flick the cut-out points together with the generator connected up.

From Tractor serial number 957E–58225, a sealed regulator has been fitted. With this type of regulator, momentarily connect together the " D " and " A " terminals on the regulator, with the generator connected up.

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Fig. 7
Removing the Pole Piece Screws

DRIVE END PLATE BEARING

To Remove

1. Remove the pulley, key and collar and dismantle the generator.

2. Press the armature shaft out of the drive end plate.

3. Drill out the rivets which secure the bearing retainer plate to the end plate and remove the plate.

4. Press the bearing out of the end plate and remove the bearing washer, felt washer and retainer from the bearing housing.

To Replace

1. Clean the bearing housing and bearing and lubricate with high melting point grease.

2. Place the retainer, felt washer and bearing washer in the housing.

3. Locate the bearing in the housing and press it home, using an adaptor of sufficient diameter to take the thrust on the outer race of the bearing.

4. Fit the bearing retainer plate. Insert four new rivets from the outside of the end bracket and open the rivet ends by means of a punch to secure the plate rigidly in position.

5. Ensure that the metal clip and retainer are located in the groove on the armature shaft and press the drive end plate on to the shaft so that the retainer plate abuts the clip.

6. Reassemble the generator and refit the pulley.

COMMUTATOR END PLATE BEARING

To Remove

1. Remove the generator commutator end plate and remove the brushes.

2. Remove the bearing bush by screwing a $\frac{5}{8}$ in. tap into the bush for a few turns and pulling out the bush with the tap. Screw the tap squarely into the bush to avoid damage to the end plate.

3. Remove and clean the felt ring and aluminium four-lobed washer.

To Replace

NOTE.—Before fitting the new bush it should be allowed to stand for about 24 hours, immersed in thin engine oil. The bush is of the porous bronze type, and this will allow the pores of the bush to be filled with lubricant. Do not drill a lubricating hole through the bush or attempt to ream it.

1. Insert the felt ring and aluminium four-lobed washer.

2. Refit the bush in the end plate, using the driver CPT.9507, so that the top of the bush is flush with the bottom of the chamfer.

3. Reassemble the generator.

THE VOLTAGE CONTROL REGULATOR

The regulator unit consists of a cut-out and voltage regulator. Normally, the regulator requires very little attention in service.

However, should it be suspected that it is not functioning correctly, tests should be made to ensure that the rest of the electrical circuits are in good condition and are not affecting the operation of the regulator.

Important points which can give a false indication of a regulator fault are given below, and should be carefully checked before attempting to effect any replacements.

The regulator is fitted inside the instrument panel immediately below the rear of the fuel tank. To gain access to the regulator, disconnect the proofmeter drive and the engine stop control cable from the fuel injection pump, remove the instrument panel side plates and extract the two set-screws securing the instrument panel to the fuel tank rear support bracket. Draw the panel towards the rear of the tractor and turn it to gain access to the regulator.

Preliminary Checks

Fan Belt

Make certain that the generator support brackets are securely tightened in position. Check the fan belt and ensure that it is adjusted correctly without the slightest suspicion of belt "slip." A slipping belt may cause an erratic or low charging rate. Ensure that the fan belt is correctly aligned and that the pulleys are not damaged.

Battery

Check the battery condition as previously described. Top up if necessary. Clean off any corrosion from the battery terminals and cable ends and make certain that the top of the battery is clean and dry.

A sulphated battery or corroded terminals will result in a low output even though the open circuit setting of the regulator may be correct. (Both these conditions will probably result in unsatisfactory starter motor operation.)

If a battery has a short-circuited cell, or the top of the battery has become soaked with acid, or is in a poor condition due to abuse or prolonged service, it will result in a high charging rate.

Check the earth connections from the battery and the regulator to ensure that they are tight and in good condition.

Generator and Connections

Check that the generator is functioning satisfactorily and ensure that the leads "D" and "F" are not crossed either at the regulator or generator. If the leads are crossed, the regulator points will have "welded" together the moment the engine was started. Make sure that the leads are not broken or damaged and that the connections are tight.

Test the generator as previously described.

TESTING AND ADJUSTING THE REGULATOR (After Serial No. 957E–58225)

From Tractor Serial No. 957E–58225 a new regulator has been fitted and due to the unit being sealed it is not possible to make repairs to it, but the following tests are given to enable the regulator to be checked and, on current units which have adjustment apertures, for adjustments to be carried out when determining electrical system faults.

As the new regulator has no "A1" terminal (necessitating a new wiring loom) and different mounting bolt dimensions, it cannot be used as a direct replacement for the previous regulator, except by the fitting of a new instrument panel (or modifying the existing panel) and the new wiring loom.

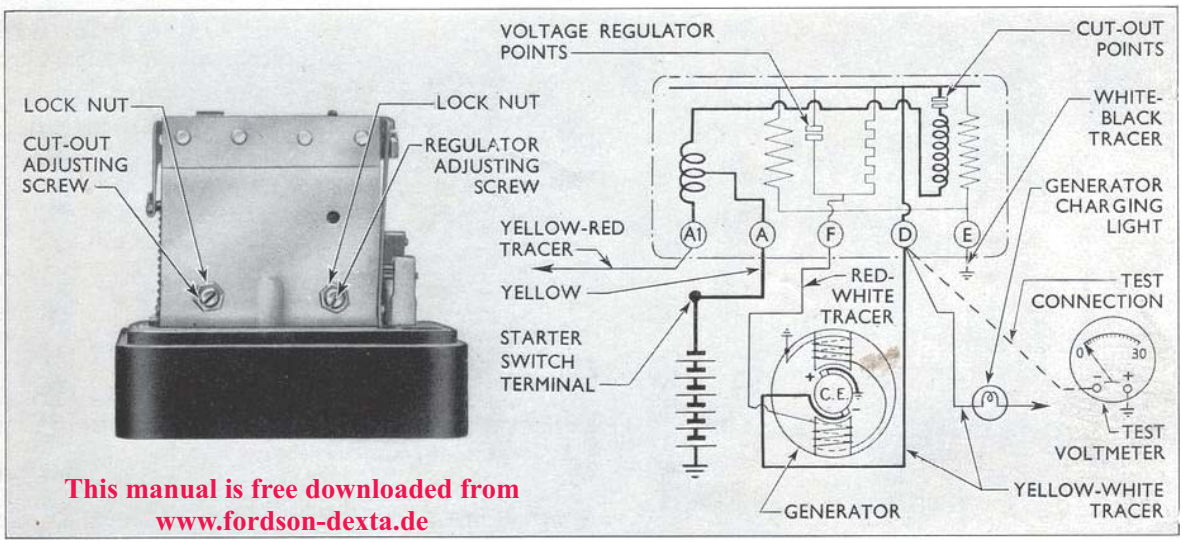

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Fig. 8
Regulator and Wiring Diagram

Open Circuit Voltage Test

1. Withdraw the cable from terminal marked " A."

2. Connect the negative lead of a test voltmeter (0–30 V) to terminal " D " on the regulator and the positive lead to a good earth or the terminal " E."

3. Tests must be made with the regulator cold, i.e. immediately on starting the engine, the atmospheric temperature should be noted by means of a thermometer.

4. Start the engine and increase its speed to maximum engine r.p.m.

5. Observe the voltmeter reading, it should lie between the limits given below for the approximate temperature of the regulator unit.

Atmospheric Temperature	*Regulator Setting Volts*
50°F. (10°C.)	16.1—16.7
68°F. (20°C.)	16.0—16.6
86°F. (30°C.)	15.9—16.5
104°F. (40°C.)	15.8—16.4

6. If the voltage at which the reading becomes steady occurs outside these limits the regulator must be adjusted. This operation can be carried out by means of a screwdriver with an insulated blade passed through the right-hand of the two holes on the regulator unit. A screwdriver with a bare blade should not be used due to the risk of a short circuit.

Ampere Output Test

1. With the lead to the " A " terminal disconnected, connect an ammeter in series with the lead " A " and terminal " A."

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Fig. 9
Voltage Regulator

2. Speed up the engine and observe the charging rate. This will vary according to the state of charge of the battery, up to a maximum of 11 amps.

Cut-out Test

1. Connect the voltmeter between the " D " terminal and a good earth or the " E " terminal.

2. Switch on an electrical load (e.g. the headlights).

3. Start the engine and slowly increase its speed, at the same time observing the voltmeter needle. When the cut-out contacts close, a slight flick of the needle will be noticed, and this should occur within the cut-in voltage limits of 12.7—13.3 volts. If necessary the cut-out can be adjusted by means of an insulated screwdriver passed through the left-hand of the holes in the casing.

TESTING AND ADJUSTING THE REGULATOR (Before Serial No. 957E–58225)

Before Tractor Serial No. 957E–58225 a regulator with a removable cap and consequently, fully adjustable, was used and details of the checking and adjustment of this regulator are given below.

1. Insulate the cut-out points with a thin strip of mica or withdraw the cables from the terminals marked " A " and " A1 " (see Fig. 8) and join them together.

2. Connect the negative lead of the test voltmeter (0–30 V.) to terminal " D " on the regulator and the positive lead to a good earth.

3. Adjustment must be made with the regulator cold, i.e., immediately on starting the engine the atmospheric temperature should be noted by means of a thermometer.

4. Start the engine and gradually increase the speed until the voltmeter needle " flicks " and then steadies.

This should occur at a voltmeter reading between the limits given below for the approximate temperature of the regulator unit.

Atmospheric Temperature	*Regulator Setting Volts*
50°F. (10°C.)	16.1—16.7
68°F. (20°C.)	16.0—16.6
86°F. (30°C.)	15.9—16.5
104°F. (40°C.)	15.8—16.4

If the reading is not between these limits, the regulator is in need of adjustment.

5. Increase the speed gradually to maximum r.p.m. when the voltmeter needle should not rise more than 0.5 volt above the tabulated readings.

If the voltmeter reading continues to rise as the engine speed is increased, possibly swinging the needle right over, it is indicative that either the regulator points are not opening or there is a poor or no earth between the regulator and the body.

If the points are not opening, the regulator should be renewed, as it is probably that they are " welded " or shorted, or there is an open circuit in the shunt coil.

6. If the voltage at which the reading becomes steady occurs outside these limits the regulator must be adjusted.

Shut off the engine and remove the cover. Slacken the lock-nut of the regulator adjusting screw (see Fig. 8), and turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Again run up the engine and repeat as above until the correct setting is obtained.

Adjustment of regulator open-circuit voltage should be completed within 30 seconds, otherwise heating of the shunt winding will cause false settings to be made.

A generator run at high speed on open circuit will build up a high voltage. Therefore, when adjusting the regulator, increase engine speed *slowly* until the regulator operates, otherwise a false setting may be made.

7. Reconnect the wires to terminals " A " and " A1 " or remove the insulation from the cut-out points.

Ampere Output Test

1. Connect a test ammeter in series with the lead " A " and terminal " A."

2. Speed up the engine and observe the charging rate. This will vary according to the state of charge of the battery.

To Clean the Regulator Points

These must be removed for cleaning, and this should be carried out as follows :—

1. Slacken the locknut securing the fixed contact and screw to its bracket. Unscrew and remove the fixed contact and screw.

2. Remove the two armature screws and lockwashers (see Fig. 9) and detach the metal strip.

3. Move the fixed contact mounting over slightly, enabling the moving contact bracket to be lifted out. Take care not to lose the insulating strips positioned on either side of the fixed contact mounting bracket.

4. Clean the contact points with a suitable cleaning fluid or carborundum paper operated in a circular movement. Carefully wipe away all traces of dirt or other foreign matter. Finally, wipe both points with methylated spirits (de-natured alcohol).

5. Replace the points in the reverse sequence to that described above in paragraphs (1) to (3), and reset the air gaps as described later.

In the event of the regulator not functioning correctly after adjustment, re-examine the regulator contacts. Any pitting or dirt must be removed as a clean smooth surface is essential.

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Fig. 10
Cut-out Points
(Setting the Fixed Contact)

Resetting the Regulator Armature

The armature or moving contacts should not normally be removed, as the air gaps between the core and the frame are accurately set and are of great importance to the satisfactory operation of the regulator. If, for any reason, however, the armature has been removed, or its setting altered, it should be reset as follows :—

1. Disconnect the battery.

2. Slacken the fixed contact screw locknut and unscrew the contact screw until it is clear of the armature moving contact (see Fig. 9).

3. Slacken the regulator adjusting screw locknut and unscrew the adjusting screw until it is completely clear of the armature tension spring.

4. Slacken the two armature assembly securing screws. Using a 0.015 in. (0.381 mm.) feeler blade, wide enough to cover the complete core face, insert the blade between the armature and core shim, taking care not to damage or burr the edge of the shim.

5. Press the armature **squarely** down against the blade and, holding it firmly, retighten the two armature assembly securing screws.

6. With the blade and armature still in the above position, screw the adjustable contact down until it just touches the armature contact. Re-tighten the locking nut.

7. Reset the regulator adjusting screw as described in " Testing and Adjusting the Regulator."

8. Reconnect the battery.

If the contact points are found to be badly worn, replace the regulator.

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Fig. 11
Cut-out Points
(Setting Armature Stop Arm)

THE CUT-OUT

Examine the cut-out points and, if necessary, clean with a suitable cleaning fluid or carborundum paper. Ensure that the points are meeting correctly (see Figs. 10 and 11).

To Test and Adjust the cut-out

1. Connect the voltmeter between the "D" terminal and a good earth, or the "E" terminal.

2. Speed up the engine slowly and note the voltage immediately before the points close.

This voltage should be 12.7 to 13.3 volts. The voltage may be adjusted by slackening the locknut and turning the cut-out adjusting screw (see Fig. 8), in an anti-clockwise direction to decrease the voltage and vice versa. Turn the adjusting screw a little at a time, tighten the locknut and re-test as above.

Resetting the Cut-out Armature

If it is suspected that the above setting is incorrect and the cut-out points setting has been disturbed, proceed as follows :—

1. Slacken the adjusting screw locknut and unscrew the cut-out adjusting screw until it is clear of the armature tension spring.

2. Slacken the two armature securing screws.

3. Press the armature down **squarely** against the copper-coated core face and, holding it there, retighten the armature securing screws.

4. Still holding the armature down against the core, bend the armature stop arm so that a gap of 0.025 to 0.040 in. (0.635 to 1.016 mm.) exists between it and the armature tongue (see Fig. 11).

5. Insert the end of a 0.010 to 0.020 in. (0.254 to 0.508 mm.) feeler blade between the outer end of the armature and core face, and set the fixed contact, by bending the arm, so that the points are **just** touching (see Fig. 10).

6. Reset the cut-out adjusting screw as described in "To Test and Adjust the Cut-out."

THE STARTER MOTOR

The starter motor is mounted on the front of the flywheel housing on the right-hand side of the engine.

The motor has four pole pieces and four sets of field coils. Four commutator brushes are fitted, two of which are earthed ; the other two are insulated and connected to the field coils. The armature shaft is supported in an outboard bearing in the starter motor drive housing.

The solenoid switch is located on the lower right-hand forward corner of the fuel tank front support and is controlled by a relay switch mounted on top of the starter motor drive housing, which is operated by the pinion actuating lever and starter control lever.

Prior to Tractor Serial No. 09A315817 the key in the centre of the lighting switch controlled the starter relay switch circuit.

From Tractor Serial No. 09A315817 the starter relay circuit key switch has been moved from the centre of the light switch and re-located on the right-hand side of the instrument panel, the light switch remaining in the original location.

The change of the switch necessitated a new wiring loom, for tractors with lights, and the previous loom is no longer serviced. When fitting a current loom to tractors with lights before 09A315817 with the previous switch arrangements, it is necessary to make the following modifications to the loom :—

(i) Tape up the ignition switch feed, colour brown which has terminal part No. ET6–14477 and is no longer required.

(ii) Remove existing heater switch to ignition switch wire 3.5 in. (88.90 mm.) long, colour brown, and replace with 28/.012 in. wire, 11 in. (279.4 mm.) long.

(iii) Change the terminal on the ignition switch return, colour red, from Part No. ET6–14477 to E1ADDN–14469.

To Test the Starter on the Tractor

If the starter armature does not rotate when the control lever is depressed ensure that the switch key is in the "on" position and check the condition of the battery and connections.

If these are in good condition run a lead from the battery negative terminal to the small terminal of the starter solenoid. If the starter now operates, check the relay switch, switch key and their connections.

If the starter motor does not operate check the solenoid and starter motor connections. Ensure that the starter motor has a good earth connection.

If the starter motor still does not operate it should be removed for examination.

To Remove the Starter Motor

1. Disconnect the positive (earthed) terminal of the battery and the cable at the terminal on the end of the starter motor.

2. Disconnect the two leads from the relay switch.

3. Remove the split pin and clevis pin securing the operating rod to the starter actuating lever.

4. Supporting the starter motor, unscrew the starter motor securing bolts evenly and detach the starter motor.

To Replace

1. Pass the drive end of the starter motor into the flywheel housing aperture and locate the motor on the mounting flange.

2. Supporting the starter motor in this position, replace the bolts, nuts and spring washers and tighten evenly.

3. Refit the clevis pin and split pin securing the operating rod to the starter actuating lever.

4. Reconnect the two leads to the relay switch.

5. Reconnect the cable to the starter motor, on later starter motors there are two terminals on the end plate—the cable should be connected to the upper terminal (the lower one being used as an earth in other applications).

Reconnect the cable to the battery.

THE STARTER MOTOR DRIVE

The starter motor drive is of the mechanical pre-engagement type operated by linkage connected to the starter control lever. The linkage is adjusted so that the relay switch contacts are closed when the pinion is almost fully meshed with the flywheel ring gear.

A multi-plate metal clutch in the pinion and clutch assembly is interposed between the armature shaft and the pinion to protect the starter motor from damage due to overloading should the engine backfire.

The clutch is set to slip at a pre-set torque figure which is approximately three times the normal full starting torque of the starter motor.

The clutch also only allows torque to be transmitted from the starter motor pinion to the flywheel ring gear, and therefore, should the pinion be inadvertently held in mesh with the ring gear whilst the engine is running, and if the engine tends to over-run the starter motor, the clutch will free-wheel and no damage will occur to the starter motor.

The clutch slipping torque is adjustable by means of shims placed between the backing ring and the clutch plates and must be reset after the clutch and pinion assembly has been overhauled.

To Remove the Pinion and Clutch Assembly

1. Remove the four dowelled screws securing the relay switch bracket to the starter motor body, and remove the bracket and cover

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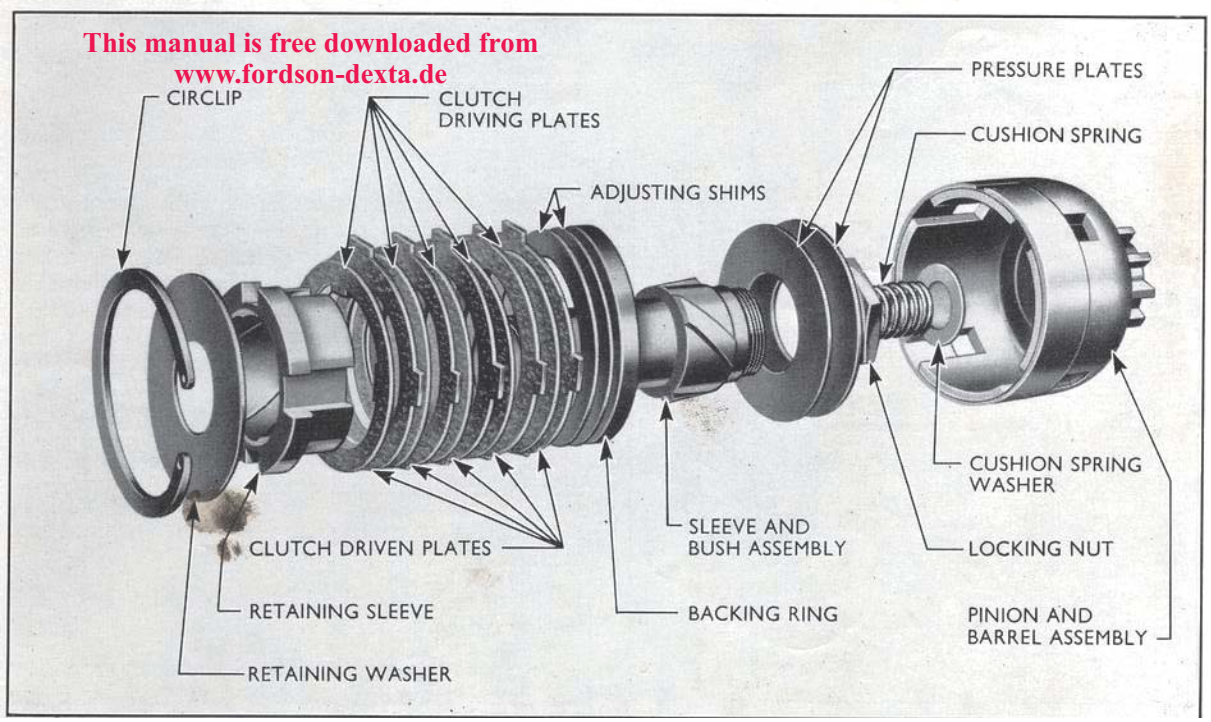

Fig. 12
Exploded View of Starter Drive

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2. Release the ends of the lever return spring from under the flange in the housing.

3. Remove the starter switch actuating lever pivot pin retaining dowel, located in a drilling in the top of the starter drive housing. Remove the pivot pin.

On previous starter motors the actuating lever pivot arrangement consisted of a threaded bolt secured with a nut and lockwasher.

4. Remove the return spring, two spacers and the two halves of the actuating lever.

On current starter motors a new starter switch actuating lever and relay switch retaining nut have been introduced. The new nut can be identified by an increase in thickness from 0.312 in. (7.925 mm.) to 0.437 in. (11.100 mm.) and the new lever by the shape of the actuating plate on its front face which was rectangular and is now circular. The new lever must only be used in conjunction with the new nut, otherwise incorrect starter engagement will occur.

5. Remove the two through bolts securing the starter motor drive housing to the starter motor body and remove the drive housing.

6. Remove the thrust washer and slide the pinion and clutch assembly off the armature shaft.

To Refit the Pinion and Clutch Assembly

1. Refit the pinion and clutch assembly to the armature shaft and refit the thrust washer.

2. Replace the starter motor drive housing, ensuring that the dowel is correctly located. Enter the two through bolts and spring washers and securely tighten.

3. Locate the lower half of the actuating lever with the thrust shoes offset away from the pinion. Fit the upper half of the actuating lever with the plain face towards the pinion. Refit the return spring and two spacers with the loop in the spring downward and away from the starter body (see Fig. 13), and enter the lever pivot pin (or bolt). Locate the spring ends in the housing behind the flange.

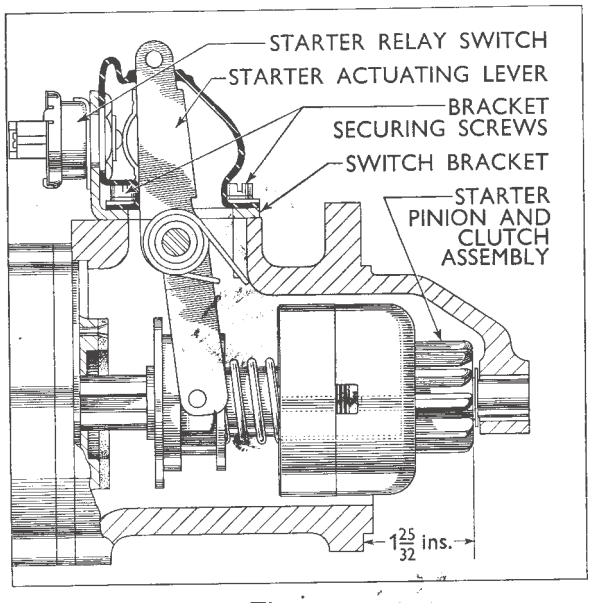

Fig. 13
Starter Actuating Mechanism in the Operating Position

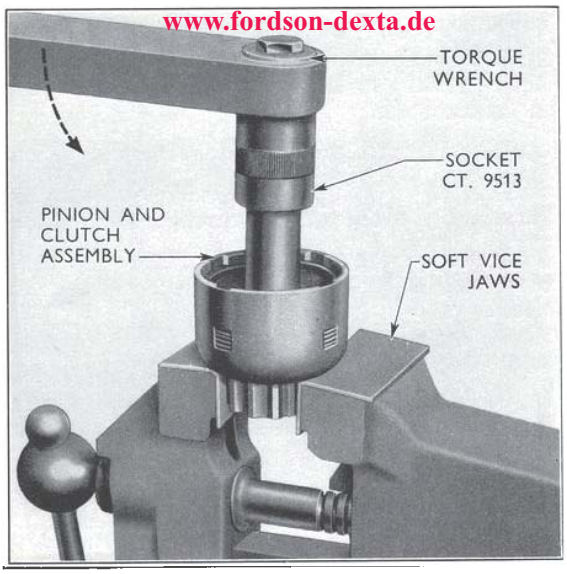

Fig. 14
Checking Starter Drive Slip Torque

NOTE.—The pivot pin (or bolt) will not enter if the lower half of the actuating lever is incorrectly located.

4. Refit the pivot pin locating dowel (or spring washer and nut to the pivot bolt).

5. Refit the relay switch cover and switch bracket assembly and enter the four dowelled screws.

6. Depress the actuating lever until the distance from the rear face of the pinion teeth to the starter motor mounting flange is $1\frac{25}{32}$ in. (81.6 mm.) as shown on Fig. 13). Adjust the relay switch bracket until the contacts are just closed with the pinion at this setting. Securely tighten the retaining screws. Check that the contacts are closed by means of a battery and bulb.

To Dismantle the Pinion and Clutch Assembly

1. Open the retaining cup securing the lock ring on the pinion and clutch assembly.

2. Depress the brake plate and remove the lock ring and retaining cup.

3. Remove the brake plate, operating bush and tension spring.

4. Remove the large internal circlip from the pinion and barrel assembly, and withdraw the sleeve and bush assembly complete with the clutch unit.

5. Remove the cushion spring and thrust washer from inside the pinion and barrel assembly.

6. The clutch unit can now be completely dismantled by removing the retaining washer, retaining sleeve, clutch plates, adjusting shims and backing ring.

7. The nut retaining the two pressure plates is secured by peening and it should only be removed if the plates require renewing.

8. Clean all parts and inspect the pinion teeth and clutch plates for wear. Ensure that the clutch plates are free to move in their respective engagement splines. Check the cushion spring and tension spring for any signs of weakness.

Renew all parts that are worn or damaged in any way.

To Reassemble the Pinion and Clutch Assembly

1. If they have been removed, replace the pressure plates, fit the locking nut and secure by peening.

2. Replace the clutch plates on the retaining sleeve and refit this assembly with the adjusting shims and backing ring on to the sleeve and bush assembly. Care should be taken to ensure that the clutch plates are in the correct order (see Fig. 12) and that the ground face on the backing ring is adjacent to the adjusting shims. The clutch plates and helices on the inside of the retaining sleeve should be smeared with a thin coating of high melting point grease before assembly.

3. Fit the flat washer and cushion spring inside the pinion and barrel assembly so that they are positioned centrally over the pinion bearing bush.

4. Install the clutch unit in the pinion and barrel assembly, fit the retaining washer and secure in position with an internal circlip.

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Fig. 15
Starter Motor Commutator End Plate

5. Position the pinion and clutch assembly in a vice so that the pinion is securely clamped in soft metal vice jaws and the assembly is upright.

6. Using the special socket (Tool No. CT.9513) and a suitable torque wrench apply an anti-clockwise torque to a central sleeve of the assembly (see Fig. 14). The clutch should not slip until the torque applied is between 65 and 80 lb. ft. (8.983 and 11.056 kg.m.).

7. If the clutch slips at below the minimum slip torque, dismantle the pinion and clutch assembly and add shims until the correct slip torque is obtained.

If the clutch slips at above the upper torque limit, dismantle the clutch and remove shims until the correct slip torque is obtained.

There are three thicknesses of shims available : 0.004 in. (0.102 mm.), 0.005 in. (0.127 mm.), 0.006 in. (0.152 mm.).

8. Replace the tension spring, operating bush and brake plate over the sleeve and bush assembly, and compress the tension spring.

9. Position a new lock ring retaining cup on the shaft and fit a new lock ring.

10. Release the pressure compressing the spring and close the outer edge of the retaining cup inwards over the lock ring.

To Examine the Brushes

1. Remove the starter motor.

2. Loosen the screw and slide the brush cover band away from the brush apertures.

3. Lift the brush springs, using a piece of wire shaped into a hook and check the movement of the brushes in the holders.

4. If the brushes are sticking, clean them with a petrol-moistened cloth and, if necessary, ease the sides of the brushes by polishing on a smooth file. When satisfactory, replace the starter.

NOTE.—If the brushes are worn so that they do not bear on the commutator or the brush lead is exposed on the wearing face, new brushes must be fitted.

If the commutator is blackened or dirty, clean by holding a petrol-moistened cloth against it while the armature is rotated.

To Remove the Commutator End Plate and Brushes

1. Remove the starter motor.

2. Slacken the cover band screw and slide the cover band away from the brush apertures.

3. Lift the brush springs and draw the brushes out of their holders.

4. Unscrew the starter cable terminal nuts and detach the spring, flat and fibre washers.

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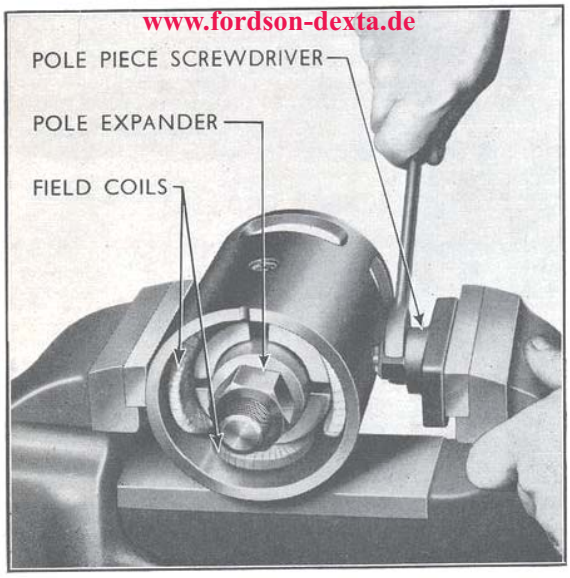

Fig. 16
Pole Piece Screwdriver and Pole Expander

5. Unscrew the two through-bolts and carefully pull the commutator end plate from the starter motor, together with the earthed brushes. Remove the armature if necessary.

6. The brush leads are soldered into tags on the earthed brush holders on the end plate and to the ends of the field coils. Carefully unsweat the brush leads from their connections and detach the brushes.

To Replace

1. Re-solder the brush leads to the field coils and earthed brush holders.

2. Before fitting the end plate, check the brush springs and renew if necessary.

It is also advisable to check the insulated brush holders to ensure that they are not earthing. Use a battery and bulb for this test.

3. Check that the fibre washers are fitted on the field coil terminal post and an insulating bush is located in the terminal post hole in the commutator end plate.

4. Check that the insulator band is located between the yoke and the end of the field coils, and pass the Insulated brushes through the apertures in the yoke.

5. Replace the commutator end plate on the starter motor yoke, passing the earthed brushes through the other apertures in the yoke and engage the dowel pin in the end plate with the notch in the yoke end.

6. Replace a fibre washer, flat washer, spring washer, nut, spring washer and nut (in that order) on the field coil terminal post and tighten the inner nut securely.

7. Replace the armature and drive end plate, if removed, lining up the notch in the plate with the notch in the yoke. Ensure that the thrust washer is fitted to the commutator end of the armature.

8. Refit the pinion and clutch assembly as previously described.

9. Lift the brush springs and insert the brushes into their holders, ensuring that they slide freely. (The field coil brushes locate in the insulated brush holders.)

10. Slide the brush cover band over the brush apertures and tighten the screw.

11. Replace the starter motor as previously described.

STARTER COMMUTATOR

The commutator should be inspected when the starter motor is dismantled. A commutator in good condition should be smooth and free from pitting or burned spots.

Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper, *not emery cloth*, while the armature is rotated.

If the commutator is badly worn or scored, remove the starter drive and detach the drive end plate. Mount the armature in a lathe, rotate at high speed, and take a light cut with a very sharp tool.

Polish the commutator with very fine glass paper. Do not undercut the mica insulation between the segments as is the normal practice with generators.

Check that the commutator segments are not earthing to the armature shaft and core by checking with a battery and bulb.

STARTER ARMATURE

The armature can be inspected after it has been removed from the starter motor yoke. Visual examination will, in many cases, reveal any cause of failure.

A damaged armature must be replaced in all cases (see table on Page 20 for interchangeability of bushes).

No attempt should be made to machine the armature core or to true a distorted armature shaft.

Armature Shaft Bushes

The bushes in the starter motor drive housing and in the commutator end plates are serviced, and can be renewed if they are found to be excessively worn or scored.

On current starter motors the armature drive end bushes have been increased in size, as shown below, and must only be used with their respective armature journals.

Before fitting any new bushes they should be completely immersed in thin engine oil for at least 24 hours.

To renew the bushes, stepped drivers should be made to suit.

After reassembling the starter motor, check that the armature shaft is free to rotate in the bushes without binding.

STARTER FIELD COILS

To Test

1. Remove the commutator end plate and withdraw the armature and drive end plate as previously described.

2. Test the field coils for continuity and earth as follows :—

Check for continuity between the two ends of the field coils, using a mains operated line tester, having a suitable bulb in circuit. Alternatively, the test prods on the Diagnosis Test Set can be used.

If the lamp does not light, there is an open circuit in one of the field coils. If the lamp lights, it does not necessarily mean that the field coils are in order, as it is possible that one of the coils may be earthing to the pole pieces or starter yoke.

This may be checked by touching one of the test prods on the starter yoke and the other on to one of the field coil tappings. If the bulb now lights, the coils are earthed.

NOTE.—The field coils are not serviced separately, as invariably it is found that if one fails the others are affected.

To Remove

1. Mark the yoke and pole pieces so that they can be refitted in their original positions.

2. Detach the fibre insulating washers and sleeve from the field coil terminal post and the insulation band from the commutator end of the yoke.

3. Holding the pole pieces with a suitable expander, mount the starter yoke and pole piece screwdriver (CPT.9504) in a vice and slacken the pole piece screws one at a time. Finally remove the screws with a crosshead screwdriver.

4. Withdraw the field coils and pole pieces from the yoke and carefully unsweat the field coil tappings from the terminal post.

To Replace

1. Locate the ends of the field coil tappings in the slot of the terminal post and solder them in position.

2. Solder new brush leads to the smaller connections on the field coils.

3. Temporarily replace the commutator end plate

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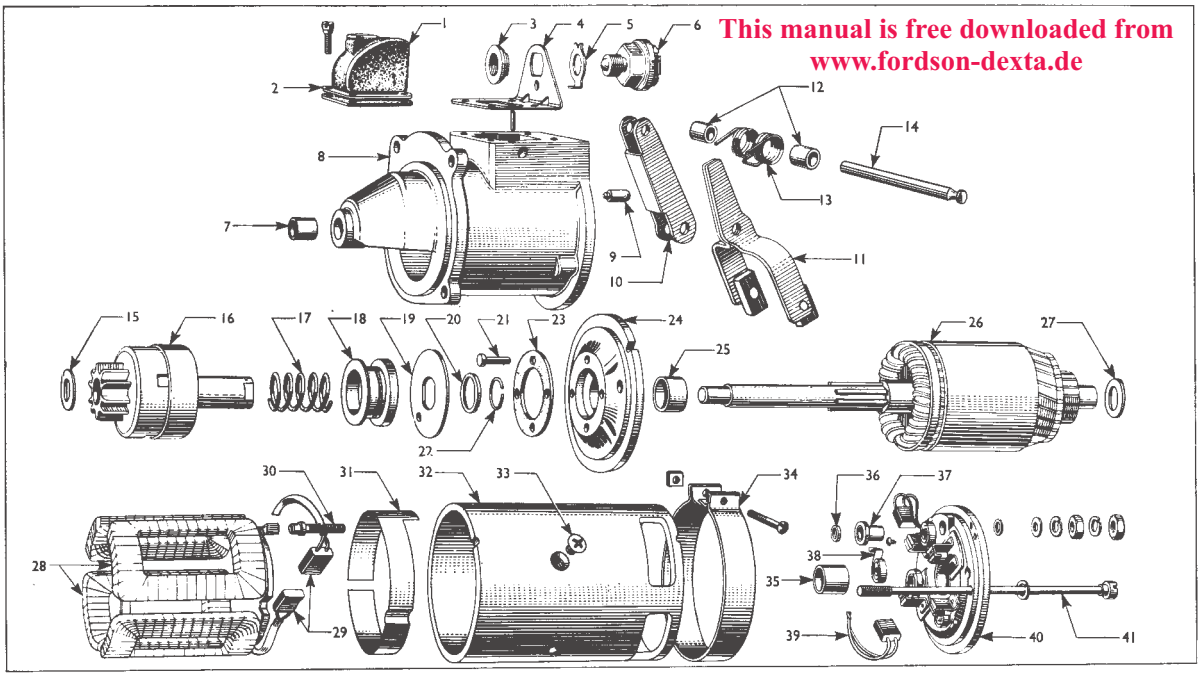

Fig. 17 **Exploded View of Starter Motor, Drive and Controls**

1 Dust cover
2 Plate
3 Nut
4 Bracket
5 Lockwasher
6 Relay operating switch
7 Drive housing bush
8 Drive housing
9 Dowel
10 Actuating lever
11 Lever and shoe assembly
12 Spacers
13 Lever return spring
14 Lever pivot
15 Thrust washer
16 Drive pinion and clutch assembly
17 Tension spring
18 Pinion and clutch operating bush
19 Pinion and clutch brake plate
20 Lock ring
21 Rivet
22 Circlip
23 Brake lining
24 Drive end plate
25 Drive end plate bush
26 Armature
27 Thrust washer
28 Field coils
29 Brushes
30 Field terminal
31 Insulator
32 Yoke
33 Pole piece screw
34 Cover band
35 Commutator end plate bush
36 Washer
37 Insulator
38 Brush spring
39 Brush
40 Commutator end plate
41 Through-bolt

on the starter yoke and note the position of the field coil terminal in relation to the yoke. Reassemble the pole pieces to the field coils so that the mating marks on the yoke and pole pieces are together.

4. Insert the field coils and pole pieces into the starter yoke, align the securing screw holes and locate the pole pieces with the cross-head screws.

5. By the use of a suitable expander press the pole pieces against the yoke.

6. Place the starter yoke and pole piece screwdriver (CPT.9504) in a vice and tighten the screws securely.

7. Remove the expander.

8. Replace the insulation band around the commutator end of the field coils between the coil tappings and the yoke.

9. Replace the insulator sleeve and washers on the field coil terminal post and check that the post is pointing along the axis of the yoke.

10. Replace the armature and commutator end plates and brushes as previously described.

Description	*Previous Dimensions*	*Current Dimensions*
Armature, (drive housing end) spigot journal diameter	0.4980 to 0.4985 in. (12.649 to 12.662 mm.)	0.5475 to 0.5483 in. (13.907 to 13.927 mm.)
Drive housing, spigot bearing, bush, length ..	0.656 in. (16.662 mm.)	0.766 in. (19.465 mm.)
Internal diameter of bush when assembled in housing	0.5012 to 0.5017 in. (12.730 to 12.743 mm.)	0.5519 to 0.5529 in. (14.020 to 14.045 mm.)
Armature (drive housing end plate) journal diameter	0.9960 to 0.9980 in. (25.298 to 25.349 mm.)	0.9970 to 0.9982 in. (25.323 to 25.354 mm.)
Drive housing end plate bearing bush length ..	0.684 in. (17.373 mm.)	0.850 in. (21.59 mm.)
Internal diameter of bush when assembled in housing	1.001 to 1.003 in. (25.425 to 25.476 mm.)	1.0005 to 1.0015 in. (25.41 to 25.435 mm.)

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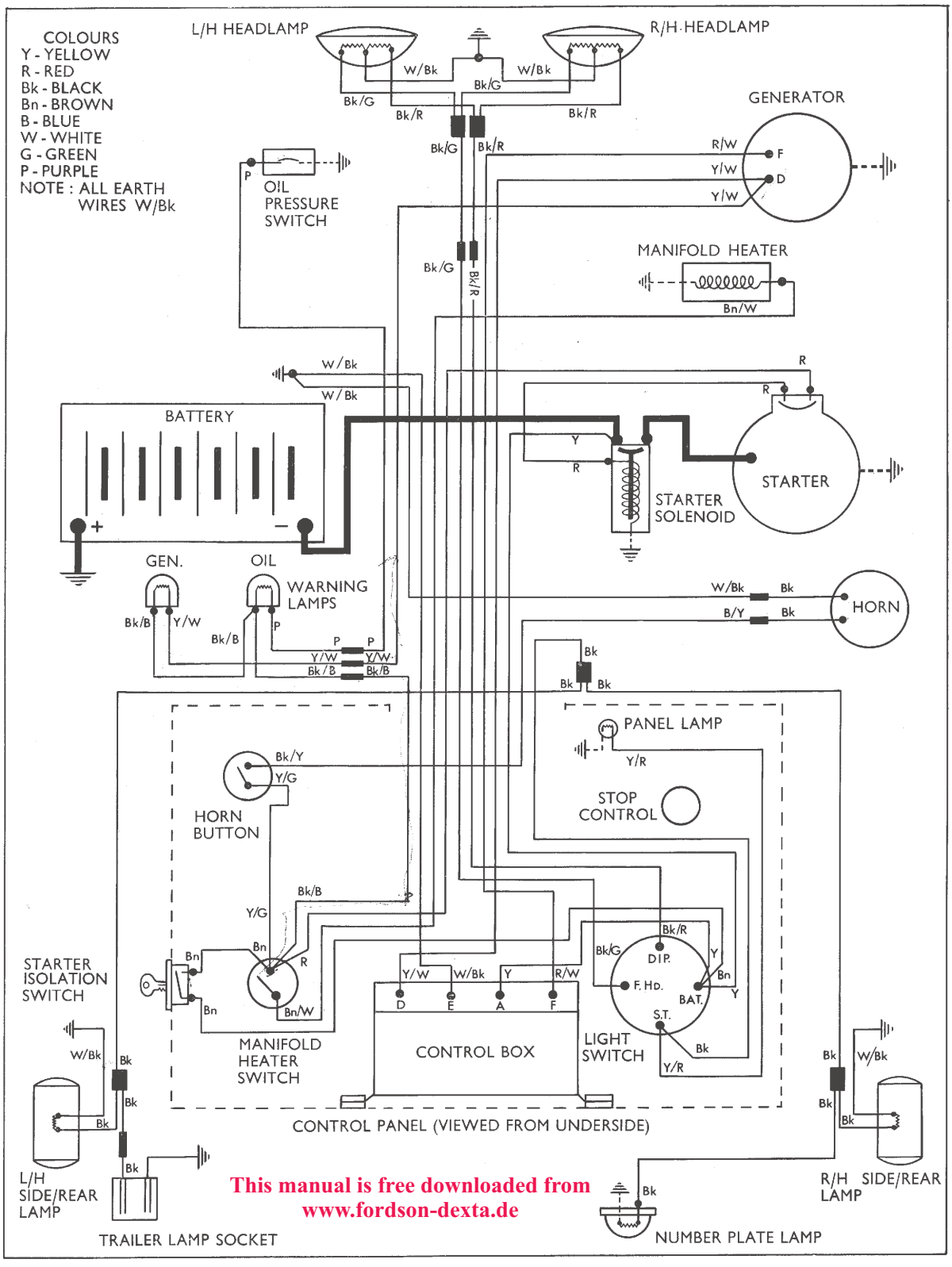

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Fig. 18
Wiring Diagram

There are existing different wiring diagrams. I will make an update for this manual soon!
Es existieren verschiedene Schaltpläne, ich werde demnächst ein Update dafür erstellen!

ELECTRICAL SYSTEM SPECIFICATIONS

Battery—12 Volt

Voltage	12 volt
Actual capacity in ampere hours when discharged in 10 hours	80
Specific gravity charged	1.270 to 1.285

Battery—6 Volt

Voltage	6 volt
Actual capacity in ampere hours when discharged in 10 hours	129
Specific gravity charged	1.270 to 1.285

Generator

Brushes :	
Number	2
Length	0.625 in. (15.87 mm.)
Wear limit	0.35 in. (8.89 mm.)
Regulation	C.V.C.
Maximum output	11 amps.
Cut-in volts	12.7 to 13.3
Cut-in speed (engine r.p.m.)	620
Maximum reverse current	6 amps.
Regulating voltage at 68°F. (20°C.)	16.0 to 16.6
Effective pulley diameter :	
Engine	5.22 in. (132.6 mm.)
Generator	3.48 in. (88.4 mm.)
Ratio to engine speed	1 : 1.5

Starter Motor

Current draw at normal temperature	450 amps.
Gear ratio	11.09 : 1
Teeth on pinion	11
Teeth on ring gear	122
Lock torque	28 lb. ft.
Normal cranking speed with engine warm	200 r.p.m.

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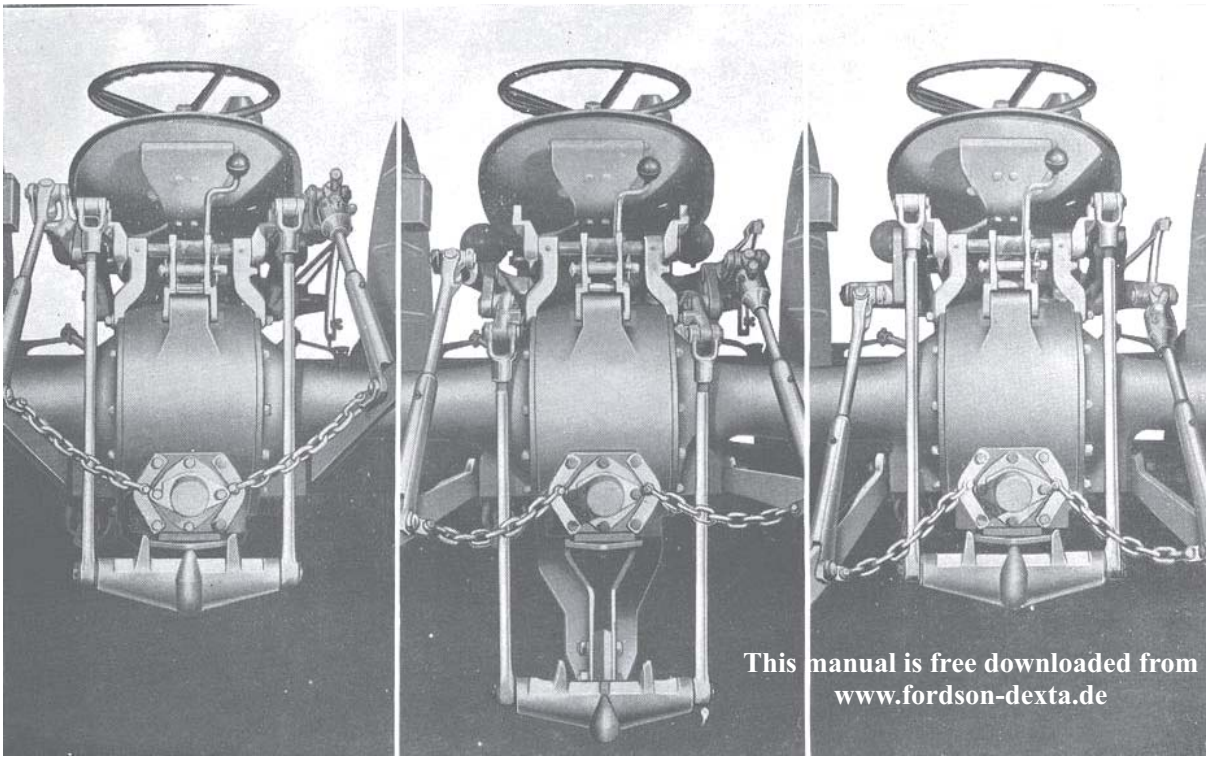
Lamp Bulbs

Headlamp (double filament, double contact) :	
Main beam	12 V—36 W
Dipped	12 V—24 W
Side and tail lamp (double contact)	12 V— 6 W
Warning lights (single contact)	12 V—2.2 W
Instrument light (single contact)	12 V—2.2 W
Voltage drop through wires	.5 V (max.)

AUTOMATIC PICK-UP HITCH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HITCH RAISED— HYDRAULIC LIFT RAISED

HITCH LOWERED

HITCH RAISED— HYDRAULIC LIFT LOWERED

Fig. 1
The Pick-up Hitch

General Description

The hydraulically operated pick-up hitch installation, which is available as a production option or in service as an accessory, provides a means whereby trailers, etc. can be " hitched " to and " unhitched " from the tractor without it being necessary for the operator to dismount from his seat.

The foundation for the hitch upper linkage is provided by two support brackets secured to the left- and right-hand rear axle shaft housing flanges, six special securing studs replacing six standard ones in the rear transmission housing. Spanning the two support brackets is the hitch release handle pivot pin, the release handle being welded to the section of pin between the brackets, whilst two locking struts secured to the ends of the pin outside the support brackets provide a means of mechanically supporting the hitch in the raised position, obviating shock loading on the hydraulic system when the hitch is in use and locking the hitch in a suitable position when not required. The right-hand locking strut, operating between two lugs cast in the adjacent support bracket, controls the total release movement of the struts whilst the spring fitted between the left-hand strut and its adjacent support bracket ensures that once the hitch is raised sufficiently the locking struts automatically move into the locking position so that the hitch remains raised until the release procedure is carried out. The hitch lifting arms pivot at their

lower ends on pins secured to the support brackets and are connected by slotted links with further pins to special hydraulic lift arms which replace the standard lift arms normally supplied with the tractor. The slotted connection of the links to the hitch lifting arms allows independent operation of the hydraulic lift and associated linkage when the hitch is not required for use (see Fig. 2).

Two lifting rods provide the connection between the hitch linkage and the hook assembly, the upper ends of the rods having a yoke and pin attachment at the hitch lifting arms, the lower ends being retained on pins projecting from the arms of the hook body which is positioned under the rear of the rear transmission housing. The hook body is bolted in its channel location in the fabricated hook frame, the forward end of which is mounted on an anchor bracket, this in turn being located by a dowel and fixed by screws to the underside of the rear transmission housing.

When the hitch is in the raised position two lugs at the top of the arms of the hook body are positioned either side of a " bumper " plate which is fixed to the underside of the rear transmission housing rearward of the anchor bracket, thus preventing excessive lateral thrust on the hook assembly when the hitch is loaded. The bumper extends over the throat of the hook and ensures a stable connection between the trailed equipment and the tractor.

Operation

In order to preclude any possibility of damage the pick-up hitch must not be operated for any purpose with a belt pulley fitted to the tractor ; conversely, however, the belt pulley may be operated in the horizontal left- and right-hand positions (but not in the downward or upward positions) on tractors equipped with the pick-up hitch (see " BELT PULLEY " section—" Operation ").

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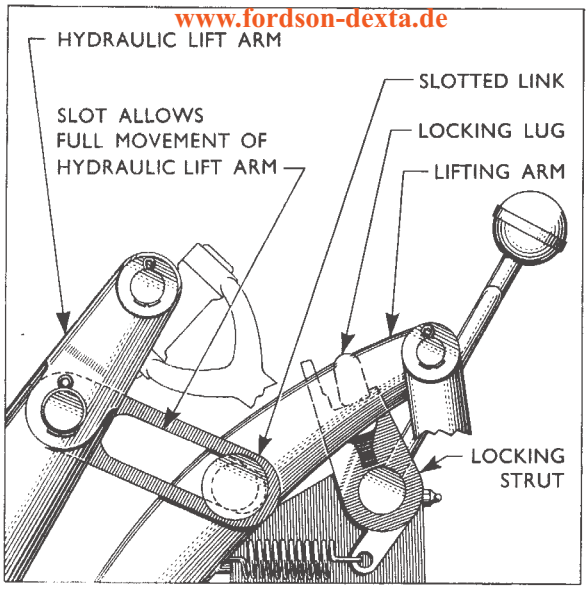

Fig. 2
Hitch Upper Linkage—Locking Struts Holding Hitch in Raised Position

The maximum load imposed on the hitch should not exceed 2,500 lbs. (1,134 kgs.) at the hook. It is recommended that the top link of the three-point linkage be removed before carrying out operations requiring the use of the pick-up hitch.

To facilitate accurate positioning of the hook, pick-up hitch operations should be performed with the hydraulic lift working under " Position Control " i.e. with the hydraulic lift control selector lever in the horizontal position.

To prevent damage to the hook the pick-up hitch when not directly in use must always be in the locked raised position i.e. with the lugs cast on the inside of the hitch lifting arms located on or above the slotted locking faces of the locking struts.

To lower the hook, the lifting arms must first be raised a sufficient amount for the lugs to clear the locking faces of the two struts. Start the engine, ensure the clutch is engaged (on tractors equipped with " Live " P.T.O. the transmission clutch may be disengaged if so desired) then move the hydraulic main control lever against the fixed stop at the top of the control lever quadrant. This will raise the hitch the required amount and enable the locking struts to be swung away from the hitch lifting arm lugs by pulling the release handle forward against the spring tension (see Fig. 3). Holding the release handle forward to its fullest extent move the hydraulic main control lever down the quadrant so that the hydraulic lift arms with lower links and the pick-up hitch lower under their own weight, the hitch lifting arms and hook assembly pivoting about their anchor points. The release handle need only be held forward until the hitch lifting arms have lowered to such an extent that the locking lugs are clear of the locking edges of the struts, after which the handle can be released and the locking struts will be repositioned under spring tension. Positioning the hook height for " hitching-up " when the lifting arm lugs are below the locking edges of the struts is controlled by movement of the hydraulic main control lever ; the lower the lever is moved down the quadrant the lower the position the hook will take up.

With the hitch hook suitably lowered, without being so low as to be damaged by ground contact, position the tractor to " hitch-up " the required equipment. When the hook is positioned under the eye of the trailer drawbar move the hydraulic main control lever slowly up the quadrant until the hook engages with the eye of the trailer then move the lever against the fixed stop at the top of the quadrant to fully raise the hydraulic lift arms and pick-up hitch. As the hitch lifting arms approach the fully raised position, the lugs on the lifting arms contact the locking struts, after which further progressive raising causes the locking struts to be swung forward against the spring tension. When the lifting arms have raised to the point where the lugs are above the edges of the struts the spring will pull the struts

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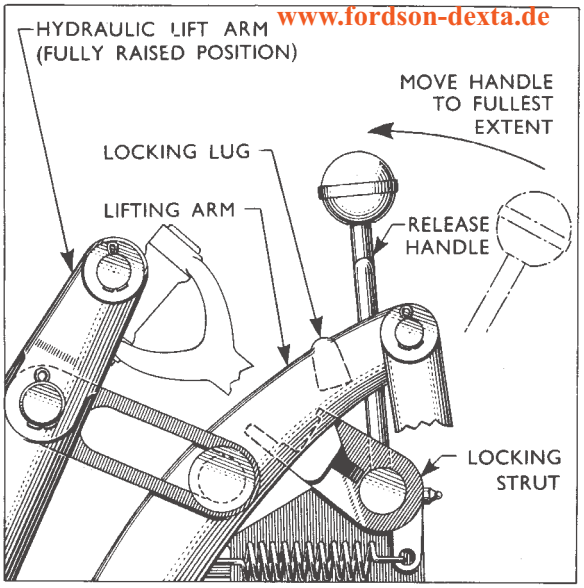

Fig. 3

Hitch Upper Linkage—Releasing Hitch from Locked Raised Position

rearward to the locking position (see Fig. 4). It is desirable that trailer loads on the hitch are supported mechanically rather than hydraulically and to achieve this end the control lever must now be moved down the quadrant sufficiently to ensure the hitch lifting arm lugs locate in the slots in the locking faces of the struts (see Fig. 2).

Operation of the hydraulic lift and associated linkage may be carried out in the normal manner when the pick-up hitch is in the locked raised position as the hydraulic lift arms operate independently of the hitch lifting arms when the latter are supported by the locking struts.

Modifying the Pick-up Hitch in Service for Special Applications

Under certain conditions where heavy loads are being carried by a front end loader it may be necessary to carry weights on the rear of the tractor in order to preserve stability. Such weight may either be carried by the linkage drawbar or by a plain bar which may be fitted between the lower links and which is supplied as an accessory. Normally the weight would be carried in the raised position and, if it is intended to carry out operations of this nature for extended periods, replacing the two standard slotted links of the hitch with two special links which are available as an accessory enables the weight on the lower links to be mechanically supported in the raised position by means of the hitch locking device.

The special links are fitted in the same way and are similar to the standard links but, having holes instead of slots, do not allow the hydraulic lift arms to move independently of the hitch lifting arms so that with the latter supported by the locking struts the hydraulic lift arms and therefore the weight on the lower links will also be supported. When the special links are fitted to the pick-up hitch its use and method of operation are unaltered but, as fully raising the hydraulic lift arms locks both the hitch and the hydraulic lift in the raised position, the procedure previously outlined for lowering the hitch from the locked raised position must now also be used when lowering the hydraulic lift with associated linkage from the fully raised position.

With the special links fitted the hydraulic lift linkage cannot be lowered without lowering the hitch hook also, therefore, to avoid damage the special links should be replaced by the standard slotted links before carrying out operations with mounted equipment such as ploughs, mowers, earthscoops, etc. and when it is required to use the linkage drawbar.

Routine Maintenance

In service, a good quality general purpose grease should be added at 50-hour intervals, by means of a grease gun, through the nipple at the rear of each support bracket, to lubricate the locking strut pivot pin and through the nipple provided at the large boss of each hitch lifting arm.

When the hydraulic lift arms are fully raised there must always be clearance between the lug cast in the centre of the hook body and the underside of the bumper and it is recommended that the clearance, which should be approximately $\frac{1}{16}$ in. (1.59 mm.) (see Fig. 4), be checked after extended periods of usage. If there is no clearance or if the clearance is excessive it should be corrected by adjusting the yokes on the hitch lifting rods an equal amount as required, bearing in mind that altering the position of the yokes on the rods half a turn will alter the clearance by approximately $\frac{1}{16}$ in. (1.59 mm.).

FITTING INSTRUCTIONS

Preparing the Tractor for Installation of the Pick-up Hitch

1. With the hydraulic lift arms fully raised, disconnect the lift rod knuckles at the hydraulic lift arms by removing the split pins and clevis pins, positioning each lower link, with lift rod, to one side when disconnected.

2. Remove the screw, locking tab and large flat washer retaining each hydraulic lift arm to the lift cross-shaft then withdraw the hydraulic lift arms.

3. At each rear axle housing flange unscrew the three nuts which must be removed in order to fit each of the two hitch support brackets (see Fig. 4) then unscrew the corresponding studs from the rear transmission housing.

4. Lightly file the face and diameter of each rear axle housing flange, removing any burrs and paint, etc. to ensure correct location of the hitch support brackets.

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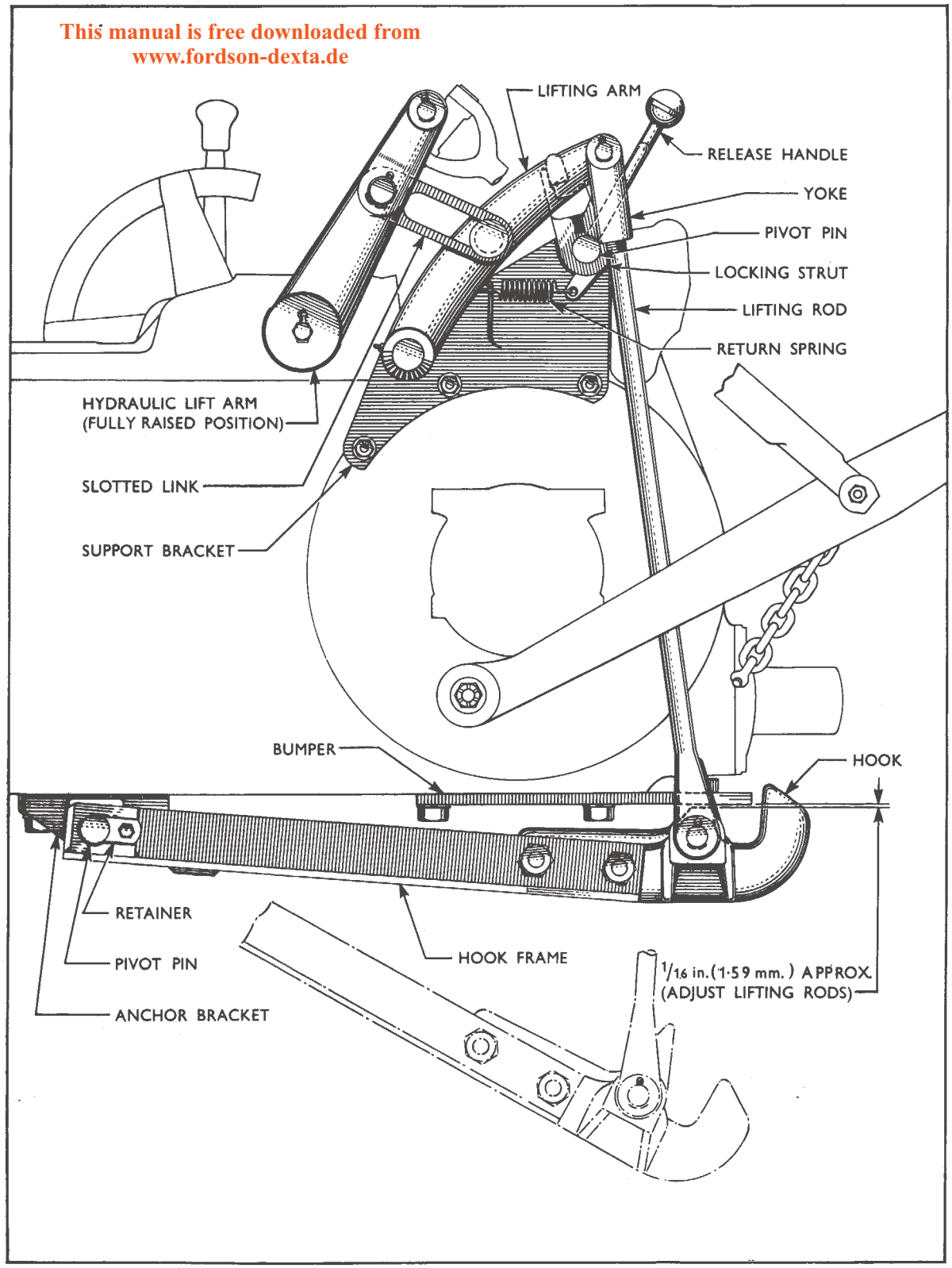

Fig. 4
Diagrammatic Illustration of the Automatic Pick-up Hitch Installation

5. Fit the six special long studs to replace the standard ones removed from the rear transmission housing, ensuring the coarse threaded end of each stud is screwed into the housing until fully tight.

Building the Minor Assemblies

Installing the pick-up hitch on the tractor will be facilitated by first building some of the hitch components into a number of minor assemblies at the bench and these operations are described separately under the appropriate headings.

At assembly, lubricate with a liberal application of a good quality general purpose grease all pivot points and surfaces subject to rotational or sliding action.

Assembly of Slotted Links to Special Hydraulic Lift Arms

1. Attach a slotted link at the boss cast on the inside of each of the two special hydraulic lift arms by inserting the appropriate pivot pin through the hole in the link and through the hole provided in the lift arm so that the pin head is adjacent to the link (see Fig. 5). Secure the pivot pins with split pins ensuring that the links pivot freely on the pins.

Assembly of Hitch Lifting Arms to Support Brackets

1. Screw a grease nipple into the threaded hole in the large boss of each of the two hitch lifting arms and into the threaded hole provided in each of the two support brackets.

2. Assemble the right- and left-hand hitch lifting arms to the corresponding support brackets by, in each case, positioning the large boss at the end of the arm against the machined face of the large boss of the support bracket with the locking lug of the arm adjacent to the bracket (see Fig. 5). Align the hole in the arm with the hole in the bracket, insert the appropriate pivot pin through the arm and into the bracket so that the securing pin hole in the pivot pin is in line with the securing pin hole in the support bracket. Retain the pivot pins by driving the 2 in. (50.8 mm.) long securing pins firmly into position, lightly grooved end of pin foremost. Check the hitch lifting arms for freedom of operation.

Assembly of Hook Body to Hook Frame

1. Lay the hook frame on the bench with the frame crossmember downwards and locate the hook body, hook upwards, in the narrow channelled end of the hook frame. Align the bolt holes in the hook body with those in the hook frame, fit the bolts, securing them with spring washers and nuts.

Installing the Pick-up Hitch on the Tractor

1. Install the left-hand support bracket on the three special studs fitted to the left-hand side of the rear transmission housing so that the hitch lifting arm is outside of the bracket with its free end towards the rear of the tractor. Locate the bracket on the rear

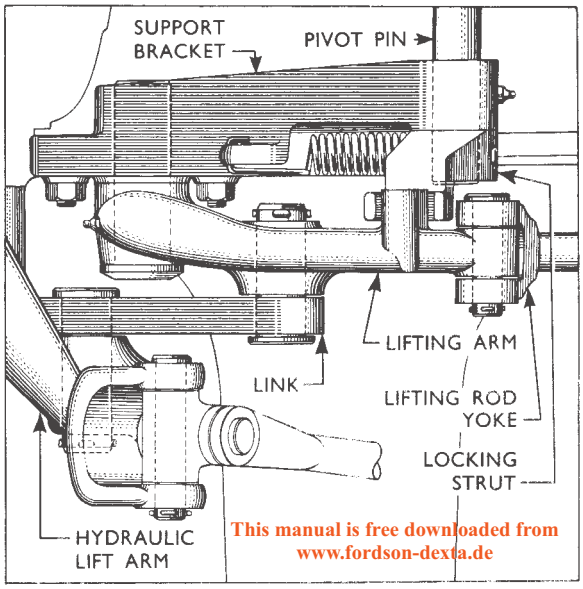

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Fig. 5
Arrangement of Hitch Upper Linkage—Left-hand Side

axle housing flange and fit the nuts to the studs without fully tightening.

2. Insert the end of the locking strut pivot pin furthest from the release handle into the bore in the left-hand support bracket and slide the pin through the bore until the release handle is adjacent to the inside of the bracket.

3. Install the right-hand support bracket at the right-hand side of the rear transmission housing in the same manner as the left-hand bracket and slide the locking strut pivot pin into the bore of the right-hand bracket so that the pin is supported in both brackets. Fully tighten the nuts to secure both the left- and right-hand support brackets ensuring, at the same time, that the pivot pin remains free to rotate in the brackets.

4. Install the left-hand locking strut, identifiable by the hole in the small projecting tongue, on the end of the locking strut pivot pin so that it is located on the outside of the left-hand support bracket with its cranked end away from the bracket (see Fig. 5). Align the securing pin holes in the locking strut and pivot pin so that the strut is vertically above the pivot pin when the release handle is offset from the upright position approximately 45° towards the rear of the tractor. Retain the locking strut by driving the securing pin, lightly grooved end of pin foremost, firmly into position.

5. Hold the left-hand locking strut against the adjacent support bracket and install the right-hand locking strut on the end of the locking strut pivot pin which will now protrude outside the right-hand support bracket. The strut must be assembled with its cranked end away from the bracket and with its small projecting tongue positioned between the two

stop lugs cast on the side of the bracket. Align the securing pin holes in the right-hand locking strut and pivot pin with the strut in the same relative position as the left-hand locking strut and drive the securing pin firmly into position.

NOTE.—The locking strut pivot pin must still rotate freely in the support brackets after fitting the locking struts. Incorrect location of the support brackets, caused by burrs, paint, etc., could cause a " bind " at the locking strut pivot pin and this condition must be corrected before proceeding with the installation.

6. Screw the hand knob securely onto the end of the release handle.

7. Move the release handle rearwards to the fullest extent then fit the return spring between the tongue of the left-hand locking strut and the cast location provided on the left-hand support bracket, linking first the short hooked end of the spring through the hole in the tongue so that the open end of the hook is towards the support bracket. Check that freeing the release handle from the forward position causes the locking struts to be rapidly returned by the spring.

8. Raise the hitch lifting arms together, checking the action of the locking struts and locate the arms on the struts.

9. Fit the special hydraulic lift arms to the lift cross-shaft, picking up the master splines at the outer ends of the shaft, with the slotted links attached to the lift arms suitably positioned for connection to the hitch lifting arms. Fit the large retaining washer, **new** locking tab and the retaining screw to each end of the cross-shaft. Tighten the screws until the lift arms just drop under their own weight with no end play between the arms and the housing. Secure in this position by bending the locking tabs against the heads of the screws.

NOTE.—Over-tightening the screws will cause the lift arms to " bind " and adversely affect the operation of the lift.

10. Position each hitch lifting arm as required to enable the free ends of the slotted links to be connected to the hitch lifting arms by means of the pivot pins. Insert the pins through the slots in the links and the holes provided in the arms so that the pin heads are against the links (see Fig. 5). Secure the pivot pins with split pins.

11. Lift each hydraulic lift lower link, together with the lift rod and reconnect the knuckles of the lift rods to the special hydraulic lift arms by means of the clevis pins. **The clevis pins must be inserted so that the heads are on the inside of the lift arms (see Fig. 5).** Secure the clevis pins with new split pins.

12. Drive the dowel fully into the appropriate hole machined in the anchor bracket so that it protrudes from the locating face of the bracket. Position the anchor bracket against the underside of the rear transmission housing (see Fig. 4), locating the dowel in the hole provided at the front end of the housing. Align the screw holes in the bracket and housing then secure the bracket in position with the four $1\frac{5}{8}$ in. (41.3 mm.) long screws fitted with spring washers.

13. Secure the bumper, plain face downwards and angled end to the rear, to the underside of the rear transmission housing, rearward of the anchor bracket, using four screws and spring washers (see Fig. 4).

14. Position the hook assembly under the rear transmission housing, hook facing upwards, locate the end of the hook frame on the anchor bracket and retain by inserting the pivot pin through the hole in the frame and bracket so that the grooved end of the pin projects from the left-hand side of the hook frame. Fit the retainer to the pivot pin groove and secure to the hook frame with the screw and spring washer (see Fig. 4).

15. Jack or block-up the hitch hook so that there is approximately $\frac{1}{16}$ in. (1.59 mm.) clearance between the lug cast in the centre of the hook body and the underside of the bumper (see Fig. 4). Attach the hitch lifting rods to the pins located one either side of the hook body and secure each rod in position by means of a plain washer and split pin. **Ensure the hydraulic lift arms are fully raised with the pins connecting the hitch lifting arms to the slotted links contacting the lower ends of the slots (see Fig. 4).** Screw the yokes onto the hitch lifting rods so that they engage the hitch lifting arms with the holes in the yokes aligned, within the limits of the adjustment, with the holes in the hitch lifting arms—**do not alter the position of the hook.** Connect the yokes to the arms, if necessary now adjusting the position of the arms to enable the clevis pins to be installed, pin heads on the inside of the yokes (see Fig. 5). Secure the clevis pins with split pins.

16. Remove the jack or blocks supporting the hitch hook and check the operation of both the pick-up hitch and the hydraulic lift ensuring that the hitch lifting rods have been correctly adjusted so that there is clearance (approximately $\frac{1}{16}$ in. (1.59 mm.) between the lug in the centre of the hook body and the bumper when the hydraulic lift arms are fully raised.

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BELT PULLEY

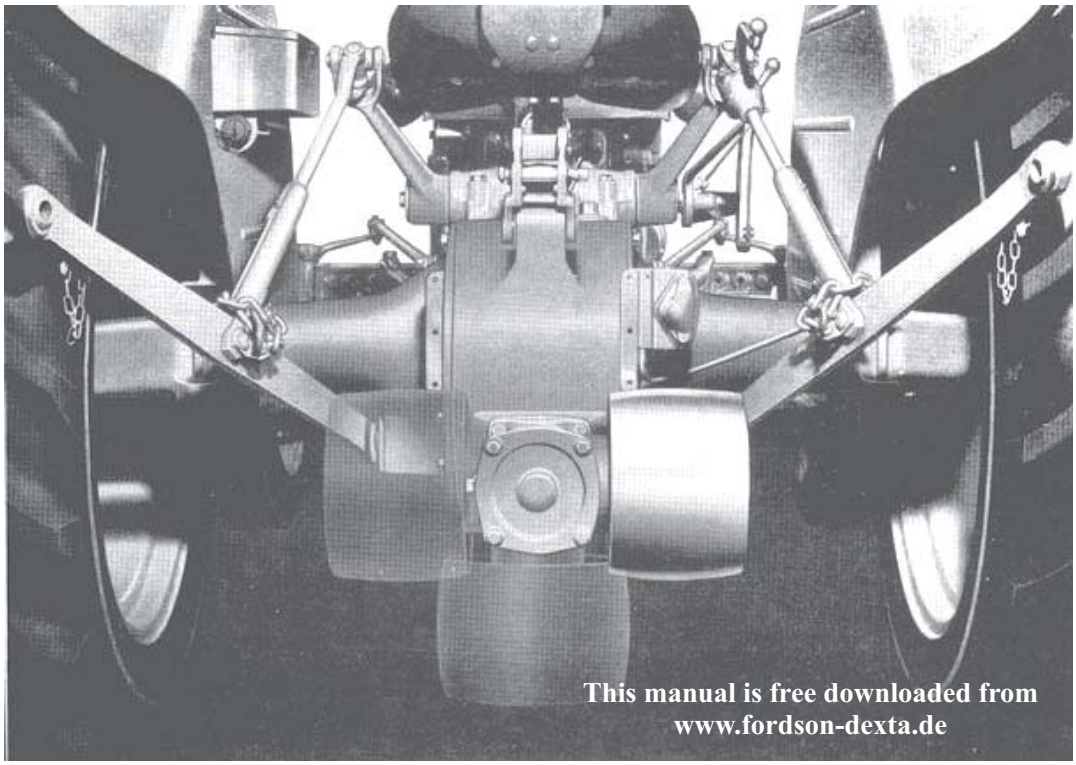
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Fig. 6
The Belt Pulley Installed on the Tractor

General Description

The belt pulley assembly, supplied as a production fitted option or as an accessory, is designed for attachment to the rear of the tractor where it is driven by the P.T.O. shaft, the P.T.O. shifter lever providing the means of positively engaging or disengaging the drive to the pulley. The pulley driving gear assembly is self-contained in its own housing and uses its own supply of oil for lubrication purposes. An internally splined shaft, carried on taper roller bearings, connects with the external splines of the P.T.O. shaft and incorporates an integral spiral bevel driving gear. Meshing with this gear is a mating spiral bevel driven pinion which turns the drive through 90° and is internally splined to the pulley shaft. Taper roller bearings are also used to support the pulley shaft, the outer end of which is formed into a flange to connect by means of four set-screws with the 9 in. (229 mm.) diameter pulley. The gears in the assembly give a speed increase of 1.87 : 1 but taken overall the engine speed is **reduced** in the ratio of 1.55 : 1. An engine speed of 2,000 r.p.m. will therefore result in a pulley speed of 1,290 r.p.m. which with the 9 in. (229 mm.) pulley corresponds to a belt speed of 3,039 ft./min. (926 metres/min.).

Belt pulley operations can be carried out with the pulley assembly installed on the tractor in any one of three positions—horizontally left, horizontally right or downwards (see Fig. 6) except on tractors equipped with a pick-up hitch when only the two horizontal positions should be used. The horizontal left- and right-hand mounting positions give clockwise and anti-clockwise pulley rotation respectively, viewed from the left-hand side of the tractor. Under no circumstances must any attempt be made to

operate the belt pulley assembly in the upward position as this could result in oil starvation of certain parts within the pulley driving gear housing.

CAUTION :—With a belt pulley assembly fitted in either horizontal position care must be taken when raising the hydraulic lift that the lower links do not foul the pulley.

Where implements other than those which are belt driven are to be used it may, to obviate damage, be necessary to remove the pulley assembly completely. It **must** always be removed when a pick-up hitch is to be used.

To Install the Belt Pulley Assembly

1. Remove the P.T.O. shaft cap and/or guard but replace the securing screws to hold the P.T.O. shaft cover plate to the rear transmission housing.

2. Detach the lower link check chain brackets from the rear transmission housing and secure the brackets to their respective lower links (see Fig. 6). If the pulley assembly is to be used in a horizontal position swing the lower link which will be adjacent to the actual pulley outwards to its fullest extent and preferably secure it in this position.

3. Fit the pulley assembly in the required operating position, sliding the splined bore of the pulley drive gear shaft onto the P.T.O. shaft until the spigot machined on the pulley driving gear housing is fully located in the bore of the P.T.O. shaft cover plate.

4. Secure the pulley driving gear housing flange to the rear transmission housing using the four screws and tapped holes previously used to retain the check chain brackets.

Routine Maintenance

Whenever the belt pulley assembly is put into use check before operating and subsequently at daily intervals that the oil in the pulley driving gear housing is up to the level of the filler plug with the assembly in either one of the horizontal mounting positions. If the oil level is low add sufficient good quality oil of the same specification as that used in the transmission to bring the oil up to the required level in the housing.

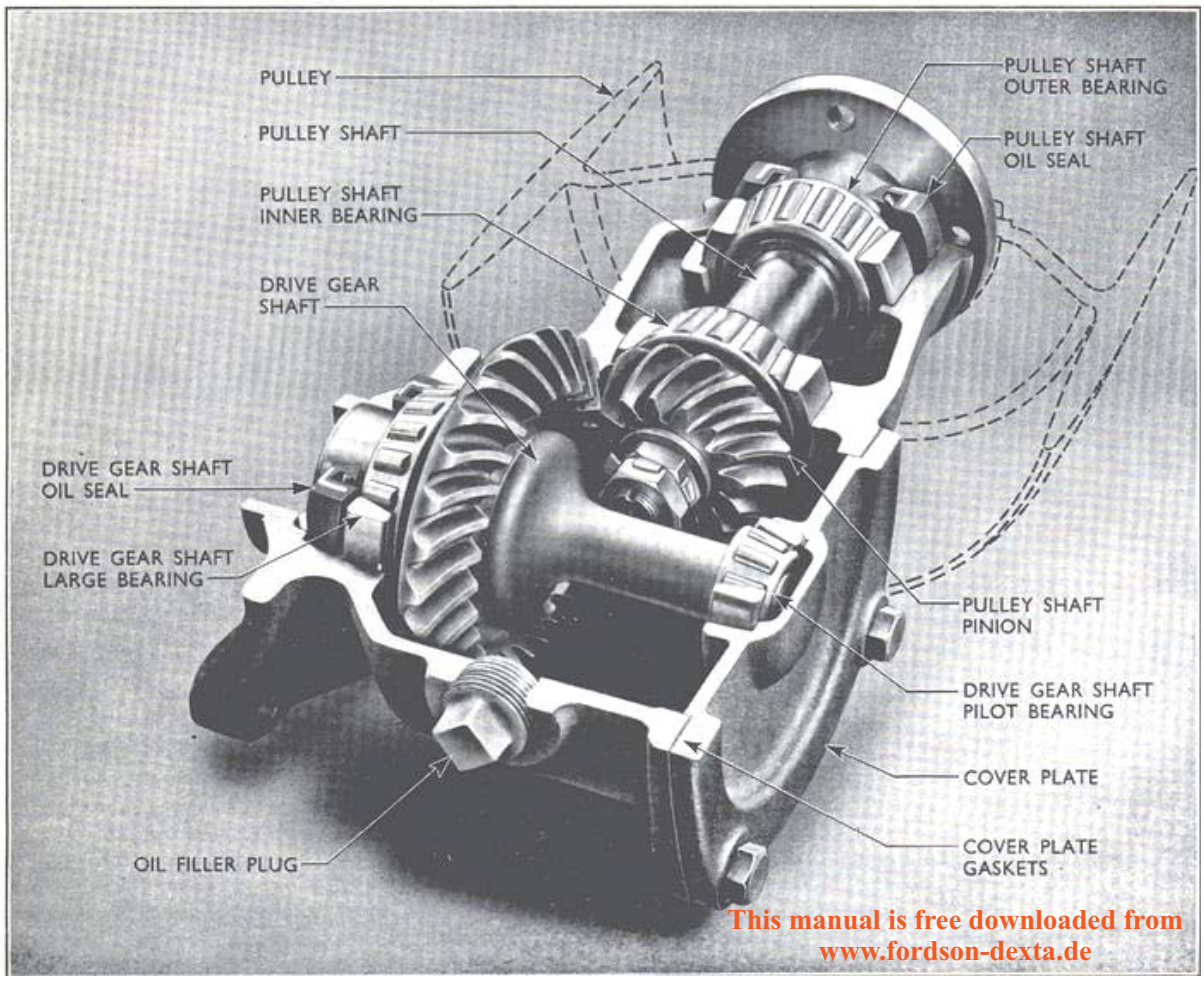

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Fig. 7
Belt Pulley Assembly in Section

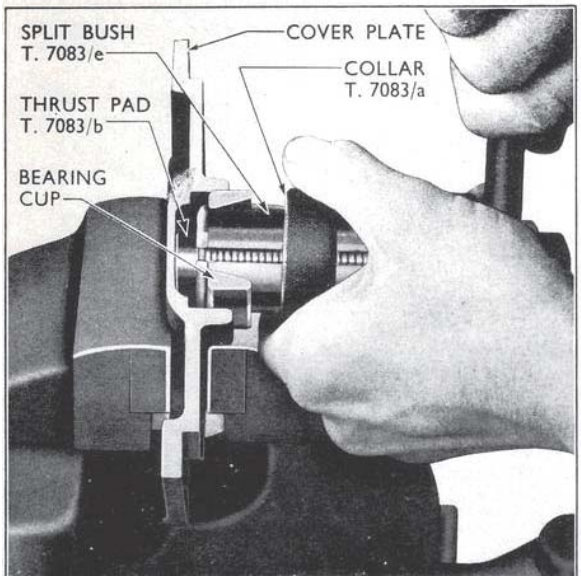

Fig. 8
Cover Plate and Bearing Cup Cut-away to show Tool T.7083 Removing Cup

REPAIR OPERATIONS

To Dismantle the Belt Pulley Assembly

1. Remove the four screws and spring washers securing the pulley then lift it from the spigot of the pulley shaft.

2. Unscrew the filler plug from the housing and drain off the oil.

3. When the housing is empty of oil remove the four screws securing the cover plate and lift it away from the housing. The cover plate is spigot-located in the housing (see Fig. 7) which, together with the use of sealing compound at the joint, may make it necessary to tap the plate out of position and in such circumstances, care must be taken not to damage the edges of the joint faces of the plate or housing. Remove any aluminium foil cover plate gaskets which come away with the cover plate or which may remain on the face of the housing.

4. To extract the drive gear shaft pilot bearing cup from the cover plate use Tool T.7083. Assemble the tool so that the centre screw is entered into the threaded bore at the plain end of the split bush T.7083/e, the sections of which must be in the correct sequence so that they are positioned by the thread of the centre screw with their rimmed edges in line. Enter the small thrust pad T.7083/b in the bore at the open end of the split bush, with the plain face away from the centre screw. Hold the sections of the split bush together to prevent the thrust pad from coming out of position, insert the end of the bush through the bearing cup in the cover plate and locate the rimmed edges of the sections of the bush behind the bearing cup. Pass the collar T.7083/a over the tool centre screw and locate it around the end of the split bush. Fit the handle to the centre screw then, holding the collar and split bush, turn down the centre screw to extract the bearing cup from the cover plate (see Fig. 8).

5. Straighten the tabs of the locking washer fitted between the two locknuts on the inner end of the pulley shaft (see Fig. 7). Remove the locknuts, locking washer and plain washer to enable the pulley shaft to be withdrawn from the housing, if necessary driving it out of position using a suitable brass or copper drift against the flanged end of the shaft. As the shaft moves out of the housing its splined diameter will pass out of the pulley shaft bevel pinion and through the pulley shaft inner bearing cone leaving them inside the housing, whilst the pulley shaft outer bearing cone will come away with the shaft and draw the pulley shaft oil seal out of the housing with the shaft. With the pulley shaft removed, extract the bevel pinion and inner bearing cone from the housing.

6. To remove the pulley shaft outer bearing cone or oil seal from the shaft first install the slave ring in Main Tool T.7000, which should be suitably held in a vice equipped with brass vice jaws. Insert the small end of the pulley shaft through the slave ring towards the tool centre screw so that the bearing cone is within the slave ring. Locate the split adaptors T.7000–23/a around the bearing cone and in the slave ring then turn the centre screw to press the shaft out of the bearing cone (see Fig. 9). With the bearing cone removed the oil seal is free to be withdrawn from the shaft.

7. Withdraw the drive gear shaft, complete with pilot and large bearing cones, through the housing cover plate aperture.

8. To remove the drive gear shaft pilot bearing cone from the shaft use Main Tool T.7000 with

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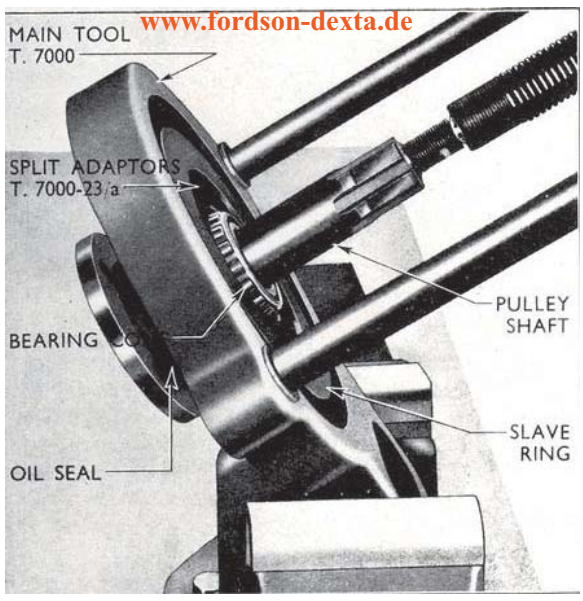

Fig. 9
Removing Pulley Shaft Outer Bearing Cone

slave ring installed. Position the end of the shaft carrying the pilot bearing cone in the bore of the slave ring with the bevel gear outside the tool. Fit the split adaptors T.7000–24/a around the pilot bearing cone and in the slave ring. Install the extension adaptor T.7000–24/g on the end of the tool centre screw and press the shaft out of the bearing cone (see Fig. 10).

9. Removal of the drive gear shaft large bearing cone is carried out again using the Main Tool T.7000 but for this operation the slave ring is not required. Position the shaft so that the large bearing cone is inside the bore of the tool with the hollow end of the shaft towards the tool centre screw, then locate the split adaptors T.7000–25/a around the bearing cone and in the tool. Fit the thrust pad T.7000–25/d to the hollow end of the shaft and operate the tool to press the shaft out of the bearing cone (see Fig. 11).

10. If it is required to remove the pulley shaft inner and outer bearing cups from their bores in the housing, drive them **squarely** out of position. A drift of soft metal rod approximately ½ in. (13 mm.) diameter and 15 in. (381 mm.) long can satisfactorily be used through the filler plug hole in the housing to drive the outer cup from its bore and the same punch can, if required, be used to remove the inner cup. Care must be taken when removing either bearing cup not to damage the shoulder of the bore against which the cup seats and, in addition, when removing the outer bearing cup not to damage the threaded filler plug hole.

11. The drive gear shaft large bearing cup is removed from its bore in the housing using the Main Tool PT.1024 with the aluminium adaptor ring T.1024–6/a attached to the tool body, after first locating the split adaptors T.1024–6/b in the bearing

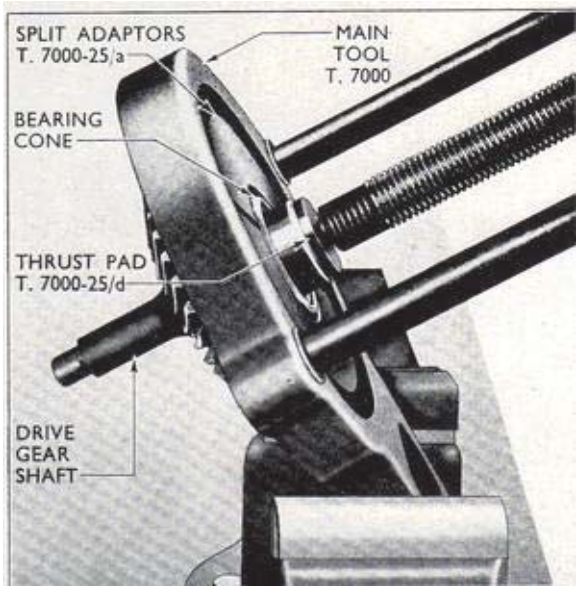

Fig. 11
Removing the Large Bearing Cone from the Drive Gear Shaft

cup. Position the tool, with the large wing-nut screwed up to the handle of the tool and with the knurled nut removed from the end of the tool centre spindle, so that the aluminium adaptor ring is located in the housing cover plate aperture with the centre spindle passing through the bore of the split adaptors in the bearing cup into the bore in the housing. Refit the knurled nut securely to the end of the tool centre spindle, draw the centre spindle out of the tool body to move the knurled nut into the bore of

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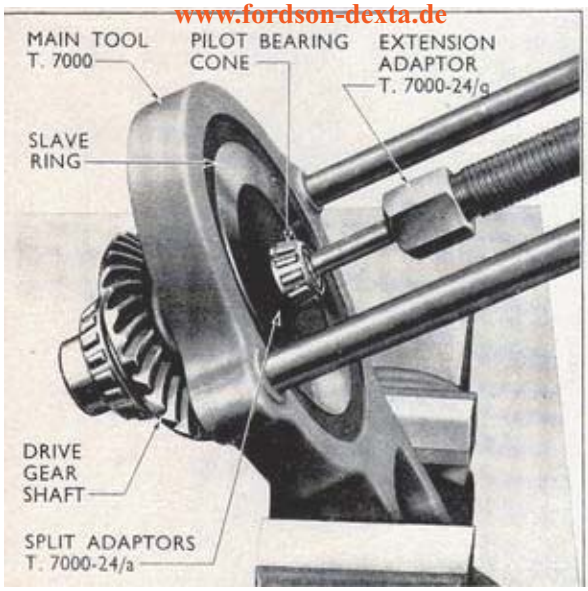

Fig. 10
Removing the Pilot Bearing Cone from the Drive Gear Shaft

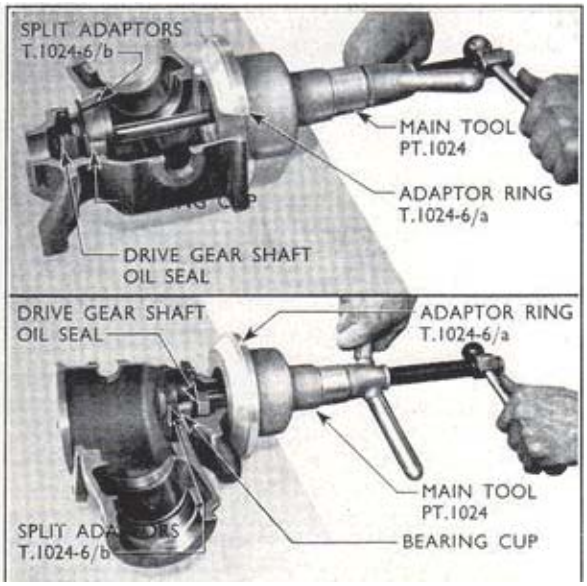

Fig. 12
Housing Cut-away to show Removal (Top) and Replacement (Bottom) of Large Bearing Cup

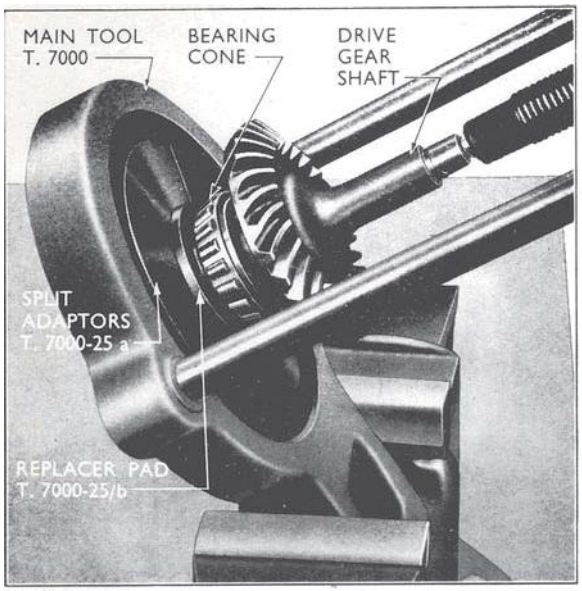

Fig. 13

Replacing the Large Bearing Cone on the Drive Gear Shaft

the split adaptors then screw down the large wing-nut to extract the bearing cup (see Fig. 12—Top).

12. After removing the drive gear shaft large bearing cup the drive gear shaft oil seal is exposed and can be removed from its bore in the housing.

To Rebuild the Belt Pulley Assembly

The spiral bevel gear which is incorporated in the drive gear shaft and the pulley shaft pinion (see Fig. 7) are manufactured as matched pairs and for this reason neither of these parts should be renewed individually i.e. if it is necessary to fit a new drive gear shaft a new pulley shaft pinion must also be fitted and vice-versa.

When replacing the taper roller bearing cups and cones ensure that the presence of dirt or burrs does not prevent them from being pressed fully onto their seats otherwise the meshing of the drive gear and pulley shaft pinion, controlled by manufacturing limits, may be adversely affected.

1. To fit a new drive gear shaft oil seal to the housing use Tool T.7087 with the 550 handle, inserting the tool through the housing cover plate aperture to drive the seal into the appropriate bore in the housing. Always ensure that when the oil seal is installed its sealing lip faces into the housing (see Fig. 7).

2. The drive gear shaft large bearing cup is drawn into the bore in the housing adjacent to the drive gear shaft oil seal by first positioning the Main Tool PT.1024 so that the aluminium adaptor ring T.1024-6/a, which must be fitted to the tool body, locates on the mounting spigot of the housing with the centre spindle of the tool passing into the housing. Insert the large bearing cup through the housing cover plate aperture and pass it over the tool centre spindle. Fit the split adaptors T.1024-6/b to the cup and around the tool centre spindle and move the cup with adaptors so that the latter locate on the knurled nut at the end of the centre spindle. Draw the centre spindle out of the tool body, which will position the bearing cup at the entrance to its bore in the housing and screw down the large wing-nut to pull the cup into position so that it seats against the shoulder of the bore (see Fig. 12—Bottom).

3. If the pulley shaft inner and outer bearing cups have been removed, new cups may be driven **squarely** into position in the housing , no special tools are required but it is recommended that soft metal drifts are used. In the case of the inner bearing cup the drift previously mentioned for removing the cups ($\frac{1}{2}$ in. (13 mm.) diameter and 15 in. (381 mm.) long approximately) may be used through the filler plug hole in the housing.

4. To assemble the large bearing cone to the drive gear shaft remove the slave ring from Main Tool T.7000, fit the split adaptors T.7000-25/a to the tool and position the replacer pad T.7000-25/b on the split adaptors, parallel spigot of the pad located in the counterbore of the adaptors. Position the large bearing cone on the replacer pad so that the small diameter end of the cone is adjacent to the pad, locate the large end of the drive gear shaft in the bearing cone then press the cone onto the shaft (see Fig. 13).

5. The pilot bearing cone is replaced on the drive gear shaft using Main Tool T.7000 with slave ring installed. Fit the split adaptors T.7000-24/a to the slave ring then position the replacer pad T.7000-24/d on the split adaptors so that the recessed end of the

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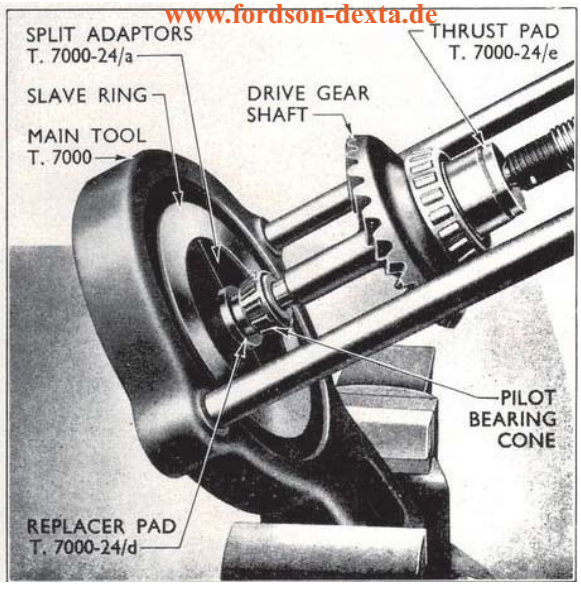

Fig. 14

Replacing the Pilot Bearing Cone on the Drive Gear Shaft

pad is towards the tool centre screw. Position the pilot bearing cone on the replacer pad with the small diameter end of the cone inner race located in the recessed end of the pad and install the drive gear shaft in the tool so that its small end is positioned at the entrance to the bore of the bearing cone. Fit the thrust pad T.7000–24/e to the hollow end of the shaft and turn the tool centre screw to press the bearing cone onto the shoulder of the shaft (see Fig. 14).

6. Install the drive gear shaft, complete with pilot and large bearing cones, in the housing.

7. Install the pulley shaft oil seal, plain face of the seal adjacent to the pulley securing flange of the shaft then fit the pulley shaft outer bearing cone using Main Tool T.7000 with slave ring and split adaptors T.7000–23/a. Position the replacer pad T.7000–23/b on the split adaptors, parallel spigot of the pad located in the counterbore of the adaptors and install the pulley shaft outer bearing cone on the replacer pad so that its small diameter end is adjacent to the pad. Fit the pulley shaft to the tool so that it is located in the bearing cone and turn the tool centre screw to press the cone fully into position on the shaft (see Fig. 15).

8. Locate the pulley shaft inner bearing cone in its cup in the housing then install the pulley shaft pinion so that it meshes with the drive gear shaft bevel gear and align the pinion with the bore of the bearing cone. Enter the pulley shaft, with oil seal and outer bearing cone assembled, into the housing so that the splined diameter of the shaft passes through the inner bearing cone to pick-up the splined bore of the pinion. Lightly tap the pulley shaft through the pinion sufficiently to allow the plain washer and one locknut to be securely fitted to the threaded end of the shaft.

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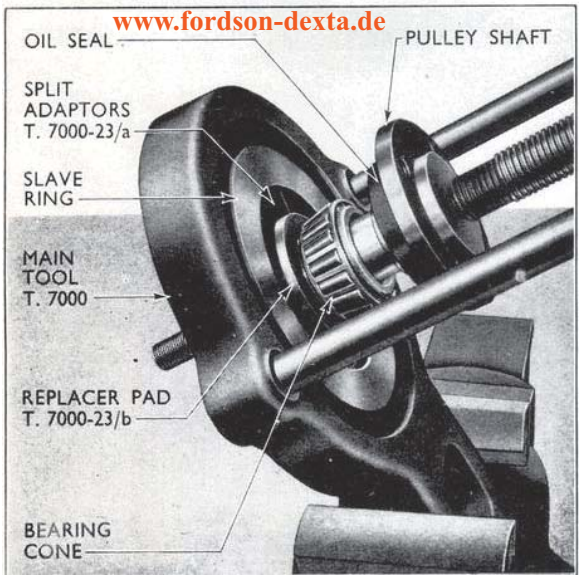

Fig. 15
Replacing Pulley Shaft Outer Bearing Cone

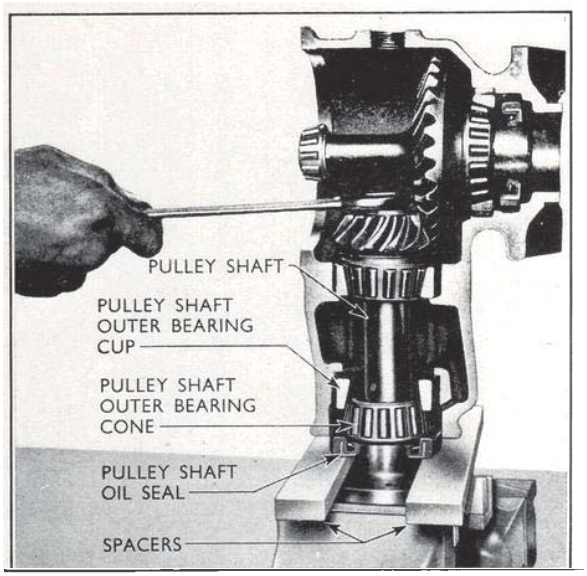

Fig. 16
Housing Cut-away to show Installation of Oil Seal when Replacing Pulley Shaft

9. Invert the assembly and grip the small spigot diameter at the flanged end of the pulley shaft in a vice fitted with brass vice jaws.

Move the oil seal up the pulley shaft to enter it into the bore of the housing and fit two suitable spacers (metal or wood strips approximately $\frac{3}{8}$ in. (10 mm.) thick and 6 in. (152 mm.) long) between the oil seal and the pulley shaft flange, one either side of the shaft. Tighten down the locknut at the inner end of the pulley shaft and draw the oil seal into position (see Fig. 16). As the pulley shaft moves into the housing loosely fit a new locking washer and the second locknut to the threaded end of the shaft, picking-up the keyway in the shaft with the internal key of the washer. The oil seal is correctly positioned when it is flush with the edge of the housing i.e. when the spacers contact the end of the housing. Remove the spacers and continue to draw the pulley shaft into the housing until by rocking the housing about the shaft a barely perceptible movement of the housing can be felt, indicating that the pulley shaft bearings are correctly adjusted, then tighten the locknuts together **ensuring that the one used to draw the shaft into position does not move, otherwise the bearing adjustment will be affected.**

NOTE.—When checking the bearing adjustment the pulley shaft oil seal tends to restrict the movement of the housing about the shaft and it is important that this is not misinterpreted as correct bearing adjustment otherwise excessive clearance may exist between the pulley shaft bearing cups and cones.

After tightening the locknuts together ensure that the bearing adjustment is still correct and secure the locknuts by bending a tab of the locking washer over flat against each locknut.

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Fig. 17
Determining Total Thickness of Cover Plate Gaskets Required

10. Install the drive gear shaft pilot bearing cup in the housing cover plate, ensuring that it seats on the shoulder of the bore.

11. Before finally assembling the cover plate to the housing it is necessary to determine the total thickness of aluminium foil gaskets which must be fitted between the cover plate and the housing to ensure approximately .002 in. (.05 mm.) end-float on the drive gear shaft bearings. To determine the total thickness of cover plate gaskets required, first clean and remove all burrs from the joint face of the cover plate and the corresponding face of the housing. Ensure the drive gear shaft is fully located in the housing and fit the cover plate without any gaskets. Adjust the position of the cover plate, ensuring that it remains located on the drive gear shaft, so that an even clearance exists between the plate and the housing ; check the gap with feeler gauges (see Fig. 17). Select cover plate gaskets with a total thickness sufficiently larger than the gap to give an end-float of approximately .002 in. (.05 mm.) on the drive gear shaft bearings when the cover plate is secured to the housing.

NOTE.—The aluminium foil cover plate gaskets are supplied in three thicknesses each of which can vary within .003 in. (.08 mm.)—see " BELT PULLEY SPECIFICATIONS," therefore, to obtain a required total thickness of gaskets it will be necessary to physically measure the thickness of each gasket selected. Under no circumstances must the total thickness of the gaskets selected for fitment to the cover plate be such that no end-float will exist on the drive gear shaft bearings when the cover plate is finally fitted to the housing. Any of the cover plate gaskets removed at the time of dismantling may, if necessary, be re-used after cleaning thoroughly providing they are in no way damaged.

12. Having selected the gaskets required, remove the cover plate from the housing, apply a coating of good quality sealing compound to the joint face of the plate and housing, also to both faces of each gasket to be fitted. Install the gaskets and cover plate then fit the four securing screws. Using a suitable torque wrench gradually tighten the screws alternately to a torque of 35 to 40 lbs. ft. (4.8 to 5.5 kg.m.).

13. Fill the housing with sufficient good quality oil of the same specification as that used in the transmission, to bring the level to that of the filler plug hole when the assembly is in either of the horizontal positions it assumes when installed on the tractor—approximate capacity of housing 1 pint (.6 litres). Screw the filler plug firmly into position in the housing.

14. Install the pulley on the flange of the pulley shaft with the rim of the pulley closest to the offset pulley hub away from the housing (see Fig. 7). Secure with the four screws and spring washers, tightening the screws to a torque of 40 to 45 lbs. ft. (5.5 to 6.2 kg.m.).

BELT PULLEY SPECIFICATIONS

General

Type	Rear mounted—P.T.O. driven
Engine/pulley gear reduction	1.55 : 1

Speed at 2,000 Engine r.p.m.

Pulley	1,290 r.p.m.
Belt	3,039 ft./min. (926 metres/min.)

Pulley

Diameter	9 in. (229 mm.)
Width	6½ in. (165 mm.)

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Pulley Shaft

Bearings	2—taper roller
End-float on bearings	.002 in. (.05 mm.) approximately

Drive Gear Shaft

Bearings	2—taper roller
End-float on bearings	.002 in. (.05 mm.) approximately
Internal spline	6 splines—major diameter 1⅜ in. (35 mm.)

Gearing

Type	Spiral bevel
Teeth in driving gear	28
Teeth in driven pinion	15
Ratio	1.87 : 1

Cover Plate

Gasket material	Aluminium foil
Gasket thicknesses	.012/.015 in. (.30/.38 mm.) .016/.019 in. (.41/.48 mm.) .020/.023 in. (.51/.58 mm.)

Lubrication

Type	Semi-immersion and splash
Lubricant grade	As transmission—see " SPECIFICATIONS AND REPAIR DATA—REAR AXLE "
Lubricant capacity	1 pint (.6 litres) approximately

Tightening Torque

Pulley securing screws	40 to 45 lbs. ft. (5.5 to 6.2 kg.m.)
Cover plate securing screws	35 to 40 lbs. ft. (4.8 to 5.5 kg.m.)