

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 tools 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 selection 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.

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**Ford Motor Company Limited,
Service Department,
Tractor Division,
Dagenham,
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BRAKING SYSTEM

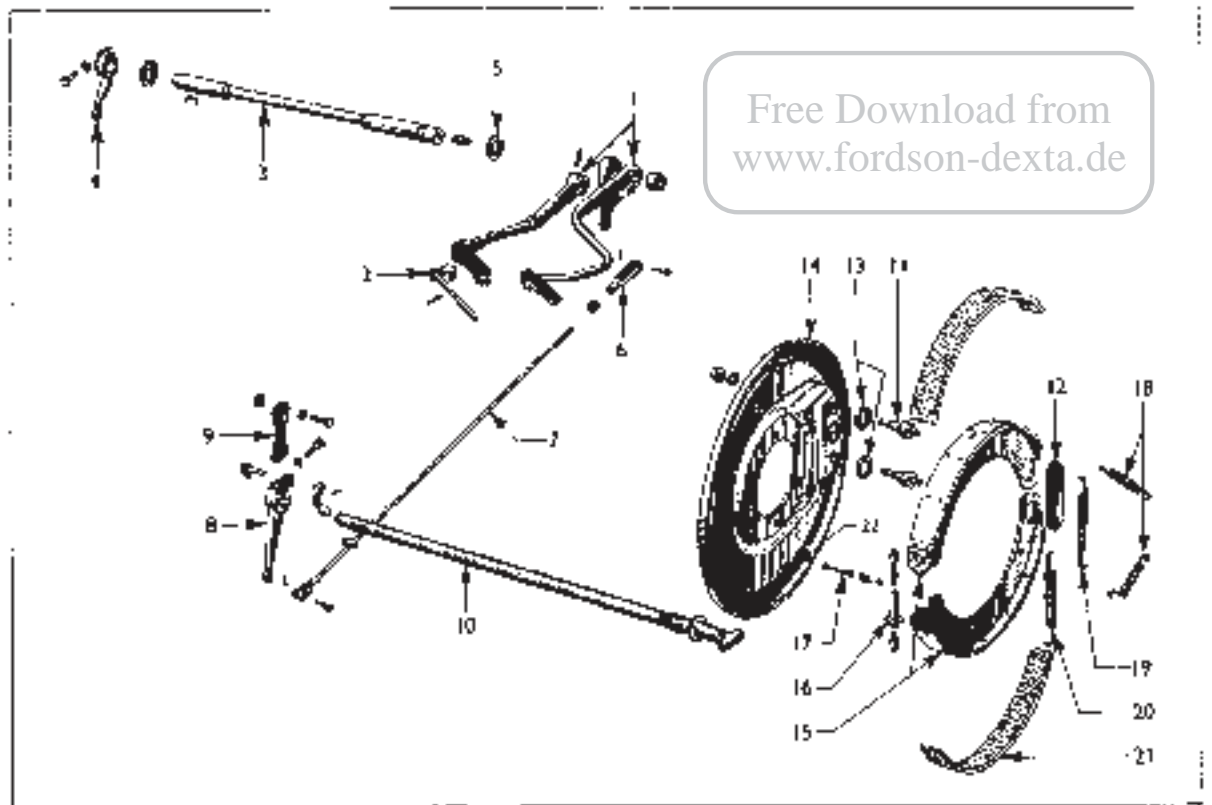


Fig. 1
Exploded View of Braking System

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

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 and 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.

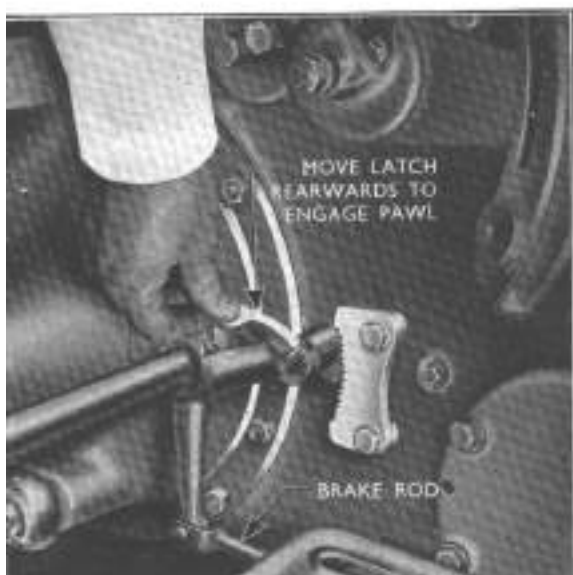


Fig. 2
Applying the Parking Latch



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 siderod)
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.

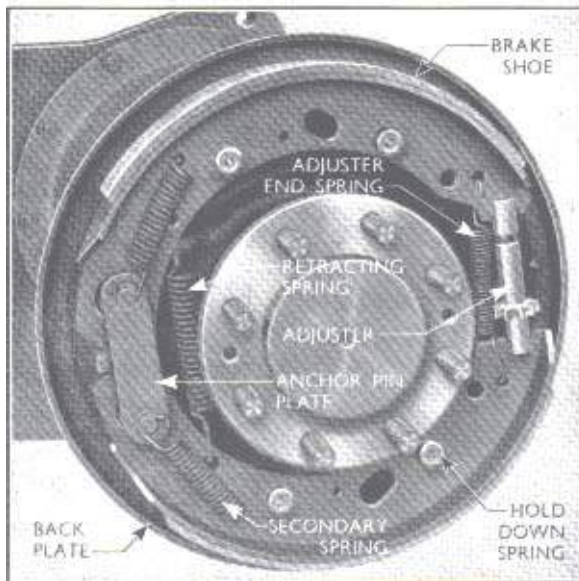


Fig. 4
Brake Shoes and Springs

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 adjustment to 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.

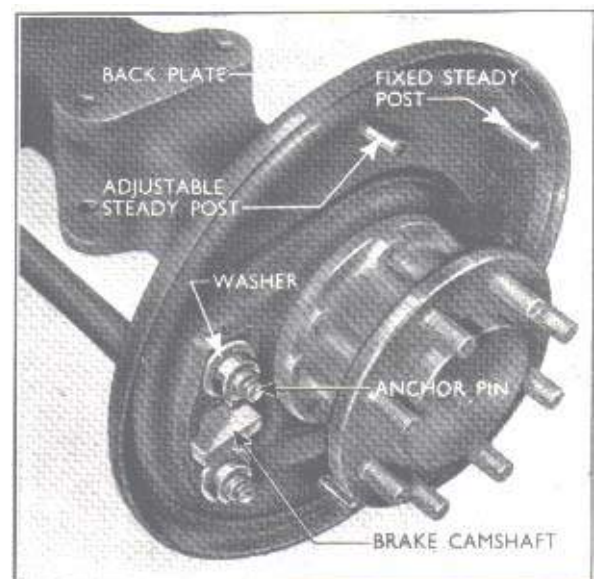


Fig. 5
Back Plate and Anchor Pins

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 damaged 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 length 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.

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 rods 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 correct 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 used 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.

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.



Fig. 6
Track Width Setting



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.

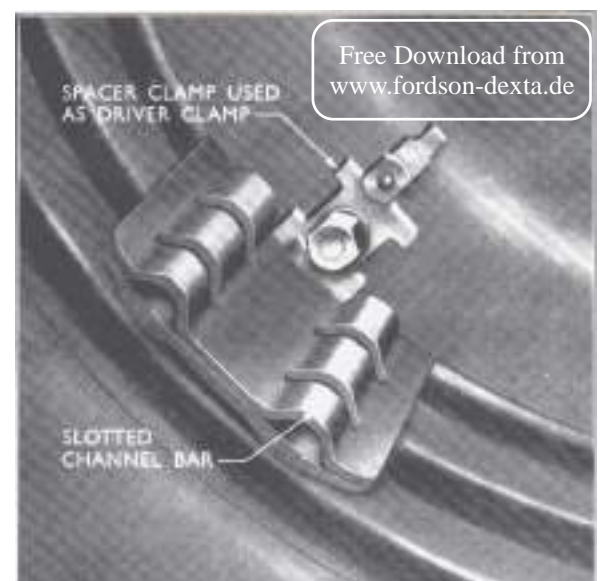


Fig. 8
Spacer Clamp Used as a Driver Clamp

NOTE:- With the wheels reversed (dished outward) it will be necessary to set the spacer clamp and 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
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5.50 x 16	20 lbs./sq.in. (1410 gm./sq. cm.) 26 lbs./sq.in. (1830 gm./sq. cm.) with front wheel weights
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Rear

10 x 28	Free Download from www.fordson-dexta.de				12 lbs./sq.in. (845 gm./sq. cm.)
12 x 28					12 lbs./sq.in. (845 gm./sq. cm.)

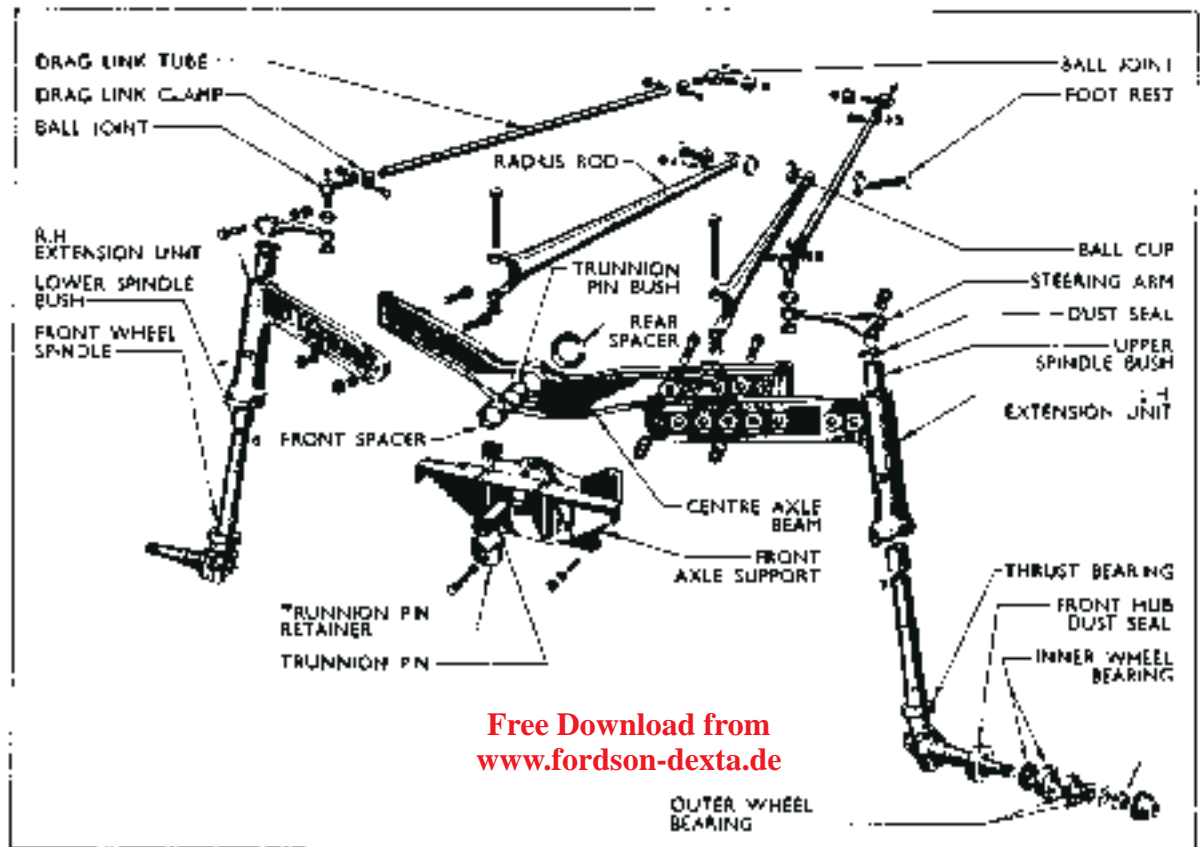
Wheel Weights

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)

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 between 1/4 in. and 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



Fig. 3

Front and Rear Drag Link Ends

positioned so as to lie across the split in the tube.

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.

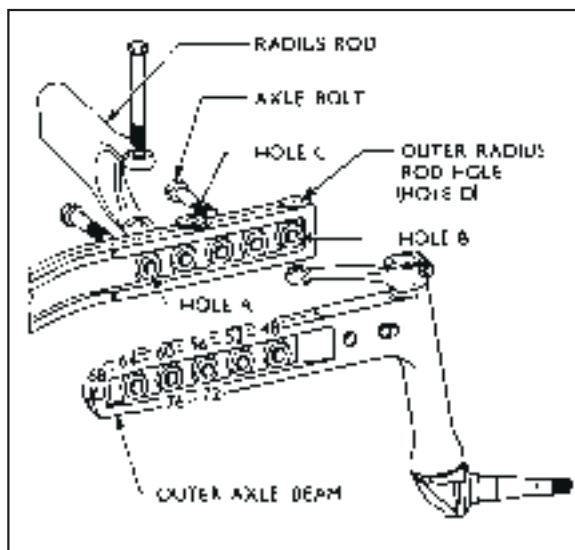


Fig. 2
Track Settings

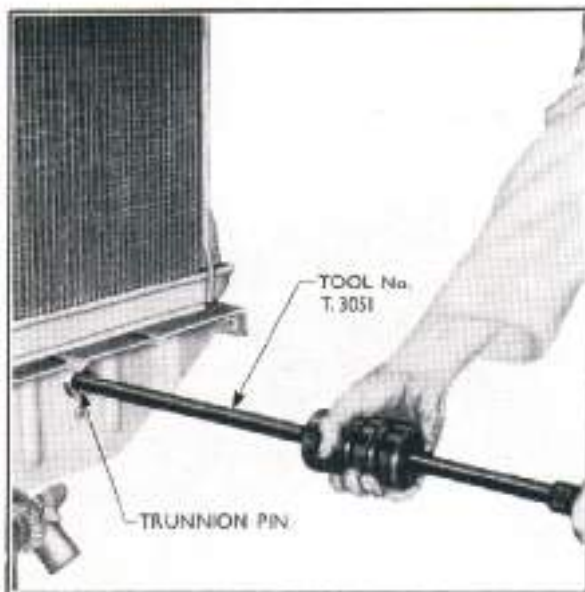


Fig. 4

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 reassemble 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).

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.



Fig. 6 Replacing the Spindle Bushes

FRONT AXLE SPECIFICATIONS

Track with 4.00 x 19 tyres

Track with 500 : 16 bytes

Metric equivalent

Inches	48	52	56	60	64	68	72	76
Inches	—	52	56	60	64	68	72	76
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	1 to 1/2 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 34.000 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.)

<i>Tightening Torque Figures</i>	<i>lbs. ft.</i>	<i>kg. m.</i>
Front axle extension bolts	100 to 110	13.83 to 15.21
Trunion 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

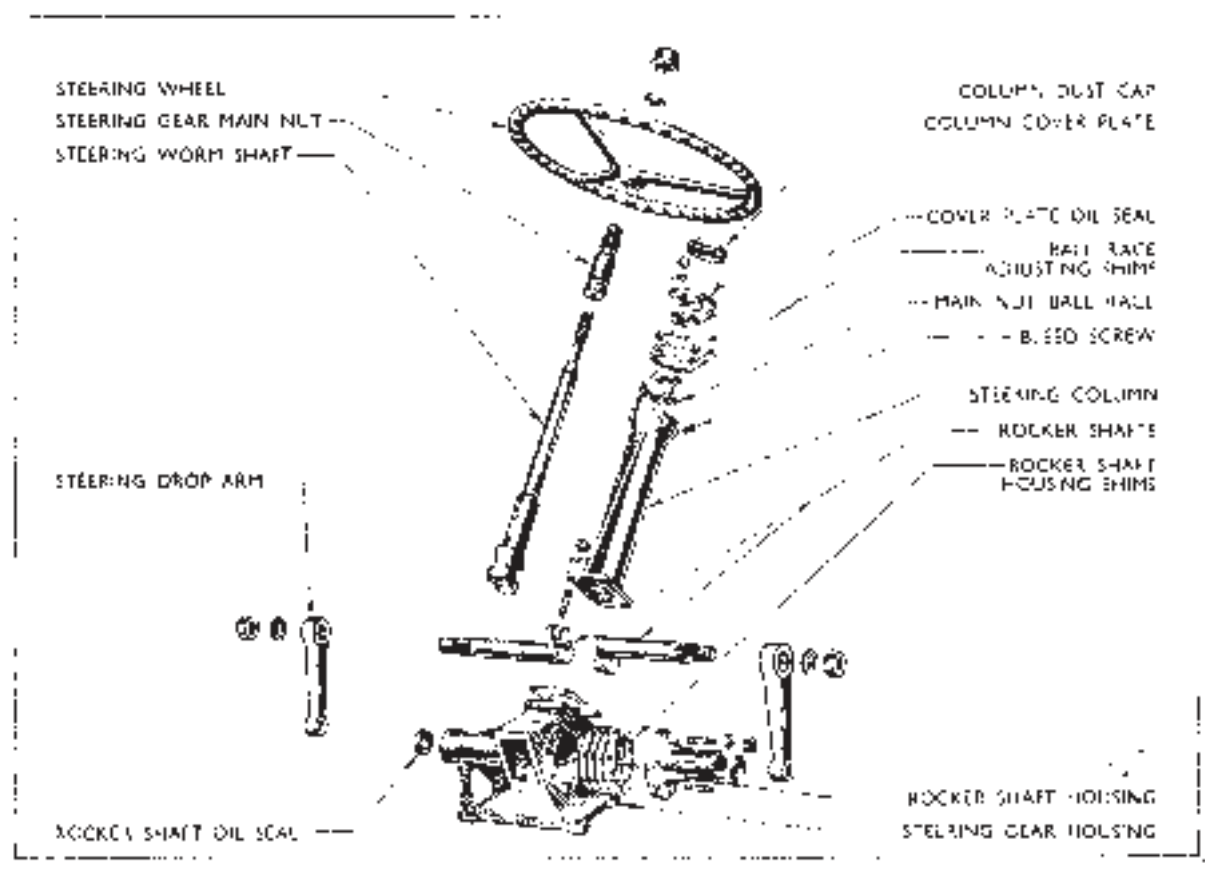


Fig. 7
The Steering Gear

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 in 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.).

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 completely 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.

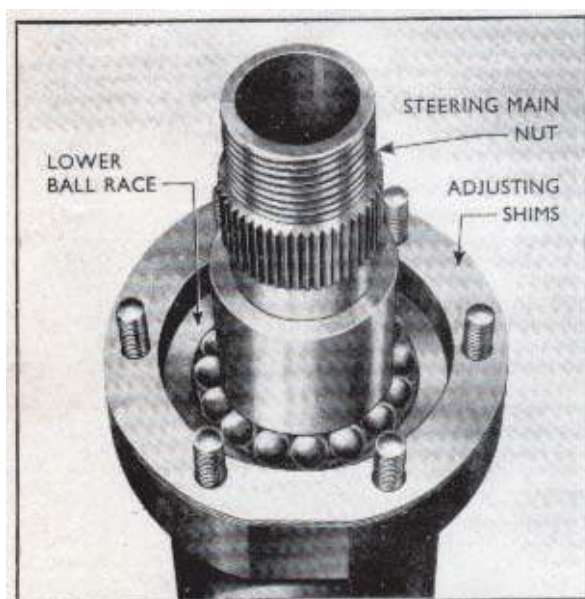


Fig. 8
The Steering Main Nut

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. (975 mm) approx.
Right-hand drag link	39.1 ins. (993 mm) 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 lines.

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 bouncer 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.

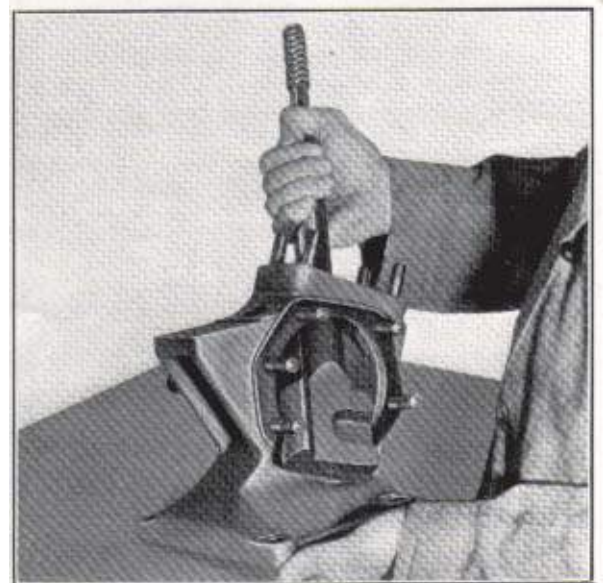


Fig. 9
Removing the Steering Worm Shaft

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 broughed 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.

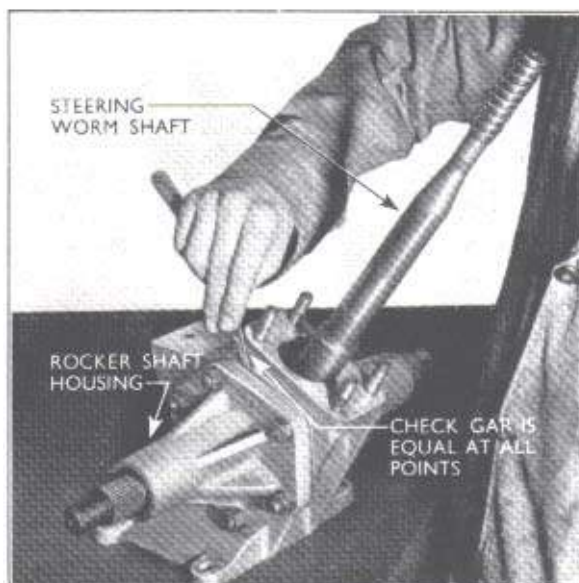


Fig. 10
Rocker Shaft Adjustment

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. (.051 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	..	..	..	..	..	..	..	..	..	2½ 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 Dextra and the Standard Dextra 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 Dextra 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 retaining 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.

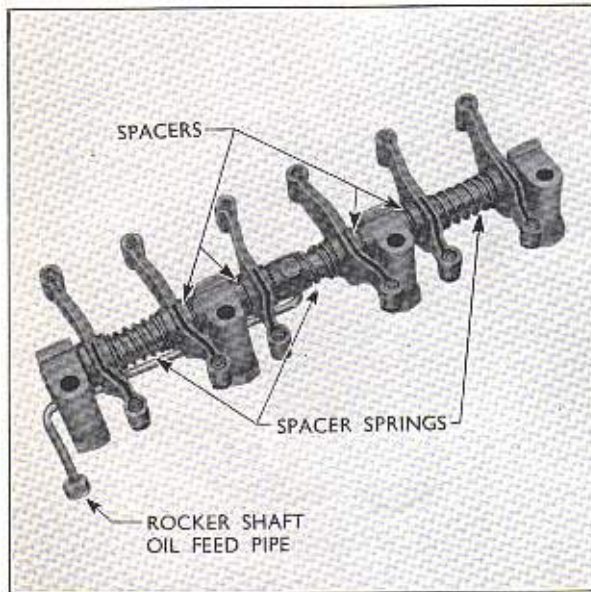


Fig. 1
Rocker Shaft Assembly

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.

10. 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.

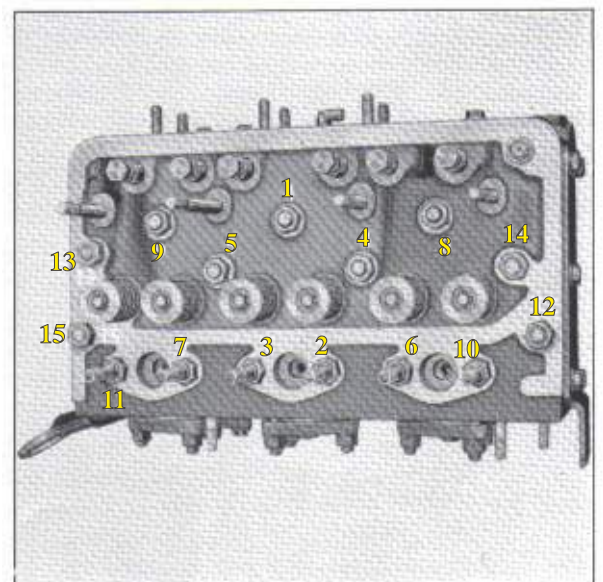


Fig. 2
Correct Sequence for Tightening Cylinder
Head Nuts

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-695).

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 $\frac{11}{16}$ in. (13.98 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 $\frac{3}{4}$ in. (19.05 mm.) the original type of stud, $\frac{1}{2}$ in. (12.7 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: $1\frac{1}{8}$ in. (29.868 mm.) as against $1\frac{1}{4}$ in. (30.48 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.

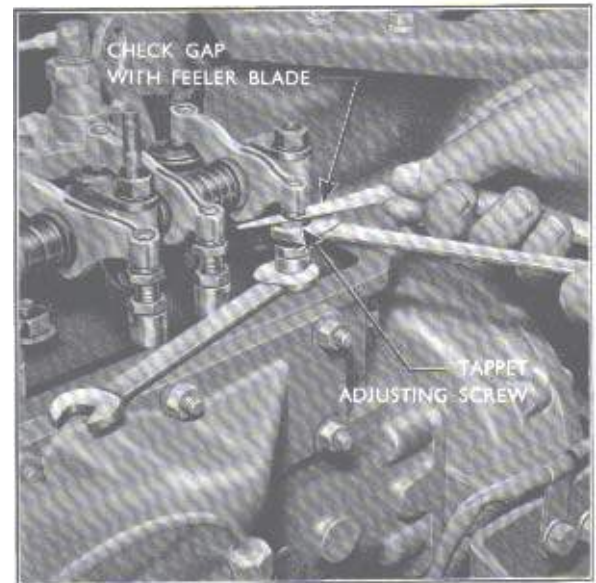


Fig. 3
Adjusting Valve Clearances

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 in 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 0.001 in. (0.025 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 bracket.

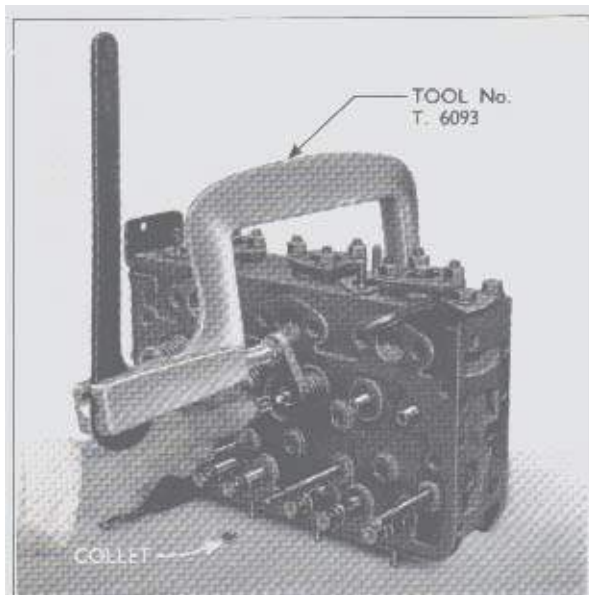


Fig. 4
Valve Spring Compressor

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 0.012 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.

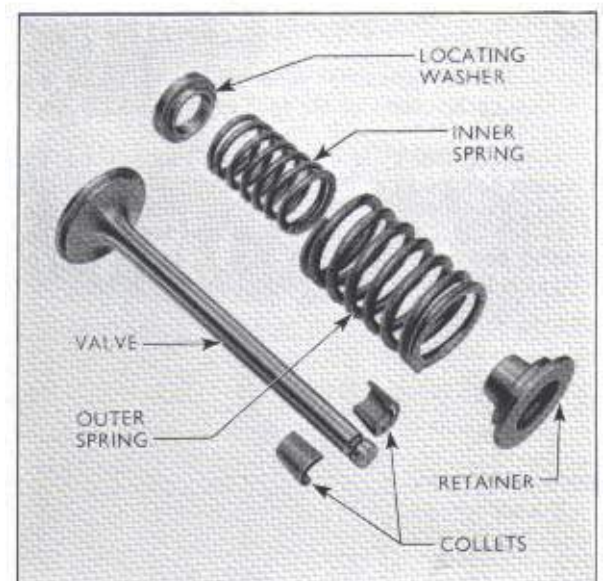


Fig. 5
Valve and Springs

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 0.384 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 stop 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 hole in the cylinder head, so that the angled adaptor (T.6073-2A c) 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.

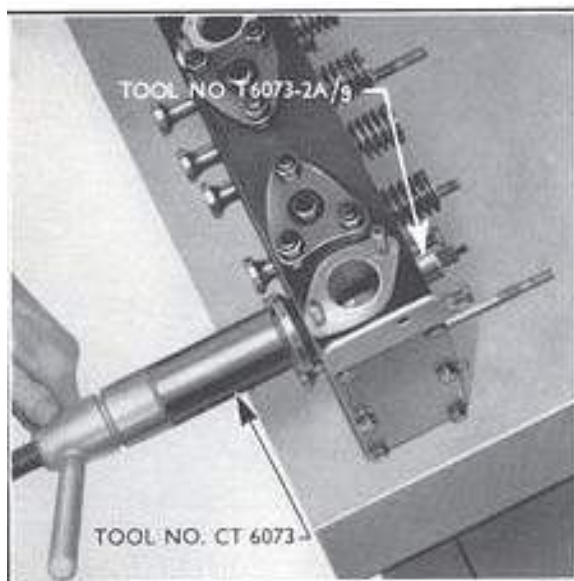


Fig. 6
Replacing a Valve Guide

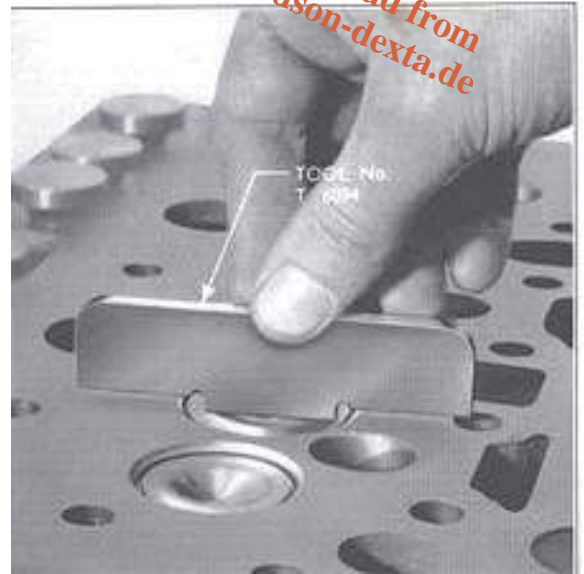


Fig. 7
Checking Valve Head Clearance

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

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

Valves which are badly burnt, 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 $\frac{1}{8}$ 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 collars.
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 parts. 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 belts 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.

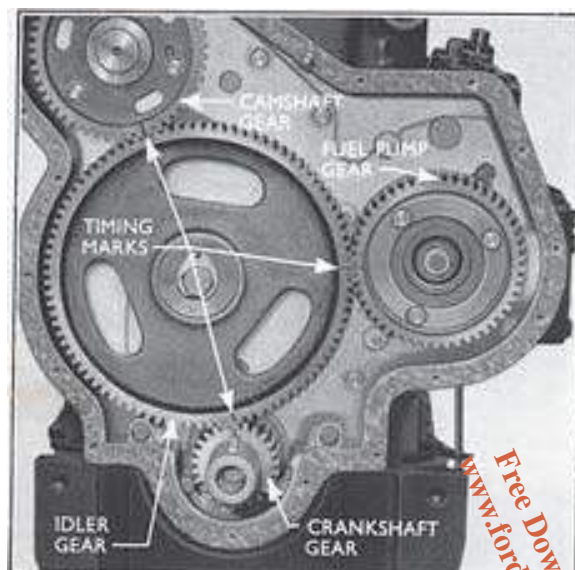


Fig. 8
Timing Marks



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 hand 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.



Fig. 10
Idler Gear Spigot

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.

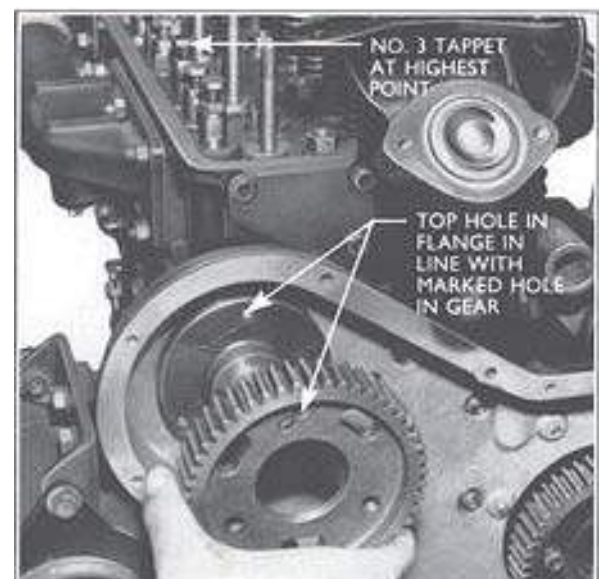


Fig. 11
Fitting the Camshaft Gear

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

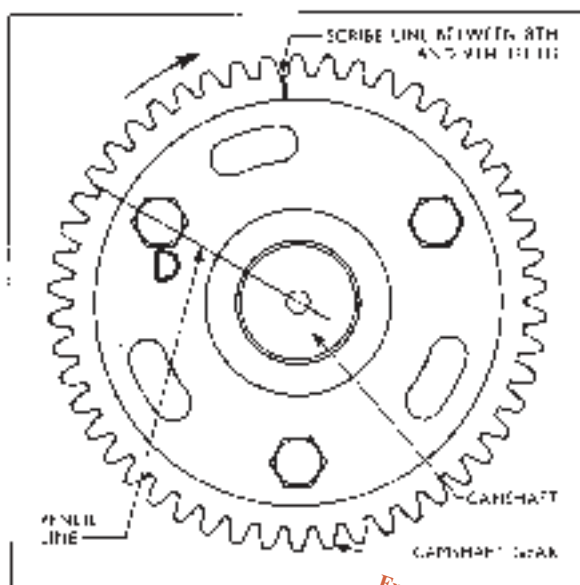


Fig. 12
Marking New Camshaft Gear

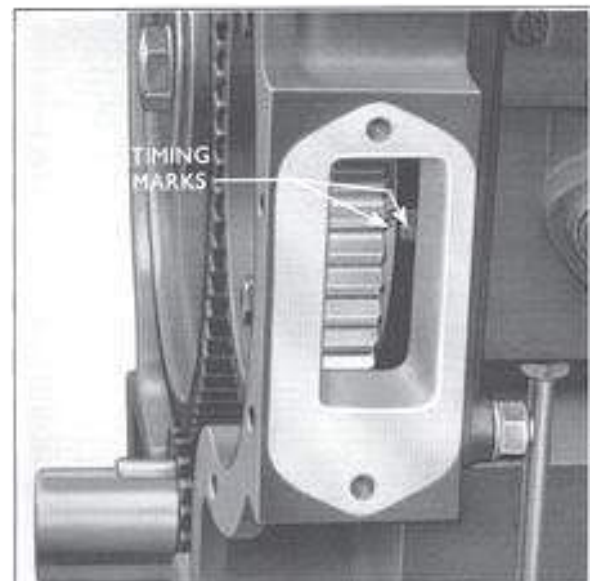


Fig. 13
Fuel Pump Timing Marks (T.D.C.)
(pneumatic governor)

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.

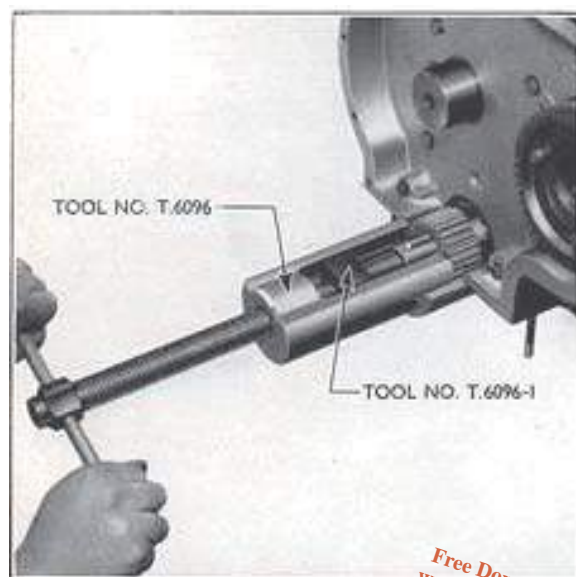


Fig. 14
Removing Crankshaft Gear

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 boxes around the screw holes. Where this height is $1\frac{1}{4}$ in. (34.9 mm.), use screws 2 in. (50.8 mm.) in length—where the box height is $\frac{1}{4}$ in. (19 mm.), use screws $1\frac{1}{2}$ 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 pump 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 proometer 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.

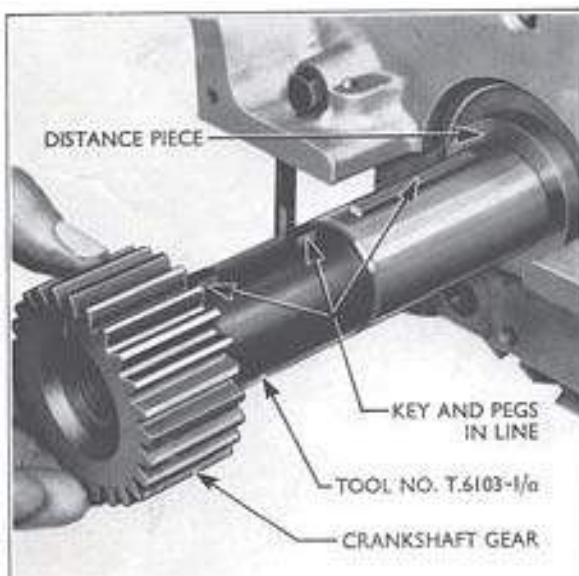


Fig. 15
Fitting the Crankshaft Gear to the
Alignment Adaptor

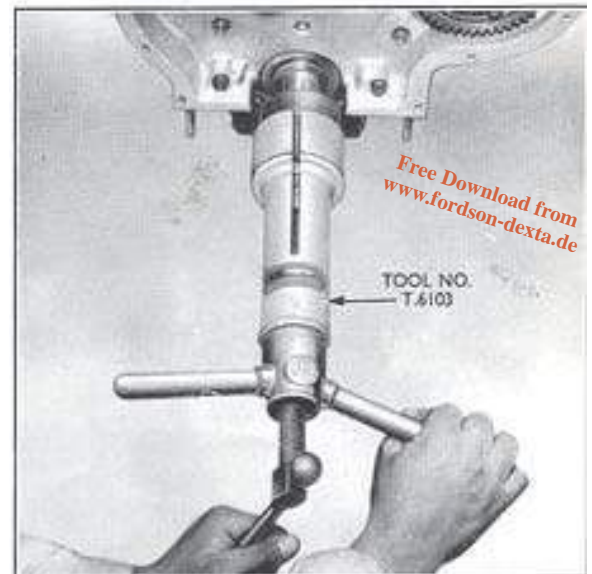


Fig. 16
Replacing the Crankshaft Gear

3. Replace the idler gear spigot so that the locating peg locates in the through drilling in the spigot (see Fig. 16).
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 pump 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 proometer drive cable. When fitting the stop control cable ensure that there is approximately $\frac{1}{2}$ in. (6.3 mm.) free



Fig. 17
Flywheel and Ring Gear

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movement at the stop control knob on the control panel.

FLYWHEEL AND RING GEAR

To Remove the Flywheel

1. Separate the engine from the gearing 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.

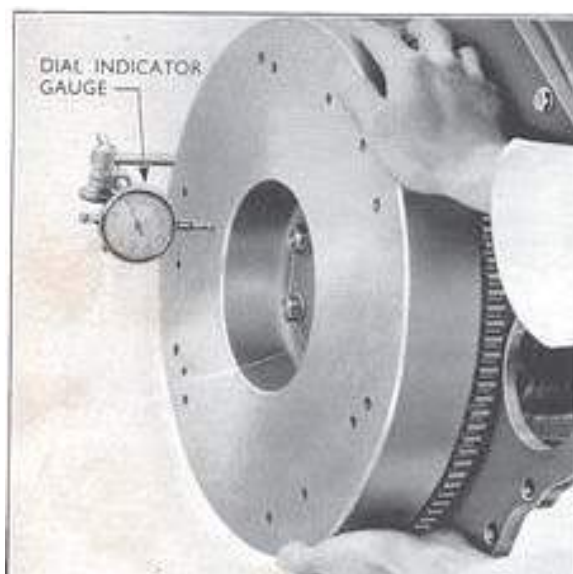


Fig. 18
Checking Flywheel "Run-Out"

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.

4. 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 tooth 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. 19
Removing Clutch Pilot Bearing



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 13.

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 haffle 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 seal 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.

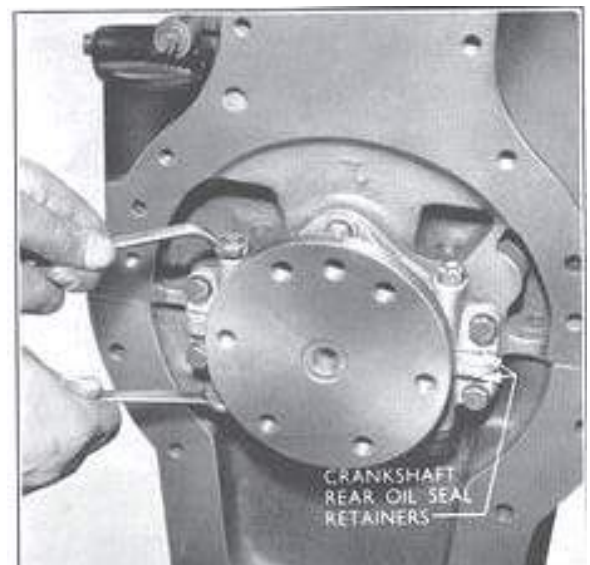


Fig. 21
Crankshaft Rear Oil Seal Retainer

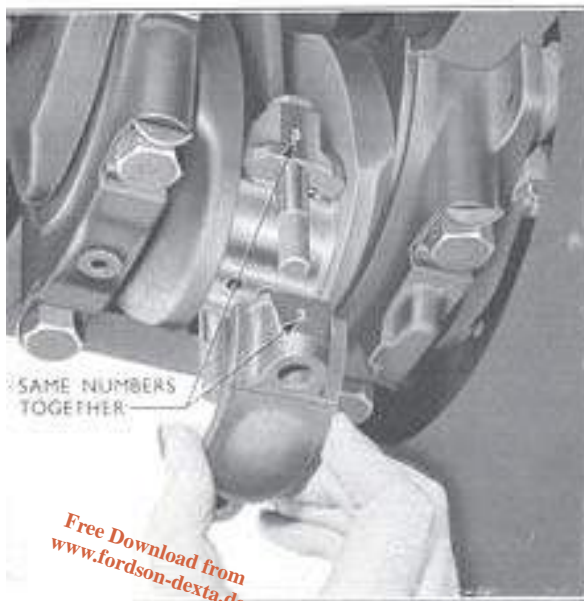


Fig. 22
Replacing Connecting Rod

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 crankshaft) 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 in the left-hand side of the engine (opposite side to crankshaft).



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 $\frac{1}{16}$ in. (1.594 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. (2,366 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

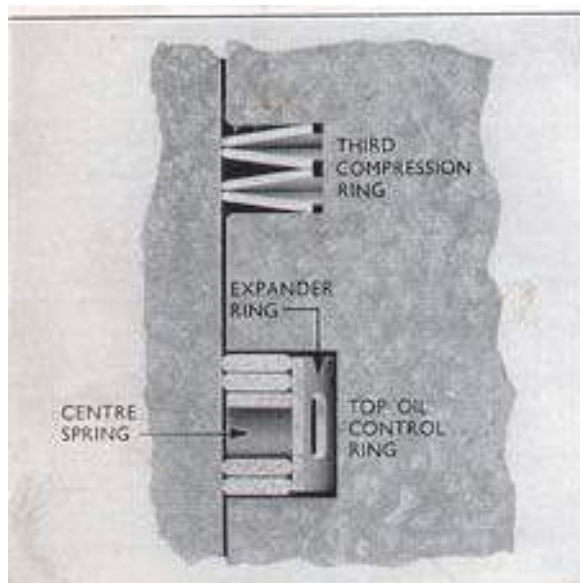


Fig. 24
Laminated Ring Arrangement

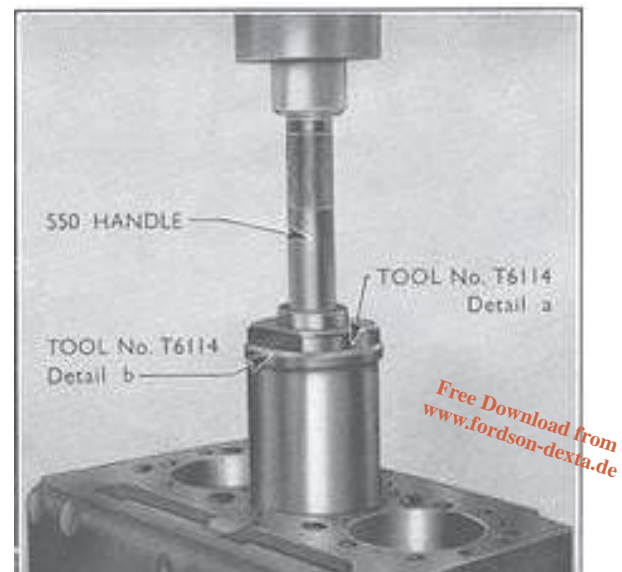


Fig. 25
Replacing a Cylinder Liner

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 in 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 bending 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.)	3.600 in. (91.44 mm.)
to	to
3.502 in. (88.951 mm.)	3.601 in. (91.465 mm.)
Liner bore size	
3.478 in. (88.341 mm.)	3.555 in. (90.297 mm.)
to	to
3.482 in. (88.443 mm.)	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.

Connecting 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.

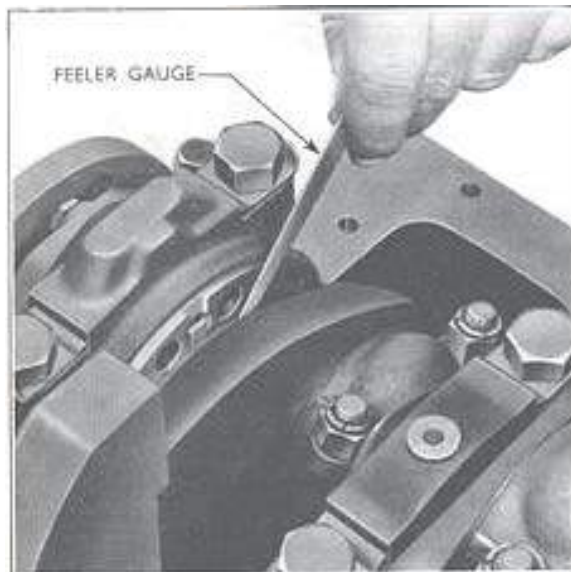


Fig. 26
Checking Crankshaft End-float

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 in 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 caps, 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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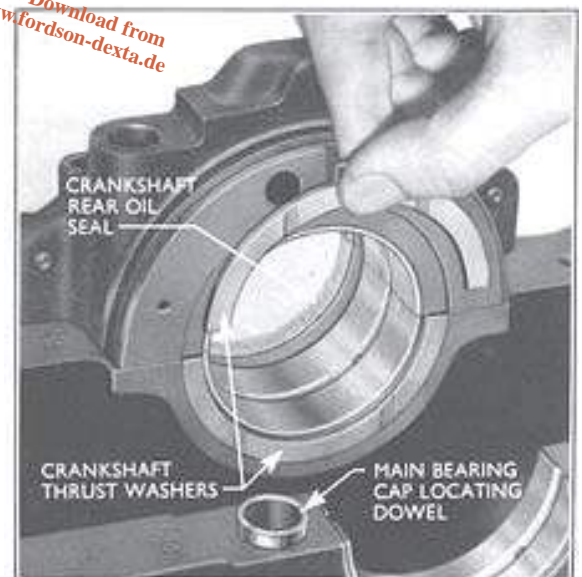


Fig. 27
Crankshaft Thrust Washers

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. J.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 crankshaft).

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.

SPECIFICATION AND REPAIR DATA—ENGINE

General Data

	Standard Dextra	Super Dextra
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 Dextra	Super Dextra
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	3.685 to 3.695 ins. (93.637 to 93.663 mm.)	3.6915 to 3.6925 ins. (93.663 to 93.683 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

	High silicon, aluminium alloy	
Type		
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.)

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 9.007 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. (31.764 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-floor	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. (69.872 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 0.007 in. (0.178 mm.) clearance

Idle 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 8.075 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.)

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. (33.359 to 33.452 mm.)
Valve stem diameter—inlet and exhaust	0.311 to 0.312 in. (7.889 to 7.923 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 0.3153 in. (7.976 to 8.014 mm.)
Valve guide outside diameter	0.5005 to 0.501 in. (12.713 to 12.723 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 ¹
Outer	7.25 ¹ 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	1.838 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 in 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. (310.37 to 311.43 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.)

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 on 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 post 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 doweled 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 $\frac{1}{2}$ 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

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

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 adapter plate from its dovetailed 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 rocker 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 slip at the rear of the cylinder head.*

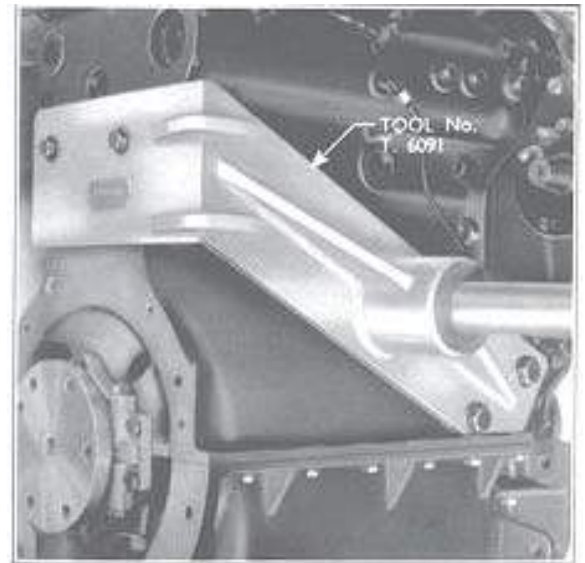


Fig. 28
Engine Stand Bracket

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 slantproof 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 adapters (Tool No. T.335-2).
23. Remove the timing case cover set-screws and carefully remove the cover.

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, over 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

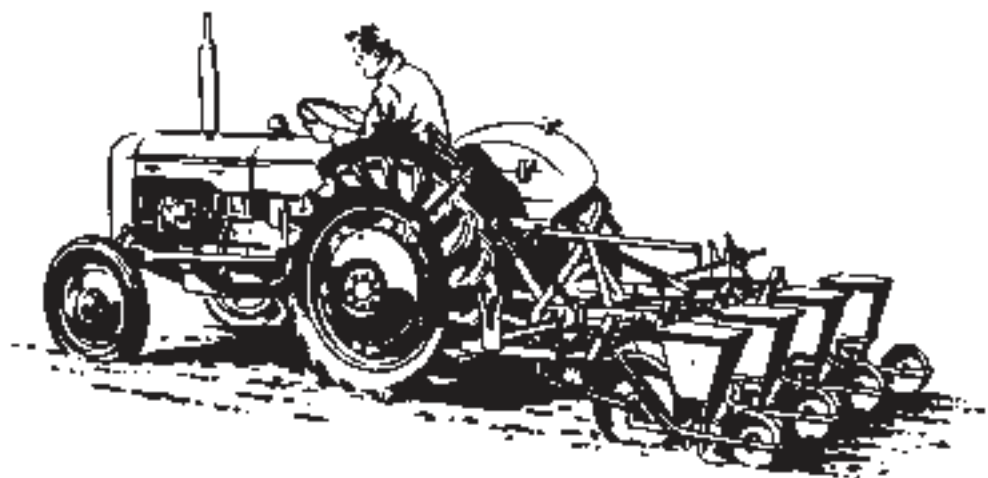
on the connecting rod big end positioned on the left-hand side of the engine (opposite side to camshaft). Compress the piston rings using a suitable piston assembly ring, push the pistons down the cylinder bores and reassemble the big end caps to the crankshaft, with the corresponding numbers on cap 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. T16095). 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.
- 17a. *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.

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 steering wheel? Farmer one: The steering wheel is fixed on the other side.



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LUBRICATION SYSTEM

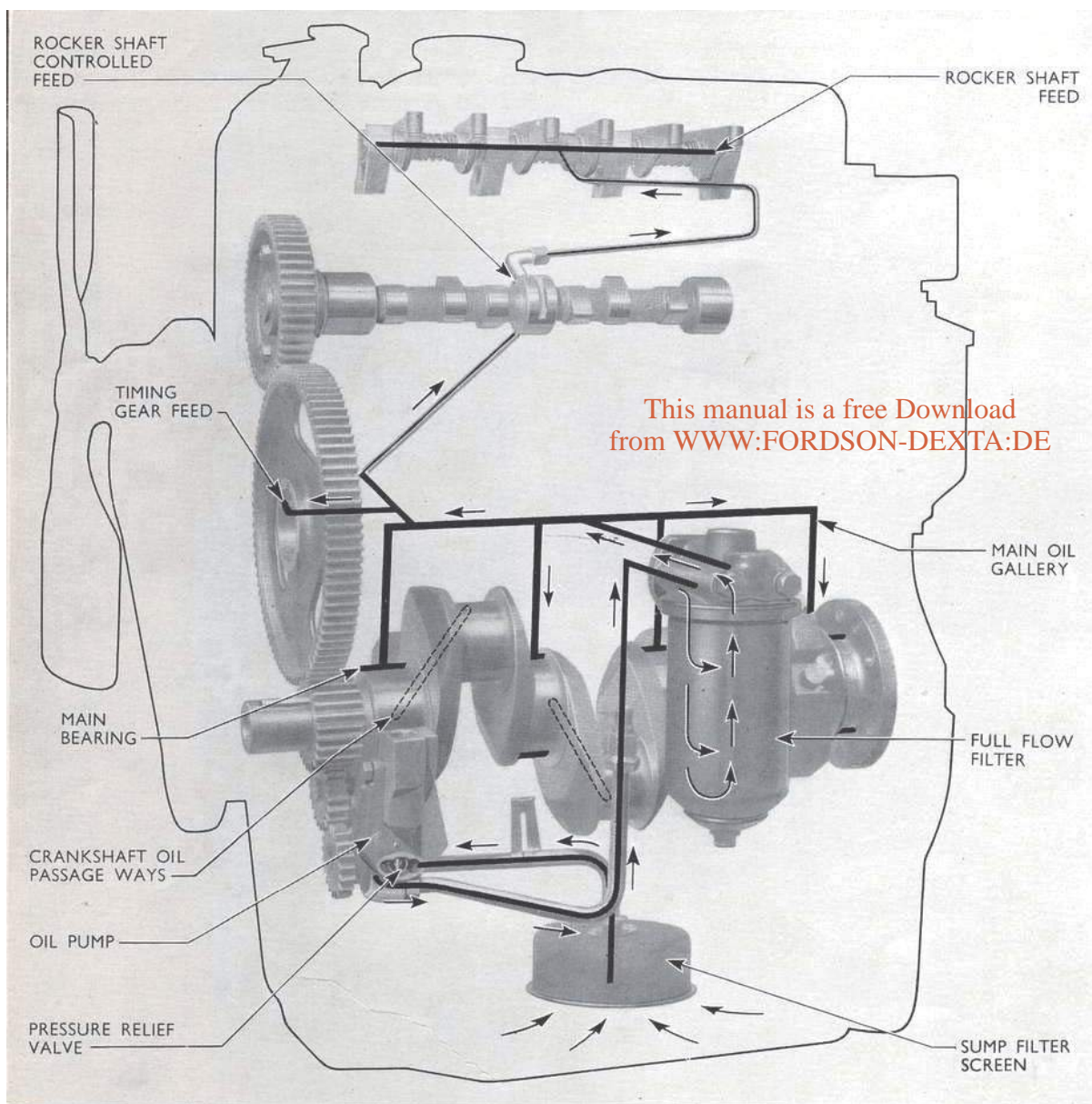


Fig. 29
Engine Lubrication System

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 $\frac{1}{2}$ 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.

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

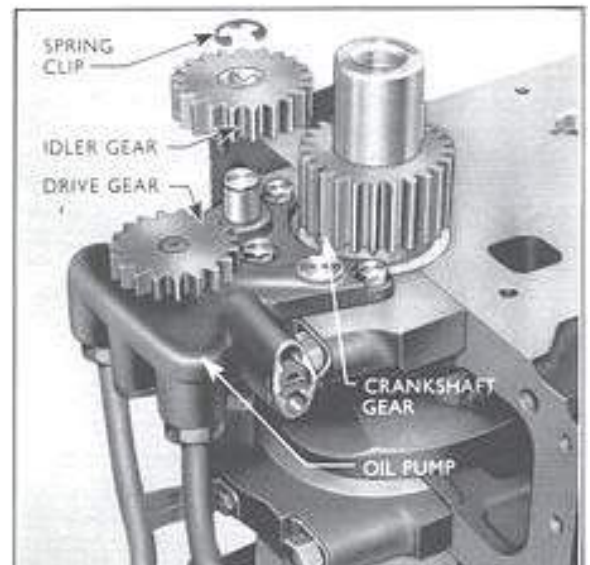
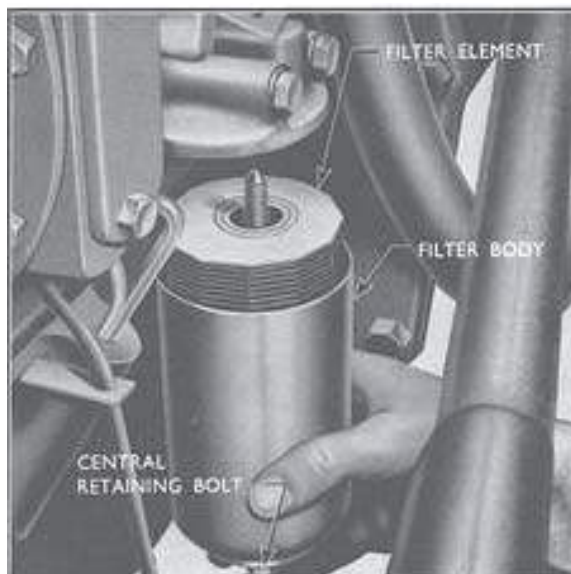


Fig. 31
Oil Pump and Idler Gear

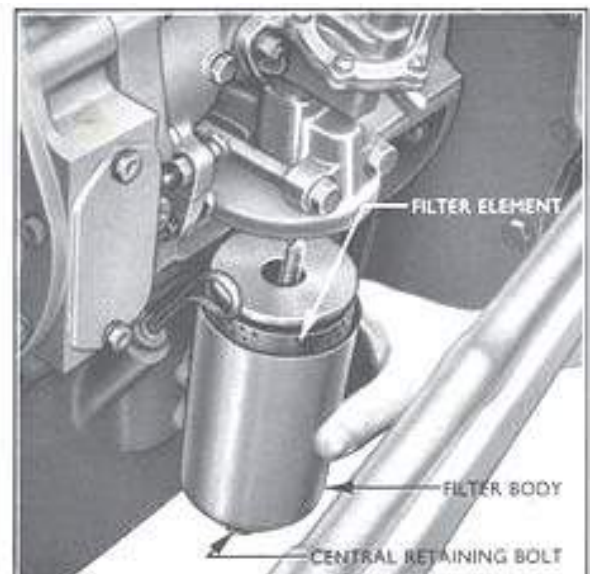
torque of 10 lbs. ft. This manual is a free Download from WWW:FORDSON-DEXTA:DE

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 passed 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 parts 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.

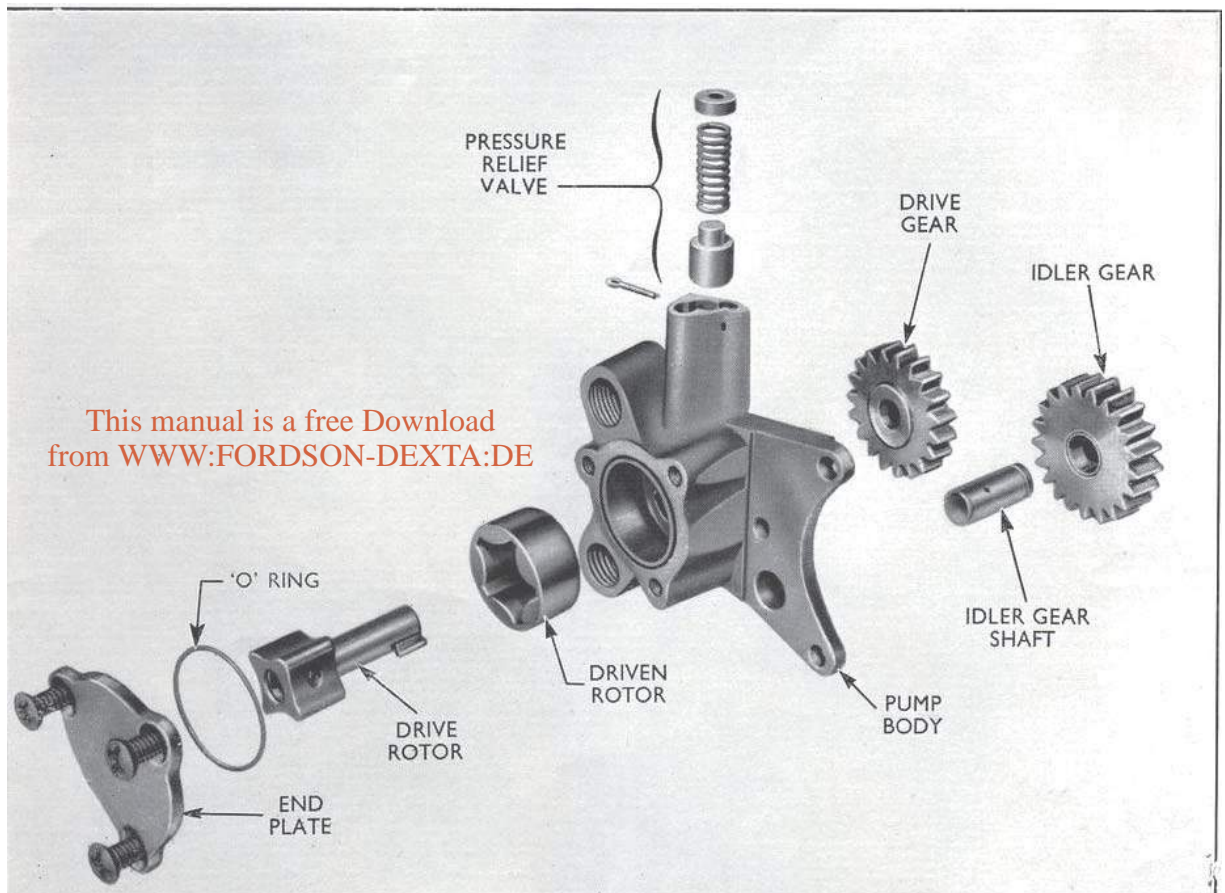


Fig. 32
Exploded View of Oil Pump

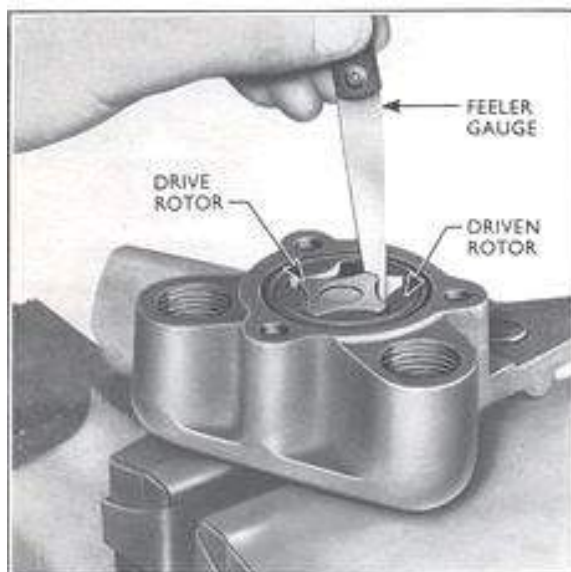


Fig. 33
Checking Drive to Driven Rotor Clearance

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.

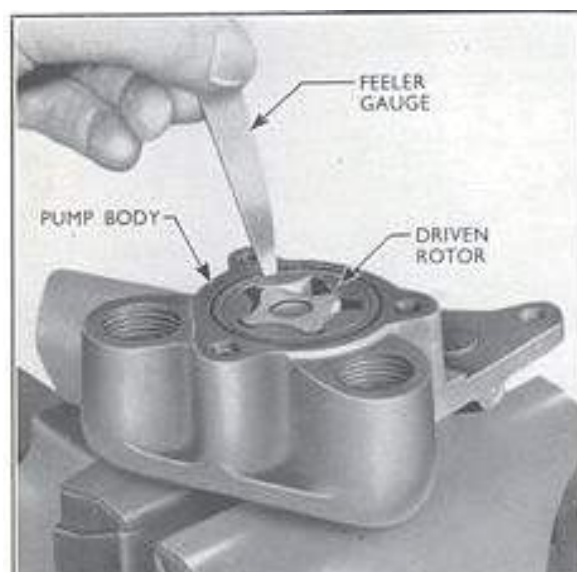


Fig. 34
Checking Driven Rotor to Body Clearance



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 pump 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 spring 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 1 in. (25.4 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 $\frac{1}{2}$ 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. (0.153 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 pump 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.

<i>Possible Cause</i>	<i>Possible Remedy</i>
(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

<i>Possible Cause</i>	<i>Possible Remedy</i>
(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.

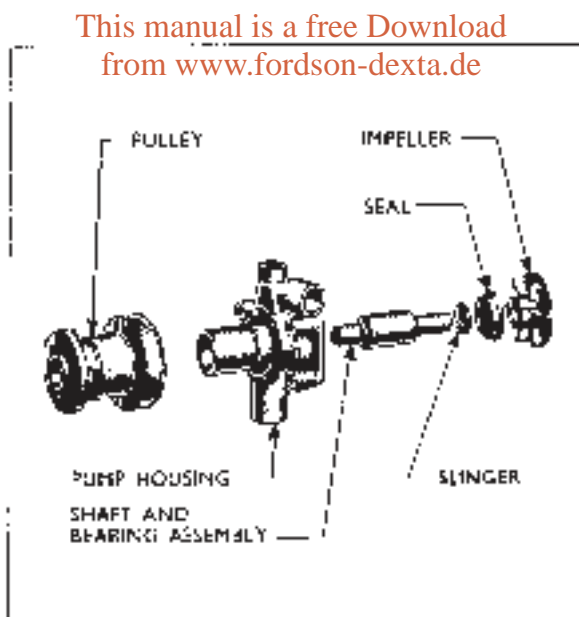


Fig. 36
Exploded View of Water Pump

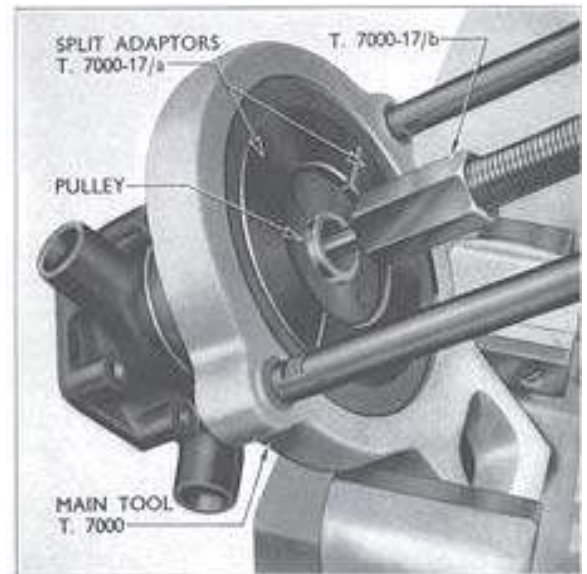


Fig. 37
Removing the Pulley

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.

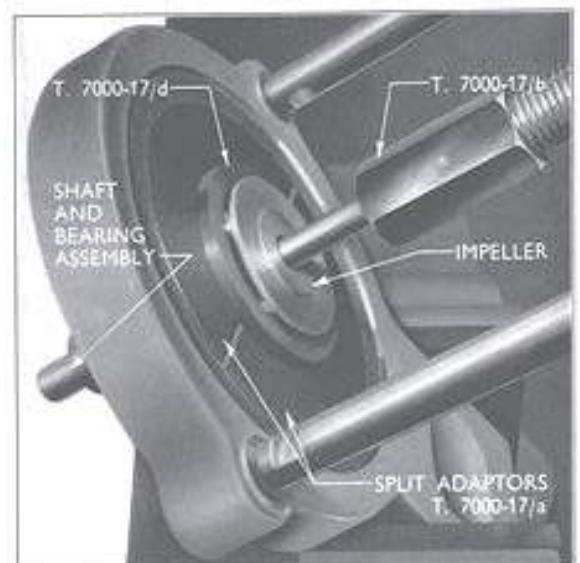


Fig. 38
Removing the Impeller

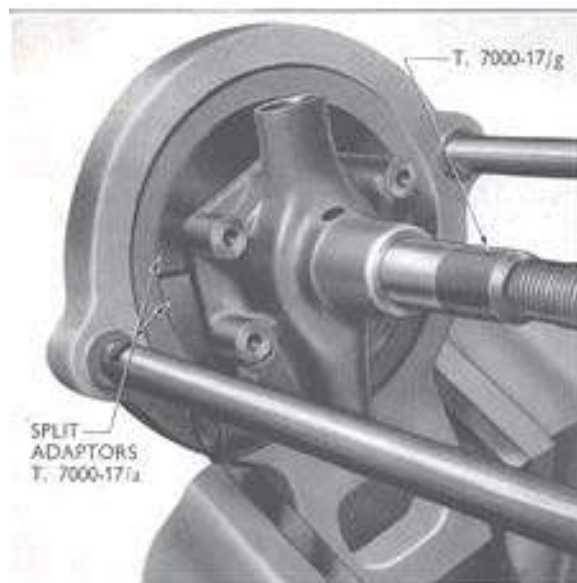


Fig. 39
Replacing the Shaft and Bearing Assembly

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.7000-17c) 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

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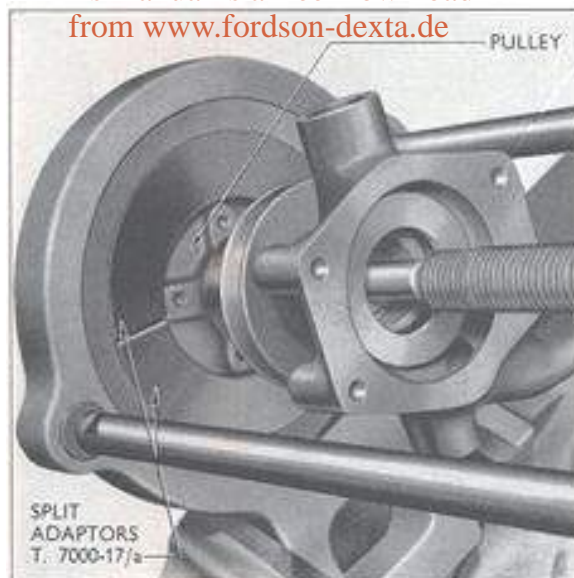


Fig. 40
Replacing the Pulley

impeller blades and the housing face as shown on Fig. 41.

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.

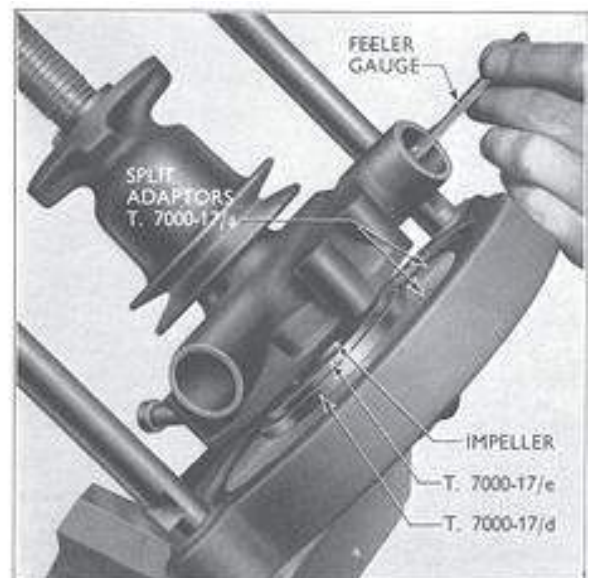


Fig. 41
Replacing the Impeller

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 3½ in. (7.9 cm.) as against 2½ 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 MF-1163-B in Water	Anti-Freeze Protection	Specific Gravity	MF-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 −16°F. (−28.9°C.)	1.040	3.75	2.13	11.25	6.39

FAULT DIAGNOSIS

Engine Overheats

<i>Possible Cause</i>	<i>Possible Remedy</i>
(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.

FUEL SYSTEM

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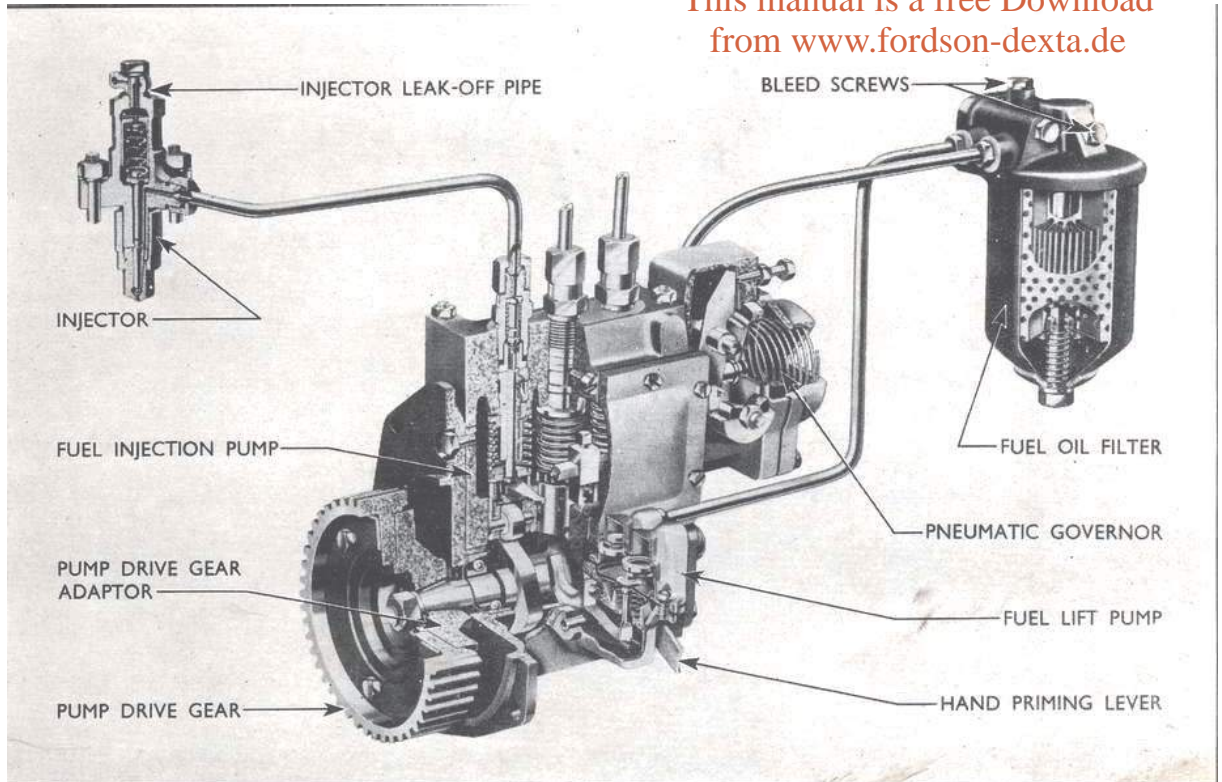


Fig. 1
Fuel Injection System

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 lbf. 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.

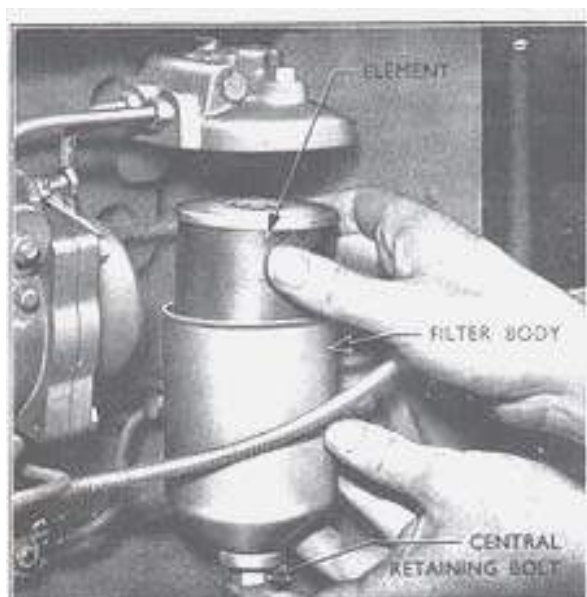


Fig. 2

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 let 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 haffle 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 screens in the main air cleaner, or dirty oil in the oil bath will



Fig. 4

Removing the Air Cleaner Base

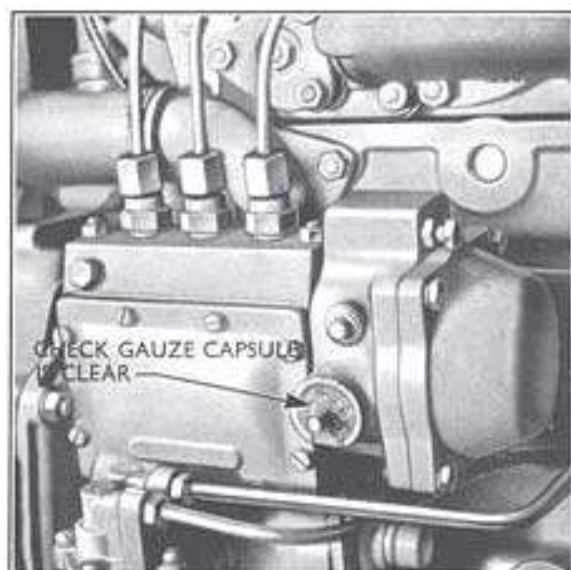


Fig. 5
Governor Filter Capsule

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.

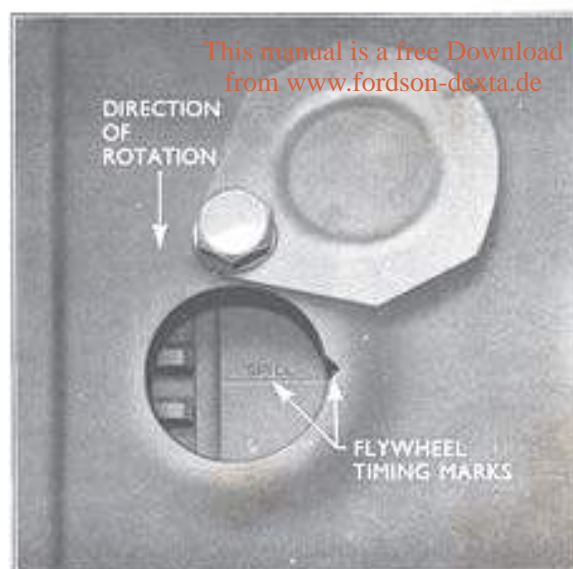


Fig. 6
Flywheel Timing Marks

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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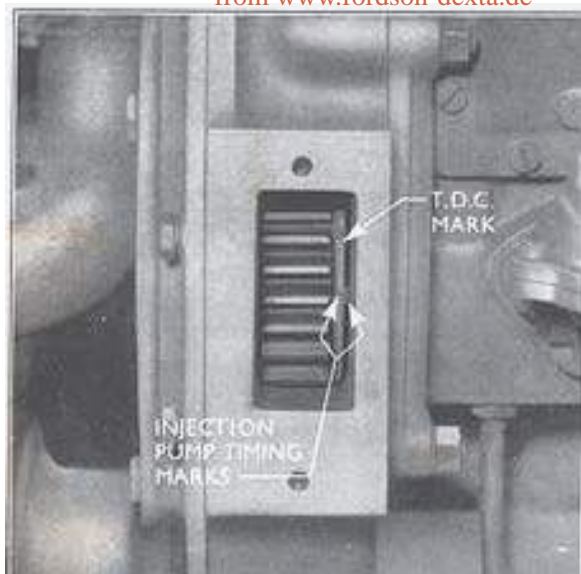


Fig. 7
Fuel Injection Pump Timing Marks

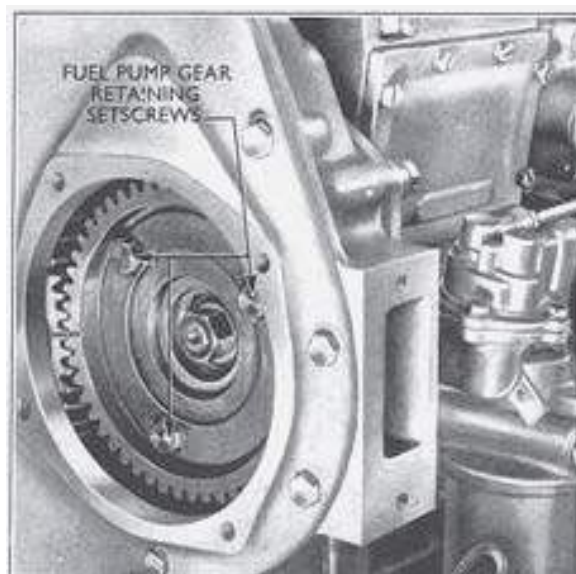


Fig. 8
Fuel Injection Pump Gear

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 pin 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 of 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. (4.14 Kg.m.).

6. Replace the injector pipe and ensure that each end is seating correctly before the union nuts are tightened.

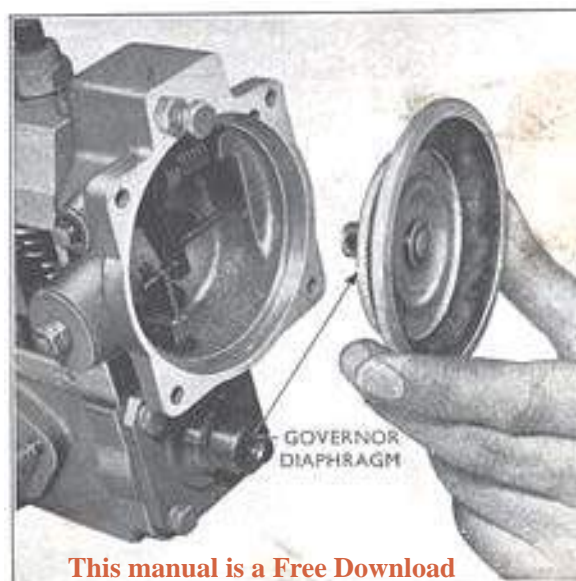
FUEL INJECTION PUMP

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 pressuremeter 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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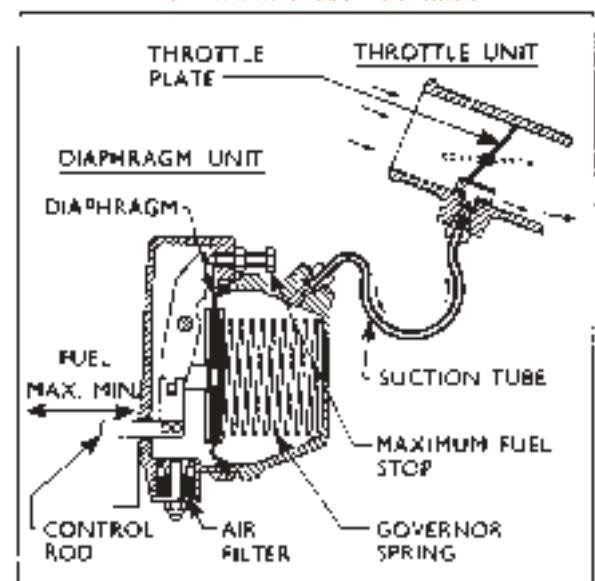


Fig. 11
Pneumatic Governor

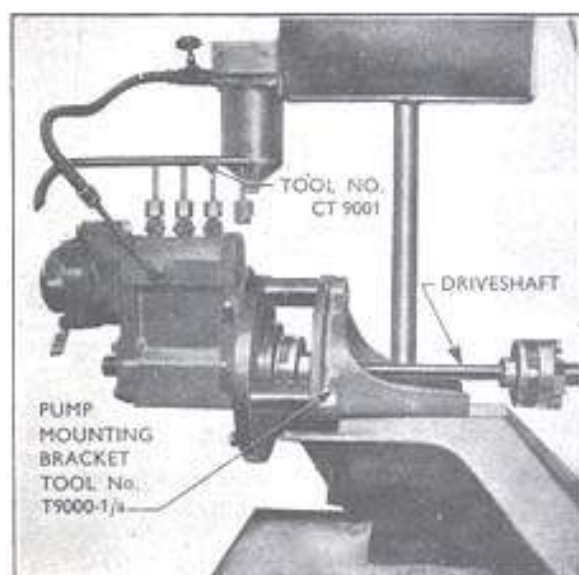


Fig. 12
Injection Pump Flushing Pipe

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 countersink screw, retaining the front half of the governor case to the canbox, 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 canbox 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

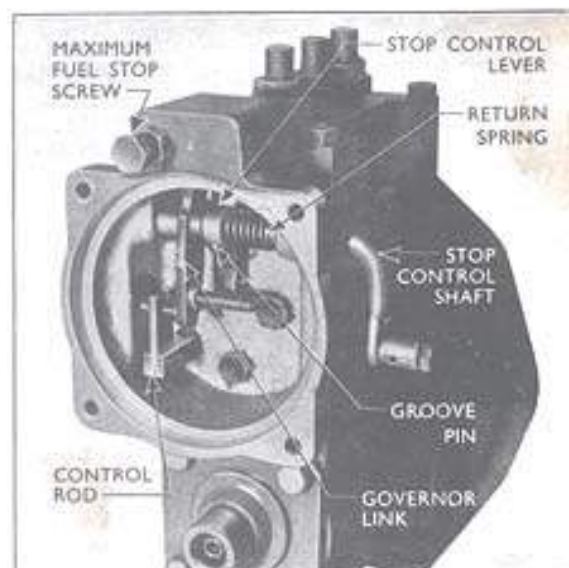


Fig. 13
Pneumatic Governor Linkage

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.

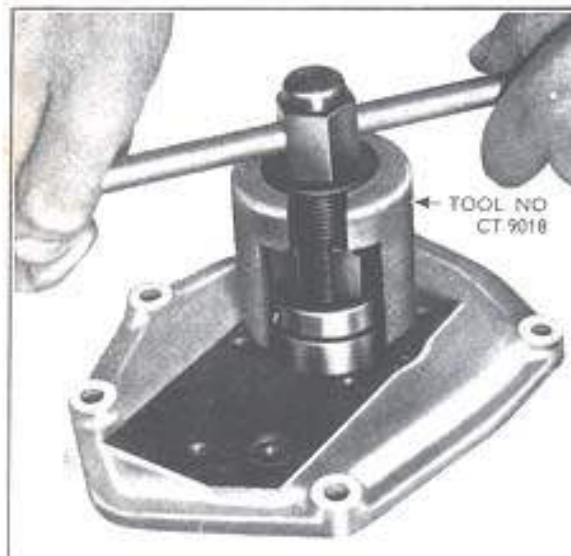


Fig. 14
Removing the Camshaft Outer Races

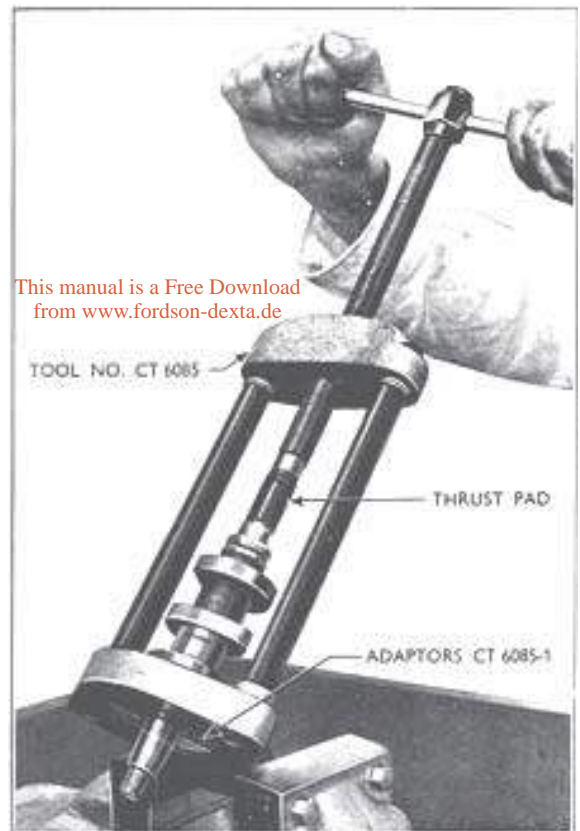


Fig. 15
Replacing the Camshaft Inner Races

20. Remove the four bolts retaining the prooftometer 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 prooftometer 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 prooftometer 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.

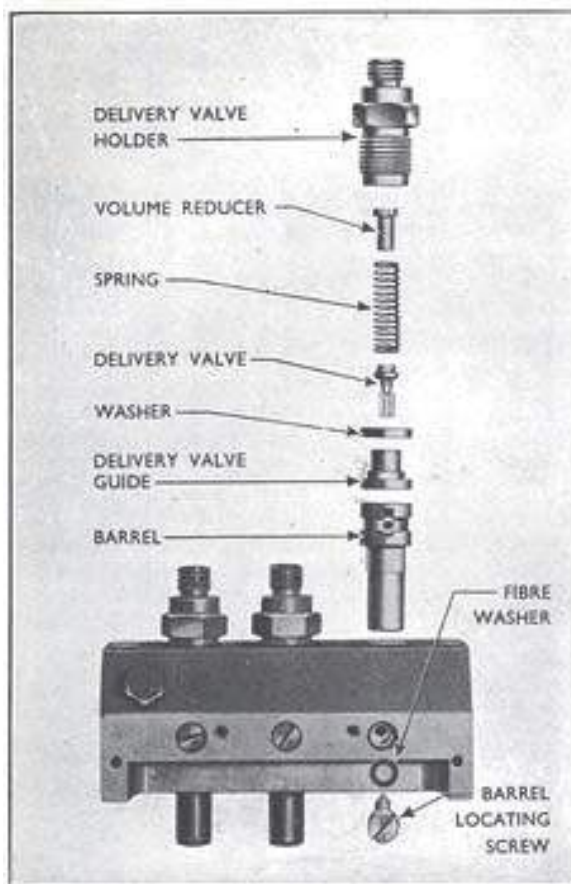


Fig. 16
Delivery Valve and Guide

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 adapter (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.

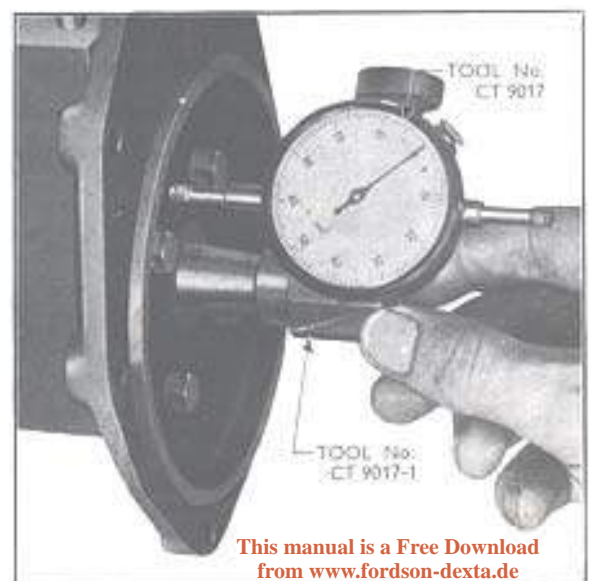


Fig. 17
Checking Camshaft End-float

Identification No.	Thickness
1	0.177 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 taper 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.

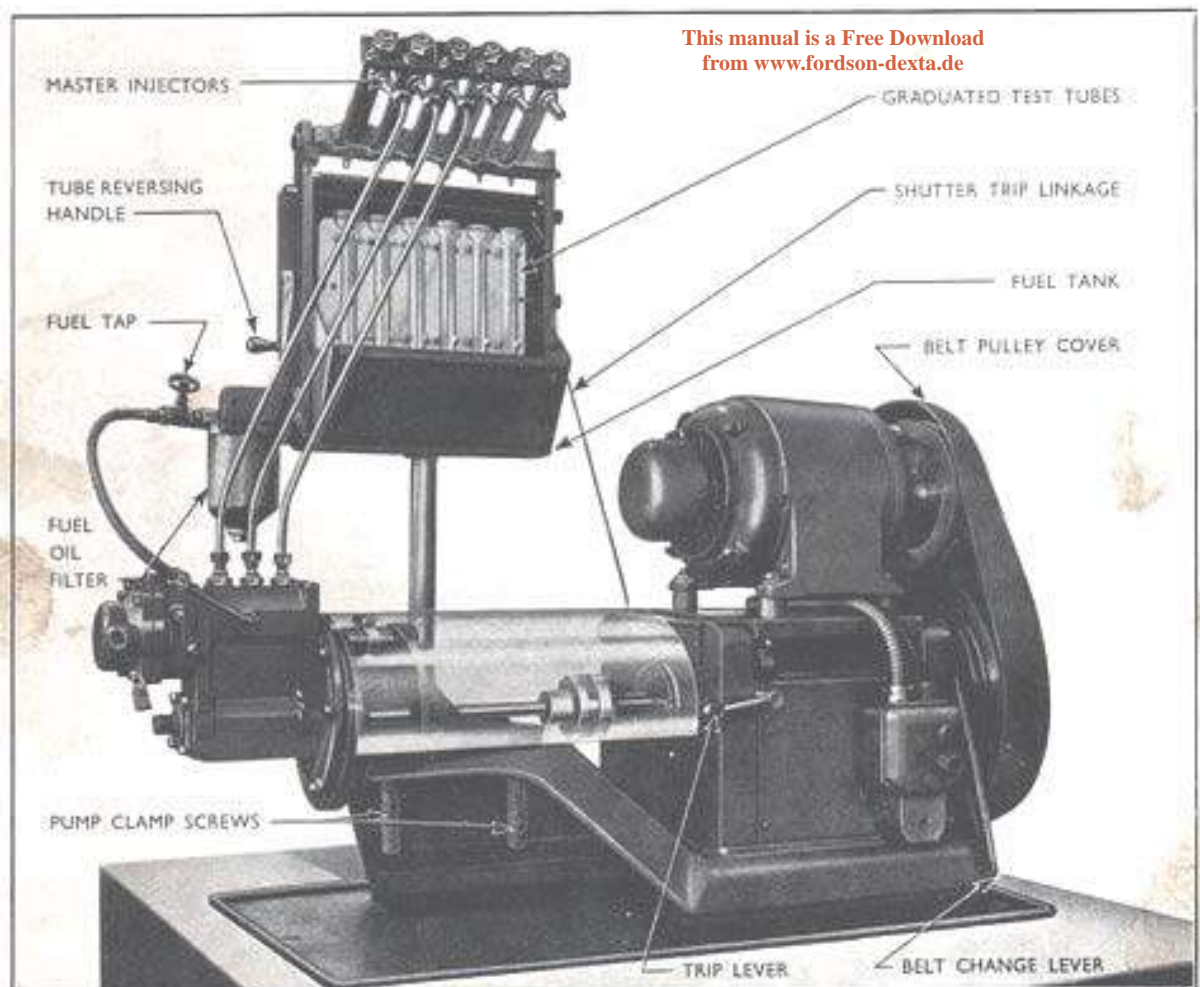


Fig. 18
Calibrating and Phasing Test Equipment

Holding the lower ends of the plungers, fit the pump housing to the canbox ensuring that with the pump lying on its side the plunger arms face upwards with their slots in the tops of the tappets. Securely tighten the four nuts, fitted with spring washers, securing the housing to the canbox.

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 canbox 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.9000-1A) 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 out-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. 26).

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.

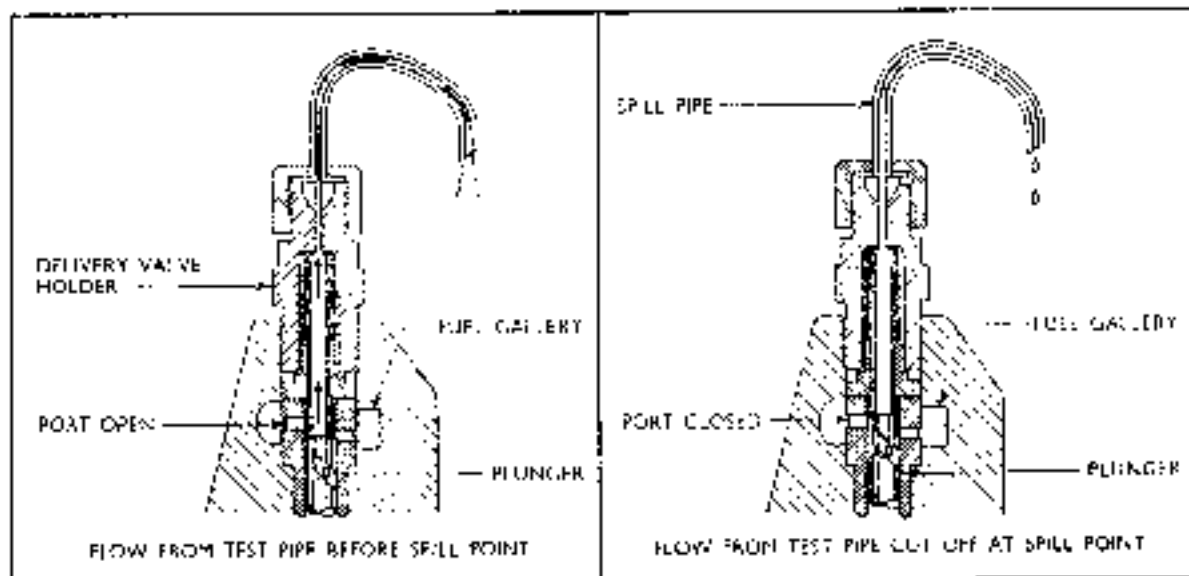


Fig. 19
Principle of Spill Timing

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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 pumping 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.

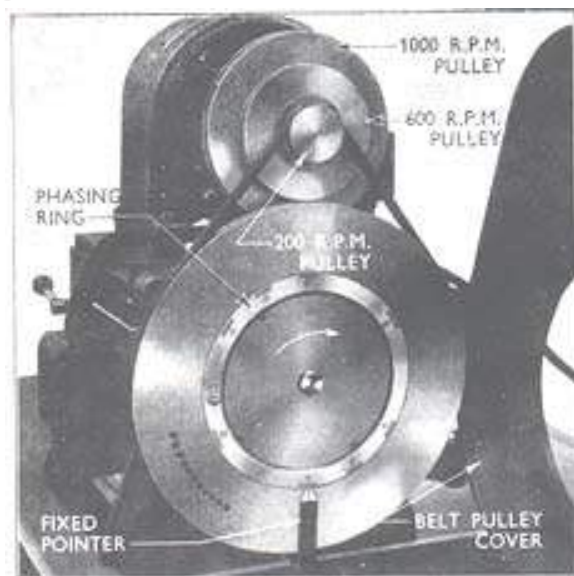


Fig. 20
Checking Pump Phasing

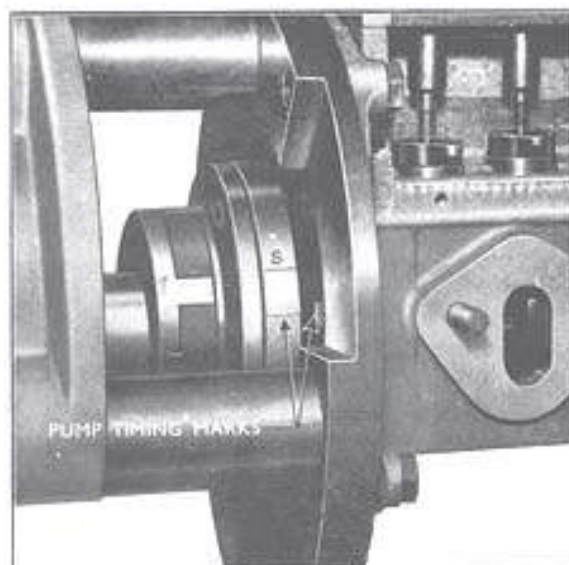


Fig. 21
Checking No. 1 Element Spill Point

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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 $\frac{1}{2}^\circ$. 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 in 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

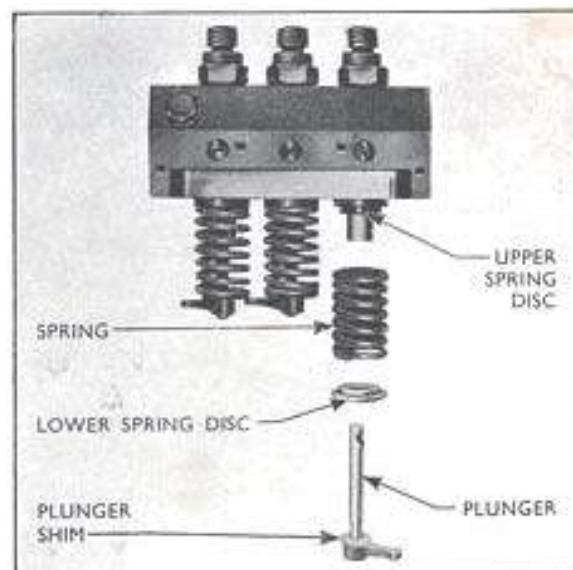


Fig. 23
Fitting Springs and Plungers

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).

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.c.s. 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.

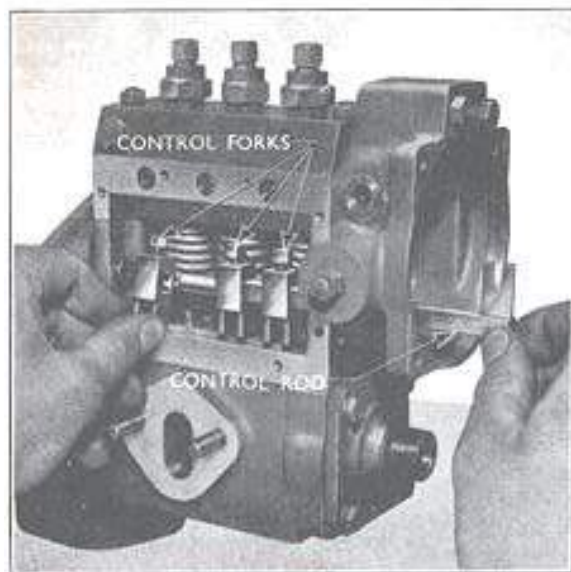


Fig. 24
Fitting the Control Rods and Forks

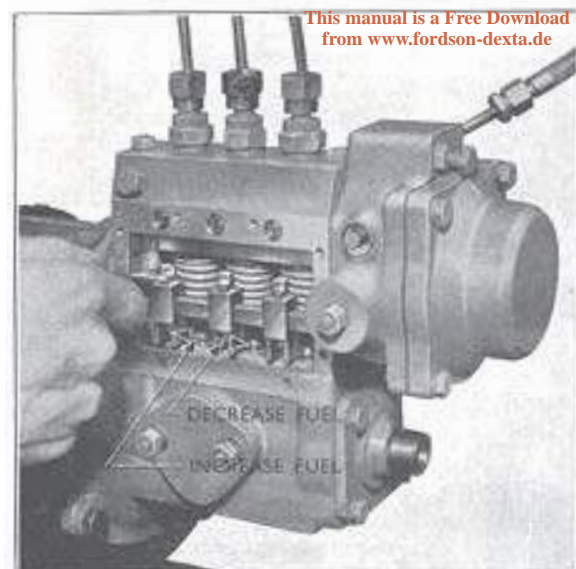


Fig. 25
Adjusting the Forks

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 proofmerer 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.

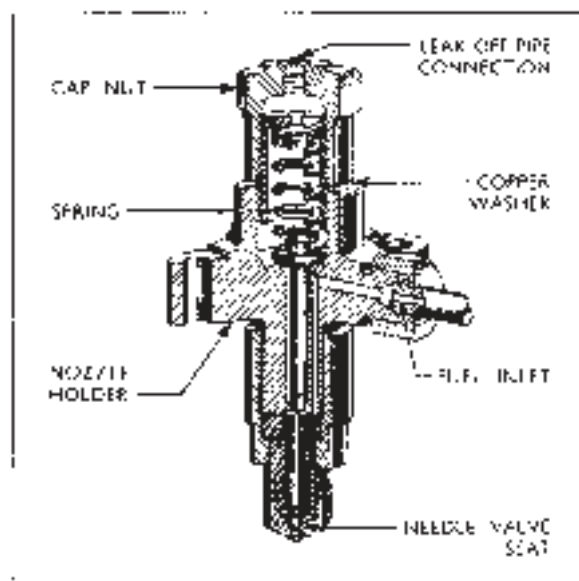


Fig. 26
Sectioned View of Injector

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 injector.
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.9025-7a), 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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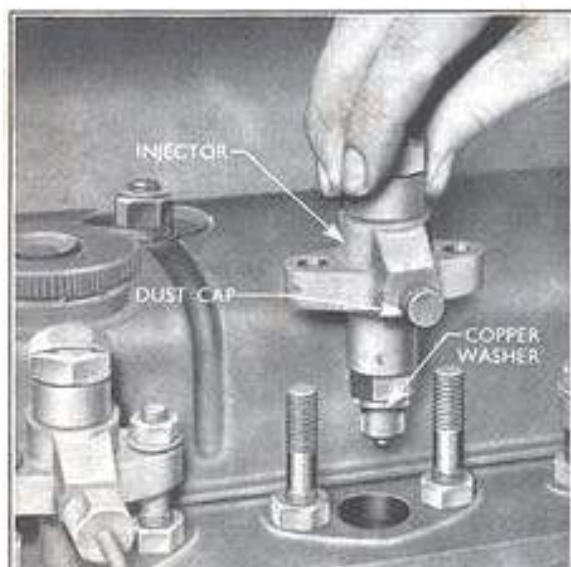
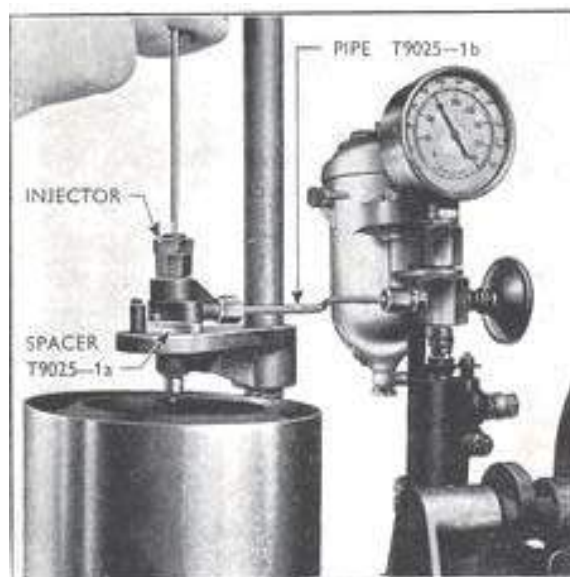


Fig. 27
Removing an Injector

**Removing an Injector**

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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 screw-driver, 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.



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 valves 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 the 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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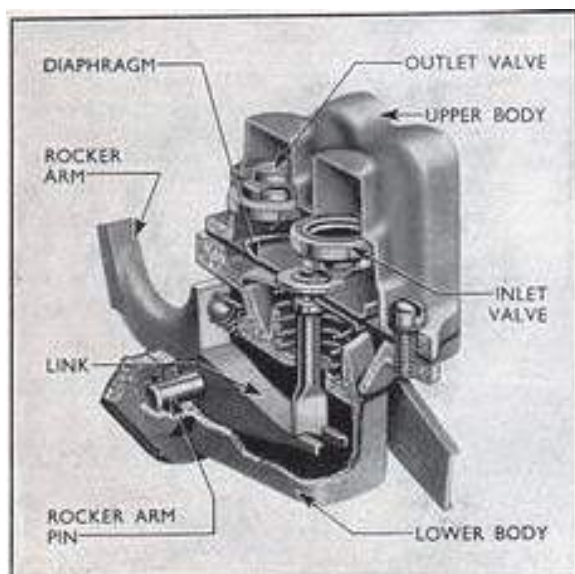


Fig. 30
Sectioned View of Fuel Lift Pump

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 tap 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. Litter 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 9223) 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

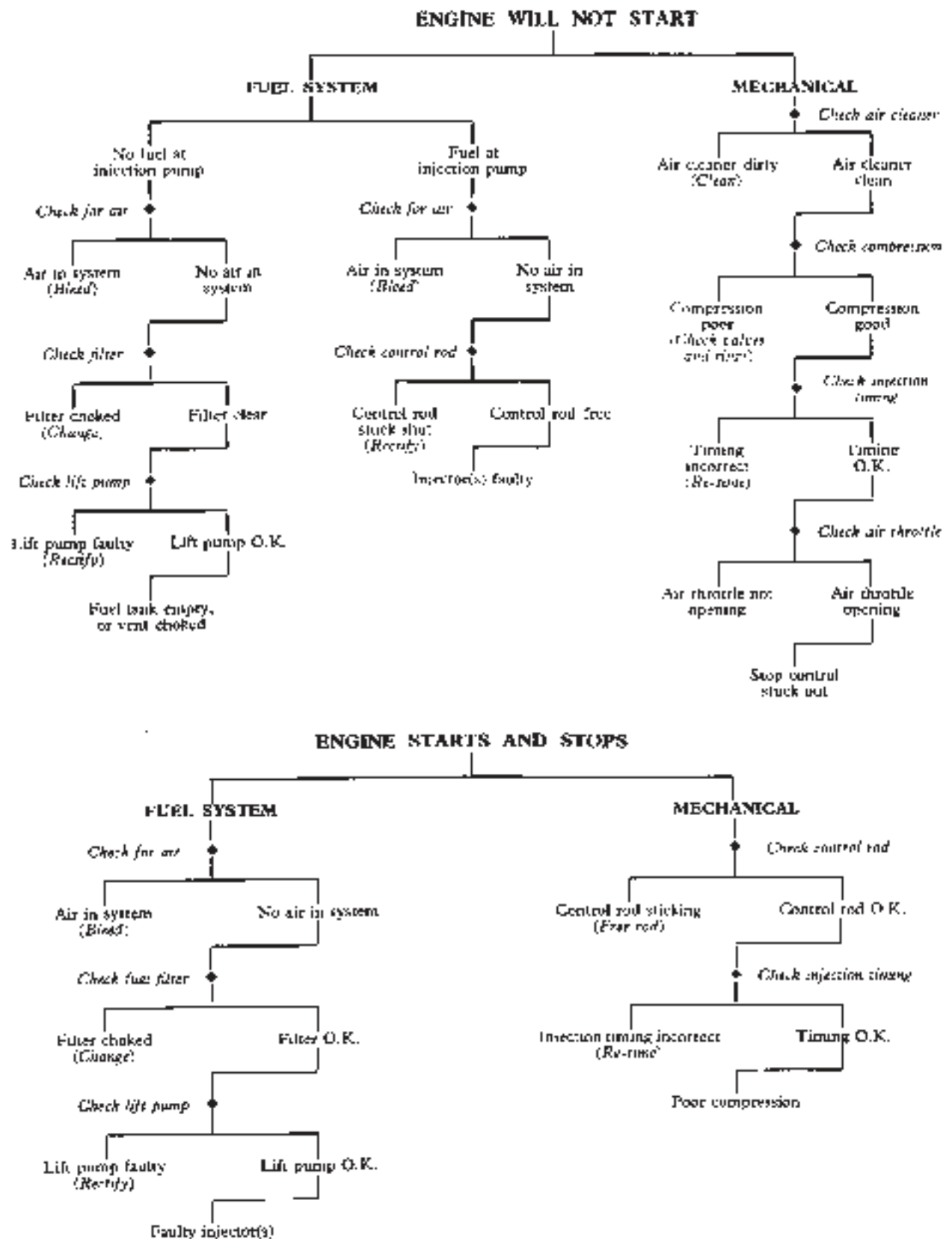
1. Remove and clean the air filter as described on page 3.
2. Remove the rubber hose between the main air cleaner and the inlet manifold, check for obstructions and operate the throttle lever to ensure that the throttle plate travels as far as its stop, giving sufficient opening at the throttle.
3. Check all valve clearances.
4. Check the evenness of the cylinder compressions by turning the crankshaft with the starting handle.

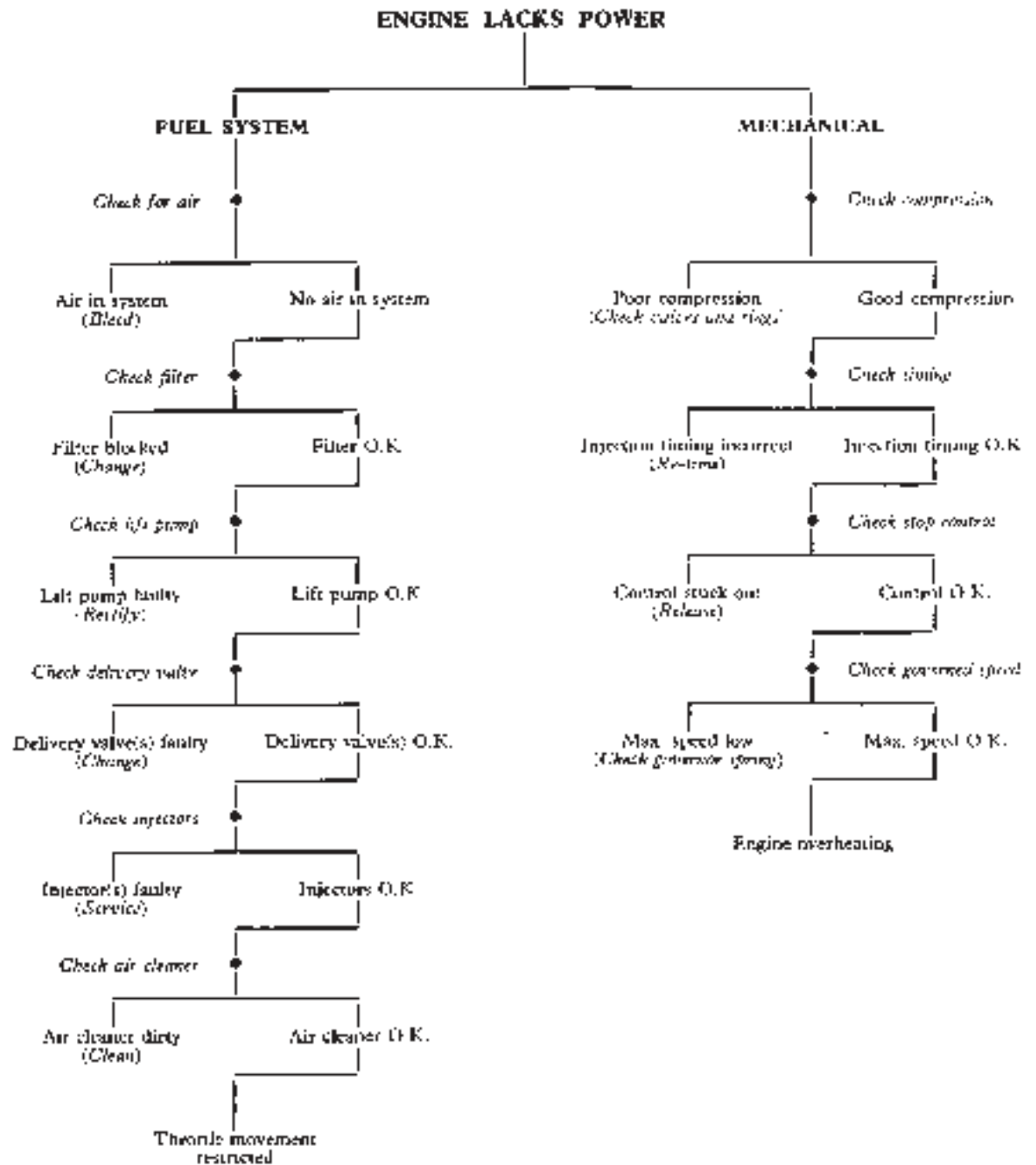
Governing

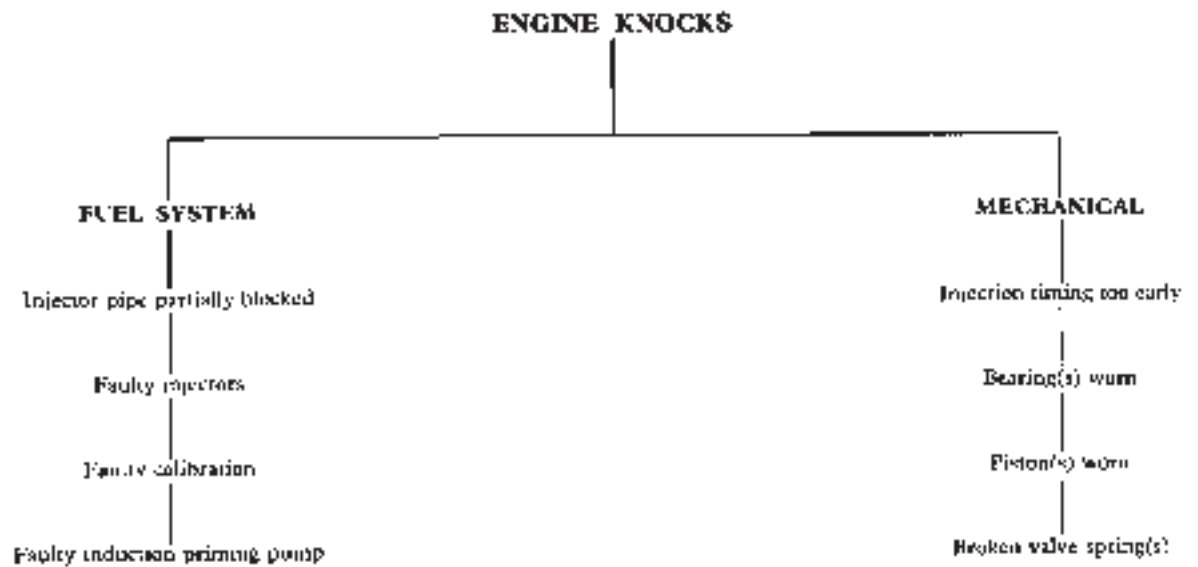
1. Check the maximum "No Load" speed of the engine. This should be 2,200 r.p.m. If the air system has previously been checked as outlined, and the maximum "No Load" speed is low, check the governor main spring. The length of the spring should be as outlined in the Specification Section on page 25.
2. 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.

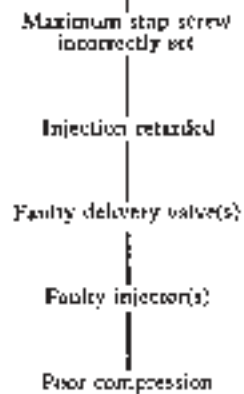
The foregoing is intended as a guide for a complete diagnosis of running faults. By carrying out the checks as outlined, faulty components, such as injectors or injection pumps, can be easily and accurately diagnosed.







ENGINE EMITS EXCESSIVE SMOKE



FUEL SYSTEM SPECIFICATION**Fuel Tank**

Capacity	7 Imp. gallons (31.8 litres) including 1 gallon (4.55 litres) reserve
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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
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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. x 6 mm.
Camshaft rotation	.. .. .	Clockwise from drive end
Lubrication	.. .. .	Self-lubricating after initial filling
Camshaft end-flush	.. .. .	.002 to .006 in. (.051 to .152 mm.)
Camshaft end-flush shim	.. .. .	.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 .031 in. (.8 to 1.3 mm.)
Plunger and 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.c.s.
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 $\frac{1}{8}$ 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	.. .. .	1.691 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

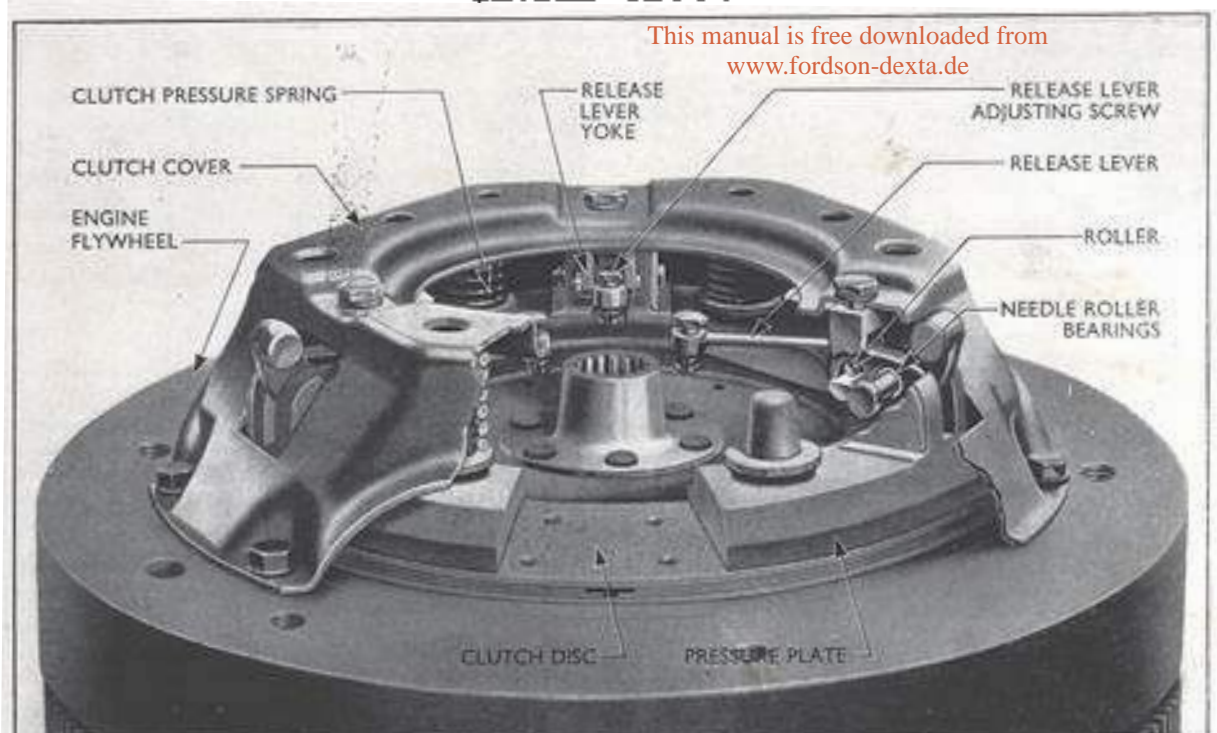


Fig. 1

Exploded 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 $\frac{1}{4}$ 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

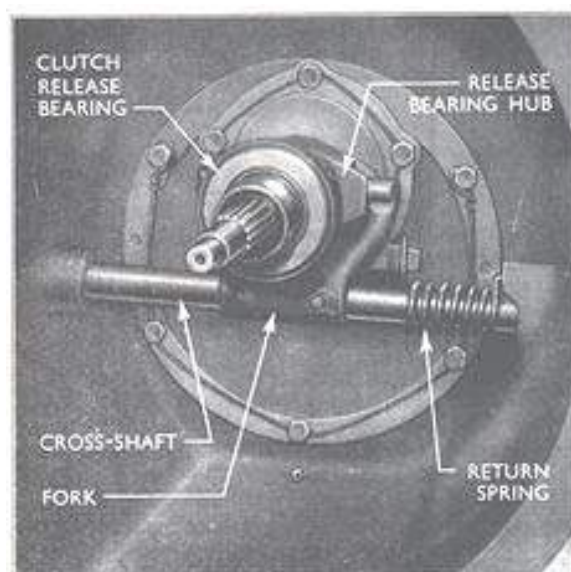


Fig. 2
Clutch Release Mechanism

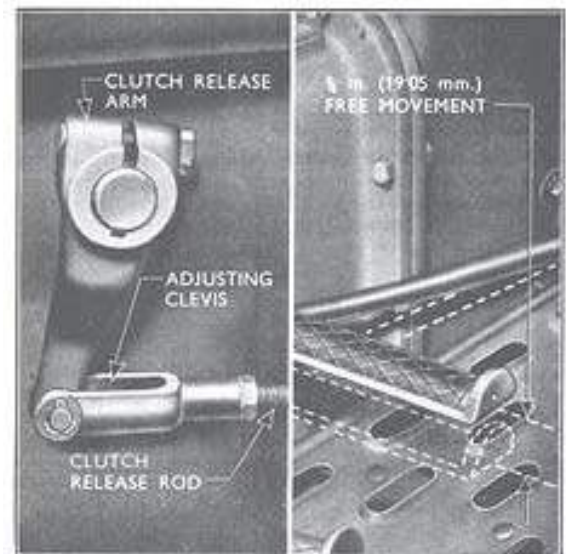


Fig. 3
Clutch Pedal Free Movement Adjustment
(Single Clutch)

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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 $\frac{1}{4}$ 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 luncheon 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.

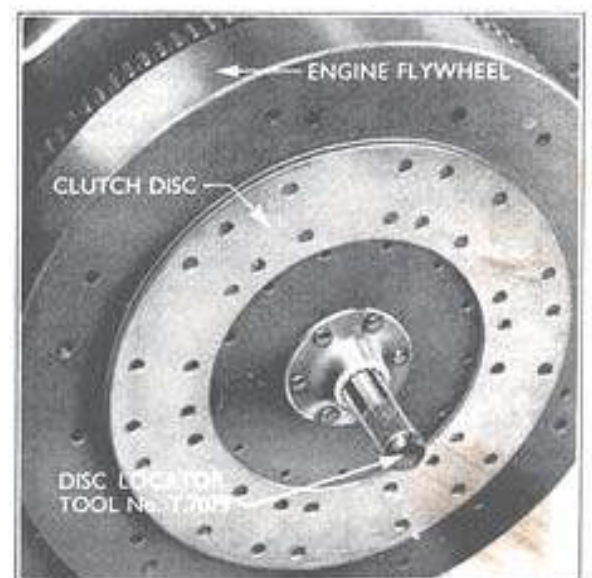


Fig. 4
Positioning the Clutch Disc on the Flywheel

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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

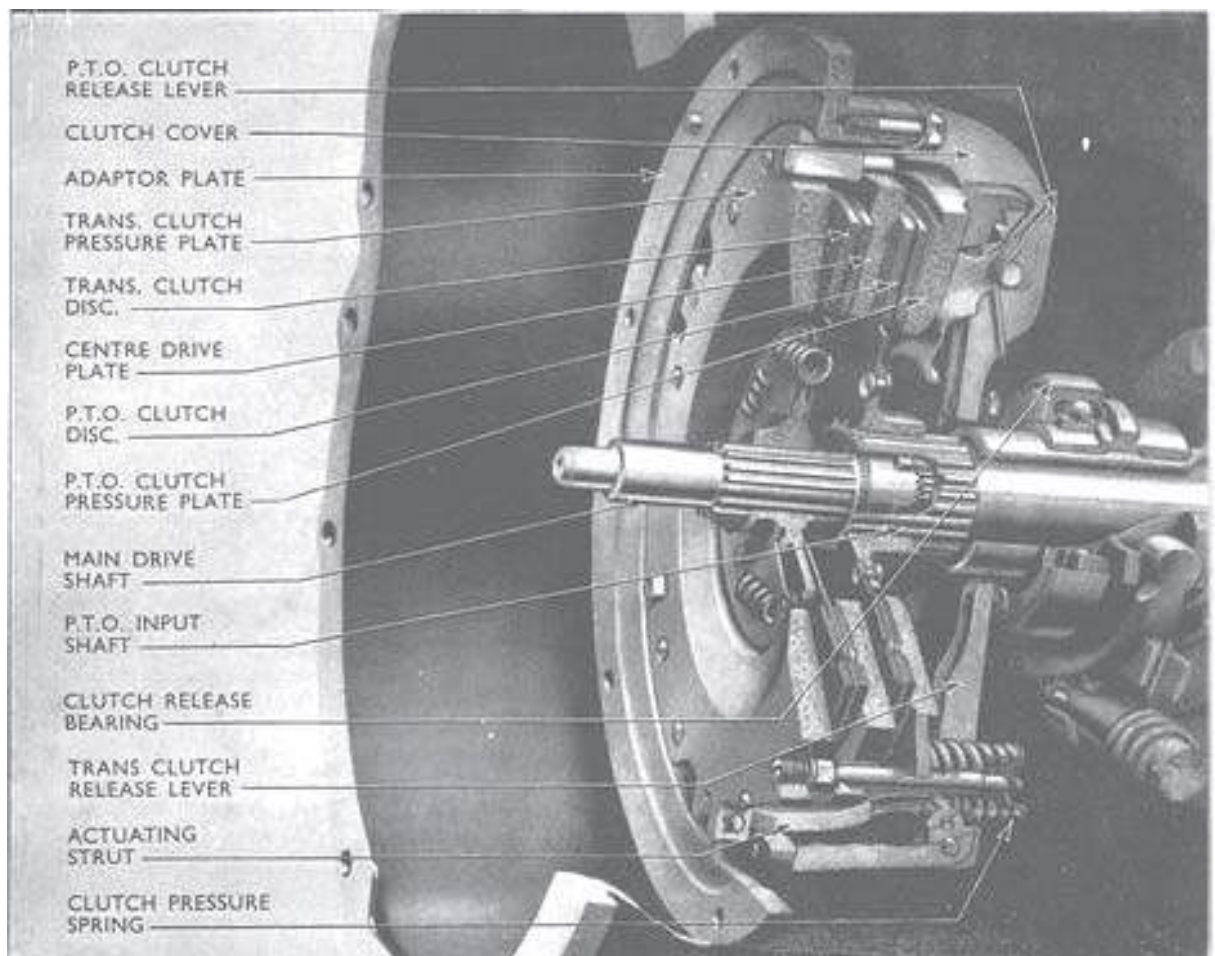


Fig. 5
Clutch Housing Cut-away showing Sectioned
View of the Double Clutch Installation

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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 $\frac{1}{4}$ 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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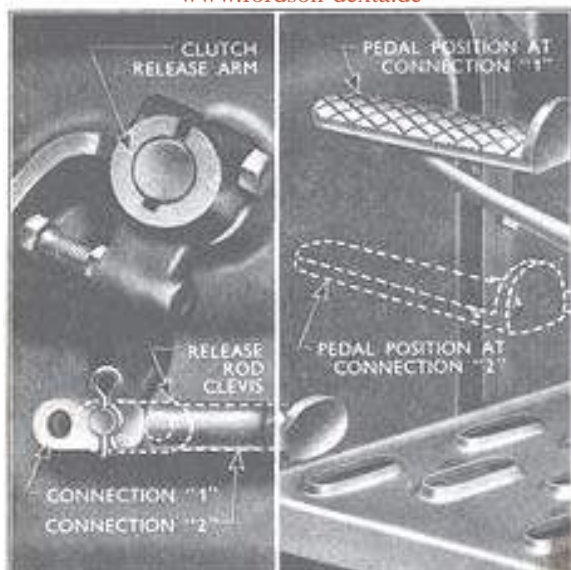


Fig. 6
 Alternative Release Rod Connections and
 Resultant Clutch Pedal Positions

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 $\frac{1}{4}$ 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 adapter plate and remove the clutch.
3. The adapter 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.

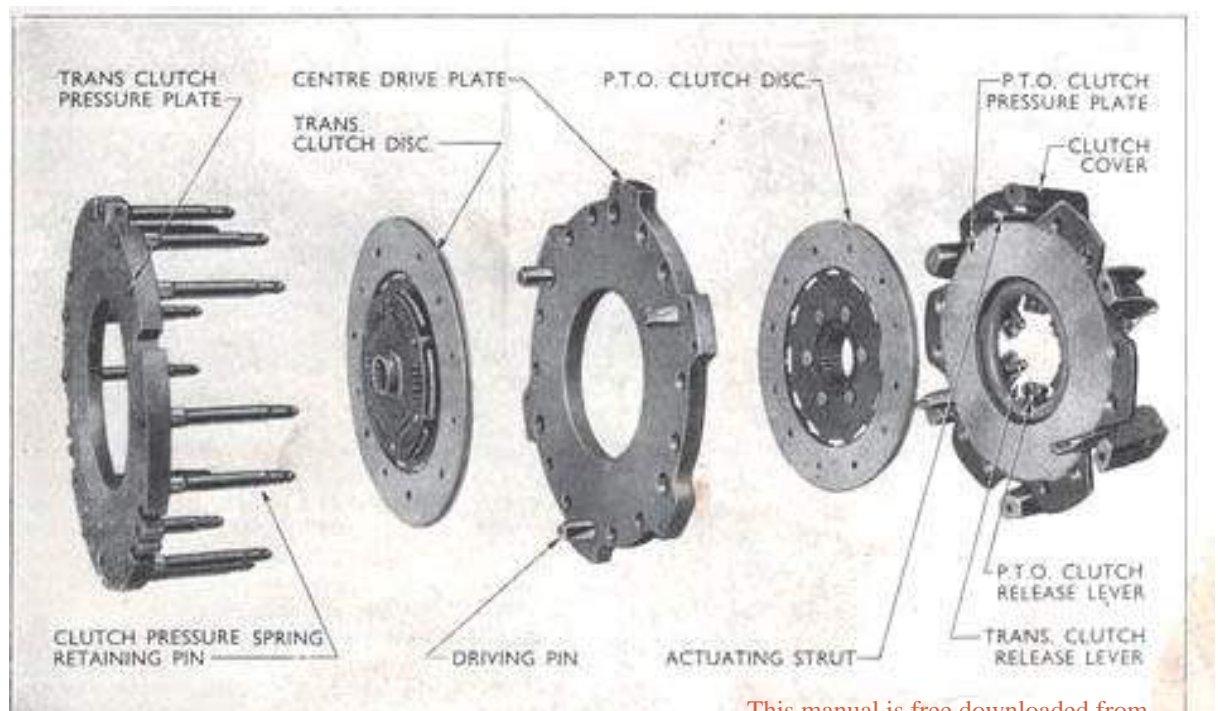
2. With the three centre drive plate locating pegs removed from the Double Clutch Assembly Fixture (Tool No. 7502), place the clutch assembly on the fixture with the cover upwards. The large diameter at the bottom of the fixture centre spindle should locate in the bore of the transmission clutch disc 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 evil 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. (42.43 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.

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 pins, 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. Install 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.

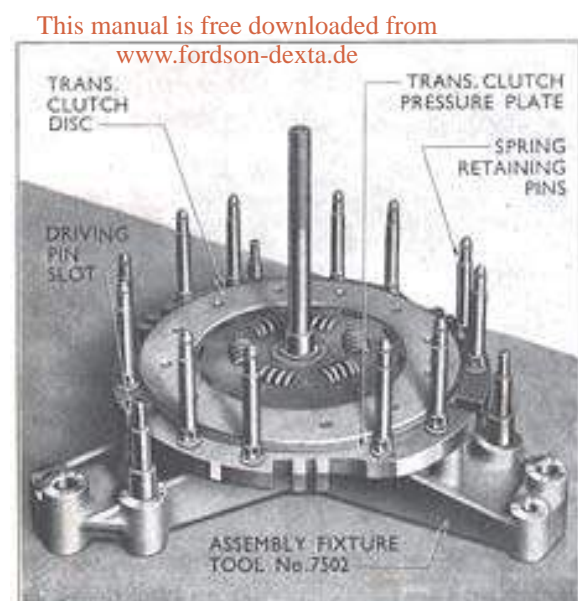


Fig. 8
Transmission Clutch Pressure Plate and
Disc Installed on Assembly Fixture

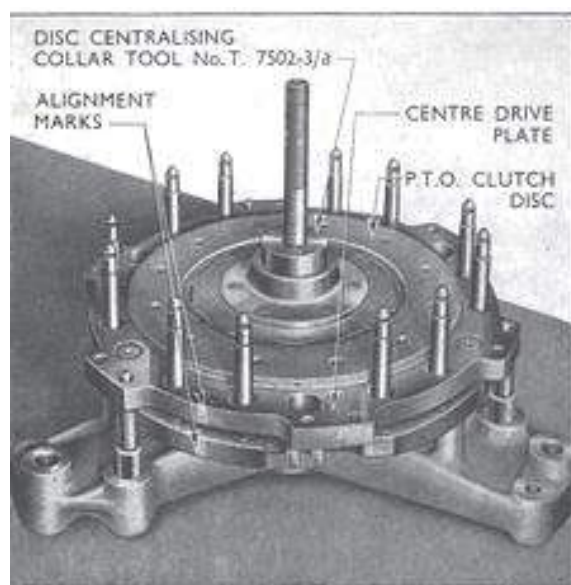


Fig. 9

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 tension spring so that the end 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 $1\frac{1}{2}$ ins. (38.57 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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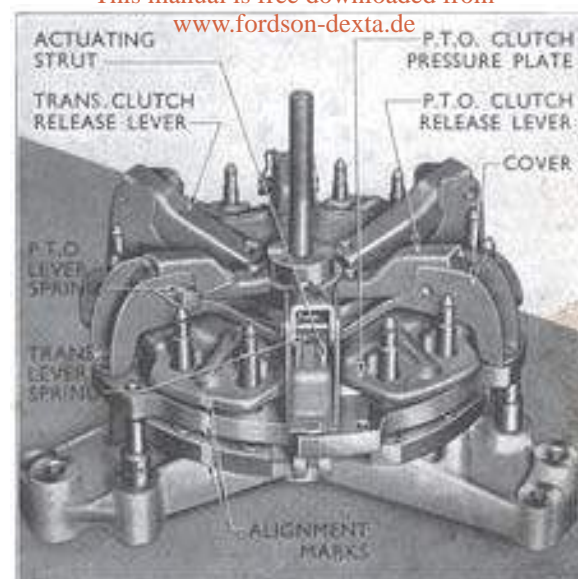


Fig. 10

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

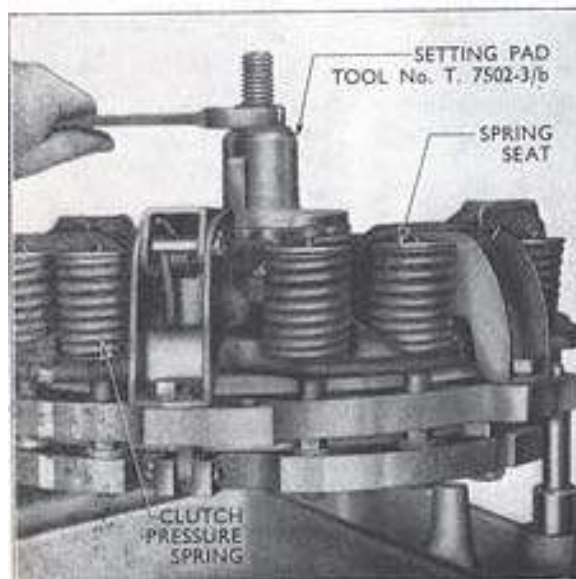


Fig. 11

Clutch Assembled - Depressing Release Levers to Insert Setting Blocks

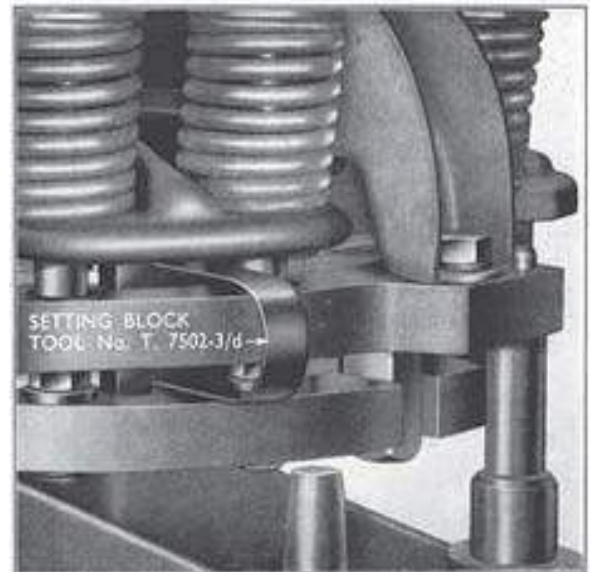


Fig. 12

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 ($\frac{1}{4}$ 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, last is 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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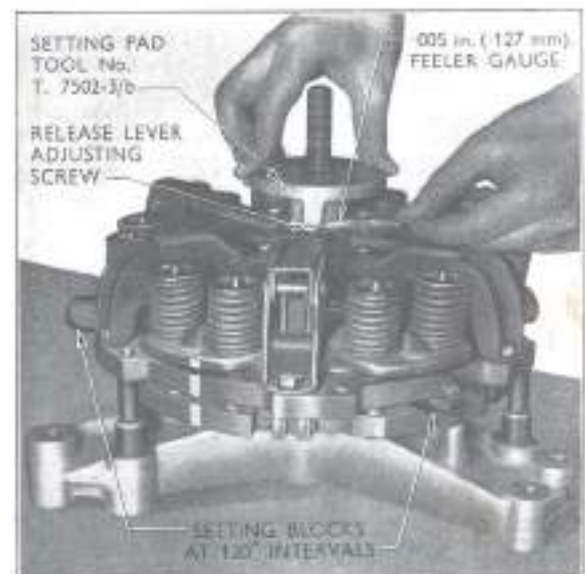


Fig. 13
Checking the Setting of a Release Lever
Adjusting Screw

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.

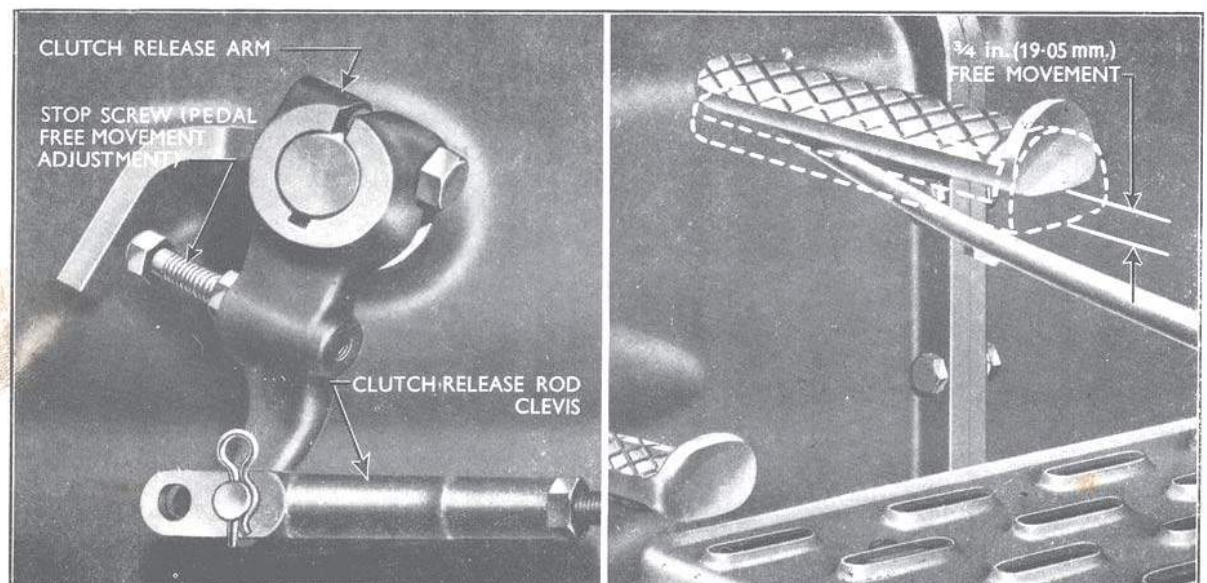
8. Tighten the release rod clevis locknut and with the release rod connected to the release arm to give the required pedal operation, fit the spring retaining clip to the clevis pin.

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 heading "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 incor-

porating 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.	..	..	..	..	..	..	16.969 in. (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	..	..	..	..	..	..	1.38 ins. (35.85 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	7 in. (178.05 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 229.59 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. (84.92 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 229.59 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	19—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. (231.63 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. (6.91 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	1 in. (25.4 mm.)