Blue Ribbon Service

Service Manual

INTERNATIONAL® CUB® 154, 184 AND 185 LO-BOY® Tractors and Mower

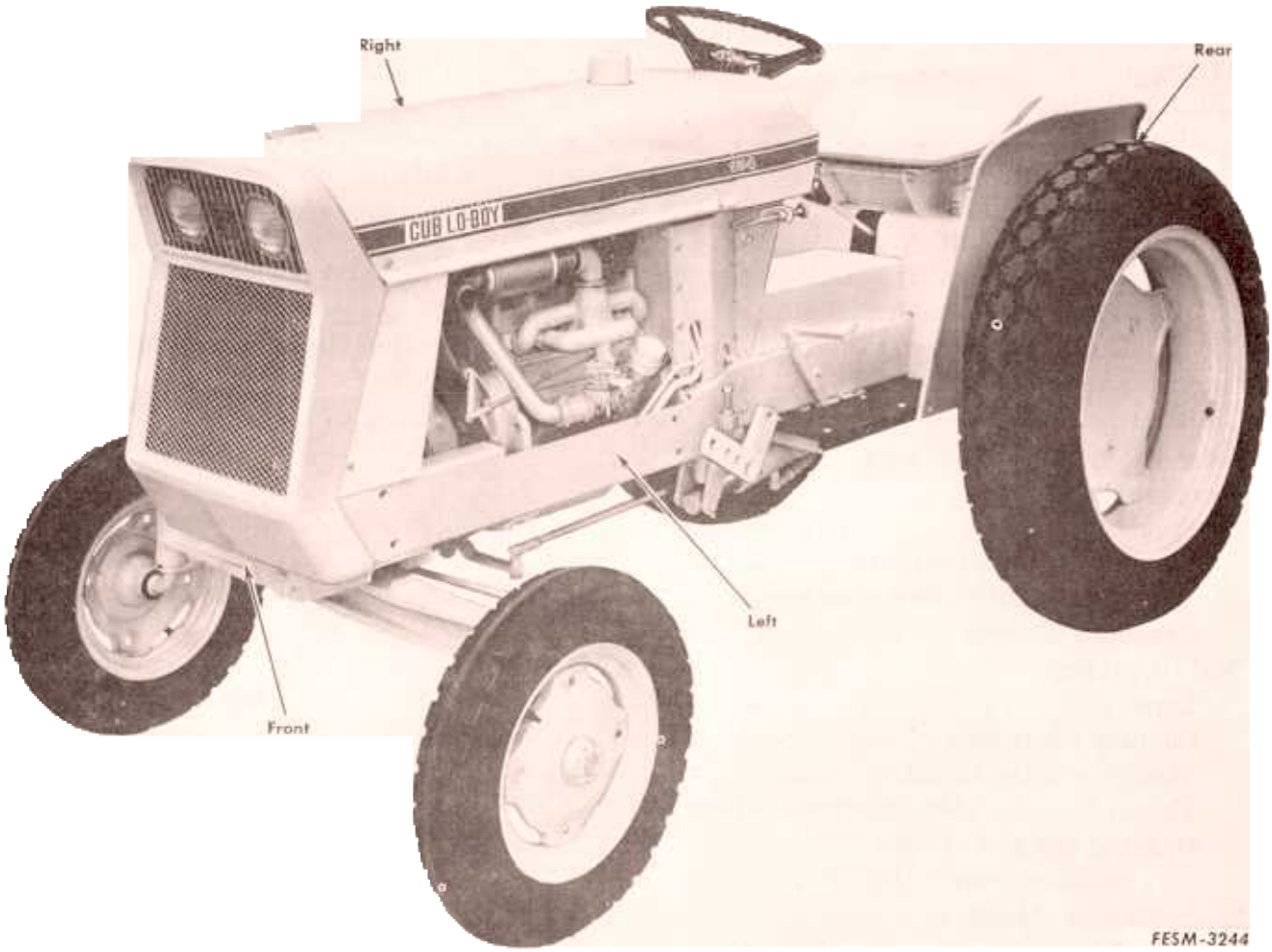
GSS-1408 W/Revision 4
September, 1978

INTERNATIONAL HARVESTER
NORTH AMERICA OPERATIONS
AGRICULTURAL EQUIPMENT GROUP
401 NORTH MICHIGAN AVENUE • CHICAGO, ILLINOIS, 60611, U.S.A.

Section 1

ENGINE

Contents


Right
Rear
CUB LO-BOY
Left
Front
FESM-3244

Specifications

General

Model	C-60	
Number of cylinders	4	
Bore and stroke - inches	2-5/8 x 2-3/4	
Displacement - cubic inches	59.5	
Engine rpm (governed)	154	184 & 185
Low idle ± 25	475	600
High idle ± 25	2420	2510
Rated load ± 10	2200	2300
Compression ratio	7.5:1	
Compression pressure at cranking speed - psi	130	
Firing order	1-3-4-2	
Ignition timing		
High idle	16° BTDC	
400 rpm	TDC	
Distributor point gap - inch	.020	
Spark plug gap - inch	.023	

NOTE: Proper ignition timing at high idle is essential for best performance and engine life. Therefore, the distributor should be set to give the exact timing at high idle. Any variance that may exist then will occur at the low idle end of the advance curve.

Crankcase

Cylinder bore - inches	2.625 - 2.627

Crankshaft and Main Bearings

Crankshaft	
Type	Counter balanced
Number of main journals	3
Main journal diameter - inches	1.623 - 1.624
Crankpin diameter - inches	1.498 - 1.499
Main Bearings	
Type	Tri-metal, precision
Running clearance - inch	.002 - .003
Thrust bearing location	Center
Thrust bearing side clearance - inch	.004 - .008
Bearing OD and spread	
Front and rear - inches	1.777 + .020
Center - inches	1.777 +.002 to .015
Camshaft	
Drive	Helical gear
Cam lobe lift (total) - inch	.232 ± .002
Journal diameter	
Front - inches	1.871 - 1.872
Center - inches	1.746 - 1.747
Rear - inch	.872 - .873
Crankcase bearing bore diameters	
Front - inches	1.8740 - 1.8755
Center - inches	1.7490 - 1.7505
Rear - inch	.8740 - .8755

Camshaft - Continued

Thrust taken by	Thrust plate
Number of bearings	3 (bored in crankcase)
Bearing running clearance	
Front and center - inch	.002 - .0045
Rear - inch	.001 - .0035
End clearance - inch	.003 - .012

Connecting Rods

Type	I-Beam
Side clearance - inch	.005 - .012
Bearing running clearance - inch	.002 - .003
Bearing type	
Upper end	Bronze bushing
Lower end	Tri-metal, precision
Bearing OD and spread - inches	1.625 + .025
Piston pin bushing ID - inch (installed)	.6879 - .6882

Pistons

Type	Cam ground
Material	Aluminum alloy
Overall length - inches	2.875
Diameter - inches	2.6230 - 2.6234
*Skirt clearance, bottom - inch	.0016 - .0024 (measured at 90° from pin hole)
Number of rings per piston	3
Piston pin hole bore - inch	.6877 - .6880
Width of ring groove - inch	
Top compression	.0955 - .0965
Second compression	.0955 - .0965
Oil control	.1880 - .1890
Ring clearance in groove - inch	
Top compression	.0020 - .0035
Second compression	.0020 - .0040
Oil control	.0015 - .0030

Piston Pins

Type	Full floating
Diameter - inch	.6875 - .6876
Length - inches	2.185 - 2.195
Clearance between end of pin and retainer ring - inch	.010 - .030
Clearance in rod bushing - inch	.0003 - .0007
Clearance in piston - inch	.0001 - .0005

*See "Piston Fit in Bore", page 1-31.

Piston Rings	
Compression	
Number per piston	2
Type	
Top	Chrome
Second	Plain
Width of ring	
Top - inch	.0930 - .0935
Second - inch	.0925 - .0935
End gap	
Top - inch	.007 - .017
Second - inch	.007 - .017
Oil Control	
Type	Chrome, wide slot
Number per piston	1
Width - inch	.1860 - .1865
End gap - inch	.007 - .020
Valves	
Head diameter	
Intake - inches	1.089 - 1.099
Exhaust - inch	.901 - .911
Face angle - degrees	45-1/2
Stem diameter	
Intake - inch	.3095 - .3105
Exhaust - inch	.3095 - .3105
Clearance in guide	
Intake - inch	.001 - .003
Exhaust - inch	.0015 - .0035
Valve Seats	
Seat angle - degrees	45
Seat width	
Intake - inch	3/64
Exhaust - inch	3/64
Valve Guides	
Length - inches	1.34
Inside diameter	
Intake - inch	.3115 - .3125
Exhaust - inch	.3120 - .3130
Installed height below crankcase surface - inches	1-3/32
Valve Springs	
Free length	
Intake - inches	1-31/32
Exhaust - inches	1-7/16
Test length	
Intake - inches	1-1/4
Exhaust - inches	1-3/16
Test load	
Intake - pounds	23
Exhaust - pounds	14 - 16

Valve Tappets

Diameter - inch	.591 - .592
Length - inches	2.370 - 2.380
Clearance in crankcase - inch	.0007 - .0032
Valve lash (engine cold) - inch	.015

Valve Timing

Intake opens - degrees	10 before TDC
Intake closes - degrees	45 after BDC
Exhaust opens - degrees	45 before BDC
Exhaust closes - degrees	5 after TDC

Cylinder Head

Bolt diameter - inch	3/8
Torque - ft. lbs.	45

Timing Gears

Crankshaft pinion	18 teeth
Camshaft gear	36 teeth
Idler gear	36 teeth
Governor-ignition gear	18 teeth
Type of teeth	Helical
Backlash - inch	.003 - .006
Idler shaft retainer bolt tension	90 ft. lbs.

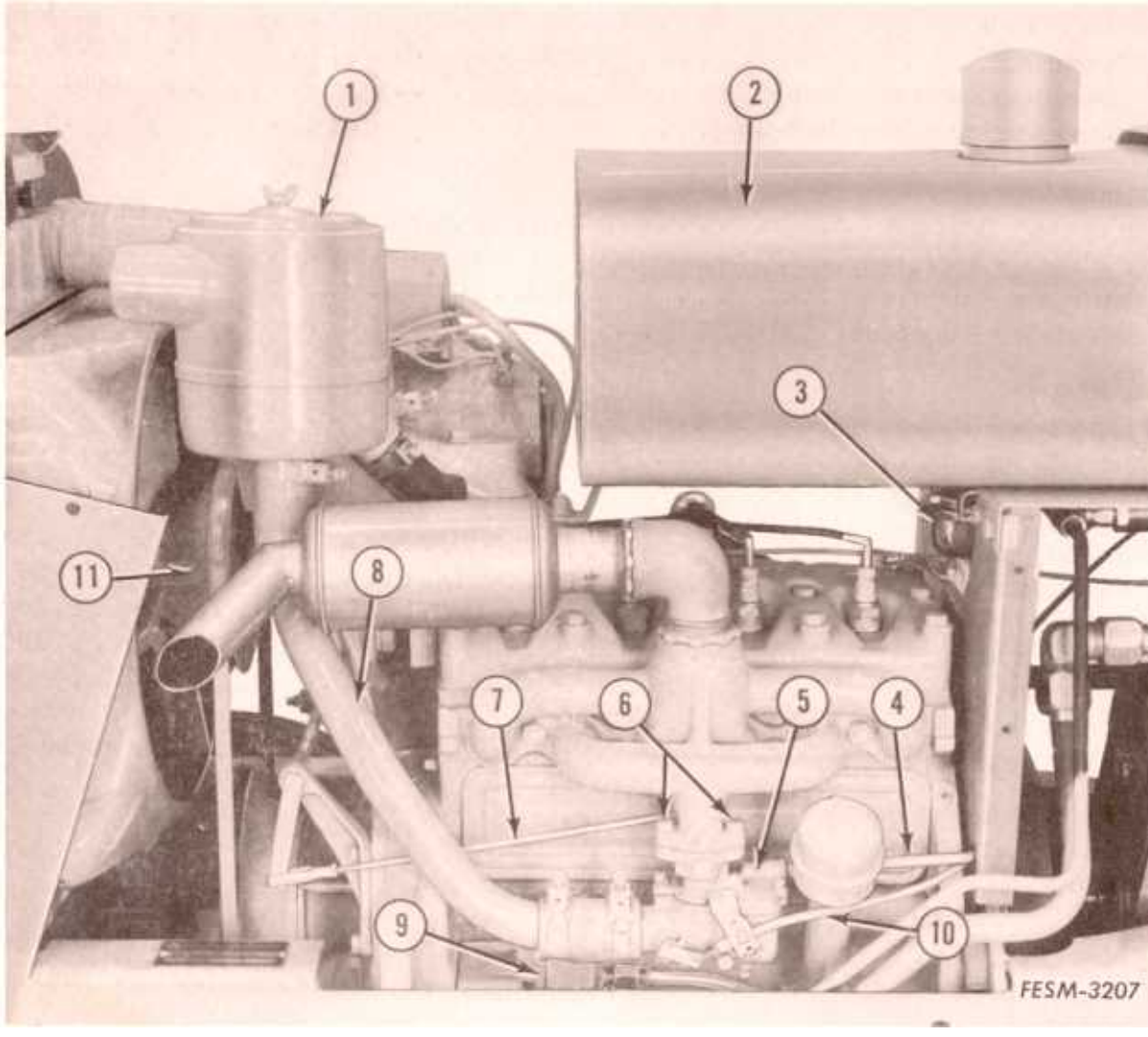
Lubrication System

Oil pressure at 2200 rpm - psi	30
Oil pump	
Type	Gear
Drive	Direct from camshaft
Gear backlash - inch	.003 - .006
Number of teeth	
Idler gear	13
Drive gear	13
Oil pressure valve regulating spring	
Free length - inches	2-31/32
Test length - inches	2-15/32
Test load - pounds	9-1/2
Pressure regulating valve	
Valve diameter - inch	.6205 - .6215
Location	In crankcase

Special Torques (foot pounds)

Cylinder head	45
Main bearing	55
Connecting rod	16
Flywheel	45
Idler gear retainer bolt	90
Manifold	20
Crankshaft pulley	80
Spark plugs	30

ENGINE REMOVAL



1. Air cleaner
2. Fuel tank
3. Fuel strainer
4. Fuel line
5. Carburetor
6. Capscrews
7. Governor-to-carburetor connecting rod
8. Air cleaner pipe
9. Hydraulic oil pump
10. Choke cable
11. Cooling fan assembly

1. Disconnect the battery ground cable at the battery.

2. Drain the crankcase oil and remove the drain plug in the water inlet elbow and drain the coolant.

3. Remove the hood and side sheet sections.

4. Shut off the fuel at the fuel strainer (3) and disconnect the fuel line (4) from the fuel strainer and the carburetor (5).

5. Remove the fuel tank (2).

6. Disconnect the choke cable (10) from the carburetor.

7. Remove the air cleaner (1) and air cleaner pipe (8).

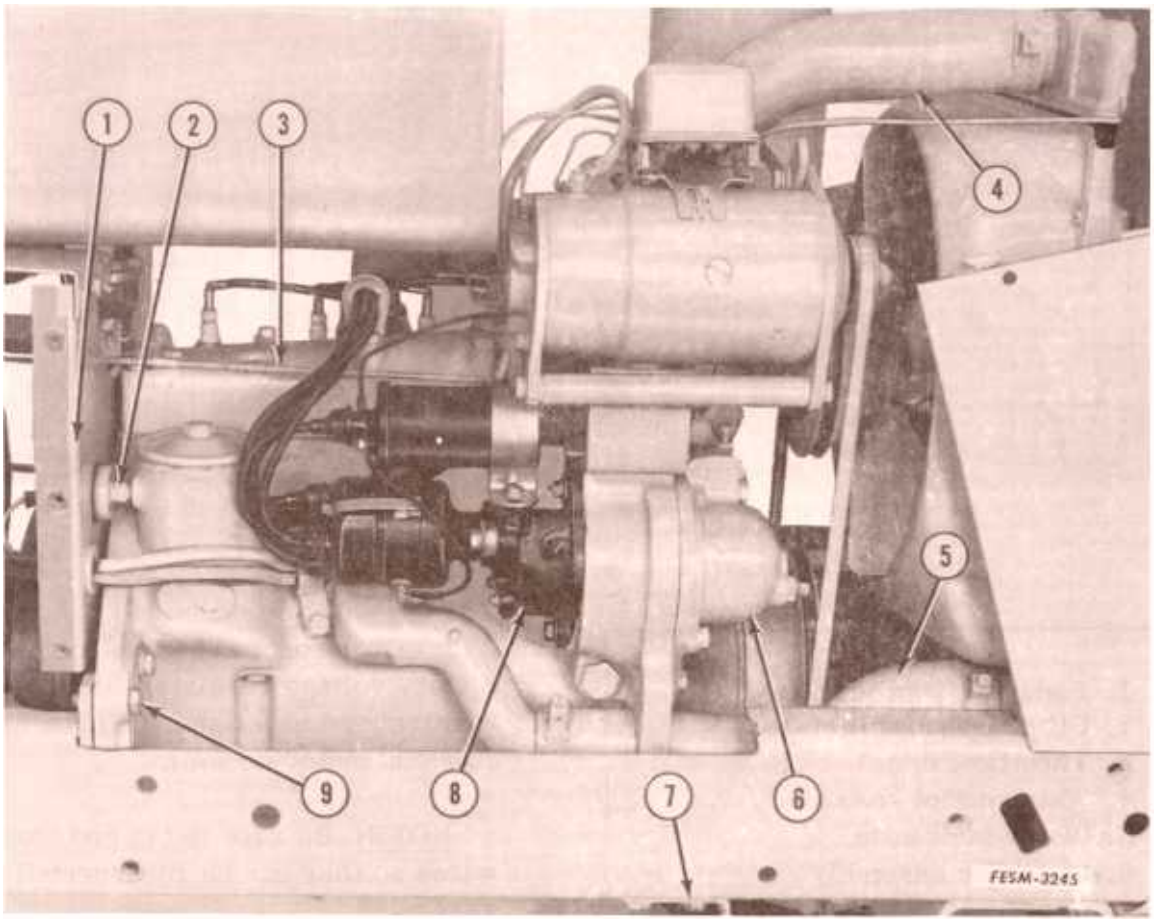
8. Disconnect the oil lines to the hydraulic pump (9) if so equipped.

NOTE: Be sure to plug all openings in tubes and parts to prevent dirt from entering the system.

9. Disconnect and remove the radiator hoses (4 and 5).

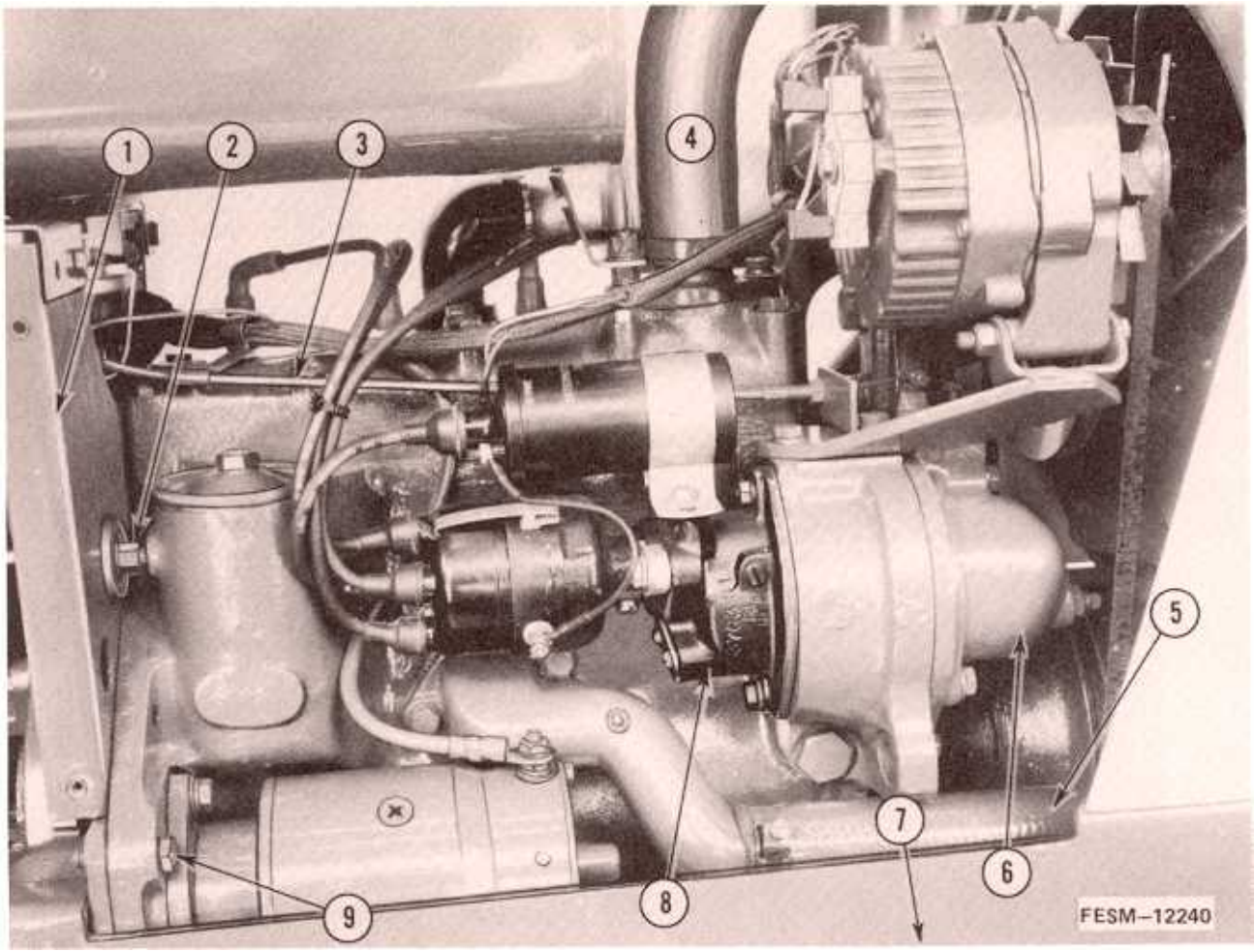
10. Remove the cooling fan assembly and lay in shroud.

11. Disconnect the throttle cable (3) from the governor (6).



154 & 185 Tractors

1. Pedestal front sheet
2. Oil pressure switch
3. Throttle cable
4. Water outlet hose
5. Water inlet hose
6. Governor assembly
7. Capscrew (one on each side)
8. Ignition unit
9. Capscrew (two on each side)



184 Tractor

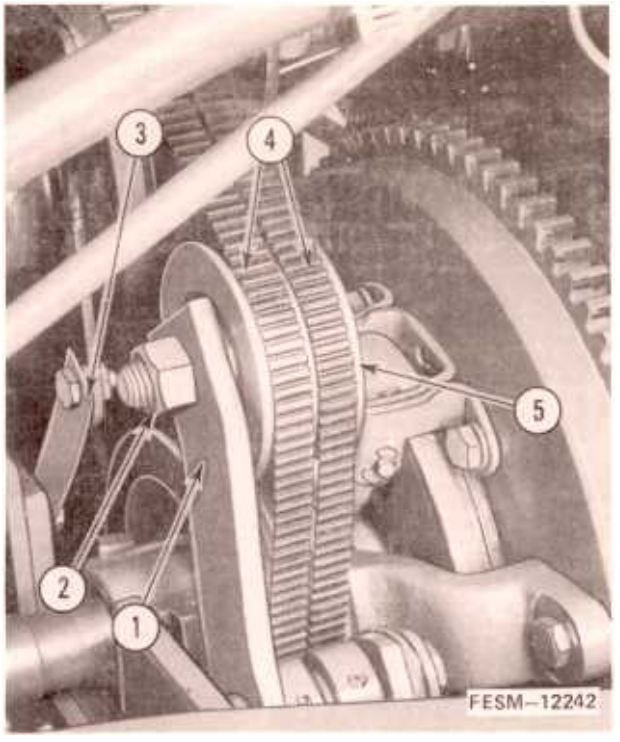
1. Pedestal front sheet
2. Oil pressure switch
3. Throttle cable
4. Water outlet hose
5. Water inlet hose
6. Governor assembly
7. Capscrew (not shown)
8. Ignition unit
9. Capscrew (two on each side)

12. Disconnect the wires to the generator, voltage regulator, coil positive terminal and headlights (alternator and cranking motor on 184).

NOTE: Be sure to tag and identify all wires so they can be reconnected correctly.

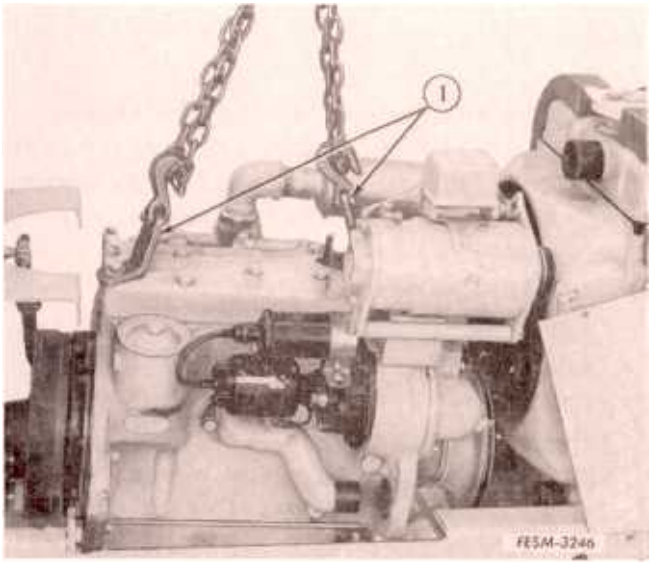
13. Disconnect the oil pressure switch assembly (2).

14. Remove the capscrews securing the pedestal front sheet (1) to the engine and remove the front sheet.



15. Relieve the IPTO clutch belt tension by pushing in on the idler tension arm nut with a 3/4 inch wrench and then remove the drive belts from the tension arm pulley.

1. Idler tension arm
2. Idler tension arm nut
3. Anchor strap
4. Clutch belts
5. Idler tension pulley



1. Attaching brackets FES 100

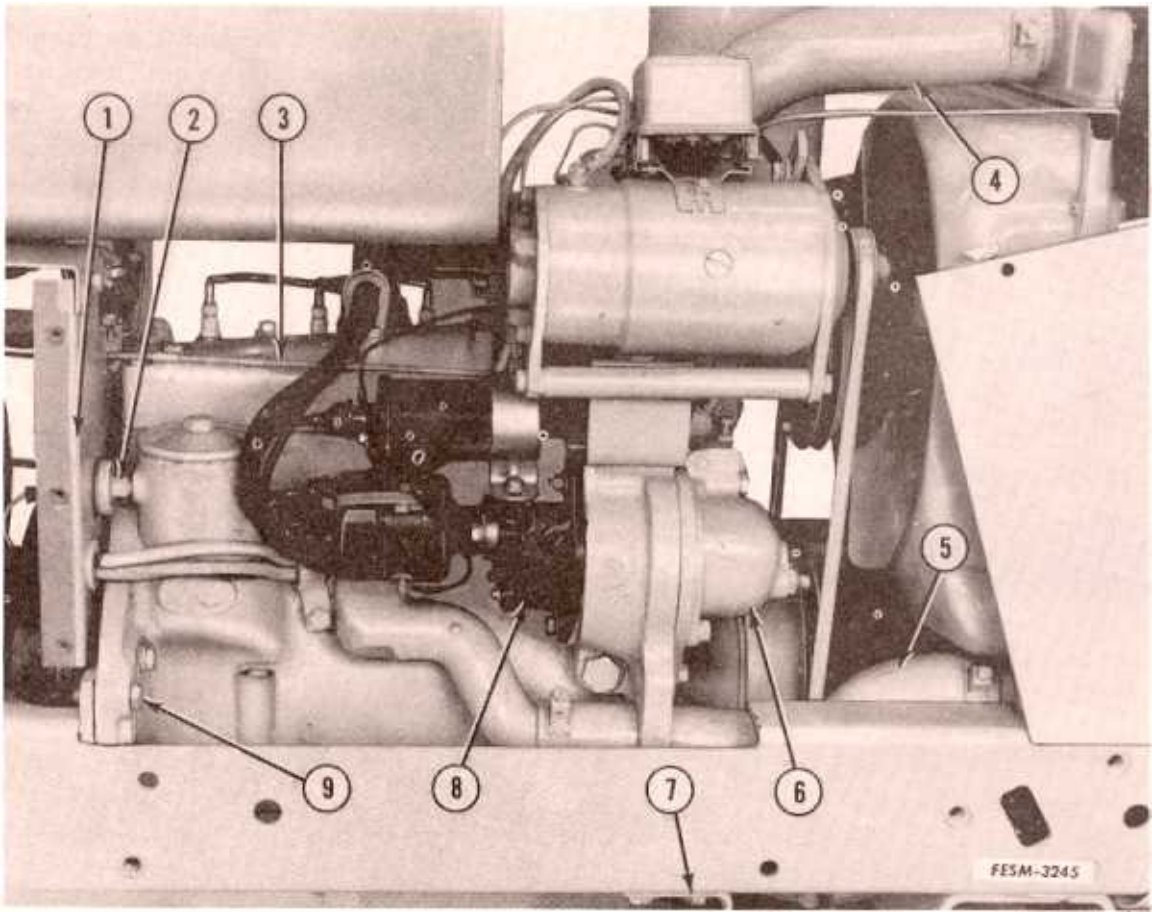
16. Remove the frame top cover. Move the snap ring forward from the groove on the drive shaft. Slide the drive shaft back until it clears the flywheel retainer.

17. Remove the capscrews securing the clutch coupling hub to the flywheel.

18. Remove the six capscrews, two in front (7) and four in back (9), securing the engine to the frame.

19. Using attaching brackets FES 100 (1), attach a chain hoist to the engine and lift it out of the tractor.

ENGINE INSTALLATION



154 & 185 Tractors

1. Pedestal front sheet
2. Oil pressure switch
3. Throttle cable
4. Water outlet hose
5. Water inlet hose
6. Governor assembly
7. Capscrew (one on each side)
8. Ignition unit
9. Capscrew (two on each side)

1. Using a chain hoist and attaching brackets FES 100, install the engine in the tractor. Install the six capscrews securing the engine to the frame and tighten securely.

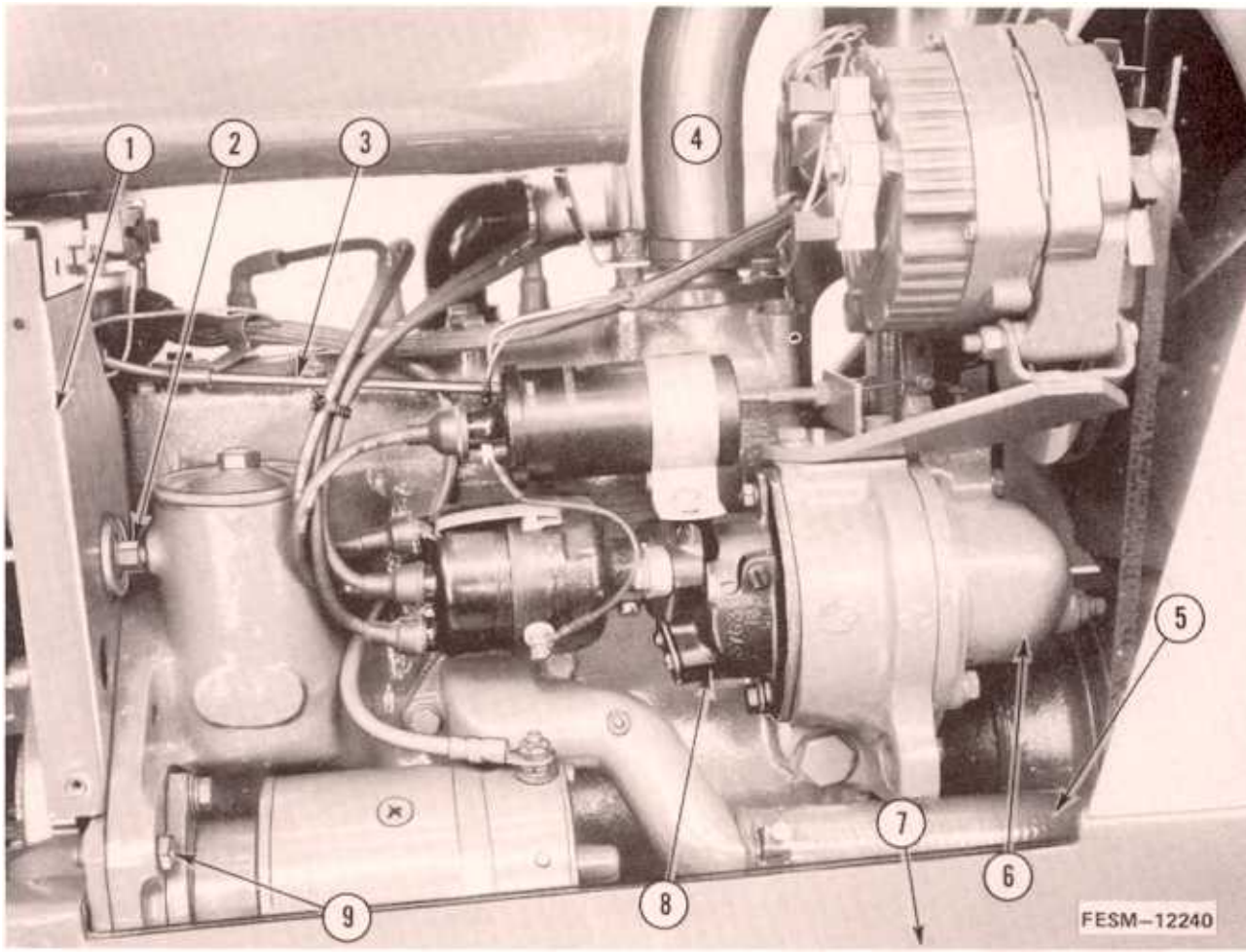
2. Install the capscrews securing the clutch coupling hub to the flywheel. Slide shaft forward into flywheel retainer to pilot coupling and tighten securely. Position shaft in operating position and install belts.

3. Install the pedestal front sheet (1) and secure with the capscrews.

4. Connect the oil pressure switch assembly (2).

5. Connect the wires to the generator, voltage regulator, coil positive terminal and head lights (alternator and cranking motor on 184).

6. Connect the throttle cable (3) to the governor (6).



184 Tractor

1. Pedestal front sheet
2. Oil pressure switch
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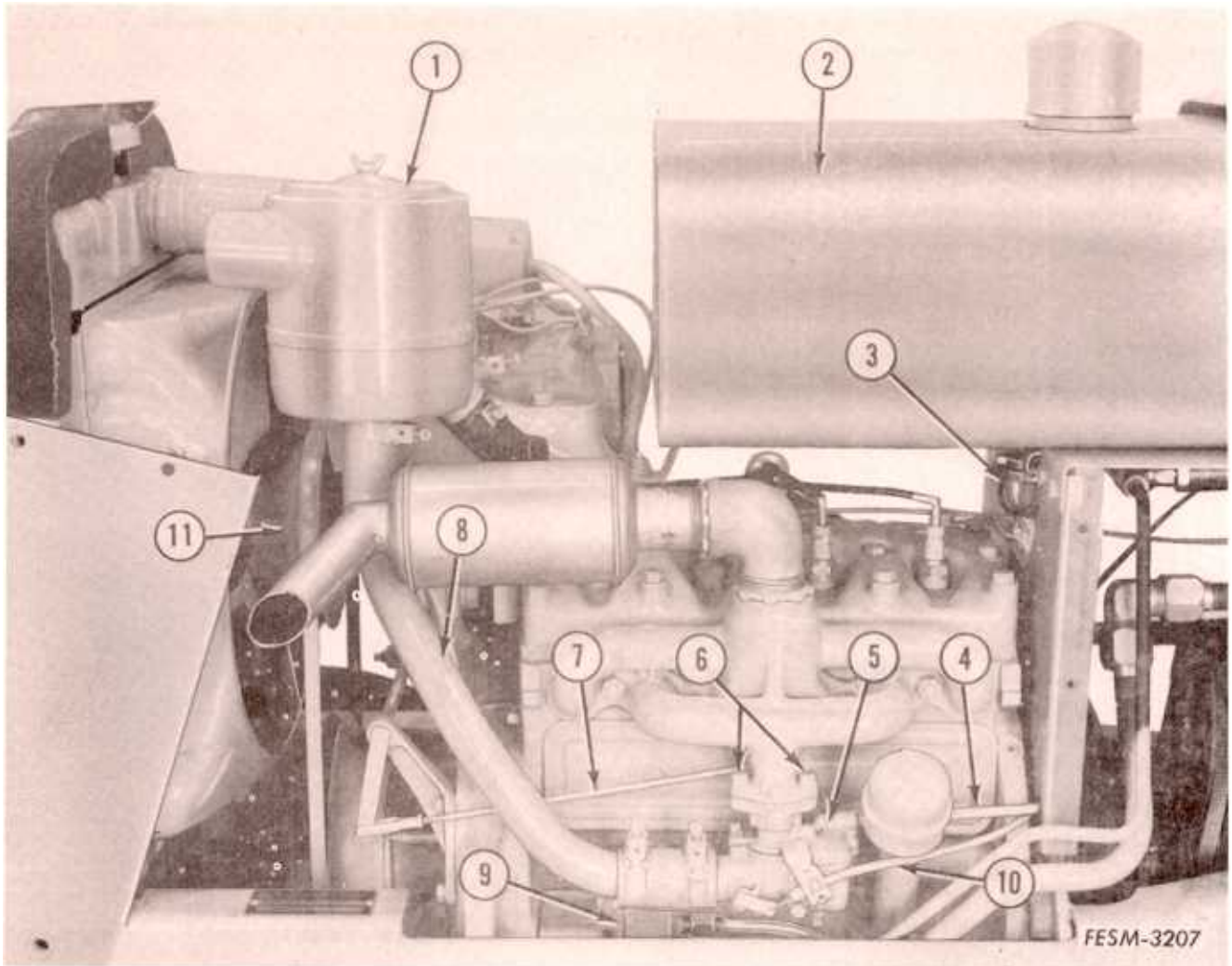
4. Water outlet hose
5. Water inlet hose
6. Governor assembly
7. Capscrew (not shown)
8. Ignition unit
9. Capscrew (two on each side)



1. Air cleaner
2. Fuel tank
3. Fuel strainer
4. Fuel line
5. Carburetor
6. Capscrews
7. Governor-to-carburetor connecting rod
8. Air cleaner pipe
9. Hydraulic oil pump
10. Choke cable
11. Cooling fan assembly

7. Install the cooling fan assembly (11). Be sure the fan blades clear the radiator shroud. If clearance is not sufficient, reposition fan shroud.

8. Connect the radiator hoses.

9. Install the air cleaner (1) and air cleaner pipe (8). Be sure air cleaner pipe connections are good to prevent dirt from entering the engine.

10. Connect the oil lines to the hydraulic pump (9), (if equipped).

11. Connect the choke cable (10) to the carburetor (5).

12. Install the fuel tank (2) and connect the fuel line (4) to the carburetor and the fuel strainer (3).

13. Install the frame top cover, side sheets and hood.

14. Fill the crankcase with oil and the radiator with coolant. Refer to the Operator's Manual.

15. Connect the battery ground cable.

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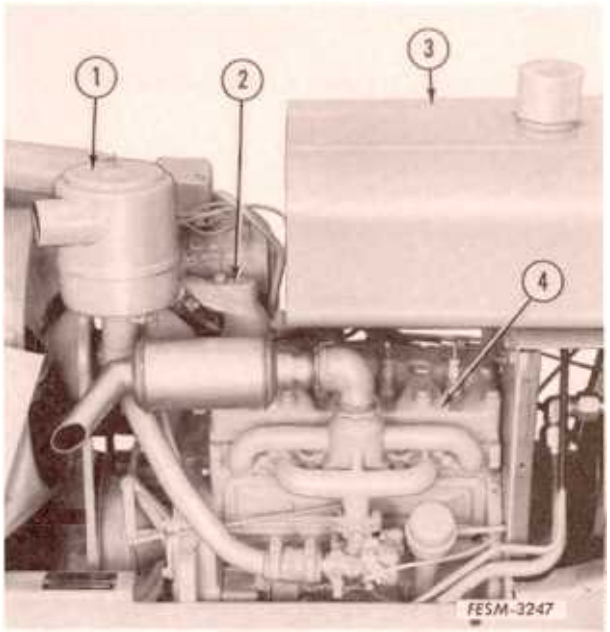
CYLINDER HEAD

Removal



1. Remove the pipe plug in the water inlet elbow and drain the coolant.

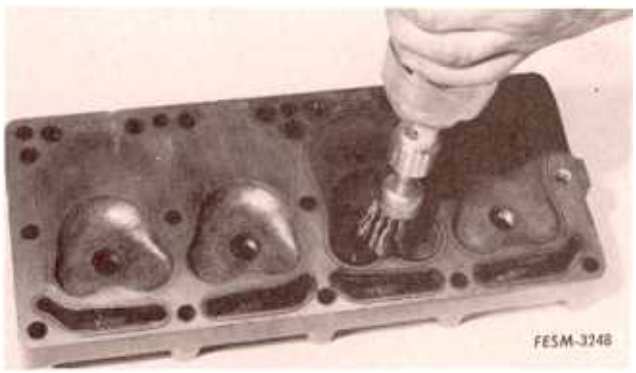
2. Remove the hood, fuel tank (3), air cleaner (1) and water outlet elbow (2).

3. Remove the spark plugs.

4. Remove the cylinder head cap-screws and lift off the cylinder head and gasket.

1. Air cleaner
2. Water outlet elbow
3. Fuel tank
4. Cylinder head

Inspection And Repair



1. Check the head and gasket for "blow-by" or compression leaks.

2. Remove carbon from combustion chamber cavities with a wire brush.

3. Clean cylinder head combustion cavities with cleaning solution.

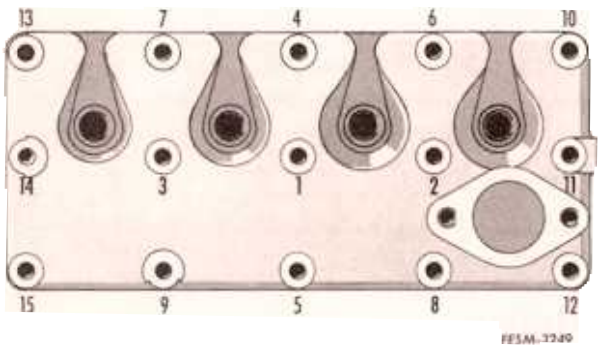
4. Carefully inspect head for cracks.

5. Use a straight edge and inspect for warped head, particularly in any area which shows "blow-by."

6. Inspect water jacket in head for an accumulation of rust or lime deposit which would affect circulation of cooling water and cause hot spots. Clean if necessary

7. Thoroughly clean the gasket surface to insure proper sealing of the new gasket.

8. Be sure to use a new gasket.



Installation

1. Using a new gasket, install the cylinder head on the engine.

2. Install the cylinder head cap screws. Using the sequence shown, tighten evenly in steps to 45 ft. lbs. torque. Be sure to install all brackets and mounting clips under the cap screw heads before tightening.

3. Install the spark plugs and tighten to 30 ft. lbs. torque.

4. Install the water outlet elbow, air cleaner, muffler, fuel tank and hood.

5. Refill the radiator with coolant.

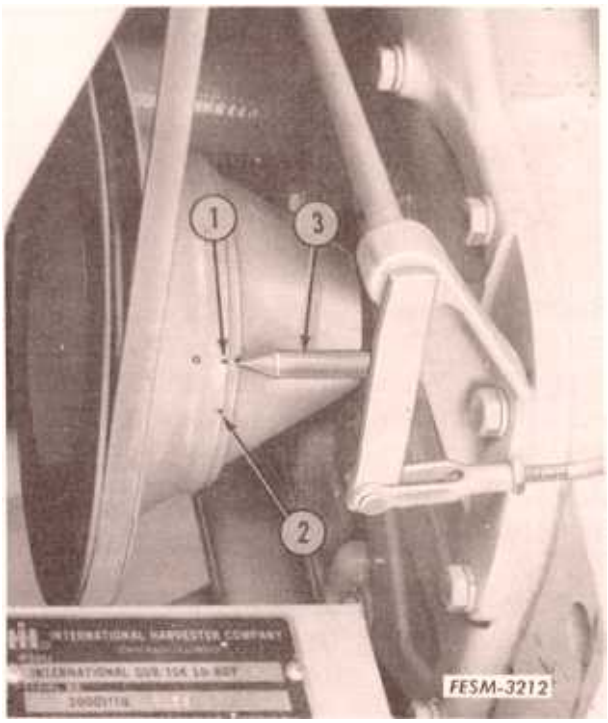
Valves

Valve Lash Adjusting Procedure

Following the simplified procedure in the chart below, all valves can be adjusted accurately. Note that the engine does not need to be cranked four times to position the piston of each cylinder on T.D.C. All valves are adjusted by cranking the engine only twice.

Four valves are adjusted when the No. 1 piston is at T.D.C. (compression) and the remaining four are adjusted when the No. 4 piston is at T.D.C. (compression).

WITH	ADJUST VALVES (Engine Cold)							
No. 1 Piston at T.D.C. (Compression)	1	2	3		5			
No. 4 Piston at T.D.C. (Compression)				4		6	7	8



1. O mark
2. 16° mark
3. Timing pointer

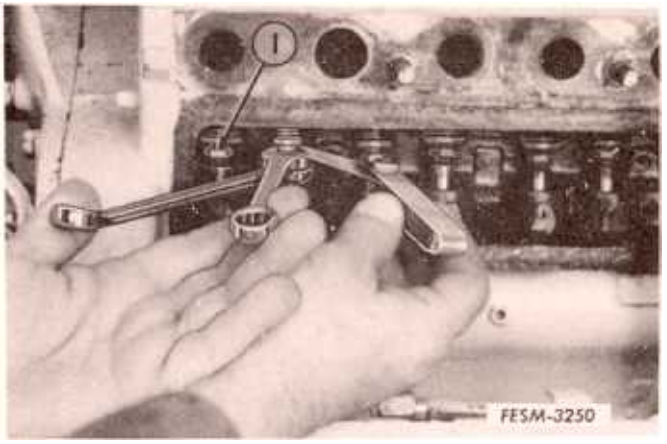
1. Remove the intake and exhaust manifold assembly. Remove the valve tappet cover. With the cover removed, inspect the entire valve assembly for rust and dirt. Clean the assembly with cleaning solvent. Inspect for looseness in the valve assembly and for worn or broken valve springs.

2. Remove the spark plugs from No. 1 cylinder (nearest the radiator) and No. 4 cylinder.

3. Place a thumb over the No. 1 spark plug opening and slowly hand crank the engine until an outward pressure can be felt. Pressure indicates the piston is moving toward top-dead-center of the compression stroke.

4. Continue cranking slowly until the O mark (1) on the fan drive pulley is in line with the timing pointer (3) on the crankcase front cover.

NOTE: Valve tappets have self-locking tappet screws. Adjustment requires two wrenches, one to hold the tappet and one to turn the tappet screw.



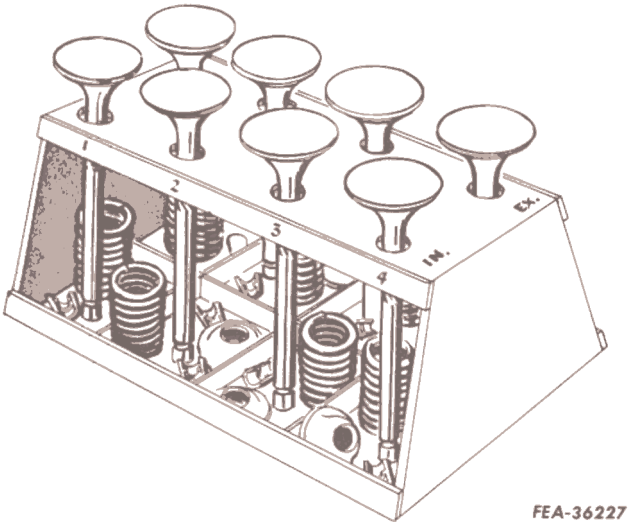
1. No. 1 valve

5. Insert the feeler gauge between the valve tappet and the valve stem. The specified clearance is .015 inch (engine cold). Turn the adjusting screw in or out as necessary to give a slight drag on the feeler gauge. Adjust the four valves specified in the chart on page 1-15.

6. Crank the engine until the No. 4 piston is on T.D.C. (compression) and the O mark (1) on the fan drive pulley is in line with the timing pointer (3). (Refer to illustration on page 1-15.) Adjust the remaining four valves.

7. Install the valve cover being sure to use a new gasket. Check for any oil leaks.

8. Install the intake and exhaust manifold assembly.



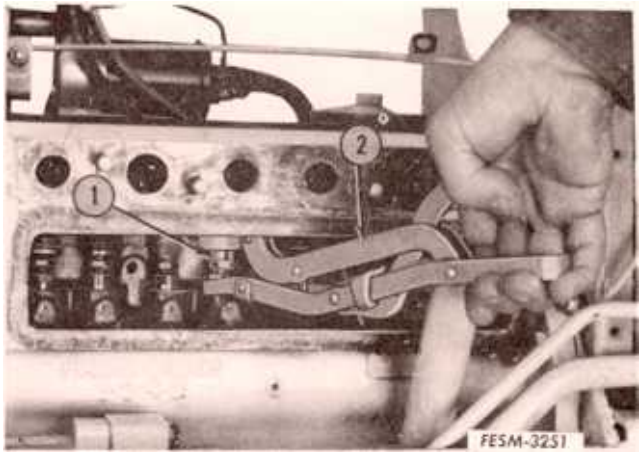
Removing Valves

NOTE: When valve assemblies are removed, all parts should be kept in order. They may then be reinstalled in the same ports, from which removed, if they are to be used for further service.

1. Drain the cooling system and remove the cylinder head. Refer to page 1-13.

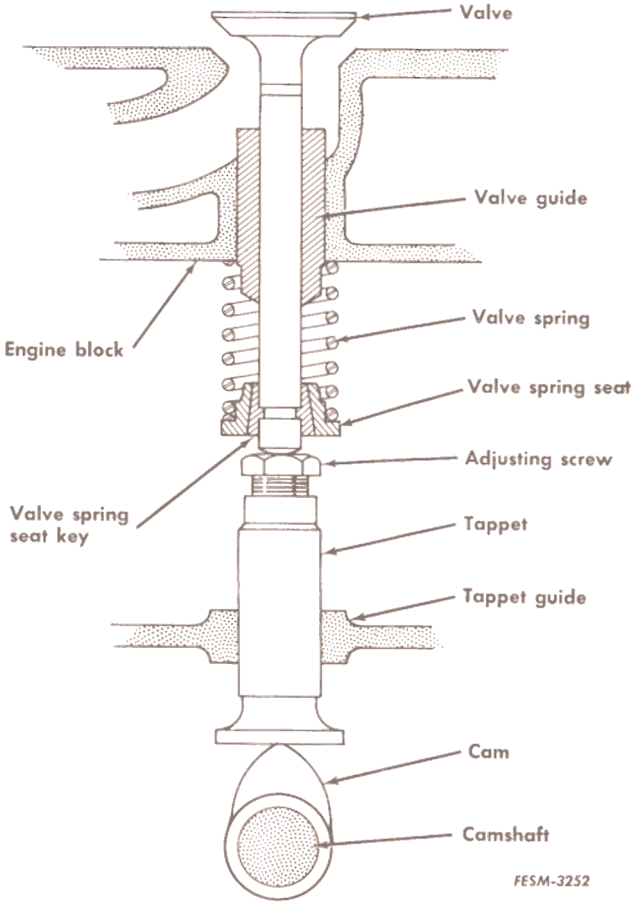
2. Remove the intake and exhaust manifold assembly.

3. Remove the valve tappet cover, and turn down the tappet screws several turns so the springs may be removed easily and to prevent interference with valve stems after seats and faces are reground.



4. Compress the valve springs with a suitable tool and remove the valve spring seat keys (1). Be careful not to compress the springs more than necessary as they can be distorted.

1. Valve seat key
2. Valve spring compressor



5. Remove the valves, valve spring seats and valve springs. Be sure to keep valves in order so they may be installed in the same port.

NOTE: To remove the tappets the camshaft must be removed.

Inspection

General

Carbon deposits on the valves and valve seats are normal and cannot be avoided completely. However, such deposits are detrimental to engine efficiency and valve assembly life as the amount of carbon in the engine increases.

The rotating mechanism used on the exhaust valves greatly extends the service life of the valves.

Valves and valve seats should be examined for pitting, burning, warping and other defects.

The formation of carbon cannot be avoided. However, it can be held to a minimum by the use of only good grade fuels and accurate engine timing.

Warpage, burning and pitting of valves is mainly directed against the exhaust valves which are exposed to the high temperature flow of exhaust gases. Such defects are generally caused by valves failing to seat tightly and evenly, permitting exhaust blow-by. This, in turn, can generally be traced to hard particles of carbon being present on the slopes of the valve seats. It may, however, be due to weak springs, insufficient valve clearance, or warpage and misalignment of the valve stem or guide.

Warpage, chiefly occurs on the valve stem due to its exposure to heat. Out-of-round wear occurs when the seat has been pounded by a valve head which is not in line with its stem or guide.

Misalignment is a result of wear, warpage, and distortion. Wear, when accentuated by insufficient lubrication, will eventually create sloppy clearances with resultant misalignment.

Warpage of the valves, and in known extreme instances, that of the crankcase, can result from the engine overheating due to a blocked, dirty or insufficiently filled cooling system.

Most frequently, however, warpage of a valve stem or a guide is due to uneven temperatures being applied along its length. The lower part of the guide and stem is near the combustion heat, and the upper portions are closer to cylinder head water passages. Valve materials are carefully chosen to withstand such varying temperatures. However, an engine that is allowed to operate continually in an overheated condition is definitely open to valve stem and guide distortion and warpage. Distortion can also be caused by failure to tighten cylinder head bolts to the specified foot-pounds torque and in the sequence recommended. Valve clearances are also affected in this manner. Thus any abnormal wear, warpage or distortion affecting a valve guide will destroy its function as an accurate bearing to maintain the valve head concentric with its seat, and will prevent leak-proof seating.

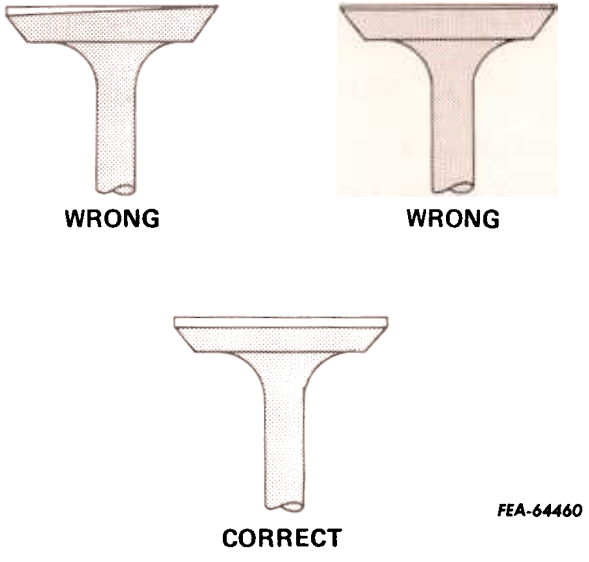
Oil and air sucked past worn intake valve stems and guides into the combustion chamber, cause excessive oil consumption, form excessive carbon, and dilute fuel.

Examine the engine for signs which may indicate the reason for the need of valve reconditioning. Dry and rusted valve springs are an indication that the oil passages to the valve levers may be blocked, causing wear on the valves and guides, and resulting in improper valve action. A defective gasket under the valve cover will permit the entrance of dirt which will cause undue wear on the valve stems and guides and damage to the valve springs.

Valves

1. Remove all carbon from the valve head and stem. Valve stems should be lightly polished with an extremely fine abrasive cloth sufficiently to remove the carbon deposits only. Because of the nature of the valve deposits, solvent cleaning ordinarily will not remove all the deposits from the valves. Wire brushes will do this job satisfactorily, but only brass wire brushes should be used since steel brushes may scratch the surface. Such scratches are likely to cause localized stresses in an operating valve and may eventually result in fatigue fractures of the valve. For similar reasons the use of coarse emery paper should be avoided.

2. Inspect each valve. See that the stem is not worn excessively and that the head is not burned or warped. Check the grooves in the stem to see that they have not lost the shoulders through wear, which prevents the valve seat retainer keys from fitting snugly.



3. All valves having bent, worn, warped or seriously pitted stems should be replaced. Replace any valve that cannot be satisfactorily refaced with a definite margin maintained. The amount of grinding necessary to true the valve face is a definite indication of the valve head warpage from the axis or centerline of its stem. With excessive warpage, a knife edge will be ground on part or all of the valve head due to the considerable amount of metal that must be removed to completely reface. Maximum heaviness in a valve head is required for strength and to provide as large an area as possible for heat dissipation. Knife edge valves lead to breakage and warpage.

4. Clean and examine all valve springs for rust, pitting, broken or set coils. Test each spring against the spring specifications (see "Specifications") using a spring load tester. Replace all springs that do not meet specifications.

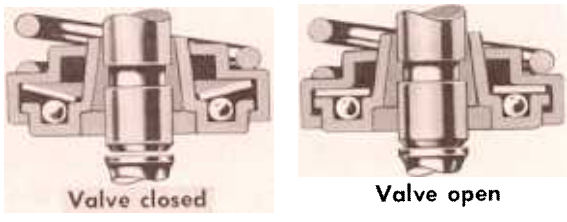
5. Clean all valve spring seats with solvent, and examine them for rust, cracks and bending characteristics. Replace parts as necessary.

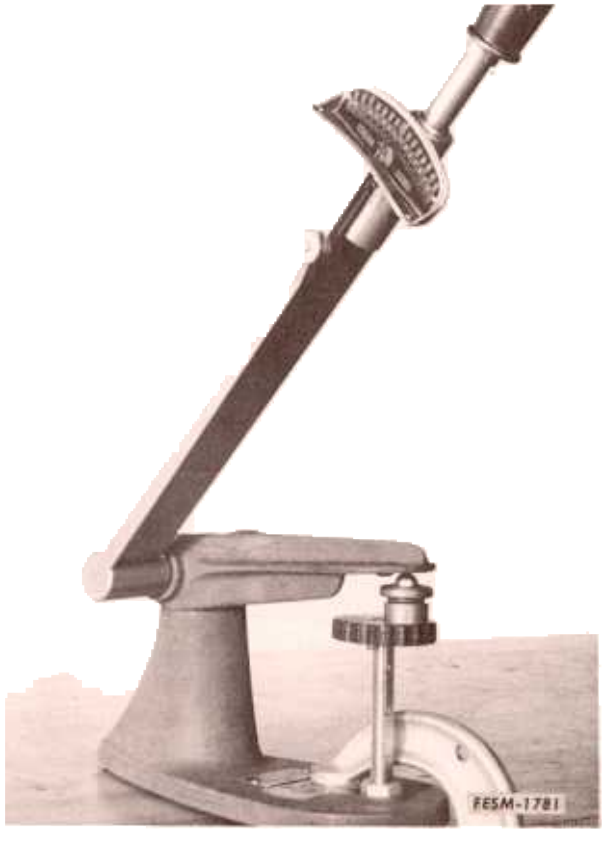
Valve Seat Retainer Keys

Clean parts thoroughly in solvent. Check the ribs in the inside of the keys to see that none are worn sufficiently to cause looseness. The keys must fit snugly into the valve stem groove. Check the keys for wear on the outside surface which might allow the valve spring retainer to slide over the key.

Valve Guides

Clean the bores of the valve guides, using a wire rifle brush and solvent. Blow out all carbon with compressed air. Position a light at the bottom of the guide bore, and examine the walls for burning, cracking and signs of excessive wear. Check the inside diameter of the guide bore at several points around its circumference and along its length. Replace any guides considered unserviceable or that appear close to a serviceable borderline.





NOTE: All valve reconditioning equipment requires the installation of a pilot in the valve guide to produce a seat concentric with the guide bore. For this reason the guides must be clean and meet the engine specifications before the valve seats can be reconditioned.

Valve Seats

Remove all carbon and any remaining gasket material from the crankcase surface. Inspect all valve seats for cracks. Remove the carbon from the valve seat recesses or counterbores.

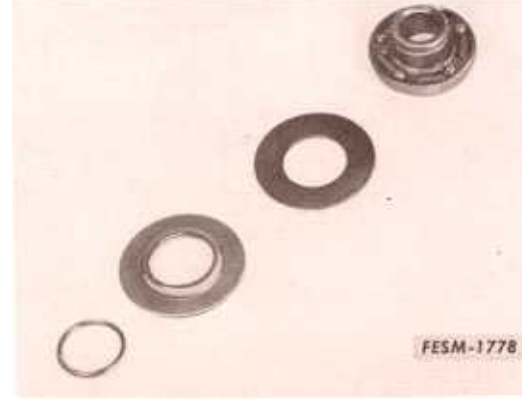
Rotocap

When the Rotocap is in operation, the valve spring is compressed (valve opened), the bellville washer is brought to bear on the steel balls. This causes the balls to roll down the ramp in the retainer thus rotating the valve.

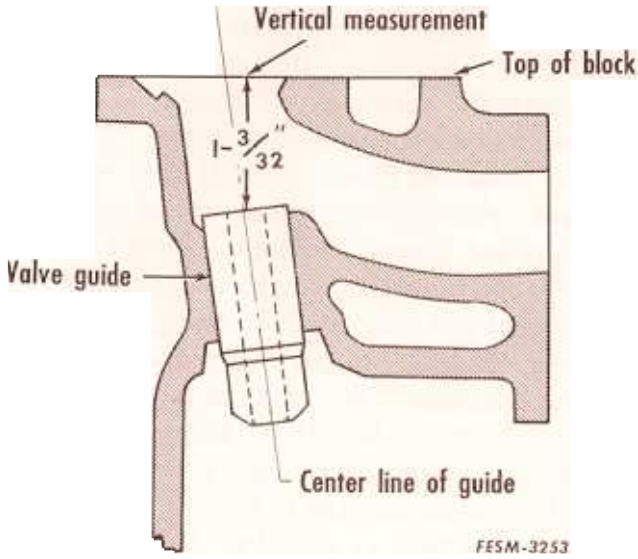
Testing Rotators

Use any valve spring tester and a steel ball placed on an inner sleeve, then rapidly oscillate the load.

You should perform this oscillation up to the test load indicated in "Specifications". Be sure the rotator is lubricated internally. The rotators should be cleaned, checked and reinstalled at each overhaul period.



Observing the operation of the valves prior to tear-down of the engine is beneficial in preventing unnecessary checking of worn rotators. Mark the valves with a pencil as movement is relatively slight.



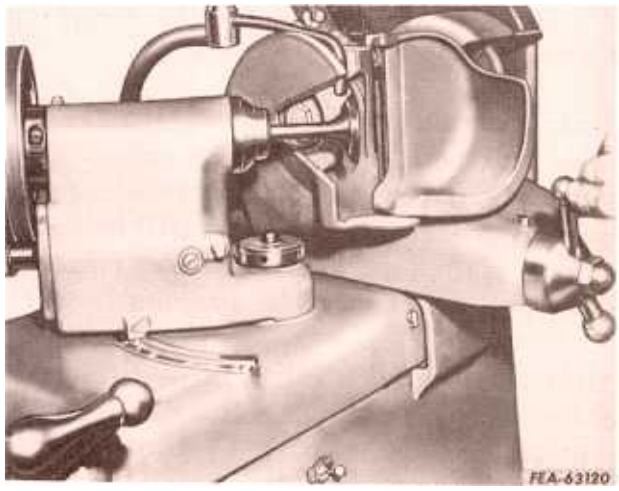
Reconditioning

Valve Guides

1. Press the guides from the crankcase.

2. Install new guides from the top of the crankcase, and press them into the crankcase bores to a measured distance of 1-3/32 inch from the top surface of the block to the top center of the guide.

3. All guides furnished as service parts are reamed to size; however, as they are a press fit, it is necessary to burnish them after installation to remove any possible burrs or slight distortion caused by the pressing operation.



Valves

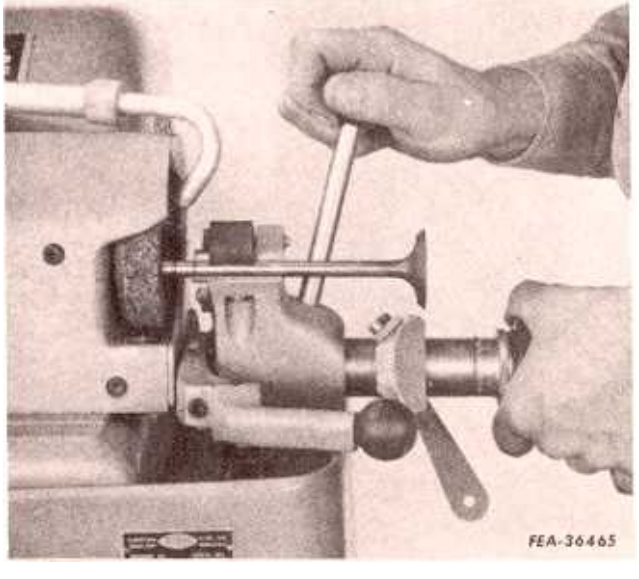
After being thoroughly cleaned and inspected, valves that are fit for continued use should be reconditioned as follows:

1. Set the valve refacing machine to grind the specified angle of 45-1/2 degrees and dress the grinding stone.

2. Insert a valve in the chuck and take a light cut across its face. This is a check to determine whether the valve can be reconditioned to service standards with a correct amount of margin maintained. Warpage that may not be apparent in the visual inspection will be clearly definable.

Avoid taking heavy grinding cuts as this heats the valve head excessively, producing an unsatisfactory valve face, and necessitates dressing the grinding wheel frequently. Repeated light grinding cuts are preferred until a true face of even width is obtained around the valve. Avoid passing the stone beyond the face of the valve as this will cause ridging and grooving of the stone surface and make dressing of the stone necessary. Reject all valves with distorted heads which produce an uneven face and valves which grind down to a thin edge.

One of the principal difficulties in reconditioning valves is to obtain nearly identical angles on the valve seat and valve face. The importance of these angles in the grinding operation cannot be overemphasized, because it is impossible to produce a flat or square seat by lapping.



The grinding stones on both the valve refacing machine and valve seat grinder should be dressed before starting a reconditioning job.

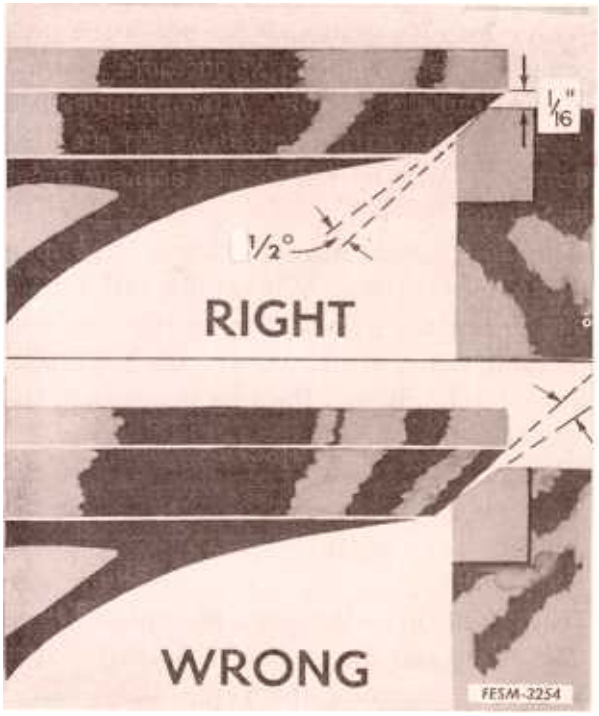
You will be unable to determine how closely the angle of the seat will match the valve face until the valve and seat have been ground and a check made with a very light tint of Prussian blue. If a full seat-width contact around the entire circle of seated valve is not shown, the angles do not match. It will then be necessary to redress the valve seat grinding stones, changing the angle sufficiently to correct the error. The correction should be made on the valve seat, and not on the valve. No more material should be removed from the valve face than is necessary to true it up and remove the burned or pitted portion. New valves should not be refaced, but should be checked for trueness. When a satisfactory match of valve seat and valve face angles has been obtained, the adjustment of both the valve refacer and the seat grinder should be locked in position, in order to eliminate this trial-by-error method on additional valves having the same angle.

At times unusually large amounts of heat scale may be found on exhaust valves, which is hard on the grinding stone. Frequent redressing of the stone will be necessary to maintain a smooth even surface and a uniform set of valve face angles.

After refacing each valve, inspect the end of the stem. If wear is noticeable, reface the end of the stem. Grind sufficiently to true-up the end of the stem.

Perhaps it has been noticed that on many International Harvester Farm Equipment engines, the valve face and seat are ground to an "interference angle". This means that the sum of the seat angle and the face angle do not equal 90 degrees.

This is done to avoid the possibility of grinding a reverse interference angle, and to help prevent the accumulation of combustion deposits on valve faces and seats. It is nearly impossible for anyone to grind perfectly matching angles.



Grinding of valves to an interference angle provides line contact of the valve face to the seat for the first few hours of operation, allowing the valve and seat to "wear in" to a good tight contact. Interference angle has the effect of increasing the pressure per square inch on the seat, thus causing any deposits which cling to the face or seat to be squeezed out of the way and eventually blown out.

Valve Seats

The primary purpose of a valve seat is to seal the combustion chamber against pressure losses and to provide a path to dissipate the heat accumulated in the valve head so as to prevent burning of the seat and warping of the valve head.

The location of the valve seat on the valve face and its width, controls the amount of valve head that protrudes into the combustion chamber. It is obvious that the greater the exposure within the combustion chamber, the higher the valve temperature; or in other words, the more heat it will collect. High valve temperature and poor heat dissipation also produce excessive valve stem temperatures. This will hasten the accumulation of carbon on the stems, causing them to stick in the guides.

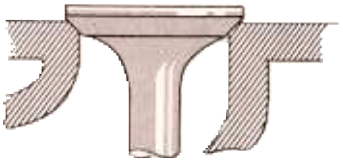
Refacing Seats

Remove all carbon, scale and oil before attempting to reface valve seats. The grinding stone, when placed against an oily seat, will become fouled, and uneven grinding will occur.

NOTE: Before installing the pilot, be certain that the valve guides are perfectly clean and meet the engine specifications. This is important; otherwise, an eccentric seat will be cut.

Dress the stone to the correct angle. Lightly lubricate and install the pilot of the correct size into the valve guide bore.

Lower the grinder head over the pilot shank until the stone just clears the valve seat. Turn on the power and very gently allow the stone to contact the valve seat. Very little pressure other than the normal weight of the stone should be used. Sudden hard pressure can cause cocking of the pilot in the guide and result in eccentric grinding. Raise the stone frequently from the valve seat to prevent overheating and to clear away grinding dust. Grind the seat sufficiently to provide an even, smooth surface.

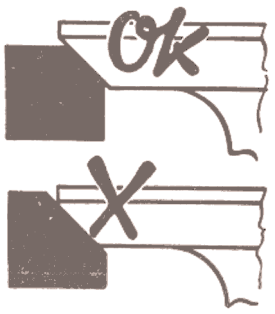


Correct Seat

Seat too wide

Seat too narrow

FESM-3255



FEA-63042

Check the seat concentricity, roundness and valve face contact using Prussian blue. Spread an extremely thin film of this blue on the valve face and insert the valve into its guide. With pressure on the exact center of the valve head, make a quarter turn rotation in the seat. Remove the valve and inspect the impression made upon the seat by the transfer of blueing, and upon the valve face by the removal of blueing. Check several times to guarantee that no error was made. If a full seat-width contact around the entire circle of seated valve is not shown, the angles do not match. It will then be necessary to re-dress the valve seat grinding stones, changing the angle sufficiently to correct the error. The correction should be made on the valve seat, and not on the valve.

The location of the area of contact between the valve and the seat is a very important factor in securing maximum valve life. Seating the valve with the sharp edge of the seat not contacting the valve face is undesirable. This sharp edge tends to break off face deposits which may lead to valve failure.

Similarly, the location of the upper line of contact well below the top of the valve face, is also undesirable because a large overhang prevents rapid cooling of the outer edge of the valve.

After grinding the seats it may be found that the seats are considerably wider than the specified width of 3/64 inch. Valve seats that are too wide may be narrowed by grinding down the top edge of the seat with a stone mounted on the grinder head. The stone must be a smaller angle than the valve seat (15^{o} preferably).

Reassembly

1. Coat the valve stems with engine oil and insert the intake and exhaust valves into their original positions.

2. Install the valve springs and valve spring seats. Compress the valve springs and install the valve seat retainer keys. Release the springs and remove the valve compressor.

3. Adjust the valve tappets. Refer to page 1-15.

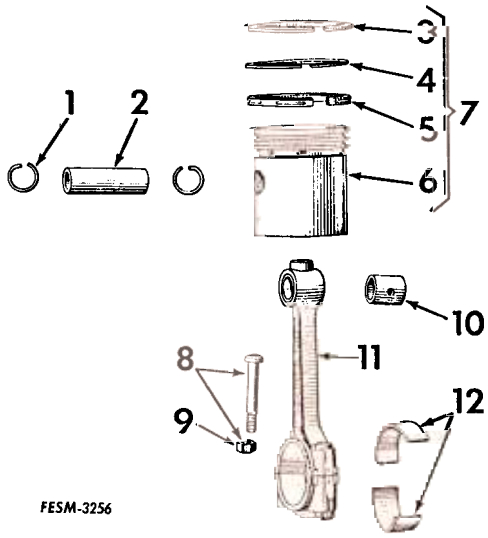
4. Install the valve tappet cover using a new gasket.

5. Install the intake and exhaust manifold assembly using a new gasket. Tighten the nuts evenly in steps to 20 ft. lbs. torque.

6. Install the cylinder head. Refer to page 1-14.

7. Refill the radiator with coolant.

Connecting Rods, Pistons and Piston Rings



1. Retainer
2. Pin
3. Compression ring
4. Compression ring
5. Oil control ring
6. Piston
7. Piston with rings
8. Bolt assembly
9. Nut
10. Bushing
11. Rod assembly
12. Bearing assembly

General

Connecting Rods

The connecting rods serve as the links between the pistons and the crankshaft. The surfaces of the rods must be kept free of scoring and dents because of the high stresses under which they function. The rod has a bushing at each end, the one at the upper end is a bushing for the piston pin which anchors it to the piston. The bearing at the crankshaft or lower end is inserted in two halves which fit around the crankshaft and are secured by a bearing cap. The bearing cap is furnished only with its connecting rod.

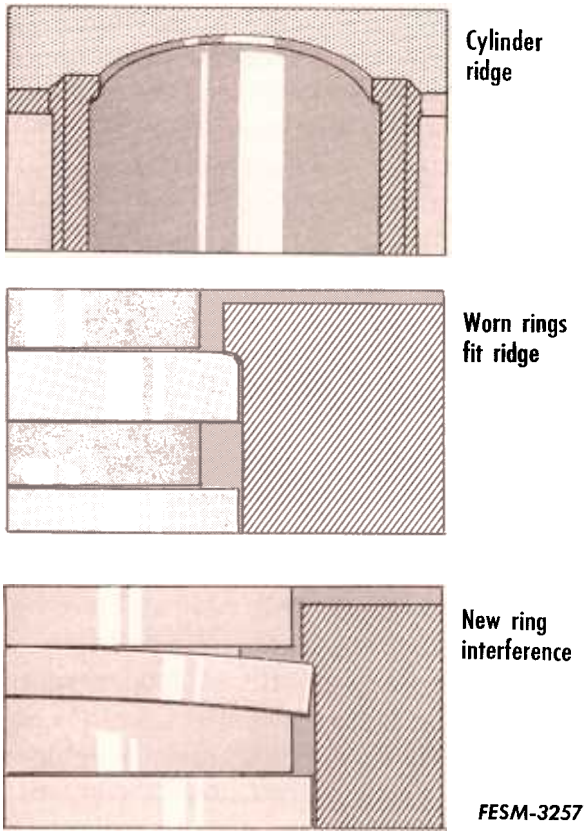
The lower bearings used in these engines are the replaceable insert type and insure correct running clearances when they are properly installed. This is possible without boring, reaming, scraping or using shims. The three important fundamentals on bearings and bearing fitting are "bearing crush," "bearing spread," and "bearing clearance." An explanation of these will be covered later.

Pistons

The piston is one of the most important units in the engine, and its condition has much to do with the performance of the engine. Its function is to receive the force of the combustion pressure and transmit it to the connecting rod and crankshaft. The escape of combustion pressure past the piston is prevented by the piston rings. The fit of the piston and rings in the sleeve must be close enough to prevent the escape of combustion gases but must be free enough to keep friction to its working minimum.

Piston Rings

The pistons are fitted with three piston rings. One oil regulating ring is fitted to each piston. The oil regulating ring provides an even circulation of lubricating oil and, therefore, an all over lubricating and cooling action for the piston and crankcase sleeve. Excess oil is wiped by the rings, back down to the crankcase. The remaining rings are compression rings. Rings should be installed on a piston so that the gaps are 90 degrees from the thrust side of the piston and 180 degrees from one gap to another.



Piston Pins

The piston pin is made of steel and is cylindrical in shape. Its purpose is to anchor the piston to the connecting rod. The pin is retained in the piston by retainer rings that lock into grooves of the piston pin bore. The pin is allowed to float in its bushing in the upper end of the rod. The aluminum of the piston is an excellent bearing material and, therefore, no bushing is provided between the pin and the piston. The bearing of the steel pin in the aluminum piston is the reason for the tight fit of the pin when the piston is cold. It is usually necessary to heat the piston in order to remove the pin.

Removal

1. Remove the cylinder head. (Refer to page 1-13.)

2. Remove the drain plug and drain the engine lubricating oil from the crankcase oil pan. Replace the drain plug.

3. Remove the cap screws securing the oil pan, and remove the oil pan and gasket.

CAUTION: Before proceeding with piston and connecting rod removal, the ridge, existing on the cylinder wall at the upper end of the ring travel, must be removed by using a ridge reamer. This prevents damage to the piston ring lands during removal of pistons, and prevents damage to new top piston rings after the installation of new rings.

4. Remove the oil pump screen and tube assembly.

5. Remove the connecting rod bearing cap nuts. Remove the bearing cap. Be sure that each bearing and cap can be identified with the connecting rod from which it was removed. Each connecting rod should be found numbered on the camshaft side of the rod, indicating its position in the engine.

6. Push the connecting rod and piston assembly to the top and lift out from the crankcase. Replace the cap on the connecting rod to avoid damage.

CAUTION: Pistons must be handled carefully to avoid damage and knocking out-of-round or alignment. When removing a piston from the crankcase, do not allow the skirt of the piston to strike the crankcase or connecting rod. Mark the pistons so they can be installed in the same position and cylinder from which they were removed. The dome of the piston is stamped with an arrow, indicating its position when properly installed.

7. Crank the engine by hand to make each rod and cap accessible and remove all pistons and connecting rods in the same manner.

Disassembly

1. Remove the piston rings with a piston ring expander. Remove the top ring first and the remaining rings in order.

2. Remove the piston pin retainer rings.

3. Remove the piston pins from the pistons. As an aid in removing the pin, heat the piston in a piston heater or dip the piston in hot-to-boiling water and then remove the pin, being careful not to damage the piston.

1. Wash all parts in a cleaning solvent.

CAUTION: Do not use a caustic solution or a wire brush for aluminum pistons. Clean the carbon from the piston ring grooves with a broken ring or ring groove cleaner.

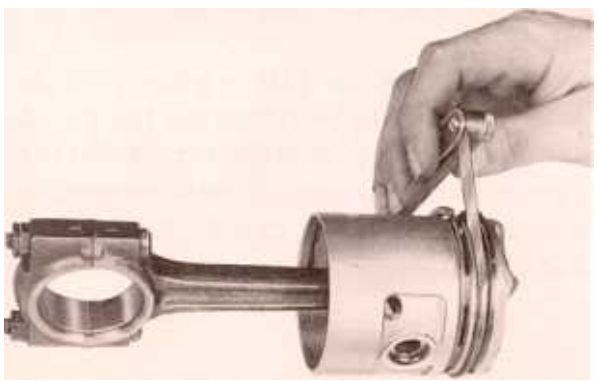
2. Inspect the connecting rods, caps, bearing shells and pin bushings as follows:

(a) All connecting rod bearings and piston pin bushings should be replaced in a major overhaul.

(b) Test rods for alignment. Rods only slightly misaligned can be straightened using the proper equipment. Badly twisted or bent rods must be replaced.

3. Inspect the pistons for cracks, breaks or scores.

4. Measure the piston skirt at right angles to the pin to determine it is worn excessively; replace if necessary. The specified piston diameter is 2.6230 to 2.6234 inches.



FESM-3259

NOTE: On a used piston, it will probably be found that the piston ring side clearances tend to increase toward the top of the piston due to the higher operating temperature prevalent at this point. When this side clearance becomes excessive, the piston will have to be replaced.

5. Measure the crankcase cylinder bores for excessive wear. The specified bore ID is 2.625 to 2.627 inches. Replacement pistons are available in .020 and .040 inch oversizes.

6. Inspect the piston pins for wear; if wear is perceptible, replace pins. Replace piston pins showing signs of corrosion or etching. Specified piston pin diameter is .6875 to .6876 inch.

7. Inspect the connecting rod bushings for scratches and burrs. Replace if necessary.

8. Connecting rod bolts must be cleaned of all foreign matter including the anti-rust materials that may be caked in the threads. This is also true of the connecting rod bolt nuts.

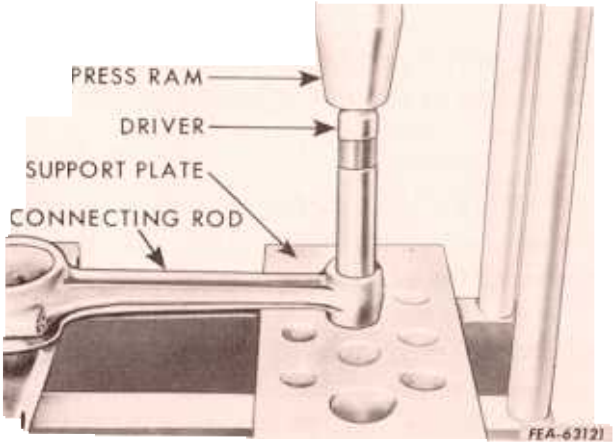
A good method of checking to determine thread condition is to turn the connecting rod bolt (threads lubricated with a light engine oil) all the way into a standard nut with the fingers. If the bolt runs in relatively free without sticking or without the need for applying more than a very light (2-4 foot-pounds) wrench effort, the bolt is satisfactory for use.

9. Rings should be checked also for the specified side clearance by placing each ring in its groove on the piston and inserting a feeler gauge around its edge.

10. Inspect the piston rings for damage. Faulty rings cannot always be detected by the eye. Engine performance and irregularities such as excessive oil consumption must be taken into consideration. Wherever there is doubt as to the serviceability of the piston rings, it is advisable to replace such parts.

11. Insert each ring into the cylinder bore for that piston. Force them squarely down inside the sleeve or cylinder bore. Position a feeler gauge between the ends of the ring, and compare the existing gap against the specified gap. If it is necessary to remove material from the ring ends because the end gap is too close, clamp a mill file in a vise, hold the ring in proper alignment and dress off the ends squarely to obtain the desired gap.

12. Inspect the "windows" of the oil regulating ring and piston for blocked oilways. Failure to keep the oilways clear will result in uneven lubrication and "hot-spots" of the piston and cylinder sleeve. All rings should fit loosely in the piston grooves without binding.



13. Place connecting rods in an arbor press and press old piston pin bushings from the connecting rods.

14. Align the new piston pin bushing on the connecting rod so that the oil hole in the bushing will match with the oil hole in the connecting rod. Press the bushing into the rod.

15. Press the bushing into place in the connecting rod and then ream to provide the specified piston pin clearance of .0003 to .0007 inch.

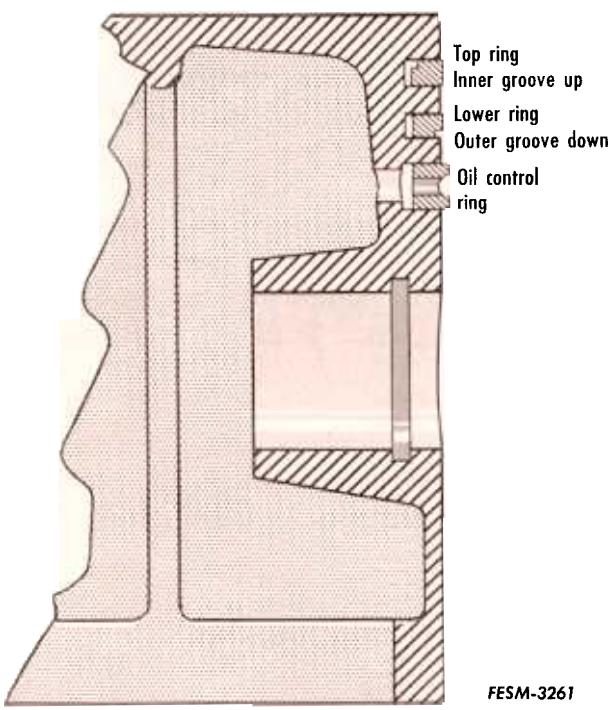
Reassembly

1. Before assembling the piston and connecting rod, check the fit of the piston pin in the piston for proper end clearance as follows:

(a) Prepare the piston and the pin for assembly as outlined in Step 2.

(b) Push the pin into the piston and install a retainer ring at each side of the piston.

(c) Push one end of the piston pin until it stops against the retainer ring on the opposite side of the piston.



(d) Using a feeler gauge, in the gap between the piston pin and the retainer ring, check for end clearance. Specified end clearance is .010 to .030 inch.

(e) Remove the retainer rings and proceed with the assembly as follows:

NOTE: When assembling the pistons to the rods, the front of the piston will be indicated by an arrow.

2. With the piston pin at room temperature (70^{O}) and generously coated with clean engine lubricating oil, and the piston heated in hot water to approximately 150^{O}F the piston pin can be entered into one boss of the piston by pushing with the hand. While the piston is hot, quickly and correctly position the connecting rod inside the piston, align the bushing in the rod bore with the piston pin holes in the piston and push the piston pin completely into position. Thoroughly dry the piston with compressed air.

3. Install a retainer ring in the groove at each side of the piston to secure the piston pin.

4. Using a piston ring expander, install the rings, oil control ring first, into the grooves of the pistons.

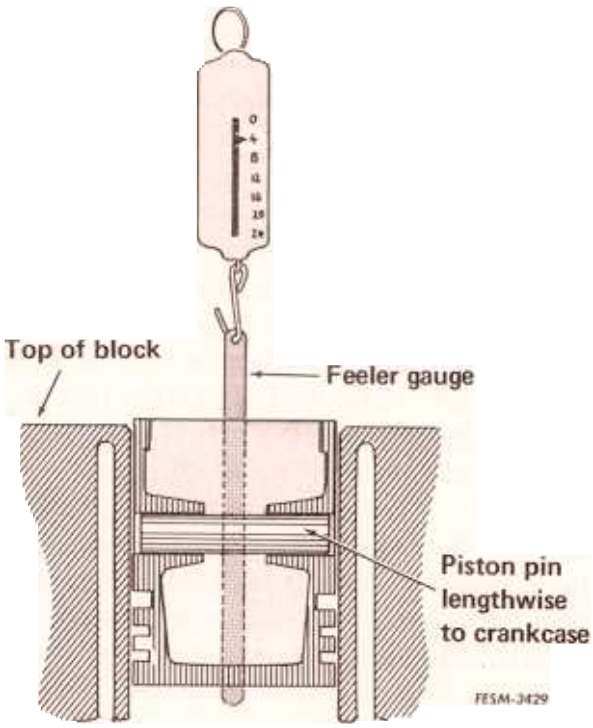
Position the ring gaps 90 degrees from the thrust side of the piston (in line with the piston pin bore) and 180 degrees from one gap to another.

Be sure the compression rings are installed with their grooves positioned as shown.

Piston Fit in Bore

Specified piston-to-bore clearance is .0016 to .0024 inch and can be determined using a 1/2 inch wide feeler gauge and a spring-type tension scale (FES 108).

The thickness of the feeler gauge that can be removed with a 2 to 8 pound pull represents the piston-to-bore clearance as outlined in the "Piston Clearance Chart." Clearances should conform to specifications.



PISTON CLEARANCE CHART

Pull in Lbs.	Feeler Gauge Thickness					
	.0015	.002	.003	.0035	.004	.0045
	Clearance in Inches					
2	.0016	.0022	.0033	.0039	.0044	.005
4	.0013	.0018	.0029	.0035	.004	.0046
6	.001	.0015	.0026	.0031	.0036	.0042
8	.0008	.0013	.0023	.0028	.0033	.0038

The chart shows the relationship between the feeler gauge thickness and pounds pull in measuring piston-to-bore clearance. Note that with a given feeler gauge thickness the actual clearance is less than the feeler gauge used when the pound pull is towards the high side of the pound pull range. This is especially true with the thinner feeler gauges.

To determine piston-to-bore clearance proceed as follows:

1. Select a feeler gauge (free of dents or burrs) of one of the thicknesses listed in the chart. Position the feeler gauge in the cylinder bore so that it extends the entire length of the piston 90^{O} from the piston pin location.

2. Invert the piston and install it in the bore so that the end of the piston is about 1-1/2 inches below the top of the cylinder block and the piston pin is parallel to the crankshaft axis.

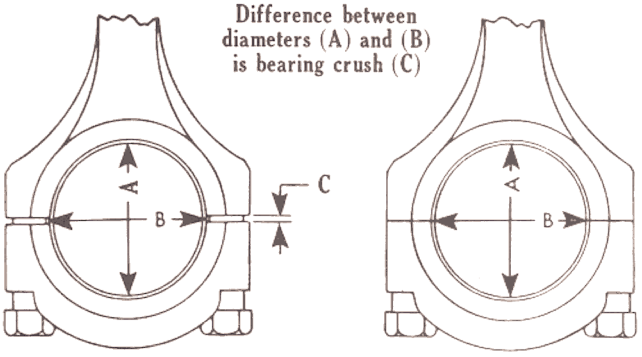
3. Hold the piston and slowly pull the scale in a straight line with the feeler gauge, noting the pull required to remove the feeler gauge. Check three times and record the average of the three readings obtained. Do not bend or kink the feeler gauge.

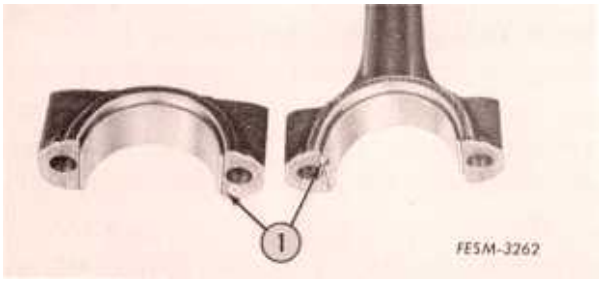
4. Refer to the chart to determine the actual clearance. The clearance is shown where the horizontal column indicating pounds pull and the vertical column indicating the thickness of the feeler gauge used intersect.

EXAMPLE: If a .003 inch feeler gauge is used and it takes 8 pounds pull to remove the feeler gauge, the clearance is .0023 inch.

5. Repeat step 3 with the piston at right angles to the crankshaft axis. Determine the clearance as instructed in step 4.

6. Measuring piston-to-bore clearance with the piston pin parallel and at right angles to the crankshaft axis will reflect any "out of round" in the bore.





1. Bearing locking tangs

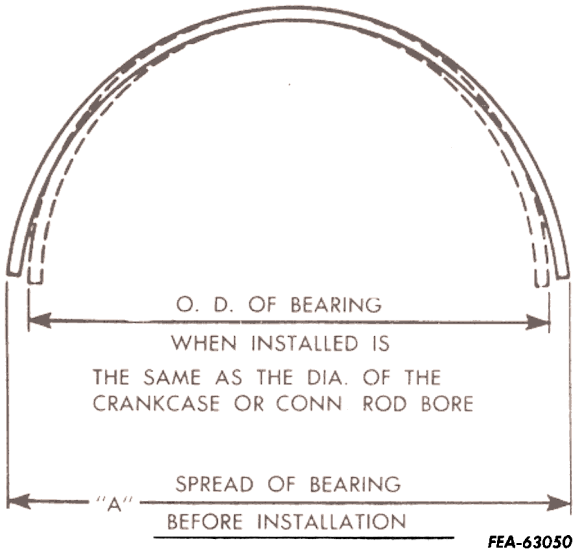
Bearing Fitting Procedure

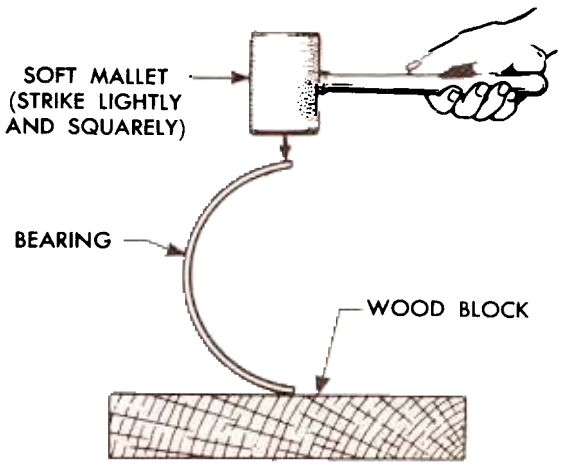
CAUTION: Bearings or bearing caps must not be filed, lapped or modified in any manner to reduce journal-to-bearing clearance. Premature bearing failure will result from attempts to reduce journal-to-bearing running clearances. While such methods will make a tighter fit at the top and bottom of the bearing, it will result in an out-of-round bore and distortion of the bearing shell. New bearing shells will have to be installed eventually and additional problems will be encountered. Such modification alters the engineered fit of the bearing shells in their bores and destroys the desired "crush".

1. When installing precision type bearings, it is important that the bearing shells fit tightly in the rod or crankcase bore. To accomplish this, the diameter of the bearing at right angles to the parting line is slightly larger than the actual diameter of the bore onto which the bearing will be assembled. When the bearing cap is drawn up tight the bearing is compressed, assuring a positive contact between the bearing back and bore. The increased bearing diameter is called "bearing crush".

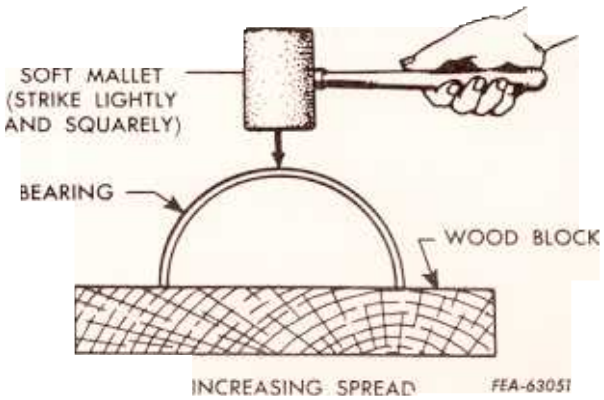
Be certain the bearings are fully seated and the locking tangs (1) on the bearings fit into the recesses.

2. To assemble the bearings with the correct "bearing crush," tighten the clamping bolts alternately and evenly to the specified torque with a torque wrench.





DECREASING SPREAD



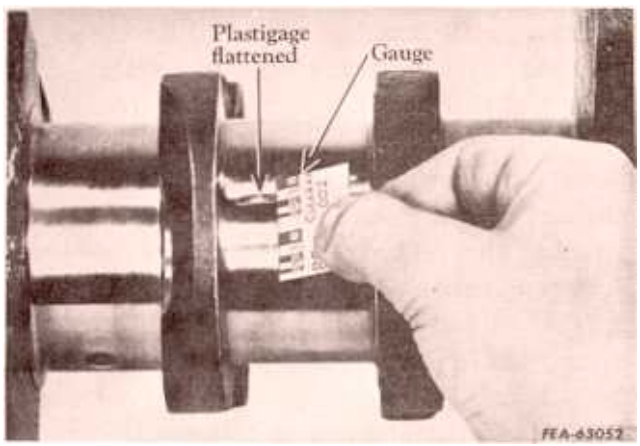
3. Main and connecting rod bearings are designed with the "spread" (width across the open ends) slightly greater than the diameter of the crankcase bore or connecting rod bore into which they are to be assembled. For example, the width across the open ends of the connecting rod bearing not in place is approximately .025 inch more than when the bearing is in position in the rod. This condition causes the bearing to fit snugly in the rod bore and the bearing must be "snapped" or lightly forced into its seat.

Rough handling in shipment, storage, or normal use in an engine, may cause the bearing spread to be increased or decreased from the specified width. Bearing spread should therefore be carefully measured and corrected as necessary before installation in an engine. Bearing spread can be safely adjusted as follows if care and judgment are exercised.

(a) EXCESSIVE SPREAD: If measurement of bearing indicates that dimension "A" is excessive, place bearing on a wood block and strike the side lightly and squarely with a soft mallet. Recheck measurement and, if necessary, continue until correct width is obtained.

(b) INSUFFICIENT SPREAD: If measurement of bearing indicates insufficient spread, place bearing on a wood block and strike the back of the bearing lightly and squarely with a soft mallet. Recheck measurement and if necessary continue until correct width is obtained.

4. BEARING CLEARANCE: When installing bearings in an engine, the proper clearance between bearing surface should be checked closely. Specified bearing clearance is .002 to .003 inch. To get an accurate measurement of this clearance, the "Plastigage" method, or virgin lead, can be used. The following instructions can be used when measuring with "Plastigage":



(a) Remove bearing cap and wipe bearing surface and exposed half of crankshaft journal free of oil.

(b) Place a piece of "Plastigage" the full width of bearing insert.

(c) Reinstall the bearing cap and tighten the self-locking cap screws to 16 foot-pounds torque.

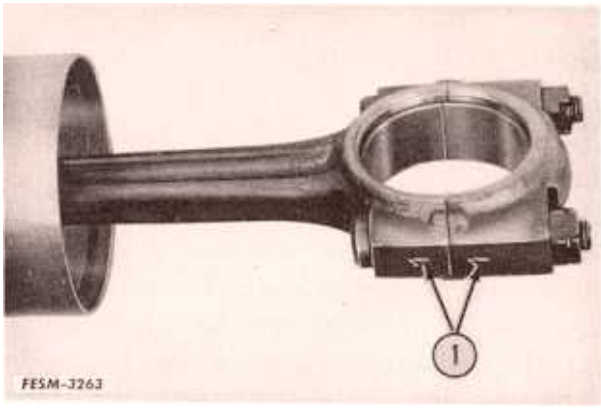
(d) Remove the bearing cap. The flattened plastic material will be found adhering to either the bearing shell or the crankshaft.

(e) To determine the bearing clearance, compare the width of the flattened plastic material at its widest point with the graduations on the envelope. The number within the graduation on the envelope indicates the clearance in thousandths of an inch.

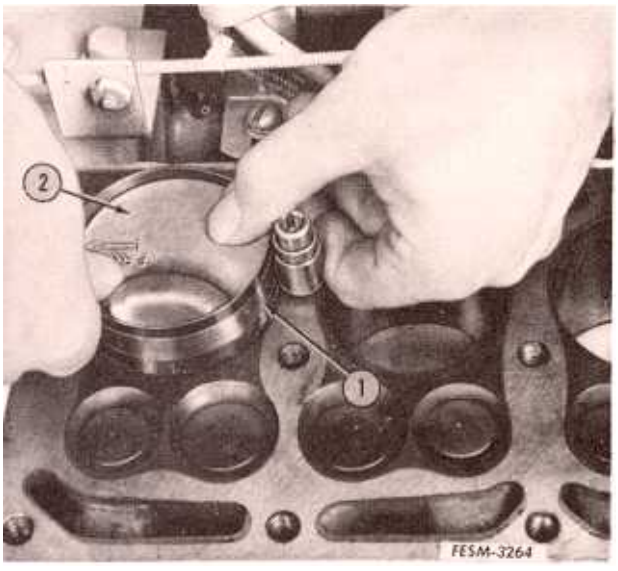
(f) If using virgin lead, carefully remove the flattened lead and measure its thickness with a micrometer.

NOTE: Do not turn crankshaft during the above procedure.

Should the readings not fall within the specified limits, and the torque wrench is known to be accurate in its measurement, remove the bearing from the connecting rod and replace it with a new one. However, with the precision bearings used, no difficulty should be encountered providing the crankshaft and/or connecting rod are in proper condition.



1. Cylinder number toward camshaft



1. Piston ring compressor
2. Piston

Installation

NOTE: When reinstalling a piston and connecting rod assembly, install the assembly in the same cylinder bore and in the same position from which it was removed. Connecting rods are stamped with the cylinder number on one side of the rod and on the same side of the bearing cap, No. 1 starting at the front end of the engine. Be sure to install the numbered side of both the rod and bearing cap so both are on the camshaft side of the engine.

1. Generously coat the piston ring compressor and bore with lubricating oil. Install the ring compressor (1) on the piston (2) and insert the piston and connecting rod assembly through the top of the crankcase.

2. Push down on the piston carefully until it is in the crankcase bore.

3. Wipe clean and oil the crankshaft journals and fit the connecting rod bearings as outlined in "Bearing Fitting Procedure."

4. Install all the pistons, connecting rods and bearings in the same manner.

5. Check the connecting rod side clearance by inserting a feeler gauge between the bearing cap and lobe of the crankshaft. The specified side clearance is .005 to .012 inch.

6. Install the oil pump screen and tube assembly.

7. Install the crankcase oil pan and new gasket. Fill the crankcase to the level on the gauge with the grade of engine oil specified in Operator's manual.

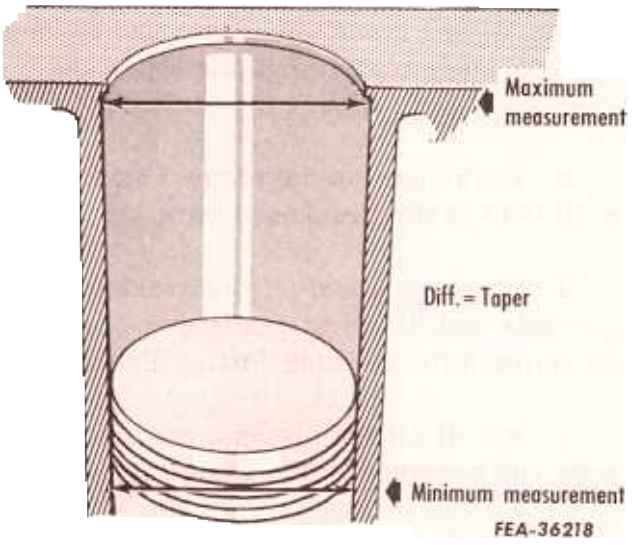
8. Install the cylinder head and gasket. (Refer to page 1-14.)

Crankcase Cylinder Re-Boring Procedure

This section covers re-boring of the cylinder bore with the engine disassembled. However, if re-boring is the only service to be performed on the engine, the crankshaft need not be removed.

When to Re-Bore

Replacement piston ring kits may be used to extend the life of the piston if cylinder wear has not been excessive. Inspect cylinder bores for scoring and roughness which indicate excessive wear. Check cylinder bores for taper and out-of-round by the use of a cylinder gauge placed at the top, middle, and bottom of bores, both parallel and at right angle to the centerline of crankshaft. To be within safe limits, the taper from top to bottom of the ring travel area must not exceed 0.005 in. and the out-of-round (egg-shape) condition must not exceed .005 in. in the cylinder bores. If the bore is worn beyond these limits, a re-boring job is required. It is advisable to re-bore for the smallest possible oversize pistons and rings. If only one or two bores require correction, it is not necessary to re-bore all cylinders to the same oversize.



Preparing the Block

Clean the water jacket with materials that will remove rust and scale and then flush thoroughly. Degrease the crankcase so that the abrasive material from the boring operation may be completely removed before reassembly.

Before setting up a boring machine on the block, the top of block must be carefully cleaned to remove all foreign materials, such as carbon, rust, or gasket cement. Use a 14 in. fine-cut, mill file to draw-file the block for removal of all burrs and high spots around the top edge and bolt holes. This will provide a smooth, true working surface for the boring operation. This is very important because the alignment of the cylinder bores depends entirely on the tightness of this working surface.

Re-Boring

When re-boring cylinders, all crankshaft bearing caps must be in place and torqued to specifications to avoid possible distortion of bores in final assembly. If all bores require the same correction, to save time bore the cylinder having the greatest amount of wear and taper first. If this cylinder cleans up to the smallest desired oversize, you can be sure that the remaining, smaller cylinder bores will clean up to the same size. Oversize pistons furnished for service are .020 in. and .040 in. oversize. No attempt should be made to cut down oversize pistons to fit cylinder bores.

To center the boring machine on each cylinder, follow closely the instructions of the boring machine manufacturer.

NOTE: If the crankshaft has not been removed, be sure the crankshaft is out of the way of the boring cutter when boring each cylinder.

Use a good single point boring bar with a sharp tool and bore all cylinders the same size, to within .002 to .001 in. of the desired finished oversize to permit finishing honing operations.

Honing

For best results, hone the cylinders to the finished size. This operation must remove all boring tool marks. Final finish should be in the range of 20 to 35 microinches. If you have no means for measuring the finish, the use of about 120 grit stones will produce approximately the correct finish.

Cylinders that are too smooth will retard run-in and may result in ring scuffing. When cylinders are too rough, rapid ring wear will result. A rigid type wet hone is preferred for the final sizing operation, but a spring hone of the glaze-breaking type may be used if the other is not available. Spring hones should be equipped with 220 grit stones and stock removal should not exceed 0.003 in. This type of hone should be dipped into SAE 10 or 20 lubricating oil before beginning the operation. Dull or dirty stones cut unevenly and generate excessive heat. Keep honing equipment sharp and clean. When finished honing, pass the hone through the entire cylinder bore at a rate of 60 cycles per minute or as necessary to provide a 30 degree (relative to the top of the sleeve) cross-hatch pattern on cylinder walls. This will insure maximum ring life and minimum oil consumption.

Cleaning

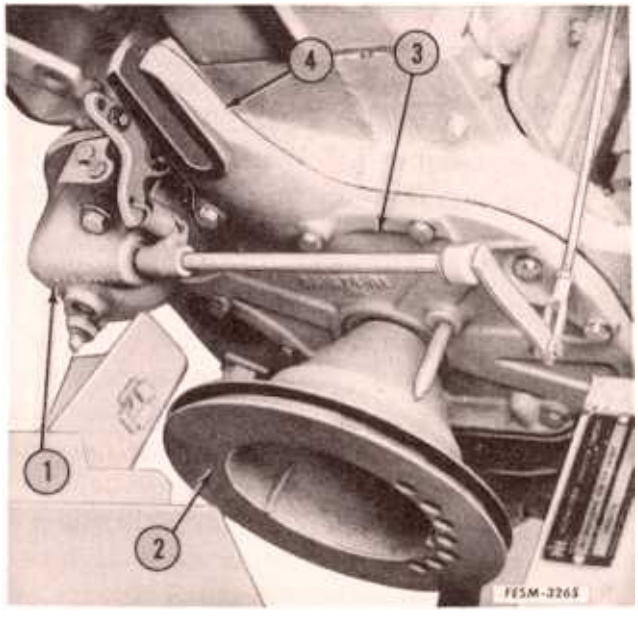
The success of any re-boring job depends on the accuracy and smoothness of the finished bores, the amount of piston clearance, and the thoroughness with which you clean the block and crankcase of all cuttings and abrasive materials resulting from boring and honing. The best reboring job will be a total loss unless the crankcase is thoroughly cleaned. Foreign material which remains causes rapid wear of pistons, rings, and cylinder walls, and will seriously damage engine bearings.

For thorough cleaning of the crankcase, washing in a tank of hot, agitated cleaning solution is the recommended procedure. If this cannot be done, use a good cleaning solution and air pressure blast followed by careful wiping with clean cloths and light lubricating oil. Surfaces should be wiped until a clean cloth shows no discoloration. Wash and blow out oil passages.

Checking Clearance

Refer to "Piston Fit in Bore" page 1-31.

Timing Gear Train and Front Cover



1. Governor assembly
2. Fan drive pulley
3. Front cover
4. Fan mounting location

General

The crankcase front cover encloses the timing gear train. It is of one piece construction. It also provides mounting for the governor and ignition drive. The gear train is comprised of the crankshaft gear, camshaft gear, idler gear and the ignition unit and governor drive gear.

Removal

To service timing gears only, the radiator assembly should be removed for ease of service.

1. Remove the cooling fan assembly.

2. Remove the distributor and distributor drive.

3. Remove the engine governor assembly (1).

4. Remove the cap screw securing the fan pulley (2) to the crankshaft. Remove the pulley.

5. Remove the cap screws from the front cover and remove the cover (3).

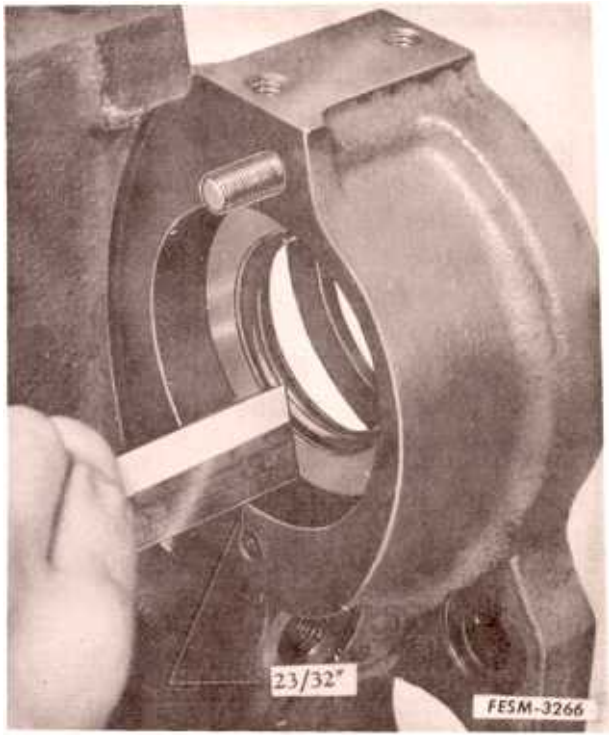
NOTE: Before removing any gears it is advisable to check the backlash of the gears to determine which, if any, require service. Check the backlash with a dial indicator or feeler gauges. The specified backlash is .003 to .006 inch.

6. Remove the idler gear shaft bolt and remove the idler gear.

7. Remove the crankshaft gear with a puller.

8. Using a puller, remove the camshaft gear.

9. Remove the ignition drive seal.



Inspection and Repair

1. Clean all parts thoroughly in a cleaning solvent and dry with compressed air.

2. Remove all gasket material from the crankcase and front cover with a putty knife so that a clean surface can be had when the new gaskets are installed.

3. Inspect all gears for excessive wear, chipping or cracks.

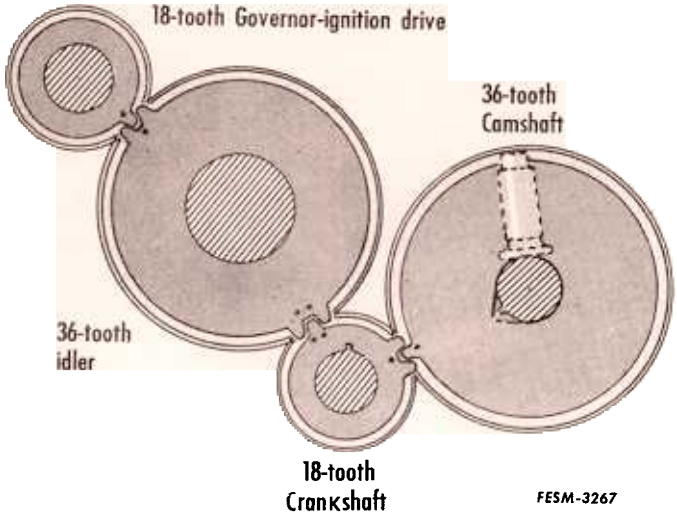
4. Inspect all keys and keyways for wear or damage and replace as necessary.

5. Be sure to install a new front cover oil seal and gasket.

Reassembly and Installation

1. Install a new ignition drive oil seal in the crankcase. The seal must be square in its bore and positioned 23/32 inch from the ignition mounting flange face.

2. Install the key in the camshaft if it was removed. Heat the camshaft gear in boiling water or a piston heater. Install the camshaft gear on the shaft with the timing marks facing out.

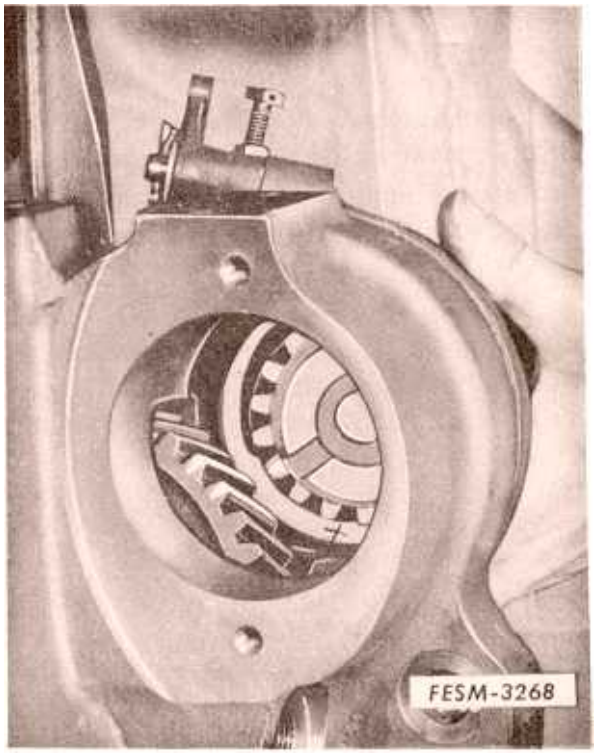


3. Install the key in the crankshaft if it was removed. Heat the crankshaft gear and install the gear, being sure the single timing mark of the camshaft gear and the single mark on the crankshaft gear are aligned.

4. Install the idler gear and shaft. Tighten the bolt to 90 ft. lbs. torque. The idler gear is correctly timed by lining up the double punch mark on the idler gear with the double punch mark on the crankshaft gear.

NOTE: Before installing the crankcase front cover, mark the top surfaces of the two teeth on each side of the single punch mark on the idler gear with chalk.

5. Install the crankcase front cover with a new oil seal and gasket. Do not tighten the cap screws at this time.



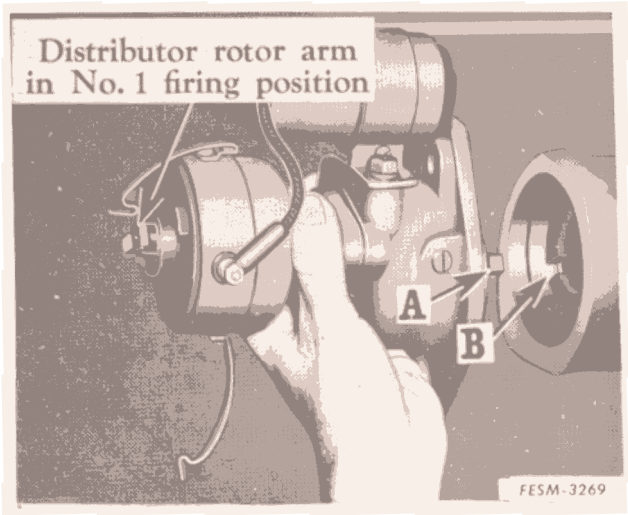
6. Install the fan drive pulley on the crankshaft. Install the cap screw and tighten to 80 ft. lbs. torque.

7. Tighten the crankcase front cover cap screws to 20 ft. lbs. torque.

NOTE: Before installing the governor assembly, mark the front surface of the ignition drive gear having a single punch mark with chalk.

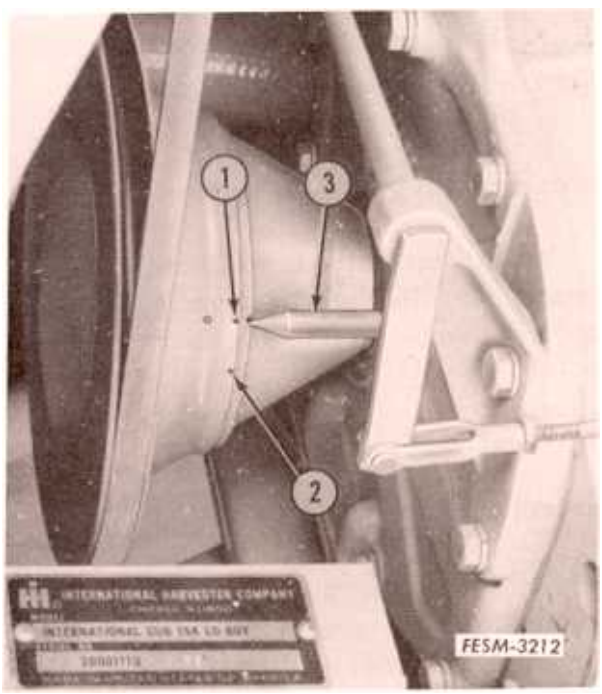
8. Install the governor assembly with a new housing gasket. Time the ignition drive gear as follows:

With the engine on top dead center of number 1 firing stroke, mesh the marked tooth of the ignition drive gear with the two chalk marked teeth on the idler gear.



9. Position the ignition unit distributor arm and drive shaft lug (A) for firing number one cylinder. Install the ignition unit on the engine, meshing distributor lug (A) and governor drive slots (B).

NOTE: Remove spark plug cables 2, 3 and 4 and ground them to prevent any chance of accidentally starting the engine.



10. Place the number one spark plug cable in a position so that the spark to ground will be audible when hand cranking the engine. Then advance or retard the ignition distributor until spark occurs as the O mark (1) on the fan drive pulley aligns with pointer (3) while hand cranking engine.

NOTE: Final ignition timing must be made with a timing light. The specified ignition timing is 16 degrees (2) before T.D.C. at 2420 engine rpm.

11. Install the cooling fan assembly and the radiator assembly.

1. O mark
2. 16° mark
3. Timing pointer

Camshaft

General

The camshaft is a single piece, drop forged shaft, with three bearing journals. The journals are supported by the machined bores in the crankcase. A helical gear, keyed to the shaft at the forward end of the camshaft is driven by the crankshaft.

The camshaft operates at one-half the engine speed.

The camshaft extends through the rear bearing bore into the oil pump body. This extended portion of the shaft is smaller in diameter than the rear bearing journal and carries a Woodruff key to drive the oil pump drive gear.

The camshaft has the main function of operating the intake and exhaust valve mechanism, by action of the lobes upon the valve tappets during rotation.

Removal

Removal of the camshaft only, requires the removal of the engine from the tractor and removal of head, valves, oil pan, flywheel, oil pump, and crankcase front cover from the engine.

1. Remove the valve tappet cover, and remove the valve assemblies. Refer to page 1-16. Be sure to identify each assembly for proper reassembly.

2. Remove the oil pump body and gears. Refer to page 1-52. Remove the key in the rear of the camshaft.

3. Remove the crankcase front cover. Refer to page 1-38.

4. Remove the two cap screws in the camshaft retainer plate through openings in the cam drive gear.

5. Turn the crankcase upside down so the tappets will fall away from the camshaft to provide clearance for removal.

6. Withdraw the camshaft from the front carefully so the crankcase bores are not damaged by nicks from the edges of the cams.

7. If necessary to remove the camshaft gear, press the gear off.

8. Remove the thrust plate and key if the camshaft gear was removed.

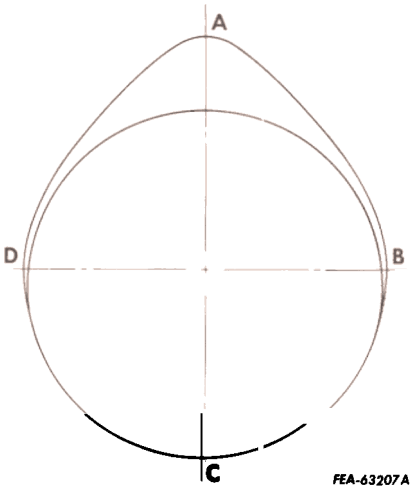
9. Lift the valve tappets out of the crankcase. Be sure to identify the tappets so they can be installed in their original bores.

Inspection and Repair

1. Clean all parts in a cleaning solvent and dry with compressed air. As inspection is completed, coat each part with clean engine oil and store safely until reassembly.

2. Inspect the camshaft journals for excessive wear. The specified journal diameters are 1.871 to 1.872 inches for the front, 1.746 to 1.747 inches for the center and .872 to .873 inch for the rear journal. If excessively worn or out-of-round, the camshaft must be replaced. Check any run-out on the camshaft using a dial indicator at the center bearing journal. Place the shaft in a lathe or between centering blocks. The total run-out must not exceed .002 inch.

3. Check the crankcase bearing bore inside diameters. The specified ID is 1.8740 to 1.8755 inches for the front, 1.7490 to 1.7505 inches for the center and .8740 to .8755 inch for the rear.



4. Inspect the camshaft lobes for excessive wear, chipping, scoring and replace if necessary. If the lifting areas of the cam lobes, when compared with new camshaft, show amount of wear exceeding .020 inch, the camshaft must be replaced. If a new camshaft is not available for comparison, the cam lobe wear can be measured with a micrometer in the following manner. Take a reading across A-C and deduct the reading B-D; this will give the lobe lift. When the cam lobe wear limit has been reached, this lift will be .020 in. less than the specified lift of .232 inch. The camshaft must then be replaced with a new one.

5. Replace the camshaft gear if the teeth are excessively worn, chipped or scored. Small nicks or burrs can be removed with a hone or fine mill file.

6. Check the condition of the thrust flange and replace if excessively worn.

7. Inspect the tappets. Replace any that are scratched or worn.

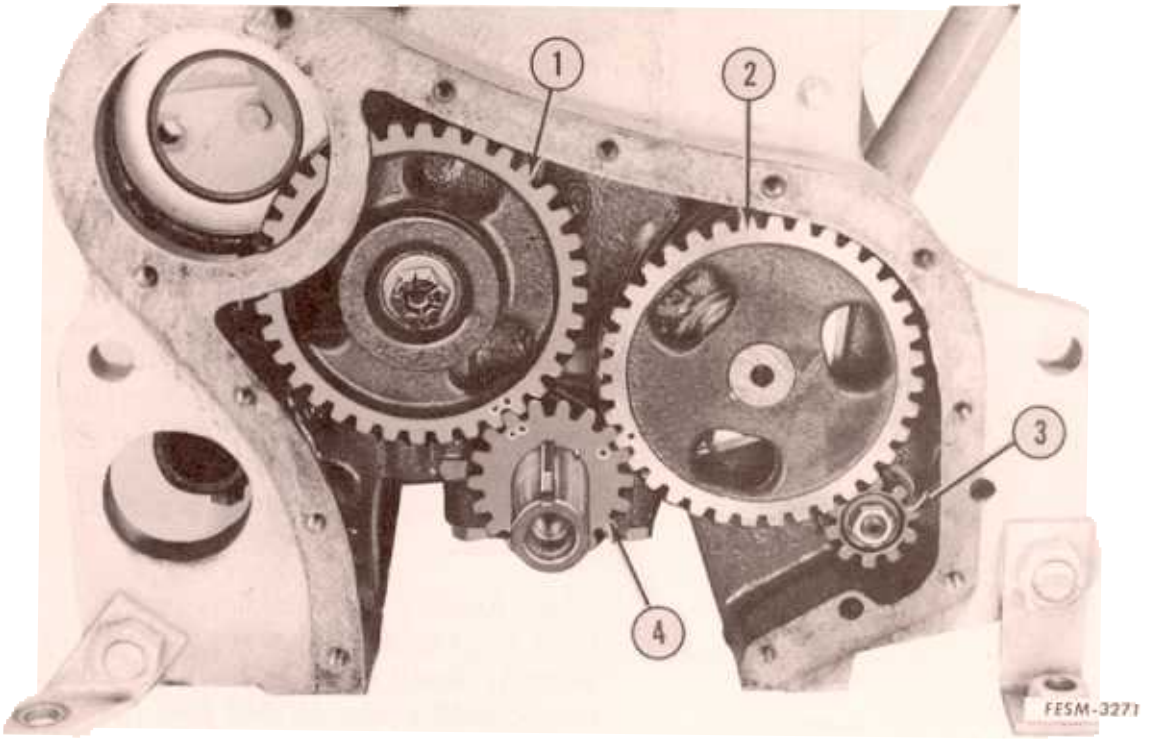
8. Be sure to use new gaskets in reassembly.

Installation

1. Install the valve tappets in their original bores.

2. Place the camshaft thrust plate on the shaft and install the key in the keyway. Heat the camshaft gear in boiling water and install the gear (with the timing mark facing out).

3. Check the end clearance with a feeler gauge between the camshaft front journal and the thrust plate. Be sure the drive gear is in place against the shoulder on camshaft. The specified end clearance is .003 to .012 inch. If the end play is excessive, replace the thrust plate with a new one.



1. Idler gear
2. Camshaft gear
3. Hydraulic oil pump drive gear
4. Crankshaft gear

4. Coat the camshaft with engine oil and install the camshaft in the crankcase. Be sure the camshaft gear (2) is correctly indexed with the timing mark on the crankshaft gear (4).

5. Secure the thrust plate to the crankcase and tighten the cap screws to 20 ft. lbs. torque. Access to each of the two screws is through the holes in the camshaft gear.

6. Install the front cover and fan drive pulley. Refer to page 1-39.

7. Install the key in the rear of the camshaft, and install the oil pump gears and body. Install the flywheel.

8. Install the valve assemblies and head. Refer to page 1-25.

9. Install the oil pan.

10. Install the engine in the tractor. Refer to page 1-11.

11. Start the engine and bring up to operating temperature.

(a) Inspect for oil leaks and check for correct engine oil pressure.

(b) Check and adjust the ignition timing.

(c) Check and adjust the valve clearance if necessary. Refer to page 1-15.

Crankshaft and Main Bearings

General

The crankshaft is supported in the crankcase by replaceable insert bearings. The precision-type bearings are not adjustable. When running clearances become excessive, replacement is necessary.

The connecting rods and all crankshaft journals are rifle-drilled to provide positive lubrication. Each main bearing cap, which contains the lower half of the insert bearings, is numbered consecutively to correspond with a number stamped on the camshaft side of the crankcase. The bearing caps are not interchangeable. No. 1 bearing cap is at the front of the engine.

CAUTION: Extreme care must be taken to guarantee cleanliness of the crankcase, crankshaft and bearings after service has been completed. Whenever possible, the crankshaft should be removed when new bearings are being installed in order to clean the crankcase thoroughly. All bearing surfaces must be free of grit and burrs. Small particles of dust and dirt left between the crankshaft and bearings will cause rapid wear and scoring of the crankshaft journal and insert. Any foreign material left between the bearings and the crankcase and bearing caps will cause distortion of the bearing and a reduction in operating bearing clearance at localized point. The frictional heat thus produced will in turn cause the bearing material to melt away from the steel back of the bearing at that point. Such melted material will create further hot spots until complete bearing failure takes place. Anything that interferes with the operating clearance of any bearing or the proper heat dissipation has its effect upon bearing life. Cleanliness cannot be overstressed.

The crankshaft front and rear oil seals will also be worn and should be replaced. This cleaning of the crankcase and replacing of oil seals is the best insurance against early bearing failures through dirt or foreign material left in the crankcase oil distribution bores or from dirt entering worn oil seals.

Main bearings are available in standard production size for new shafts or for used shafts having little or no wear and .002 inch undersize for shafts slightly worn. Also available are .010, .020 and .030 inch undersize for use with reground crankshafts. When servicing main bearings, one defective bearing will require the replacement of all three bearings; otherwise crankshaft "lay" or alignment cannot be maintained.

The replacement of crankshaft main bearings without removing the crankshaft should be done only in an emergency. When these bearings are worn sufficiently to require replacement or have failed through lack of lubrication, the entire crankcase and its oil distribution bores should be thoroughly cleaned. This cannot be accomplished without the removal of the crankshaft.

Removal

To completely service the crankshaft and bearings, the crankcase oil, cooling and hydraulic systems must be drained and the engine removed from the tractor. Refer to page 1-8.

1. Remove the fan drive pulley.

2. Remove the front cover. Refer to page 1-38.

3. Remove the flywheel and the rear oil seal retainer.

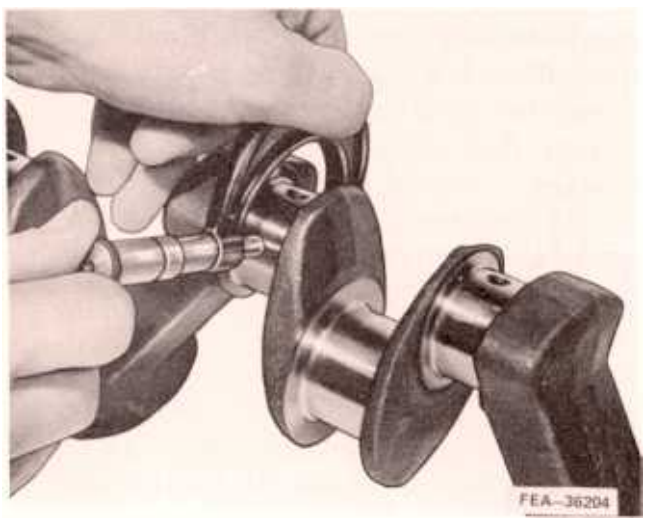
4. Remove the crankcase oil pan, and remove the oil pump screen and tube.

5. Remove the crankshaft bearing cap bolts. Tap the caps lightly with a lead hammer, if necessary, to dislodge them and remove squarely from position.

6. Remove the lower bearing from each cap. If they are to be reassembled, be certain that they are identified as to their original positions. Wrap them in clean cloths and store until reassembly.

NOTE: If the crankshaft is to be removed disregard step 7.

7. Remove the upper bearing halves from between the crankshaft and the crankcase with a thin piece of flexible soft sheet metal. Push against the end of the bearing without the positioning nib, while turning the crankshaft in the direction of rotation. The bearing will slide from position easily.



8. Remove the connecting rod bearing cap nuts and bolts and remove the caps. Push the piston and rod assemblies to the top of their travel.

9. Lift the crankshaft out of the crankcase.

Inspection and Repair

1. Clean all parts with cleaning solvent and dry with compressed air.

2. Inspect the bearings for wear and evidence of uneven bearing support. Examine the bearing caps and supporting surfaces of the crankcase for high spots and burrs.

3. Inspect the crankshaft journals for scoring and measure the diameter of each journal with a micrometer. Specified journal diameter is 1.623 to 1.624 inches. Measure each journal at two points, one at right angles to the other, in order to detect any out-of-roundness.

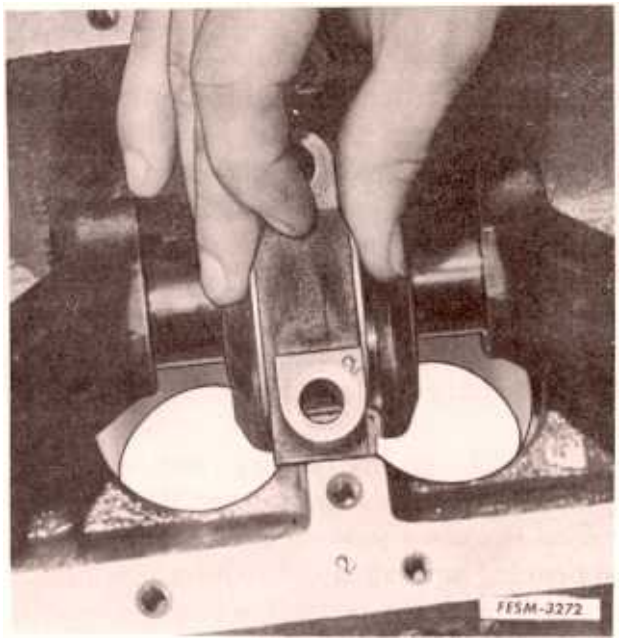
Move the micrometer over the entire width of the journal.

4. Check the connecting rod journals for out-of-round condition. Use a micrometer and take measurements at least three places around the journals. The specified rod journal diameter is 1.498 to 1.499 inches.

5. Inspect the crankshaft gear teeth for excessive wear and chipping. If necessary to replace it, pull the gear with a puller.

6. Inspect the crankcase for sludge and deposits and thoroughly clean it.

7. Replace all seals and gaskets with new ones.



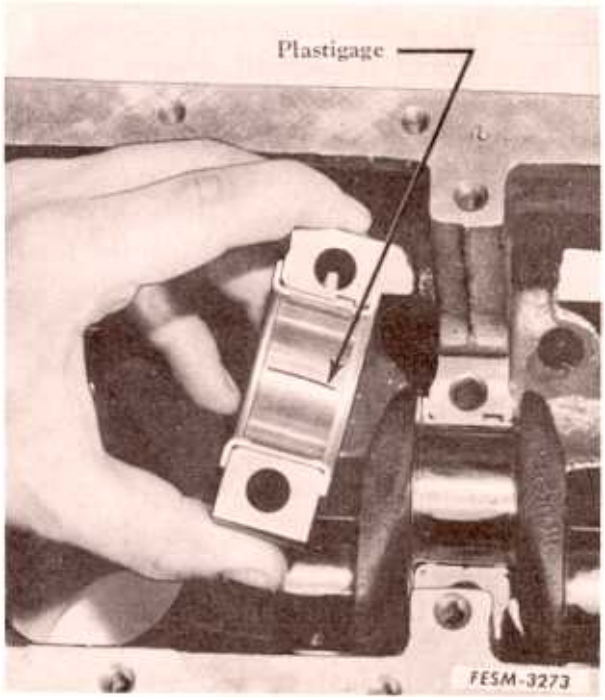
Installation

1. Wipe all surfaces of the crankshaft bearing bores of crankcase and bearing caps free of oil, and place bearing halves in the bore of the crankcase and bearing caps. Be certain the bearings are fully seated, oil holes are in alignment, and locking tangs on the bearings fit into the recesses.

2. Apply a film of engine oil on the bearing surfaces and place the crankshaft into position.

NOTE: When installing the crankshaft, be certain to correctly index the timing marks on the crankshaft gear with the idler gear and camshaft gear.

3. Install the bearing caps over the crankshaft journals, being certain to install the caps in their correct positions and with the numbered side of the caps to the camshaft side of the engine.



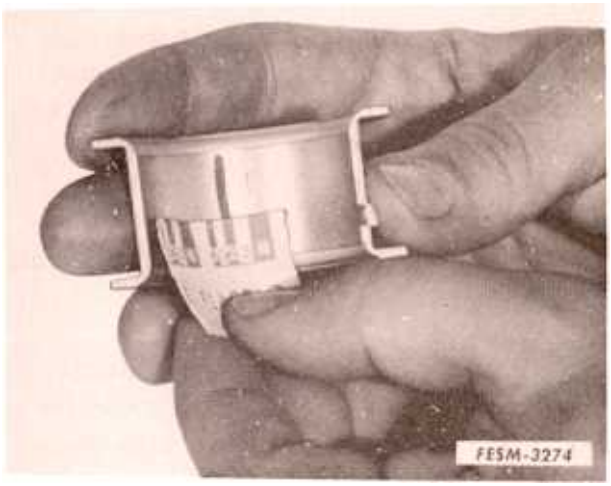
4. Check the main bearing clearances as follows:

(a) Remove the bearing cap and wipe the bearing surface and exposed half of the crankshaft journal free of oil.

(b) Place a piece of "Plastigage" or virgin lead, the full width of the bearing insert, on the crankshaft journal.

(c) Reinstall the bearing cap and tighten the cap screws to 55 foot-pounds torque.

(d) Remove the bearing cap. The flattened section of the virgin lead or "Plastigage" represents the clearance present between the bearing surface and the crankshaft journal. Measure the thickness with a micrometer or match the flattened Plastigage at several points (on either the bearing insert or the crankshaft), with the corresponding graduation on the Plastigage envelope, which indicates the clearance in thousandths of an inch. Running clearance must be .002 to .003 inch.

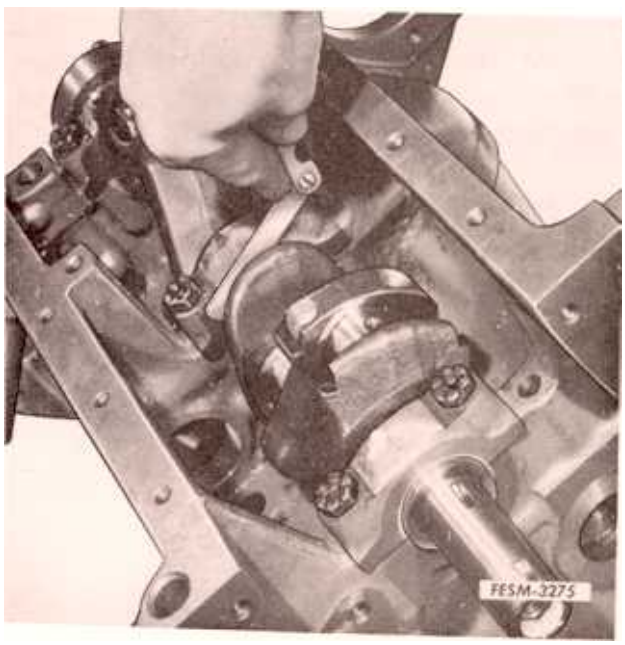


NOTE: Do not turn the crankshaft during the bearing clearance check.

(e) Should the readings not fall within the specified limits, and the torque wrench is known to be accurate, remove the bearing and replace it with a new one. However, with the precision bearings used, no difficulty should be encountered providing the crankshaft and/or crankcase and caps are in good order.

5. Install the bearing caps to their original position and tighten the cap screws to 55 ft. lbs. torque.

NOTE: When installing center main bearing cap, hold crankshaft against the rear thrust face of the upper half of the bearing. Tighten center cap bolts lightly and tap cap toward the rear before final tightening of cap bolts. This lines up the upper and lower thrust surfaces of the bearing halves and prevents binding the shaft on the thrust surfaces.



6. Check the crankshaft thrust bearing side clearance with a feeler gauge at the front side of the center bearing on both upper and lower thrust faces. Specified side clearance is .004 to .008 inch.

While making this check, be sure the crankshaft is held against the rear thrust face of the bearing to show total clearance at front side.

7. Install the connecting rod bearings and caps. Refer to page 1-35.

8. Install the hydraulic oil pump (if so equipped).

9. Install new front and rear crankshaft oil seals in their retainers.

10. Install the rear oil seal retainer.

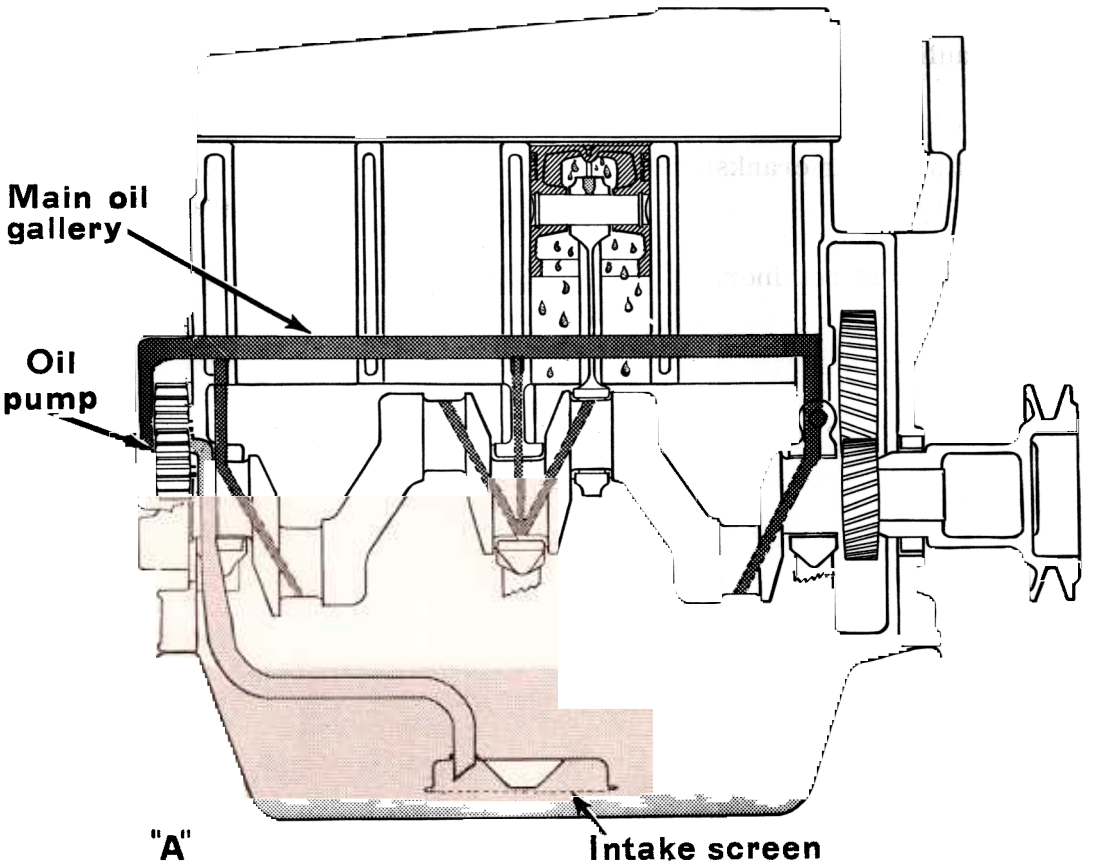
11. Install the flywheel and secure with the cap screws. Tighten the cap screws to 45 ft. lbs. torque.

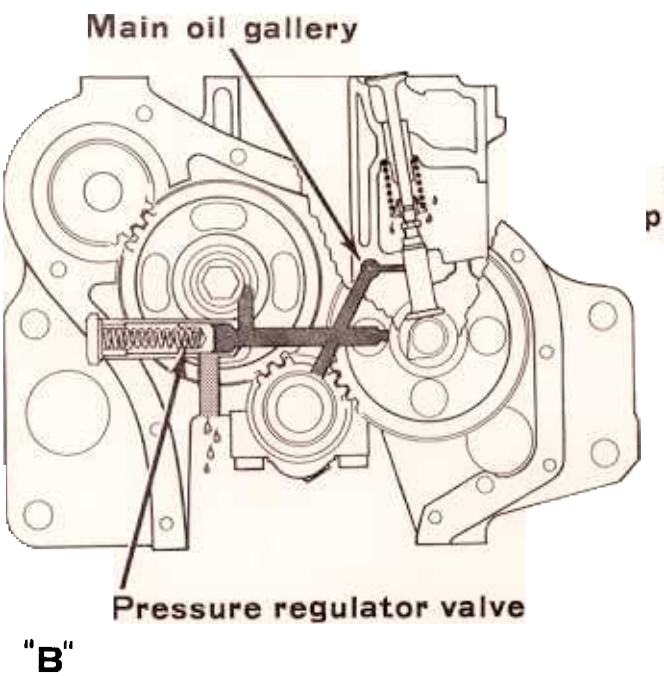
12. Install the oil pan.

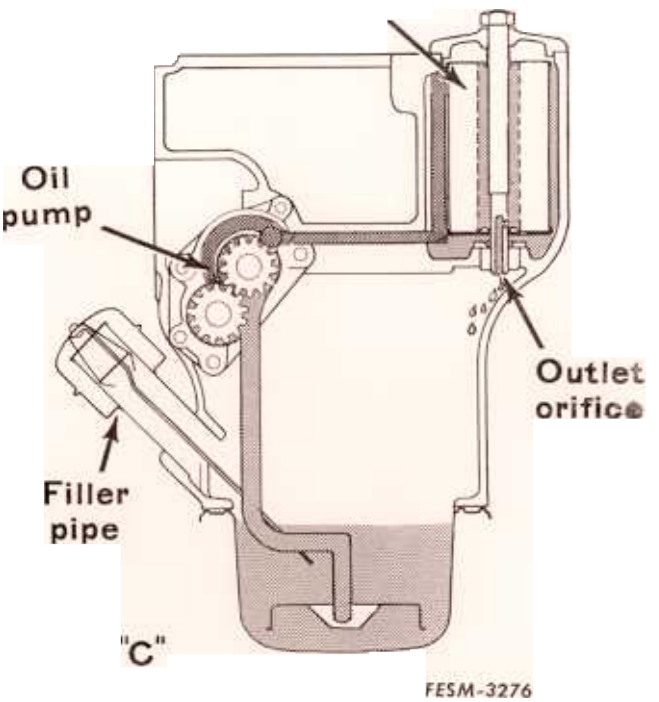
13. Install the front cover and the fan drive pulley. Refer to page 1-39.

14. Install the engine in the tractor. Refer to page 1-11.

Lubricating Oil Pump







General Description

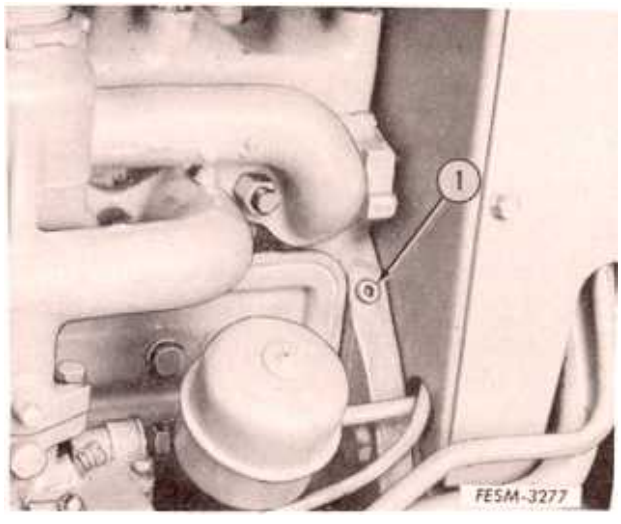
The engine lubricating oil is taken from the oil pan through a screened intake pipe up to the oil pump, where it is discharged into a gallery running lengthwise in the left hand side of the crankcase casting. From this gallery, drilled holes lead off to the valve tappets, camshaft and crankshaft main bearings.

Drillings in the crankshaft convey oil from the main bearings to each connecting rod bearing. Oil thrown from the connecting rods and main bearings lubricates the pistons, piston pins, and cylinder walls.

Another drilled hole from the main gallery supplies oil to the timing idler gear stud, and the pressure regulator valve. The pressure regulator valve and spring is retained by a hex-head plug on the right side of the crankcase near the timing gear end. Oil bypassed by the regulator valve is returned to the oil pan.

A drilled hole from the main gallery also delivers oil to the oil filter. Flow of oil through the filter element is metered by the outlet orifice in the cover retaining bolt. Cleaned and filtered oil is returned to the oil pan from the drilled retaining stud.

The timing gears and governor are lubricated by oil thrown from the front bearings of the camshaft and crankshaft, and from the idler gear stud.



1. Pipe plug

Oil Pump

The gear type oil pump is located at the rear end of the camshaft outside the crankcase behind the flywheel. The pump draws oil through a drilling in the crankcase and the intake pipe from the oil intake screen. Clean this screen each time the oil pan is removed. The connection between the oil intake pipe and the crankcase must be air tight.

A 1/8-inch pipe plug, located at the rear left side of the crankcase near the top of the flywheel housing, gives access to the pump for priming. This priming should only be necessary when the pump has been assembled dry or after long periods of storage, where the pump may have drained completely.

The oil pressure indicator shows whether the oil pump is working, when the system is correctly filled. At idle speed or above the indicator needle should register. If the needle does not register stop the engine and determine the reason.

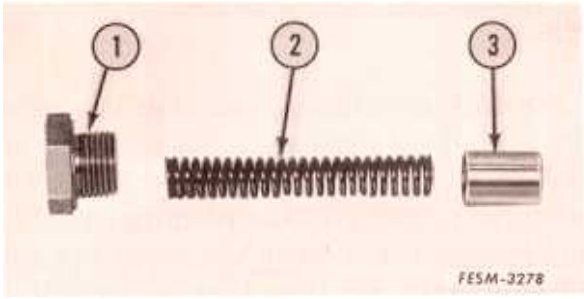
Pressure Regulator Valve

Since the normal output of the oil pump is much greater than the normal requirement of the engine lubricating system, and all the oil cannot escape through the engine bearing clearances and metered passages, a spring-loaded regulator valve is employed to release the excess oil. This valve maintains an operating oil pressure of 30 lbs. at 2200 rpm.

The piston-type pressure regulator valve and spring is located behind the hex-head retaining plug on the right side of the crankcase, near the timing gear end. The valve should slide freely in the crankcase bore and the spring should be straight so that the valve will not be cocked in the bore or on its seat.

The free length of the valve spring will give some indication of its condition. However, the best test to determine the spring's tension is to load it with the weight specified, and measure its length at that load. If this tension test is found below specifications the spring should be replaced or low oil pressure will continue.

During a complete engine overhaul, while the engine is completely disassembled, all oil passages should be cleaned, using brass rifle brushes. Also, if crankshaft or connecting rod bearings have failed due to abrasives in the lubricating oil, the engine must be completely disassembled and thoroughly cleaned. Clean all lubricating oil passages, using rifle brushes and compressed air. Clean and inspect the oil pump and pressure regulator assembly and service them as required.



1. Plug
2. Spring
3. Valve

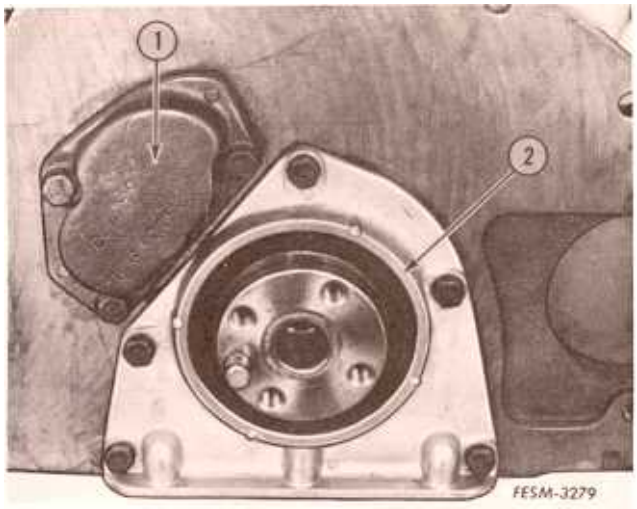
Removal and Disassembly

If oil pressure is not within specifications, the oil filter regulator valve, intake pipe with screen, and the pump may be disassembled as follows:

1. Remove filter element and clean filter case. If filter case is exceptionally sludgy, install bolt without cover and flush thoroughly.

2. Remove hex-head regulator valve retaining plug and remove the spring and valve.

3. Remove the crankcase oil pan. Remove the oil intake pipe and screen.



1. Oil pump body
2. Rear seal and retainer assembly

4. Remove the engine. Refer to page 1-8.

5. Remove the flywheel.

6. Remove the oil pump body and pump gears.

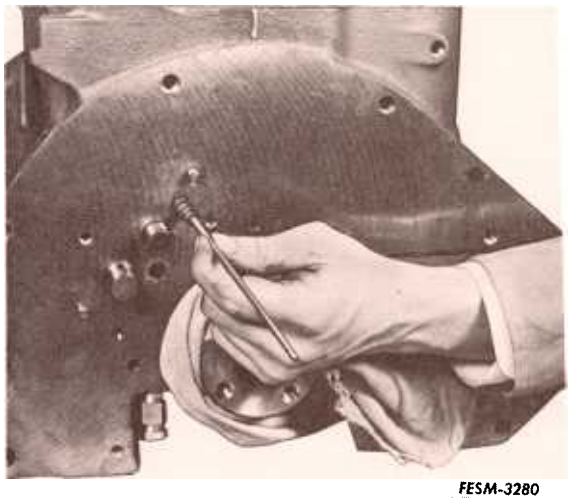
Inspection and Servicing

1. Clean regulator valve assembly and valve bore.

2. Check condition and tension of regulator valve spring. If spring is bent or rusted or the tension is not within specifications it should be replaced.

3. Check regulator valve to make sure it slides freely in its bore.

4. Thoroughly clean oil intake pipe and screen. Check screen and connections for damage.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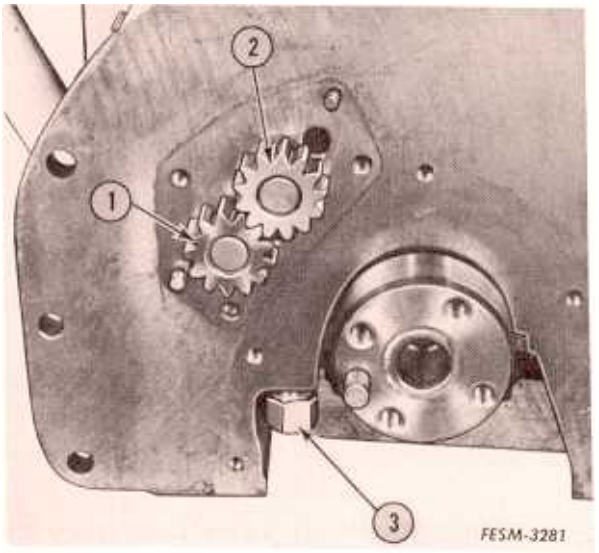
5. Check oil pump drive gear shaft and key for wear or damage.

6. Check pump gears for wear or damage.

7. Check pump body for wear or damage.

8. Clean crankcase breather.

9. Clean oil passages in crankcase with a round, bristle type or brass rifle brush.



1. Drive gear
2. Idler gear
3. Oil intake pipe connection

Reassembly

1. Install new filter element along with cover and drain plug.

2. Install regulator valve, spring and retainer, using new retainer gasket.

3. Install oil intake pipe and screen.

4. Install crankcase pan, using new gasket.

5. Install oil pump gears.

6. Install pump body, using new gasket.

7. Install the flywheel and secure with the four cap screws. Tighten cap screws to 45 ft. lbs. torque.

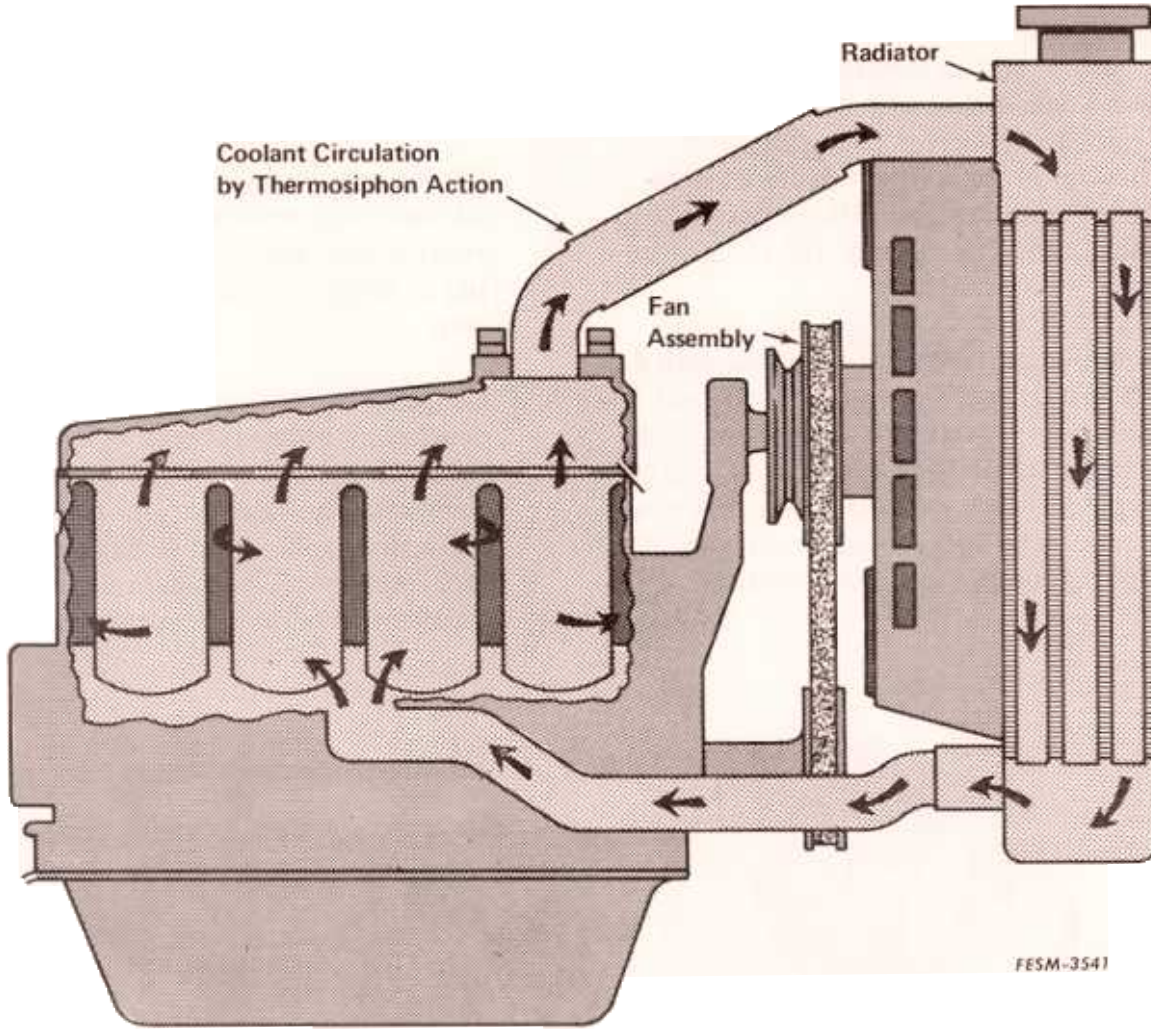
8. Install the engine in the tractor. Refer to page 1-11.

9. Fill crankcase with proper amount of specified oil.

10. Prime oil pump, start engine and check oil pressure.

11. Recheck crankcase oil level.

Cooling System



General Description and Operation

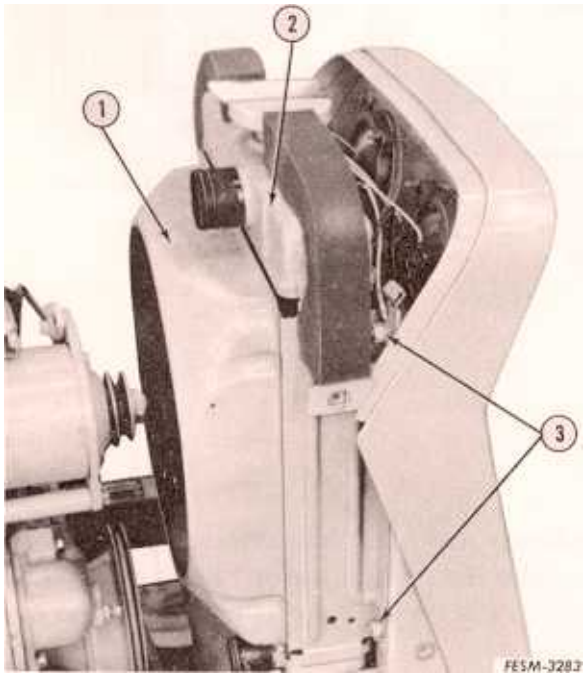
Water or an antifreeze solution circulates through the engine block and radiator by thermosiphon action. As the water in the engine becomes heated, it moves upward and enters the radiator at the top. The water is cooled by the air blast drawn between the radiator tubes by the fan. The cooled water moves to the bottom of the radiator and back into the engine block to replace the heated water passing out at the top. This creates a circulation in the system.

The radiator is the flat-tube type and is enclosed in a grill. The cooling fan is equipped with a shroud which greatly increases its efficiency. A drain plug, located on the water inlet elbow, permits the entire cooling system to be easily emptied.

Coolants

The radiator should be filled to a level slightly below the bottom of the filler neck to allow for expansion during normal operation. Use clean water, preferably soft or rain water. Water containing alkali will deposit a scale that will eventually clog passages and restrict circulation. If alkaline, acid, or saline waters are the only kind available, add IH Radiator Rust Inhibitor and Water Pump Lubricant to the coolant.

When using antifreeze, select one with an effective corrosion preventive. Do not use an alcohol-type antifreeze when the more permanent ethylene glycol type is available. Use only one type of antifreeze; mixtures will make it difficult to determine the degree of protection against freezing.



1. Fan shroud
2. Radiator assembly
3. Cap screws

Flushing the System

At least twice a year, drain the cooling system and thoroughly flush it. This is particularly important before adding antifreeze. When you remove the drain plug, be sure the opening is not clogged so that all the coolant will drain out.

Cleaning solutions. IH Cooling System Cleaner will remove an accumulation of rust, scale, sludge, and grease from cooling systems. Follow the directions on the can.

Clogging of passages in radiators and crankcase water jackets is aggravated in some communities by hard salts in the water supply. Heavy mineral deposits in the water jacket hold in heat and create local hot spots, particularly on cylinder walls and around the exhaust valve seats.

Removal and Disassembly

1. Drain the cooling system, then remove the hood and the radiator support assemblies.

2. Disconnect the water inlet and outlet hoses.

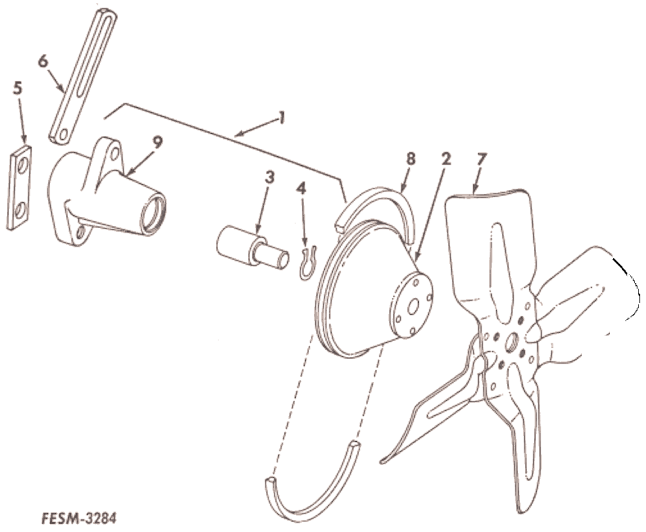
3. Remove the fan assembly from the engine.

4. Remove the cap screws (3), two on each side, and remove the radiator assembly (2) from the tractor.

5. Remove the fan shroud (1) from the radiator assembly.

6. Remove the water inlet and outlet elbows from the engine.

7. Remove the fan pulley (2) from the shaft and bearing assembly (3). Remove the shaft and bearing (3) from the fan pulley mounting bracket (9) if necessary.



1. Fan pulley assembly
2. Pulley
3. Shaft and bearing
4. Bearing retainer
5. Adapter bar
6. Motor-generator brace
7. Fan blade assembly
8. Fan belt
9. Fan pulley mounting bracket

Inspection and Repair

During servicing or repair procedures, inspection of parts and assemblies involved is always an important responsibility of the serviceman. Generally, inspection is performed after disassembly has been completed, however, in many cases, time can be saved by inspecting parts when they are being removed.

Be sure to check the following items and perform the servicing or repair that is indicated.

1. Inspect the radiator for accumulation of rust or leaks and flush out passages in the engine.

2. Check all hoses and if badly cracked, or dry and hard, they should be replaced.

Radiator Core

1. Overheating is often caused by bent or clogged radiator fins. If the spaces between the fins are clogged, clean them out with compressed air or water. Avoid poking into the spaces with any hard object.

2. If fins are bent, they should be straightened, but be careful not to damage the tubes or break the bond between the fins and the tubes. Check carefully for possible leaks after completing this work and before completely reassembling the radiator.

3. Inspect radiator passages for clogging. If this condition is found, the passages should be cleaned at a qualified radiator service station.

CAUTION: Never use chemical mixtures to stop radiator leaks except as a temporary, emergency procedure to be followed by correct servicing at an early date.

Fan Service

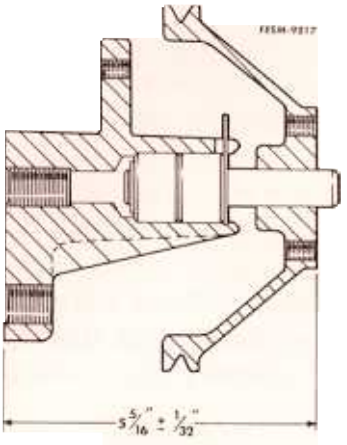
The fan is mounted on a spindle in the slotted bracket of the engine front cover. It should be as close to the radiator as possible without danger of striking it as it turns within the fan shroud.

1. Check for bent fan blades or damaged pulley assembly and repair as required.

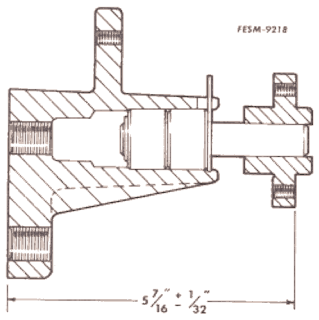
2. Inspect the fan pulley assembly for noticeable side play indicating a worn bearing. Replace as necessary.

3. Inspect the fan drive V-belt and replace it if it is badly oil soaked, if it tries to run on its side in the pulleys, if it is badly cracked beyond the cover layer, or if its sides are worn so that it will not drive the fan at the correct speed.

Press the bearing on the shaft to the distance indicated on the illustrations.



Model 154.



Model 185.

Reassembly and Installation

1. Install a new shaft and bearing in the fan pulley mounting bracket if it was disassembled. Install the fan pulley on the shaft if it was removed.

2. Install the radiator inlet and outlet elbows on the engine.

3. Install the fan shroud on the radiator assembly.

4. Install the radiator assembly on the tractor and secure with the four cap screws. Tighten the screws securely.

5. Install the fan assembly and drive belt. Adjust the belt tension to allow 25/32 inch of slack midway between the generator-crank pulleys at 25 lbs. of force.

6. Connect the water inlet and outlet hoses.

7. Install the grille housing and radiator support assemblies and the hood. Fill the cooling system with coolant and check completely for possible leaks.

Trouble Shooting

If a specific problem and remedy is not covered herein, proceed to isolate the system in which the problem occurs and then locate the defective component. The greater the number of symptoms of problems that can be evaluated the easier will be the isolation of the defect.

Much can be learned about the condition of an engine if a good visual inspection is performed before the actual cleaning operations are begun. Many engine parts give external evidence of some failure or defect which can be looked for when the engine is later disassembled. For example, a heavy accumulation of oil or grease at some spot might indicate a leaking seal or gasket; or, excessive rust and other corrosion at another place might well mean leaks in the cooling system. If an engine can be operated, unusual noises also help determine what defects to look for. However, before engine disassembly is started, the outer surface should always be given a thorough cleaning. Methods used will depend on the facilities available or other local conditions. The dry steam method is recommended since this is both fast and effective. After steam cleaning, the engine should be wiped dry with a clean cloth to minimize possible rusting. After cleaning, the exterior of the engine should once more be inspected carefully and a note made of any parts such as brackets, covers, bolts, etc., that are bent, broken, rusted or missing completely. The crankcase or cylinder block should be checked for evidence of freezing around core plugs or for actual breaks in the water jacket.

Probable Cause	Remedy
Engine Will Not Turn Over	
1. Cranking motor inoperative or defective	Replace.
2. Battery faulty	Replace Battery.
3. Cables and terminals faulty	Inspect ground cable and battery-to-starting switch cable for any faults which may cause shorting; also inspect for incorrect connections. Replace cables if necessary.
4. Starting switch defective	Replace starting switch.
5. Internal seizure	Hand crank engine with spark plugs removed and clutch disengaged. If engine does not turn easily, internal damage is indicated.
Engine Turns But Will Not Start	
1. Fuel system faulty	
(a) No fuel in tank	Fill tank with fuel.
(b) Fuel strainer bowl screen clogged	Clean bowl and screen.
(c) Water in gasoline	Drain gasoline tank, gasoline strainer and carburetor. Refill with clean gasoline.
(d) No gasoline at carburetor	Clean fuel line from tank to carburetor. Clean fuel inlet screen in carburetor. Check for clogged vent holes in fuel tank cap.
2. Battery charge low and does not turn engine fast enough	Charge or replace battery.
3. Ignition system faulty.	
(a) Broken distributor rotor	Replace rotor.
(b) Moisture in the distributor	Remove cap and rotor and dry off. Use compressed air to remove moisture from distributor.

Probable Cause	Remedy
Engine Turns But Will Not Start - Continued	
3. Ignition system faulty - Continued	
(c) Condenser shorted or open	Replace condenser.
(d) Broken distributor cap	Replace cap.
(e) Excessively pitted distributor cap contact terminals	Clean contact terminals with fine sandpaper. Blow all sand out of cap before reinstalling.
(f) Points not properly adjusted	Readjust points. Refer to "Tune-Up", page 1-69.
(g) Short or open circuit in distributor	Correct or replace.
Ignition circuit broken	Check cable from distributor cap-to-ignition coil and check spark plugs for correct wiring or loose connections.
(i) Wet or fouled spark plugs	Remove spark plugs, wipe off moisture and dry plugs. Remove carbon. Reset plug gap; refer to "Tune-Up", page 1-69.
(j) Cracked or broken spark plug insulators	Replace spark plugs.
Ignition switch inoperative	Place a jumper wire across the two ignition switch terminals on the back of the switch. Attempt to start the engine. If engine starts, the switch is inoperative and must be replaced.
4. Carburetor choked too much	Open the choke. Wait a few minutes before attempting again to start engine.
5. Air intake restricted or exhaust clogged	Service the air cleaner and clean exhaust system.

Probable Cause	Remedy
Missing and Backfiring But Fails to Start	
1. Water in gasoline	Drain fuel tank, fuel bowl and carburetor. Refill with clean gasoline.
2. Air leaks around intake manifold	Tighten manifold stud nuts. Replace gasket if necessary.
3. Improper firing order	Check spark plug cables for correct installation at spark plugs and distributor cap.
4. Distributor not correctly timed to engine	Check and adjust timing. Refer to "Tune-Up", page 1-69.
5. Moisture in the distributor	Remove cap and rotor and dry thoroughly.
6. Distributor cap shorting out	Check for loose contact terminals or dirt in cracked cap.
Missing or Cutting Out at High Speed	
1. Distributor breaker plate not grounded properly	Check ground lead wire and screws.
2. Primary lead not tightened or partially broken	Check primary lead wire and screws.
3. Weak point spring tension	Adjust point spring tension or replace points.
4. Spark plugs faulty	Check plug gap. Refer to "Tune-Up", page 1-69 for correct gap. Replace plugs if necessary.
5. Point gap incorrect	Readjust point gap. Refer to "Tune-Up", page 1-69.
6. Low voltage to spark plugs caused by defective coil	Replace coil.
7. Carburetor	
(a) Float level set too low	Check float level. Reset if necessary.
(b) Dirt in main jet	Clean out main jet. Replace if necessary.
(c) Restriction in filter	Clean out fuel inlet filter in carburetor.

Probable Cause	Remedy
Missing or Cutting Out at High Speed - Continued	
8. Poor compression:	
(a) Head gasket leaks	Replace head gasket.
(b) Burned valves	Grind valves.
(c) Worn piston rings	Replace piston rings.
Excessive Pinging - Detonation	
1. Distributor	
(a) Point gap incorrect	Readjust point gap. Refer to "Tune-Up", page 1-69.
(b) Spark advanced too far	Check and adjust timing. Refer to "Tune-Up", page 1-69.
(c) Fouled spark plugs	Clean plugs and reset the gap. Refer to "Tune-Up", page 1-69.
2. Carburetor	
(a) Main metering system too lean	Adjust carburetor. Refer to "Fuel System" Section 2.
(b) Float level set too low	Check float level and reset if necessary.
3. Cylinder head not bolted down tight	Torque cylinder head bolts. Refer to page 1-14 for tightening sequence.
Engine Does Not Operate Smoothly	
1. Pitted distributor points	Clean and readjust points or replace points.
2. Cracked distributor cap	Replace.
3. Worn or bent distributor shaft	Replace.
4. Worn breaker plate hub	Replace breaker plate assembly.
5. Worn distributor cam	Replace.
6. Improper point spring tension	Adjust point spring tension or replace points.

Probable Cause	Remedy
Engine Does Not Develop Full Power	
1. Distributor:	
(a) Point gap incorrect	Readjust point gap. Refer to "Tune-Up', page 1-69.
(b) Ignition timing incorrect	Check and adjust timing. Refer to "Tune-Up", page 1-69.
2. Low voltage to spark plugs caused by defective coil	Replace coil.
3. Fouled spark plugs	Clean plugs and reset the gap. Refer to "Tune-Up", page 1-69.
4. Carburetor:	
(a) Float level set too low	Check float level. Reset if necessary.
(b) Choke plates partially restricted . .	Reposition choke control linkage.
(c) Restricted throttle linkage	Repair or replace.
5. Insufficient air to engine	Service the air cleaner.
6. Late valve timing	Check and adjust timing. Refer to "Specifications."
7. Air leaks around intake manifold	Tighten manifold or install new gasket if necessary.
8. Exhaust restricted	Remove restriction.
9. Lack of compression	See "Lack of Compression" in this chart.
10. Governor worn out or out of adjustment	Refer to governor section of "Fuel System", Section 2.

Probable Cause	Remedy
Loss of Oil Pressure	
1. Low lubricating oil level	Add sufficient oil to bring level up to specified mark on level gauge.
2. Clogged oil filter	Change filter element.
3. Oil leaks	See "Excessive Lubricating Oil Consumption" in this chart.
4. Engine oil pressure indicator or line defective	Replace.
5. Worn main, connecting rod or camshaft bearings	Replace.
6. Dirt in oil filter relief valve or relief valve spring broken	Clean valve or replace spring.
7. Oil pump worn	Repair or replace.
8. Oil diluted or not as specified	Change oil regularly using correct grade specified in Operator's Manual.
Lack of Compression	
1. Valves sticking	Clean valve guides and stems. Grind valves if needed.
2. Worn pistons, rings and cylinder walls	Replace pistons, rings and cylinder sleeves.
3. Defective cylinder head gasket	Replace.
4. Broken valve spring	Replace.
Smoky Exhaust	
1. Engine overload	Reduce load.
2. Incorrect grade lubricating oil	Use grade of oil specified in Operator's Manual.

Probable Cause	Remedy
Smoky Exhaust - Continued	
3. Worn valve guides, valve stems, pistons and sticky or worn oil control rings	Repair or replace.
4. Distributor not properly timed	Check and adjust timing. Refer to "Tune-Up", page 1-69.
5. Choke not fully open	Open choke fully.
Excessive Lubricating Oil Consumption	
1. Oil leaks	Check and service where necessary; valve covers, tappet cover plate, crankcase front cover, oil seals at front and rear of crankshaft, oil pan plug, gasket, oil filter and oil pressure indicator tube.
2. Worn valve guides, piston rings, pistons and clogged oil control rings . . .	Replace worn parts.
3. Incorrect grade of lubricating oil	Use grade of lubricating oil specifed in Operator's Manual.
4. Over-heated engine	Refer to "Engine Overheats" in this chart.
5 Excessive oil poured into crankcase . . .	Drain oil. Add amount specified in Operator's Manual.
Excessive Fuel Consumption	
1. Distributor:	
(a) Point gap incorrect	Readjust point gap. Refer to "Tune-Up", page 1-69.
(b) Ignition timing incorrect	Check and adjust timing. Refer to "Tune-Up", page 1-69.
2. Low voltage to spark plugs caused by defective coil	Replace coil.
3. Worn or fouled spark plugs	Clean plugs and reset the gap. Refer to "Tune-Up", page 1-69 for correct plug gap setting.

Probable Cause	Remedy
Excessive Fuel Consumption - Continued	
4. Carburetor:	
(a) Float level set too high	Check float level and reset if necessary.
(b) Leaking needle or seat	Repair or replace.
(c) Choke plate not fully open	Reposition choke control linkage.
5. Restriction in air cleaner	Service the air cleaner.
Engine Noises	
1. Loose piston pin. A sharp rap at idling speed. The pin at fault can be found by short circuiting the spark plugs, one at a time, until the noise stops	Repair or replace.
2. A flat slap, when advancing engine speed under load, indicates a loose piston	Replace piston.
3. A metallic knock when idling and retarding engine speed, but disappears under load indicates worn or loose connecting rod bearings. The bearing at fault can be located by short circuiting the spark plugs one at a time. The noise will disappear when the cylinder with the defective bearing is short circuited	Replace worn bearings.
Bearing Failure	
1. Low oil pressure	Refer to problem "Loss of Oil Pressure."
2. Lack of oil	Maintain proper oil level. Check for leaks.
3. Engine runs too hot	Keep engine at normal operating temperature.

Probable Cause	Remedy
Bearing Failure - Continued	
4. Loose bearings	Install new bearings.
5. Improper lubricating oil	Use a suitable oil of non-corrosive type, correct grade and viscosity.
6. Foreign materials entering engine	Use clean oil containers when filling engine with oil and see that all gaskets on the engine are in good condition.
7. Oil lines clogged	Clean all oil passages.
8. Connecting rod bent	Align or install new connecting rod.
9. Crankshaft out of alignment	Straighten or install new shaft.
Valves Sticking	
1. Valve springs weak or broken	Install new springs.
2. Gummy deposits from inferior fuel or oil	Clean and use proper fuel or oil.
3. Valve stems scored or carboned	Clean. Install new valves if necessary.
4. Insufficient clearance between valve stem and guide	Ream guides for proper clearance.
Overheating Due to Restricted Air Flow	
1. Bent fan blades	Straighten and correct pitch of fan blades.
2. Trash between radiator fins	Clean out thoroughly between radiator fins. Use compressed air.
3. Bent radiator fins	Straighten bent fins.
4. Fan housing damaged or missing	Repair or install new fan housing.

Probable Cause	Remedy
Overheating Due to Poor Condition	
1. Restrictions in radiator core or engine water jacket	Drain system. Disconnect hoses and reverse flush the radiator and block.
2. Low coolant level	Fill cooling system to proper level. Check for leaks.
3. Pressure cap loose - coolant escaping	Tighten pressure cap.
4. Fan belt slipping or loose	Tighten if loose. Replace belt if greasy, worn or damaged.
Overheating Due to External Leakage	
1. Defective hoses or connections	Replace defective hoses. Check clamps for fatigue and replace as required.
2. Radiator leaks	Remove radiator. Test for leaks and solder.
3. Damaged gaskets	Check for leaks around water inlet and outlet elbows and cylinder head. Replace defective gaskets.
4. Cracked or warped cylinder head	Replace cylinder head and gasket.
5. Cracked cylinder block	Replace cylinder block.
6. Defective water inlet or outlet elbow . . .	Replace.
Overheating Due to Internal Leakage	
1. Warped cylinder head	Replace cylinder head and gasket.
2. Blown cylinder head gasket	Replace gasket. (Check crankcase oil for presence of water.)

Probable Cause	Remedy
Overheating Due to Internal Leakage - Continued	
Cylinder head cap screws not properly torqued	Torque head cap screws. Refer to page 1-14.
4. Cracked cylinder wall	Replace cylinder block.

Tune-Up

The following steps outline the operations which should be followed in an engine tune-up. These steps point out the various parts of the engine to be checked, cleaned, timed or repaired, as needed. For detailed information on the repair and adjustment of the components of the respective Systems, Fuel and Electrical refer to "Fuel System" Section 2 and "Electrical System" Section 10.

1. Check the throttle control.

(a) Check the operation of the control.

(b) Check the operation of the springs on the governor control rod.

(c) Check the rpm of the engine, using a tachometer.

2. Check the clearance on intake and exhaust valves and make adjustments if necessary. (Refer to "Valve Clearance Adjustments", page 1-15.)

3. Check the air cleaner and connections for possible leaks. Refer to the Operator's Manual.

4. Replace the lubricating oil filter element and clean the filter case assembly thoroughly.

5. Remove the fuel strainer bowl and clean thoroughly.

6. Flush the radiator with clean water, then drain and refill with soft water if available, or anti-freeze solution in cold weather.

7. Check the fan belt for wear and correct tension. Replace if necessary.

8. Check the distributor points, cap and condenser. Replace necessary parts and reset point gap to .020 inch.

9. Check the spark plugs. Replace broken plugs and clean and reset all plugs to be reinstalled. Set gap at .023 inch.

10. Check the ignition coil and the primary wires and be sure the connections are clean and tight. A few broken wire strands on an otherwise sound connection will still result in difficult starting and improper engine performance.

11. Check all electrical connections in both the high and low tension circuits of the ignition system.

12. Check all switches.

13. Remove and clean the carburetor inlet screen.

14. Remove the fuel bowl and check the float level. Adjust if necessary.

15. Check the float valve assembly for leakage.

16. Inspect the generator and cranking motor commutators and clean.

17. Check the ignition timing and correct if necessary. Set timing at 16^{o} before T.D.C. at high idle.

18. Check the compression pressures. Refer to "Specifications".

Section 2

FUEL SYSTEM

CONTENTS

GSS-1408 (Rev. No. 1)

Printed in United States of America

Specifications

Carburetor	154	185
Type	Up draft	Up draft
Model and size - inch	IH - 3/4	Zenith 68YY7
Liquid level - inch	9/16 - 5/8	1/2
Float height - inches	1-13/32	1-5/32
Float drop - inch	3/16	—
Bleed	56	—
Main metering jet size	.040 inch	21
Idle jet	75	12
Discharge nozzle	39	50 (drill size)
Venturi	19	17MM
Needle valve seat	52	35
Governor		
Engine rpm		
Low idle ± 25	475	600
High idle ± 25	2420	2510
Rated load ± 10	2200	2300
Governor spring		
Free length - inches	1-9/16	1-9/16
Test length - inches	2-5/32	2-5/32
Test load - pounds	39	39
Bumper spring		
Free length - inch	7/8	7/8
Test length - inch	5/8	5/8
Test load - pounds	10.5	10.5
Governor weight to pin clearance - inch	.001 - .004	.001 - .004

Carburetor

GENERAL DESCRIPTION

The fuel system consists, basically, of a fuel supply tank, fuel shut-off valve, fuel strainer, carburetor, intake-exhaust manifold, air cleaner and a variable speed governor.

Liquid fuel flows from the supply tank by gravity through the fuel strainer and sediment bulb to the carburetor. Air enters these naturally aspirated systems through the air cleaner, where dirt and abrasive material are removed.

Clean air and fuel is metered to the engine by the carburetor; in varying proportions to meet the changing demands of load and speed. The variable speed governor controls the carburetor throttle to admit a greater or lesser volume of air-fuel mixture. This supports the operator's demand for engine speed, and provides power to maintain that speed, up to the capacity of the engine.

The operation, inspection, repair and adjustment of the various parts of the fuel system are covered in the following divisions of this service manual section, under appropriate major headings.

CARBURETOR OPERATION

The function of the carburetor is to meter the required amount of fuel to meet varying demands of engine load and speed, and to discharge this fuel into the intake air stream in as fine a spray as possible.

The air-fuel ratio is not constant for all loads and speeds. Idle and low speeds require rich fuel mixture; full load, full speed operation requires the leanest fuel mixture. The modern carburetor with its air-bleed-well method of compensation, will give these proportionate air-fuel mixtures to meet load-speed demands, resulting in smooth, economical engine performance. To simplify the explanation of how the carburetor functions, we will divide it into four systems and discuss each, separately.

- FUEL SUPPLY SYSTEM
- IDLING SYSTEM
- LOAD SYSTEM
- STARTING SYSTEM

Fuel Supply System

The fuel supply system is that portion of the carburetor consisting of the fuel inlet strainer, fuel needle valve and seat, fuel float, fuel bowl and the bowl air vent.

The function of the float and fuel needle valve is to maintain an even level of fuel in the bowl. The float assembly consists of a float-body soldered to a float lever. This assembly hinges on the float axle supported by a bracket on the bowl cover. Fuel from the supply tank enters the bowl through the inlet strainer and the float needle valve. As the level of fuel rises in the bowl. the float is carried upward until the float lever forces the needle valve against its seat, stopping further inflow of fuel.

While the engine is in operation, fuel flows from the bowl through the main metering jet to the load system or idling system and the float valve maintains just enough opening to sustain a constant level of fuel in the bowl.

The bowl air vent passage is a drilling in the throttle body connecting the float chamber with an air vent channel surrounding the venturi. Air for the bowl vent, the well bleed and the idling system is taken from this channel in the venturi which, in turn, is vented to the carburetor main air intake. In this manner, all air taken into the carburetor is supplied through the air cleaner. This not only prevents entry of dirt and abrasives, but creates what is called a "balanced" vent.

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The ratio of air and fuel mixture from a "balanced" carburetor will not be seriously affected by changes in condition of the air cleaner as it becomes restricted by accumulation of dirt. A balanced type carburetor must have an airtight seal between the bowl and the bowl cover, since any air admitted into the bowl other than through the calibrated vent, will upset the ratio of air-fuel delivery and also allow entry of dirt.

In review, sustained constant level of fuel in the bowl, together with controlled venting of the bowl, insures a stable supply of fuel to the various metering systems and is unaffected by the height of fuel in the supply tank or normal operating changes in air cleaner condition.

Idling System

The idling system consists of an idle discharge port, idle adjusting needle, idle jet and the connecting channels and air bleed. This system controls the mixture at partially opened throttle for idle and slow engine speeds, until the throttle is opened sufficiently to allow the load system to function.

Fuel for the idling system enters the well through the main metering jet and is drawn through the idle jet calibration into the idle passage where it is mixed with air from the idle air bleed. The air-fuel mixture enters the air stream past the throttle plate, from the idle discharge port. The idle air adjusting screw on the carburetor is turned toward the seat to enrich the air-fuel mixture.

Load System

The load system consists of the venturi, discharge nozzle, well, well air bleed, and main metering jet. The load system as the name implies, controls the air-fuel mixture during the time the engine is loaded or is operating above idle speed.

When the throttle plate is opened a short distance beyond the idle port, a sufficient amount and velocity of air passes the venturi, and the discharge nozzle to draw fuel from this source. This condition starts the load system functioning. Within a partial load-speed range of throttle plate movement, both the idling system and load system are delivering fuel. Further opening of the throttle plate, due to increased engine load-speed results in diminished delivery of fuel from the idling system. Ultimately, all delivery of fuel from the idling system is stopped and air is being drawn from this source into the well.

The main metering jet has a calibrated opening large enough to permit the flow of the maximum amount of fuel necessary for full load operation. When the engine is stopped or idling, the level of fuel in the well and discharge nozzle is similar to the level in the fuel bowl. As the load system goes into operation with increased load and throttle opening, the fuel is drawn from the discharge nozzle at a higher rate than supplied to the well by the main metering jet. This lowers the level of fuel in the well. As the load and throttle opening is increased, the fuel level in the metering well drops below a series of "A" air bleed holes in the discharge nozzle, admitting an increasing amount of air from the well air bleed. This metered addition of air to the discharge nozzle is necessary to compensate for the fact that the partial vacuum produced at the nozzle increases out of proportion with the increased velocity of air through the venturi. Were it not for this well-air-bleed compensation, the proportion of fuel to air would rapidly increase with the throttle opening, producing an extremely "rich" mixture at full throttle, full load operation.

A small additional amount of fuel is necessary to insure prompt response for engine acceleration. When the throttle is suddenly opened, the resulting rush of air through

the venturi picks up this necessary extra fuel which remains above the main metering jet in the metering well during part throttle operation.

Starting System

The starting system consists of a manually operated choke valve mounted in the carburetor main air intake. When the choke valve plate is turned to the closed position, it restricts the air entering the carburetor.

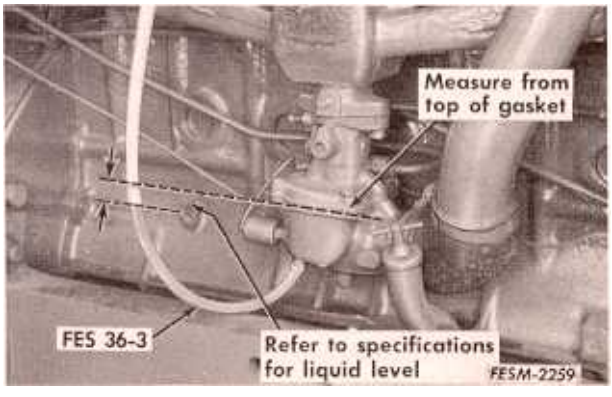
It does not, however, restrict the main air vent passage. This upsets the balance of the carburetor, allowing the increased suction to draw strongly upon the fuel discharge openings when starting the engine.

When the outside air, manifold, and engine combustion chambers are cold, it is necessary to supply a very "rich" starting mixture. Only the "lighter-ends" or more volatile portions of the fuel can be vaporized because of the low temperature and the slow movement of air past the discharge nozzle due to low cranking speed. The necessary large quantity of fuel is supplied by closing the choke valve during the cranking period. As the engine gathers speed and warms up, the choke valve is manually opened to lean out the air-fuel ratio to a normal mixture.

An opening is provided in the bottom of the carburetor main air intake to drain off any excess unvaporized fuel which may return from the manifold. This opening is protected against the entry of dust and abrasives by a felt filler. Should this filler shrink and deteriorate from age, dirt may be drawn into the engine contributing to excessive engine wear. Should this opening be painted over or otherwise plugged, no drainage is possible and flooding with raw fuel can occur if the fuel float valve leaks.

LIQUID LEVEL CHECK
(Carburetor on Engine)

The liquid level in the carburetor can be checked with the carburetor on the engine using tool FES 36-3.

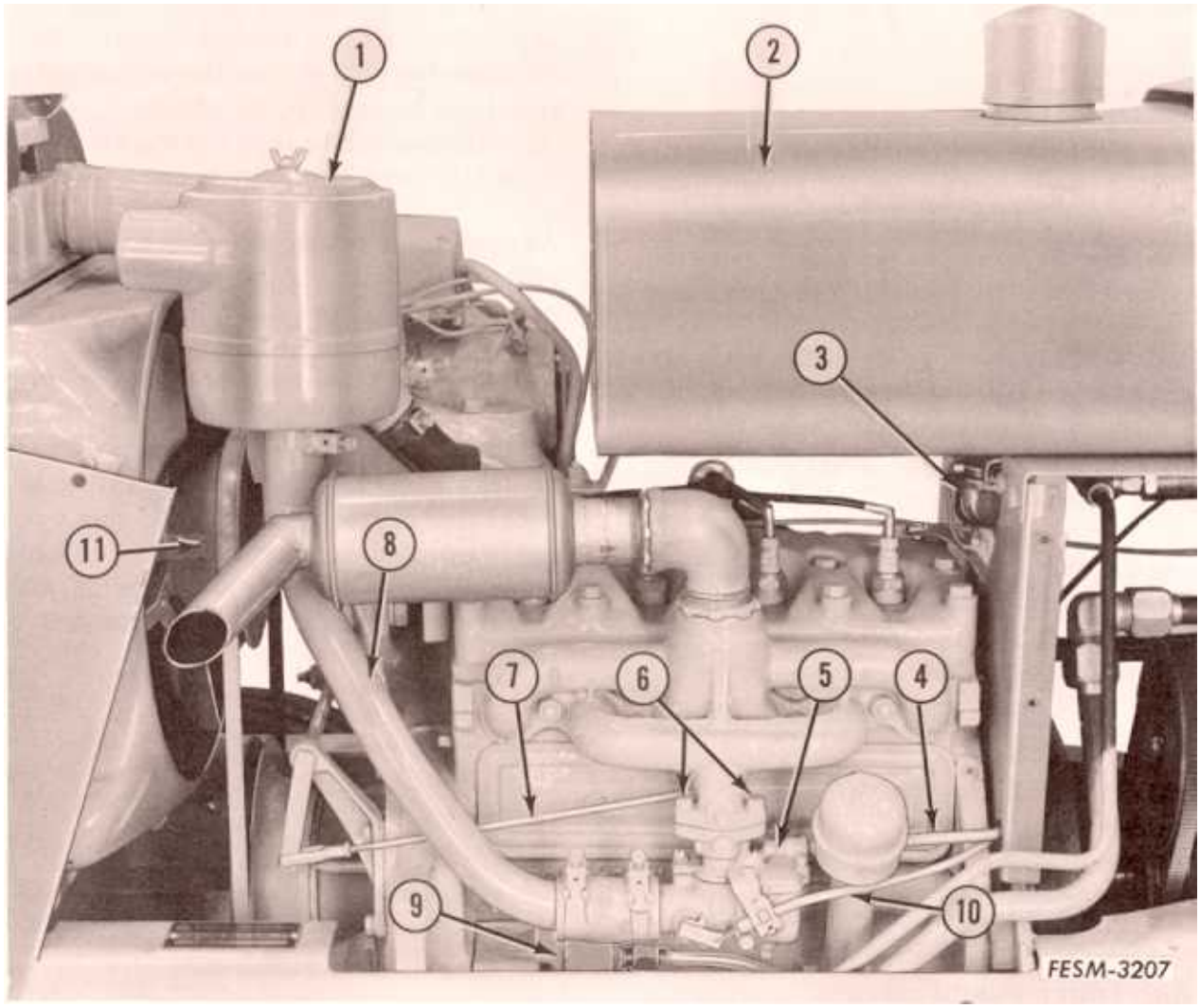


1. Close the fuel shut-off at the fuel tank.

2. Remove the drain plug at the bottom of the carburetor. Attach the tool FES 36-3 as shown.

3. Open the fuel shut-off. Fuel will flow into the tube and seek the same level as the liquid level in the carburetor.

4. Measure the distance between fuel level in the tube to the top of the fuel bowl gasket. This will be the liquid level in the carburetor. Refer to specification for specified liquid level.



1. Air cleaner
2. Fuel tank
3. Fuel strainer
4. Fuel line
5. Idle mixture adjusting screw
6. Cap screws
7. Throttle control rod
8. Air cleaner pipe
9. Hydraulic pump
10. Choke wire
11. Cooling fan assembly

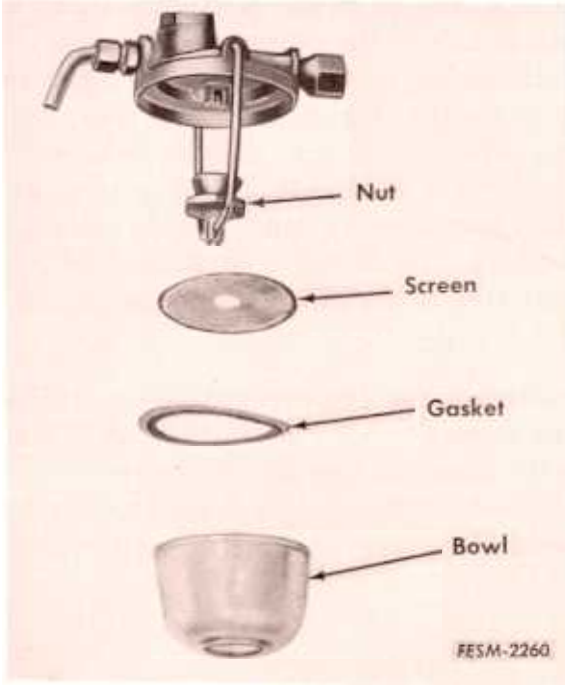
REMOVAL AND INSTALLATION OF CARBURETOR

Before removing the carburetor from the engine for cleaning, inspection or repair, clean the area and various connecting points to prevent entry of dirt into those parts which remain with the engine. Failure to perform this simple operation may result in an ultimate condition much worse than that which made the carburetor removal necessary.

After the carburetor is removed, inspect the air cleaner pipe and hose for possible air leaks wherein dirt and abrasives could enter the engine. Discard the carburetor flange gasket. Clean manifold flange of any scraps of old gasket which may adhere and would prevent sealing of new gasket.

When reinstalling the carburetor, care must be used in securing air and dust tight connections of air cleaner pipe and hose. Renew if necessary. Before reconnecting the fuel line to the carburetor, remove and clean sediment bowl and screen. Use new bowl gasket in replacing sediment bowl. Open the fuel tank valve momentarily to flush line and observe for free flow of fuel.

After the carburetor is reinstalled on the manifold, recheck the adjustment of the governor-to-carburetor control rod to insure wide open throttle at full load demand of governor, as follows. With engine stopped, advance engine speed control hand lever to create tension on the governor spring. Adjust length of governor-to-carburetor control rod so that the rod slides freely into the throttle lever, when the throttle is wide open. Lengthen governor-to-carburetor control rod by one turn in its clevis to place spring load on throttle lever, insert cotter pin and tighten lock nut on clevis. Return the speed control hand lever to a position slightly advanced from low idle position. In this condition, check the governor-to-carburetor control rod for any tendency toward binding. It may be necessary to loosen the clevis lock nut and reposition the clevis slightly to insure both ends being in the same plane to eliminate binding (after which the lock nut is retightened). Refer to the division on governor for coverage of governor adjustments.



Assemble the choke control wire and tube, being sure full movement of choke valve is assured with the full movement of choke control knob.

INSPECTION AND REPAIR

Before disassembly of the carburetor, clean the outside surfaces of dirt accumulations so that the solvent used to clean the dismantled parts will not become contaminated.

In order that individual parts may be given a thorough inspection, cleaning is important. The use of a good carburetor cleaning solvent is necessary to dissolve gum and varnish-like coatings commonly found in carburetors. The slow buildup of these coatings in jets and calibrated openings of the carburetor restricts the normal flow of fuel, and must be completely dissolved and removed to restore the original fuel flow characteristics. Where a good commercial carburetor cleaner is not available, equal parts of alcohol and benzol may be used.

After the dismantled parts have remained in the solvent long enough to dissolve the coatings, remove and rinse in petroleum base cleaning solution. Dry all parts with compressed air, blowing through all jets and channels in both directions to assure that they are clear and clean.

CAUTION: Do not use drills or wires to clean calibrated openings; any slight enlargement of these jet openings will affect the operation. Use only gum solvent and compressed air for cleaning.

Throttle Body and Fuel Bowl

The castings should be inspected for damage or broken flanges. Check mating surfaces for warpage. Where such warpage does not exceed 0.010 inch, the surface involved may be lapped on a flat surface using "00" sandpaper. Clean thoroughly after the sanding operation.

Normal clearance between the choke shaft and bowl casting bore is 0.002 to 0.005 inch. Where use of a new shaft will still result in a shaft clearance of 0.007 inch or more, the bowl casting should be replaced. Excessive wear at this point makes it impossible to seal out dirt at the seals.

The normal clearance between the throttle shaft and throttle body bore is .001 to .002 inch. Where the use of a new throttle shaft will not hold the clearance below 0.005 inch, the throttle body assembly should be replaced. Excessive wear of this throttle shaft bore will result in dirt and air leakage past seals and poor alignment of the throttle plate, affecting engine idling and governor action.

Throttle Plate

The throttle plate should be inspected for burrs or damaged edges which would prevent good contact with the throttle body bore when fully closed. Never use a buffing wheel or wire brush to clean this plate, its sharp edges must not be deformed.

When installing the throttle plate, insert it into the shaft from the top of the throttle body with the short end of the plate down (measured from the holes). Insert screws from the top, but do not tighten until the throttle plate is centered in the body bore.

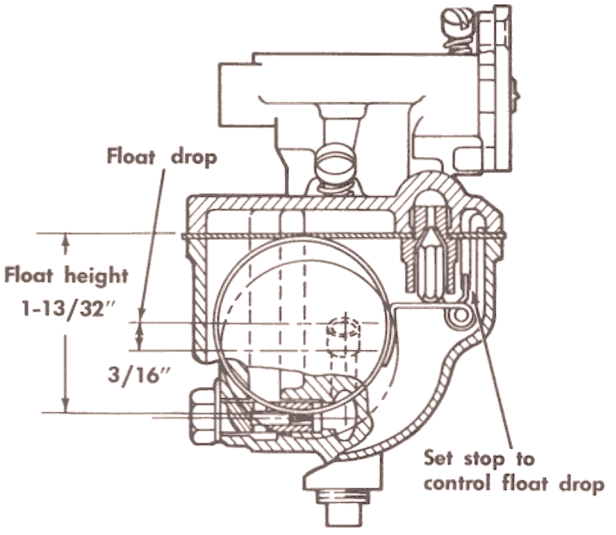
Unscrew the throttle stop screw until the plate is allowed to close fully. Holding the shaft lightly in the closed position, tap lightly on the face of the throttle plate with a brass rod to jar it into a centered position. The screws may then be tightened. The throttle plate must fit the bore closely with a minimum of light showing around its edges. The throttle shaft must be perfectly free to turn without binding at any point.

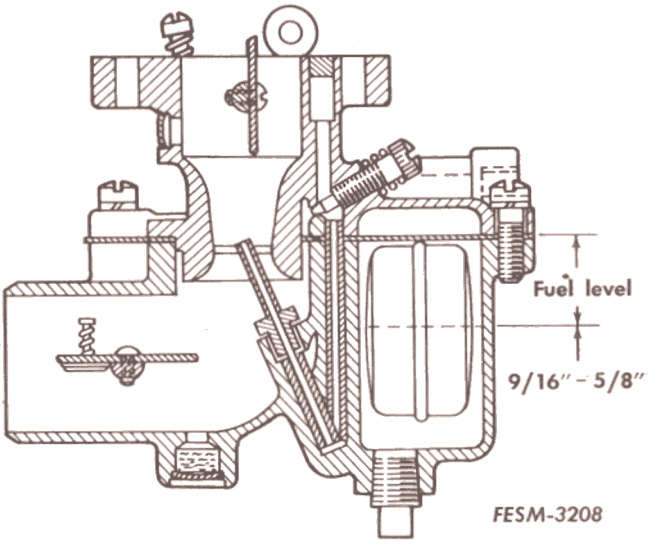
Clinch over the exposed end of the throttle plate screws to lock them in place. This can be done by using special plier FES 36-4. This must be done with care to prevent distortion of throttle shaft or plate.

Float Assembly

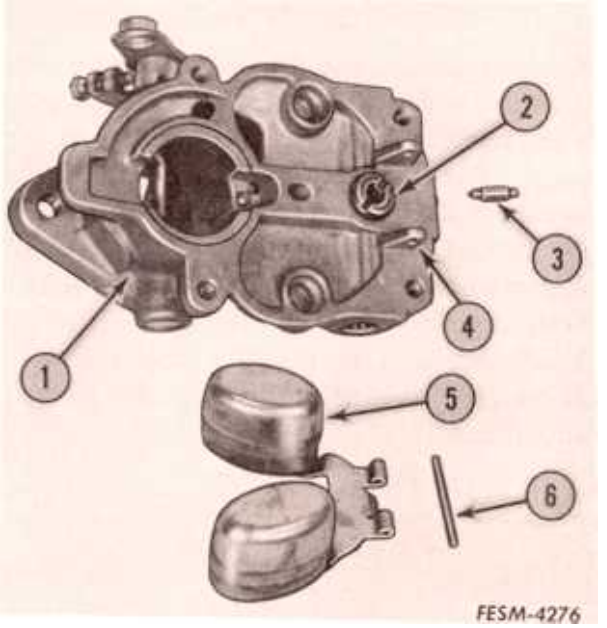
Replace the float assembly if float is loaded with fuel or if the float lever axle bearing is worn excessively. Inspect top side of the float lever for wear where it contacts the fuel needle valve.

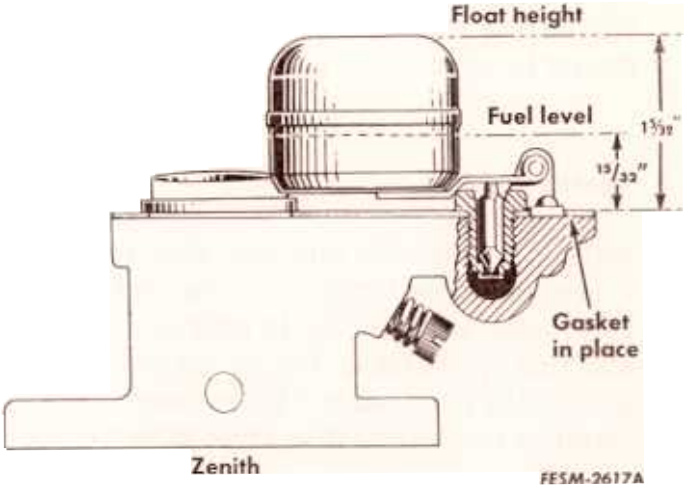
The float axle should be replaced if any wear can be detected on its bearing surfaces.





IH CARBURETOR





1. Throttle body	4. Float axle support
2. Fuel valve seat	5. Float
3. Fuel valve	6. Float axle

ZENITH

Fuel Needle Valve and Seat

If any wear can be detected on the valve face, the needle valve and seat assembly should be replaced. The float assembly, its axle, and the fuel valve are responsible for maintaining a stable and correct fuel level; all parts must be maintained in good condition. Only slight bending of the float lever should be necessary to secure the correct float height. The float lever stop where used, should be adjusted to control float drop. Proper setting of float drop prevents the float from striking and wearing on the bottom of the bowl when operating over rough terrain.

Adjusting Screw and Seat

The idle adjusting needle point must be smooth and free from grooves, caused by being closed forcibly against its seat. Where this condition is found, a new screw should be used.

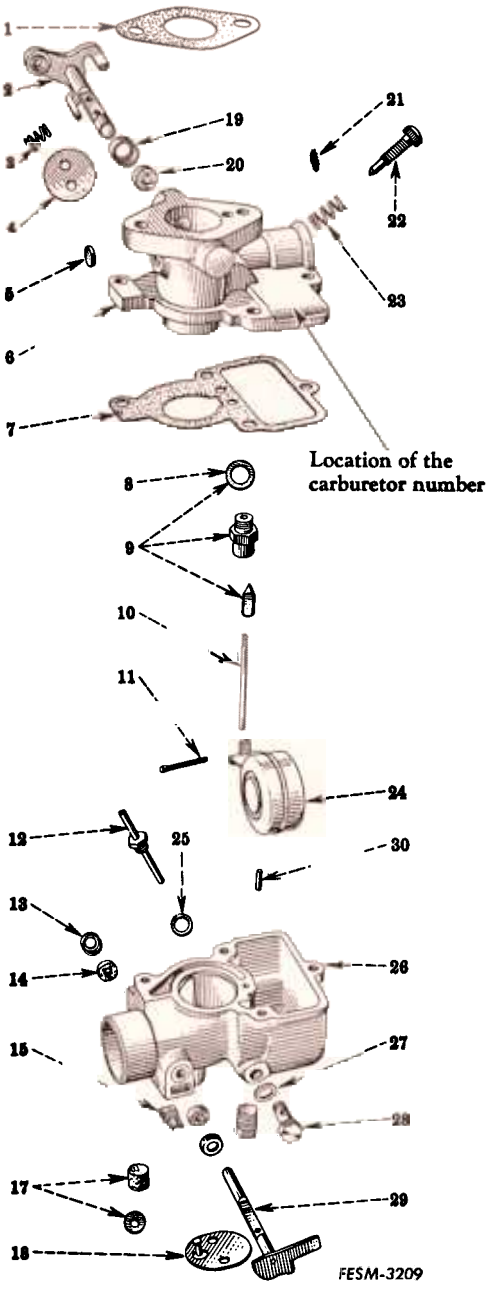
Venturi and Jets

Inspect the venturi, jets and other calibrated openings for possible damage from improper probing in previous cleaning operations. Use the carburetor identifying part number to be found stamped on a metal disc riveted to the throttle body when selecting replacement parts. Make sure you are using the parts catalog for the tractor and engine involved and that parts selected are from list headed with the carburetor identifying parts number. Failure to take this precaution when renewing parts could result in a carburetor completely out of calibration and an operation lacking power or economy.

ASSEMBLY AND ADJUSTMENT

Upon reassembly of the carburetor, be sure all new gaskets and seals are used throughout and are properly installed to insure gas tight connections. Use care when assembling fuel bowl to throttle body to prevent damage to the float assembly or the idle jet tube.

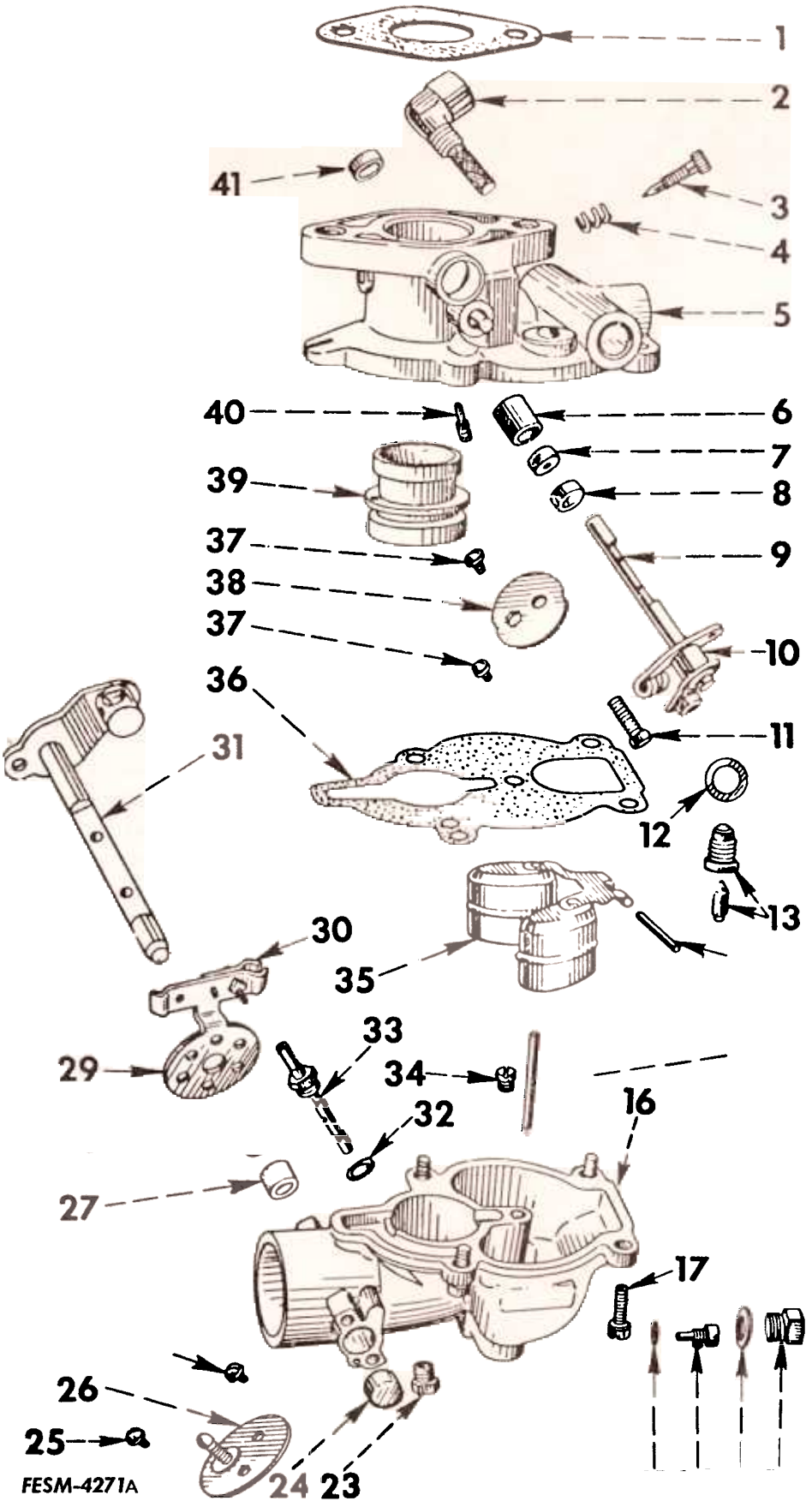
When replacing the idle adjusting screw, turn it down carefully until lightly seated. Then back it up to approximately one turn open. Forcible seating of the screw will result in damage to the tapered face of the screw and to its seat. The throttle stop screw should be set to hold the throttle plate slightly open. These settings of the idle screw and the throttle stop screw serve only as a starting point for idle adjustment.



1. Gasket
2. Throttle lever and shaft assembly
3. Idle set screw retainer spring
4. Throttle butterfly
5. Throttle body expansion plug
6. Throttle body assembly
7. Fuel bowl gasket
8. Float needle valve cage gasket
9. Float needle valve cage assembly
10. Idle tube
11. Float lever pivot
12. Discharge nozzle
13. Choke shaft dust seal retainer
14. Butterfly shaft dust seal
15. Starting shutter friction spring
16. Not used
17. Drip hole filler replacement package
18. Starting shutter assembly
19. Butterfly shaft dust seal retainer
20. Starting shutter shaft dust seal
21. Strainer screen
22. Idle adjusting screw
23. Idle adjusting screw retainer spring
24. Float and lever assembly
25. Discharge nozzle gasket
26. Fuel bowl assembly
27. Main metering jet gasket
28. Main metering jet
29. Choke valve shaft
30. Main air bleed

Exploded view — IH carburetor.

1. Gasket
2. Elbow and strainer
3. Idle adjusting needle
4. Spring
5. Throttle body
6. Throttle shaft bushing (if used)
7. Throttle shaft seal
8. Seal retainer
9. Lever and shaft
10. Taper pin
11. Throttle stop screw
12. Fuel valve washer
13. Fuel valve and seat
14. Float axle
15. Idle filler tube
16. Fuel bowl
17. Screw
18. Lower plug
19. Fibre washer
20. Main jet
21. Washer
22. Drain plug
23. Drip plug filter
24. Plug
25. Screw
26. Choke plate
27. Washer
28. Packing retainer
29. Choke valve bracket
30. Bracket clamp
31. Lever and shaft
32. Fibre washer
33. Main discharge jet
34. Well vent jet
35. Float assembly
36. Gasket
37. Screws
38. Throttle valve plate
39. Venturi
40. Idling jet
41. Plug



Exploded view – Zenith carburetor.

Adjustment of the carburetor should not be attempted until the engine has reached normal operating temperature. Then adjust throttle stop screw for the specified low idle speed and set the idle adjusting screw for smoothest engine operation. Advance the engine speed control lever for a few seconds and again idle engine, rechecking the idle adjustments for specified low idle speed and smoothest operation.

DIAGNOSING ENGINE TROUBLES

Servicemen should not be too quick in condemning carburetor operation. Poor fuel economy, loss of power, poor recovery from overload, or poor acceleration are not necessarily results of inadequate carburetion. Fuel system conditions that can affect fuel economy, while important, are relatively few in number. Make sure that none of the following conditions exist; but don't limit your investigation to the fuel system.

Fuel system conditions affecting fuel economy:

1. Float valve leakage or high fuel level.

2. Damaged or enlarged jet openings.

3. Unbalanced conditions due to bowl gasket failure or dirt-plugged air bleeds or vents.

4. Poor setting of idle adjustment to match fuel or to meet a continuing load condition.

5. Failure to return choke valve to full open position.

6. Plugged air intake and/or air cleaner.

Fuel system conditions affecting power loss:

1. Low fuel float level.

2. Obstructed fuel passages, jets or screens from dirt or fuel gum.

3. Obstructed air bleeds in carburetor.

4. Lean setting of idle adjustment.

5. Air leakage between carburetor and manifold or between manifold and intake valve ports, or cracked intake manifold.

NOTE: Conditions where engine would draw in unfiltered air will also result in rapid and excessive engine wear from dust and abrasives.

6. Carbon or coke in intake manifold, at hot spot or heated jacket, restricting the amount of air-fuel mixture available to the engine.

7. Excessive clearance between throttle shaft and throttle body.

8. Poor governor action due to wear, misalignment or binding of moving parts.

9. Plugged air intake and/or air cleaner.

Governor

PRINCIPLES OF OPERATION

The engine governor is of the fly-ball, variable-speed type. It is designed to maintain a selected engine speed within reasonably constant limits under varying load conditions, by proportioning the fuel to the load.

For its action, the governor depends upon centrifugal force developed by weights rotating about a shaft. A variable governor spring is used to counteract the centrifugal force or outward movement of the weights. This movement of the governor weights, through suitable linkage, controls the carburetor throttle opening.

When the operator starts the engine and sets the engine speed control lever for a desired speed, the governor weights move outward with the increasing speed until the centrifugal force on the weights counterbalances the tension of the governor spring. When this condition is reached, the carburetor throttle has also been moved to a position where the air-fuel mixture admitted is sufficient to maintain this desired speed.

The operator controls engine speed by use of the engine speed control lever, increasing or decreasing the governor spring tension -- not by direct connection with the carburetor throttle valve.

Increasing the governor spring tension moves the governor weights inward which, in turn, moves the throttle further open, thereby increasing the engine speed until the increased centrifugal force of the governor weights counterbalances the greater spring tension.

Decreasing the governor spring tension allows the centrifugal force to move the weights outward, closing the throttle and thereby decreasing the engine speed until the decreasing centrifugal force and the reduced spring tension again balance each other.

When a change in load occurs, there is a momentary change in engine speed. This causes the governor weights to move inward or outward, thereby opening or closing the throttle sufficiently to maintain a reasonably constant engine speed up to the full load capacity of the engine. The speed variation between fast idle and rated load speed will normally be about 10 percent in these tractor governors.

Adjustment is provided in the linkage between the governor and the carburetor to synchronize the position of the throttle with a position of the governor weights. This adjustment is most important, since it insures the full power response of a wide open throttle when the governor weights are collapsed by the reduction in speed due to application of a full load to the engine.

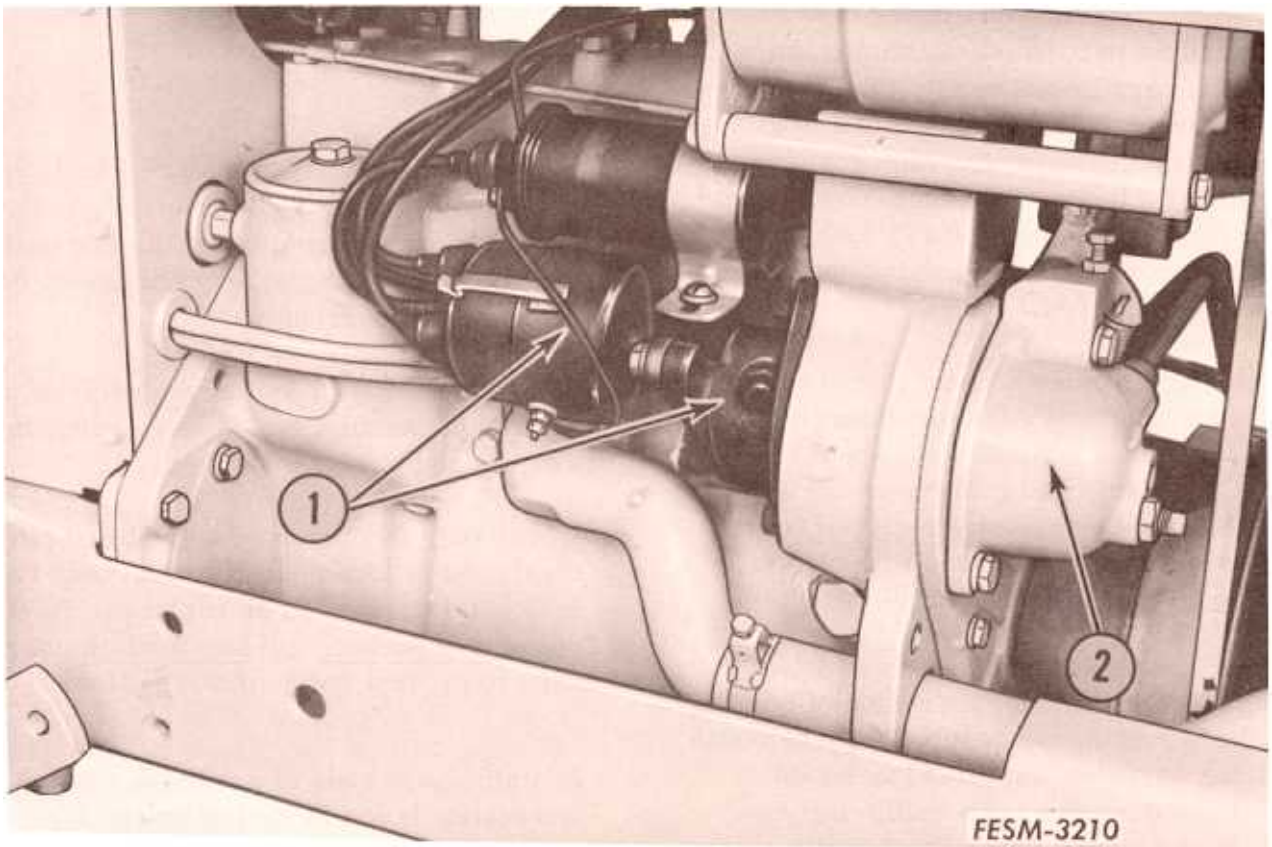
In review: With an engine supporting its load and maintaining a desired governed speed, three factors have reached an almost perfect balance. These are the forces of (1) governor spring tension (2) centrifugal force on governor weights, counteracting the effects of (3) load on the engine speed. Slight changes in load (within engine capacity) will cause slight changes in engine speed, upsetting the balance of forces and thereby opening or closing the carburetor throttle until the forces are again brought into balance.

To insure smooth, surgeless, and prompt response of the governor, all of its moving parts and linkage must move freely to follow slight changes in engine load-speed. Should binding occur at any point, a greater change in speed will take place before sufficient centrifugal force or spring tension is built up to overcome the friction and move the throttle valve. Friction increases and binding often occurs because of wear and misalignment of the carburetor throttle shaft. Sludge deposits in the governor housings can cause sluggish or rough action of governor parts and linkage. Wear of governor weights, pins, sleeve, rockshafts, or rockshaft lever also result in surging and erratic governor action.

REMOVAL, INSPECTION AND REPAIR

The governor drive gear also serves as the ignition unit drive. The governor drive gears are marked for proper mesh with mating gears at top dead center of number one cylinder compression stroke. Some reassembly time may be saved if the engine is turned to this position before removal of the governor assembly.

Before removing any of the governor assemblies for inspection or repair, clean the surrounding area and the various connecting points to prevent entry of dirt into those parts which remain with the engine.



1. Ignition unit
2. Governor assembly

After disassembly of the governor, start the cleaning of parts with a clean container of clean solvent. Wash ball bearings first. Do not spin bearings while washing. Turn them slowly back and forth while dipping the bearing up and down in the solvent to dislodge dirt. Blow out with compressed air, holding the parts to prevent the air blast from spinning them, to avoid possible scratching of balls and grooves. Flush again in clean solvent and blow-dry a second time. Examine under good light to determine if further cleaning is necessary. Add a few drops of oil to the balls and grooves, then, and only then, spin by hand to test for roughness and wear.

Wash and clean the remainder of the rotating parts in solvent, examining the weights, carrier and weight pins for damage or wear. Clearance between new weights and new pins for each governor is .001 to .004 inch. Clearances found to exceed those specified by 0.003 inch or more would be considered excessive and parts should be renewed.

Wash and clean the housing and remaining parts and examine each for damage or excessive wear. No attempt should be made to salvage old gaskets or seals. They should be carefully removed from the assembly and replaced with new to insure an oil tight, dust proof operation.

Where sludge accumulations are found in the governor housing, corrosion of bearing surfaces may have occurred. These rough bearing surfaces and their increased frictional drag are responsible for poor governor action. Excessive bearing clearance also results from sludge corrosion.

The decision on what new parts should be used to rebuild the governor assembly will be based upon the wear found and the condition of the following groups of parts:

1. Weights, pins, and weight carrier: Clearance in excess of 0.003 inch over that specified between pins and weights or carrier.

2. Governor shaft bearings and thrust bearing: Rough, pitted bearing surfaces of either plain or ball type bearings.

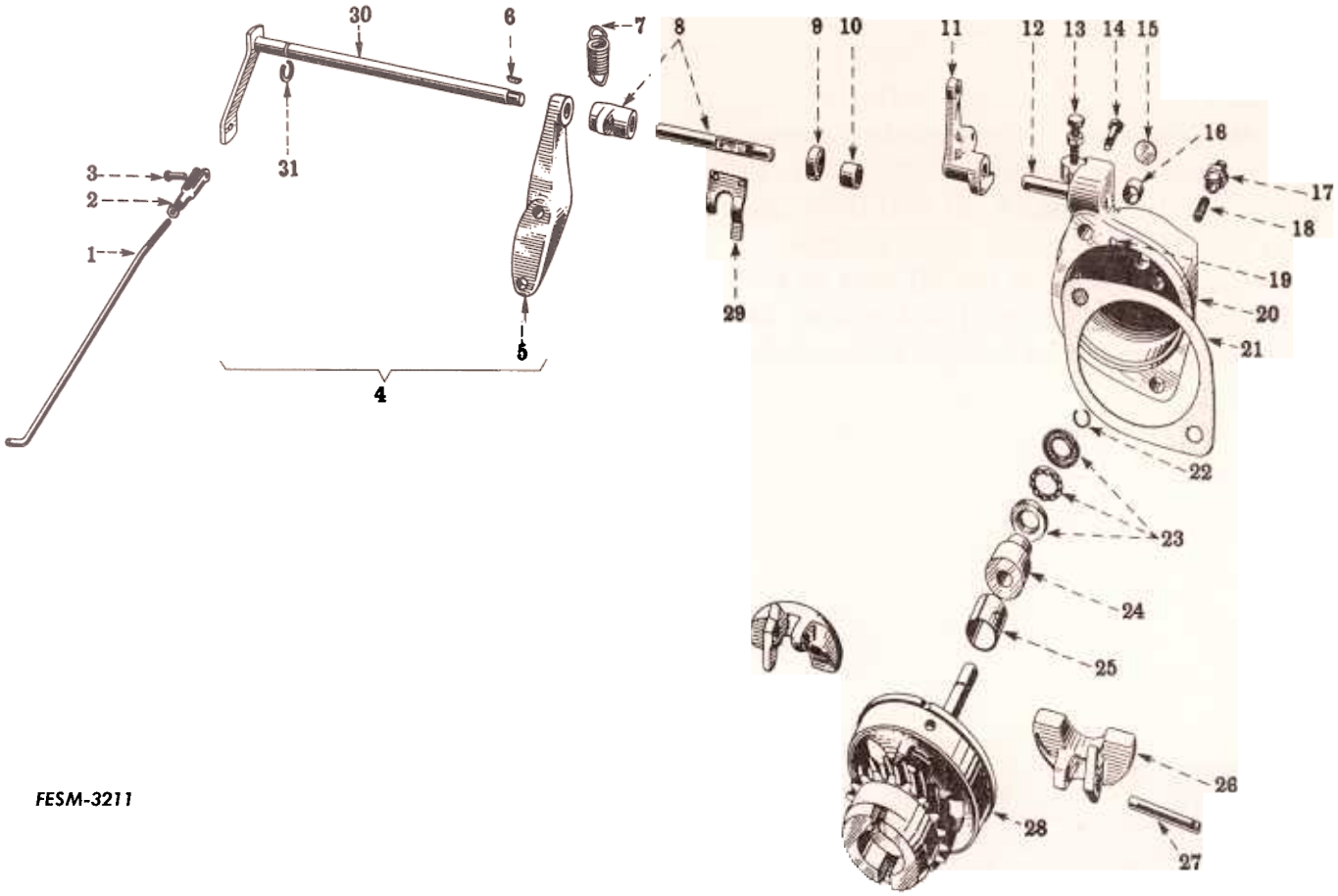
3. Rockshaft, rockshaft fork, bearings and levers: Worn or damaged rockshaft, rockshaft fork or spring levers. Rough, pitted bearings and bearing surfaces.

Where all three conditions are found, the use of new complete governor assembly should be considered, since the few parts which can be salvaged may not cover the labor cost of overhaul.

Where conditions 1 and 2 are involved, the rotating assembly, including new bearings, weights and pins, should be used.

Where only the governor weight and pin clearance is found questionable, only these individual parts need be replaced. In all cases new gaskets and new seals must be used to prevent entry of dirt and loss of oil.

Examine hook ends of governor springs and mating holes in spring levers for wear. Replace these parts where appreciable wear is found.



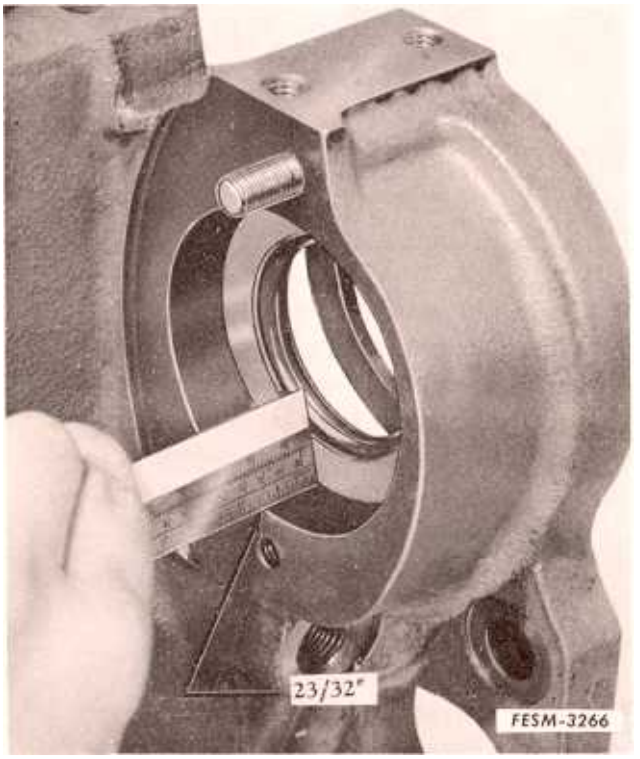
FESM-3211

1. Governor connecting rod
2. Adjusting rod end clevis
3. Rod end pin
4. Rockshaft and bracket extension assembly
5. Rockshaft extension bracket
6. Woodruff key
7. Governor spring
8. Governor and spring rockshaft assembly
9. Rockshaft oil seal
10. Rockshaft bearing
11. Spring throttle lever
12. Throttle lever shaft
13. Speed change lever stop
14. Screw
15. Expansion plug
16. Governor shaft bushing
17. Bumper spring body
18. Bumper spring
19. Governor base dowel pin
20. Governor housing assembly
21. Governor housing gasket
22. Governor sleeve stop ring
23. Governor thrust ball bearing
24. Governor thrust bearing
25. Governor base bushing
26. Governor weight
27. Governor weight pin
28. Governor with carrier and pin shaft
29. Governor tension fork
30. Rockshaft extension assembly
31. Rockshaft extension stop ring

Care must be taken in the reassembly of the governor rockshaft, rockshaft fork, bearings and seal to insure uniformly smooth movement of the rockshaft from one extreme of movement to the other. Lubricate the rockshaft oil seal thoroughly upon installation. Some slight friction resulting from drag of the oil seal on the shaft is unavoidable, but friction from any other source must be held to a minimum.

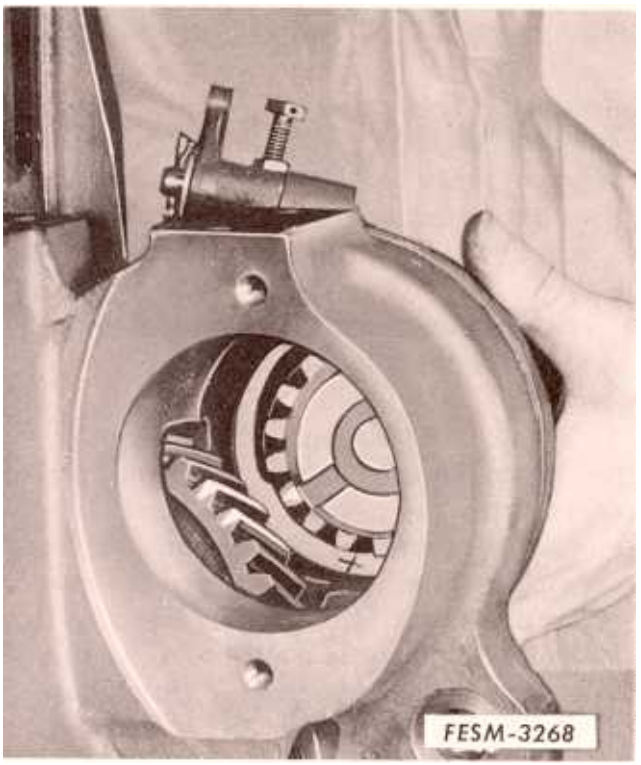
Any rough, jerking movement of the rockshaft must also be eliminated to prevent surging and erratic governor action.

Governor shaft end clearance is adjusted by placing 0.020 inch thickness of feeler gauge stock between drive gear and governor base when pressing the gear on the assembly. After gear is pressed in place, the end clearance should be within the range of 0.020 to 0.025 inch.



INSTALLATION

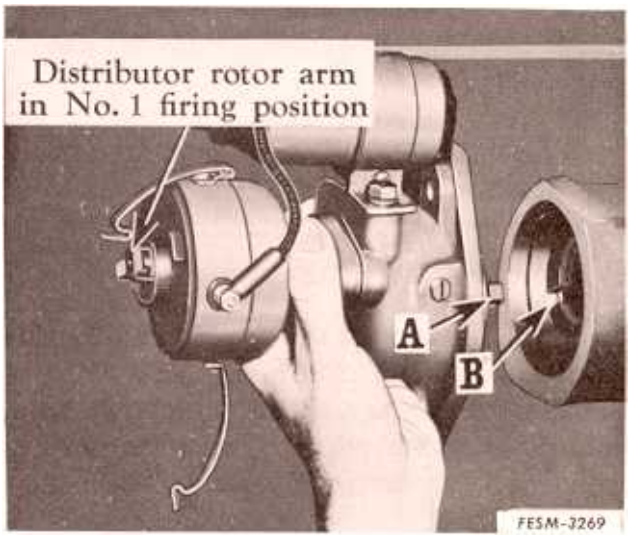
Install the governor - ignition drive oil seal with seal lip facing forward; the seal must be square in the crankcase bore and positioned 23/32 inch in from the ignition mounting flange face. The seal mating surface on the outside diameter of the gear hub must be smooth and free of cuts or scratches to prevent rapid wear or damage to seal lip. Any sharp edges on gear hub slots should be removed to prevent damage to seal during installation of governor assembly.



Install the governor assembly and ignition unit using new mounting gaskets, insure proper ignition timing as follows:

1. With the engine positioned at top dead center of number one cylinder firing stroke, locate the single punch mark between teeth of idler timing gear. Use chalk to mark top surface of two teeth on each side of punch mark.

2. Chalk the rear end of the punch marked tooth on the governor drive gear.



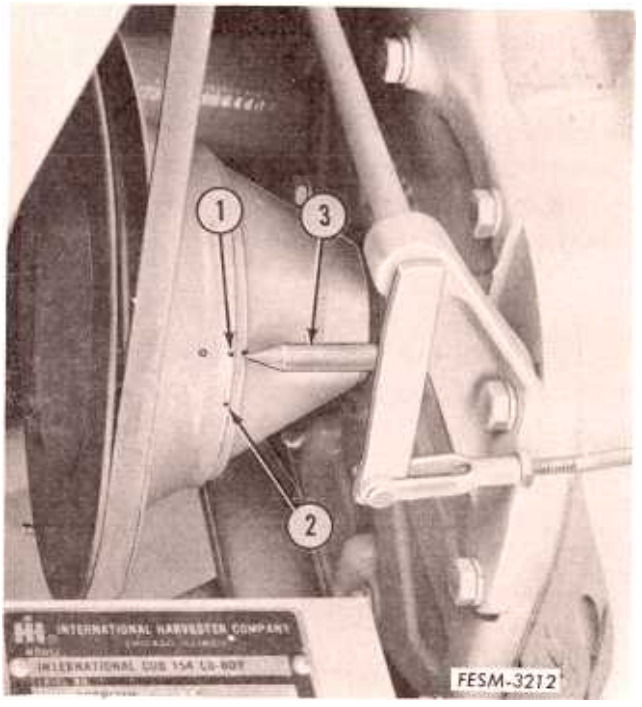
3. Install the governor assembly, meshing the marked gear teeth.

4. Position the ignition unit distributor rotor arm and (A) drive shaft lugs for firing number one cylinder. Install ignition unit on engine, meshing (A) lugs and (B) drive slots.

NOTE: Remove spark plug cables 2, 3 and 4 and ground them to prevent any chance of accidentally starting the engine.

5. Remove the number one spark plug cable from the number one spark plug and position the end of the cable so a spark discharge to "ground" will be audible while hand cranking the engine.

6. Advance or retard ignition distributor, until spark occurs as the O mark on fan drive pulley aligns with pointer while hand cranking engine.



1. O mark
2. 16° mark
3. Timing pointer

ADJUSTMENT

After installation of either new or overhauled governor assemblies, it is important that a thorough check of all four adjustments be made. The basic governor assembly may be in perfect condition, but in order to insure its full range of control it must be adjusted to its individual engine.

1. Synchronizing the governor-to-carburetor throttle movement.

Because of possible change in center-to-center distance between governor and carburetor, due to removal and replacement of manifold, carburetor or governor assemblies, the linkage between the governor and carburetor must be adjusted to establish the throttle position in relation to governor weight position. This adjustment insures the full power response of a wide open throttle when the governor weights are collapsed by reduction in rpm by application of heavy load. This governor-to-carburetor linkage must be free from binding throughout its range of movement. Adjustment procedure for all engines follows:

a. With engine stopped, advance the operator's engine speed control lever to about half speed position; sufficient to create tension on the governor spring.

b. Disconnect governor-to-carburetor control rod (either end). Hold carburetor throttle against its stop in wide-open position and adjust length of governor-to-carburetor control rod so that it may be reconnected freely without moving throttle lever or governor lever.

c. Shorten control rod one turn from the above condition, to compensate for wear, and reconnect.

d. After tightening the control rod clevis lock nut, check to be sure that both ends of the control rod are in the same plane, to eliminate possibility of binding on levers.

e. Move operator's engine speed control lever a few times between half speed and low speed position, checking the governor-to-carburetor control rod in all positions for interference or binding.

2. Low idle speed adjustment

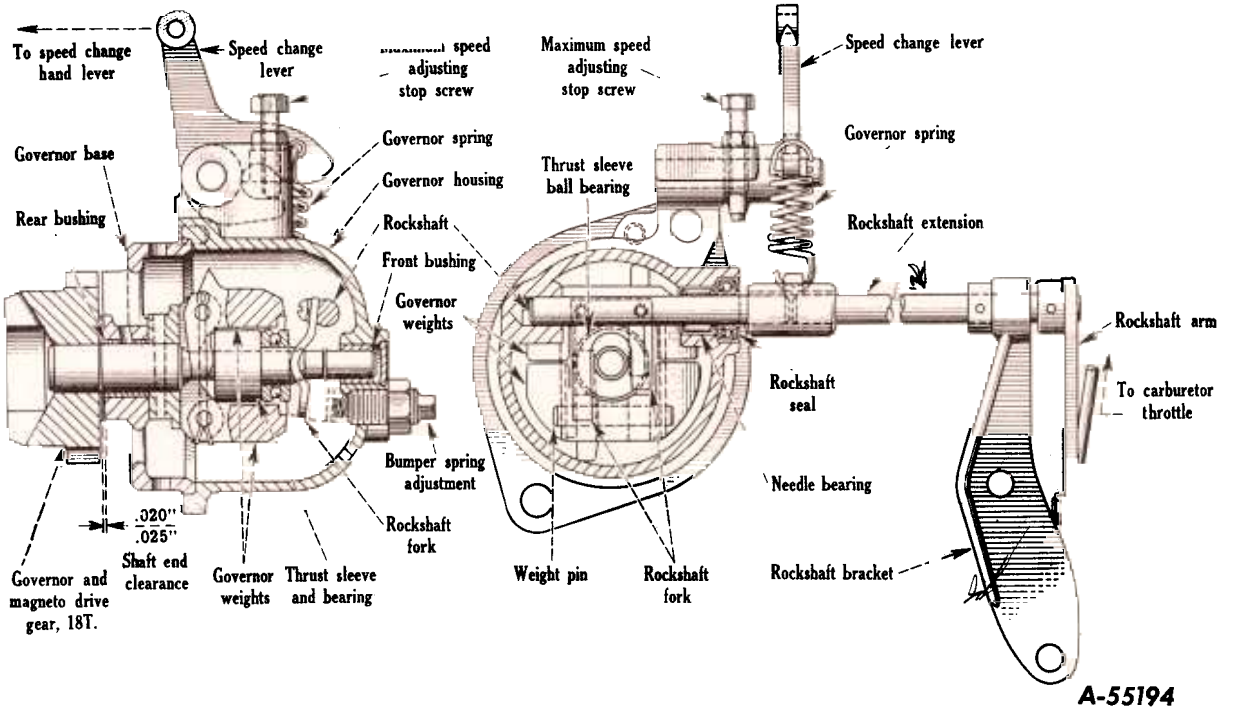
Smooth low speed engine operation depends upon careful adjustment of carburetor idle air-fuel mixture at the specified engine low idle speed. Good governor performance also is dependent on this smooth engine operation and free throttle shaft movement near closed throttle positions. Any tendency of the carburetor throttle to stick or bind in its low idle (closed) position will cause the governor to surge excessively. The governor is equipped with an adjustable bumper spring to counteract the effect of manifold vacuum on the closed position of the throttle.

Causes for binding or sticking of the throttle shaft are misalignment due to wear or interference due to improper assembly. Excessive tension adjustment of bumper spring, in an attempt to overcome these ills, will prevent the throttle from closing against its stop, resulting in greater than specified low idle speed. See carburetor "Inspection and Repair" portion of this manual section.

a. Start engine and allow it to reach operating temperature.

b. Place operator's speed change lever in the extreme low speed position. See that operator's speed change lever linkage will allow the throttle to close against its stop screw. Adjust speed change linkage if necessary. See also that governor bumper spring adjustment is not interfering with closing of throttle.

c. Adjust carburetor throttle stop screw to secure the specified low idle speed and set idle fuel mixture screw for smoothest engine operation.



d. Advance operators speed change lever for a few seconds and again idle the engine, rechecking adjustments for specified low idle speed and smoothest operation.

3. Adjusting governed fast idle speed.

To protect the engine from excessive speed, and also to provide sufficient speed to maintain the engine's rated load, the governed fast idle speed adjustment must be properly made. Be sure the service tachometer used is accurate. Do not expect the tractor tachometer to be sufficiently accurate for this operation. Adjustment procedure for all engines follows:

a. Before adjustment is attempted, the engine must be brought up to operating temperature. Engine lubricant viscosity should be correct for the season of use and should be near operating temperature.

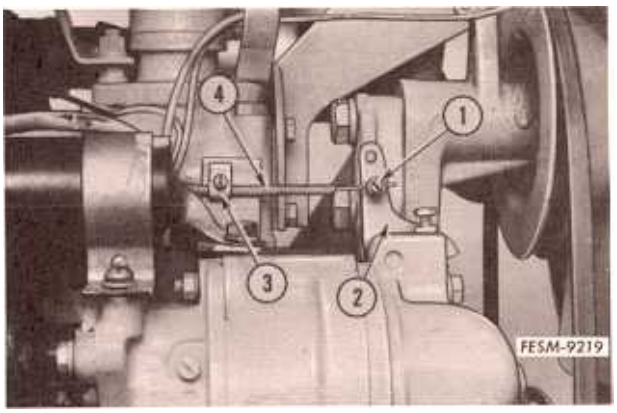
b. With engine running and accurate service tachometer in use, advance operator's engine speed control lever to maximum speed position. Be sure also that operator's speed change linkage is being held firmly against the governor maximum speed stop adjustment; reset linkage if necessary.

c. Adjust the governor maximum speed stop screw or adjustment to secure specified fast idle speed. Be sure that governor speed change linkage is being held against the stop screw in its new position when the tachometer reading is taken.

d. Place operators speed change lever in maximum speed position. Notice the fast idle speed on service tachometer. With thumb and finger, pull carburetor throttle lever toward open position, sufficient to gain 50 rpm fast idle speed. Release throttle lever instantly; the governor will react by closing the throttle and opening again, seeking its balance. Under this condition two surges of the governor are considered normal. Excessive surging would indicate binding in carburetor throttle assembly or governor rockshaft and linkage assembly as outlined previously under carburetor and governor headings. This may be corrected by adjusting the bumper spring.

e. Bumper Spring Adjustment: The adjuster may be turned in one-half turn at a time, just sufficient to reduce surging to normal. Test, as in operation (d) above, after each slight adjustment. If screwed in too far, the bumper spring will prevent the throttle from closing to low idle stop screw. Where such extreme setting of bumper spring is found necessary, it would indicate excessive friction or sticking is occurring in throttle assembly or governor rockshaft assembly. This should be corrected and the bumper spring readjusted. After the bumper spring has been adjusted properly, lock it in place with the jam nut. Where use of the bumper spring is not required to control surging, screw in until it just touches at low idle speed and then backed out 1/4 turn and locked.

NOTE: Adjustment of the maximum speed stop, to allow increased tension to be placed on the governor spring by the operator's engine speed control lever, will result in increased engine speed. Adjustment to reduce tension which can be placed on the governor spring, will result in reduced engine speed.



1. Governor control swivel pin
2. Governor spring throttle lever
3. Throttle control clamp
4. Throttle cable

Throttle Adjustment

1. Loosen the screw of the throttle control swivel pin (1) on the governor spring throttle lever (2).

2. Loosen the throttle control clamp (3) and position the throttle cable (4) in the lower part of the clamp. Leave the clamp loose.

3. Pull the cable wire thru the control swivel pin about 1/2 inch and tighten screw on control swivel pin.

4. Move throttle control lever to maximum speed position.

5. Pull throttle cable back to bring governor spring throttle lever against high idle stop screw. Tighten throttle control clamp.

6. Check engine rpm according to specifications.

Section 3

STEERING, FRONT WHEELS AND FRONT AXLE

CONTENTS

Specifications

Steering

Type	Manual, cam and lever
Bearings	Ball

Front Wheels

Bearings	Ball
Toe-in - inch	1/4 ± 1/16
Camber angle	2-1/2°
Caster angle	0
Turning radius	9.4 ft.

Front Axle

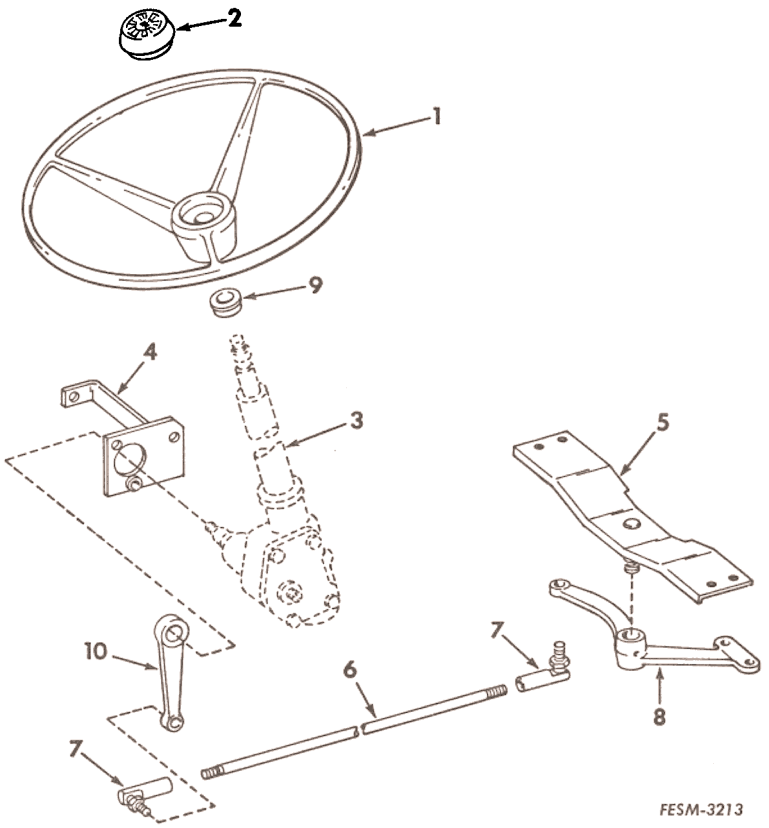
Construction	I-beam, cast iron
Support	Center pivot

Tire Size

Front - standard	4.00 x 12
Alternate	20 x 8.00 x 10
Rear - standard	8.3 x 24
Alternate	9.5 x 24 and 13.6 x 16

Wheelbase - inches	64
Tread - inches	42
Length, overall - inches	94
Width, overall - inches	52
Ground clearance - inches	13

Steering Assembly



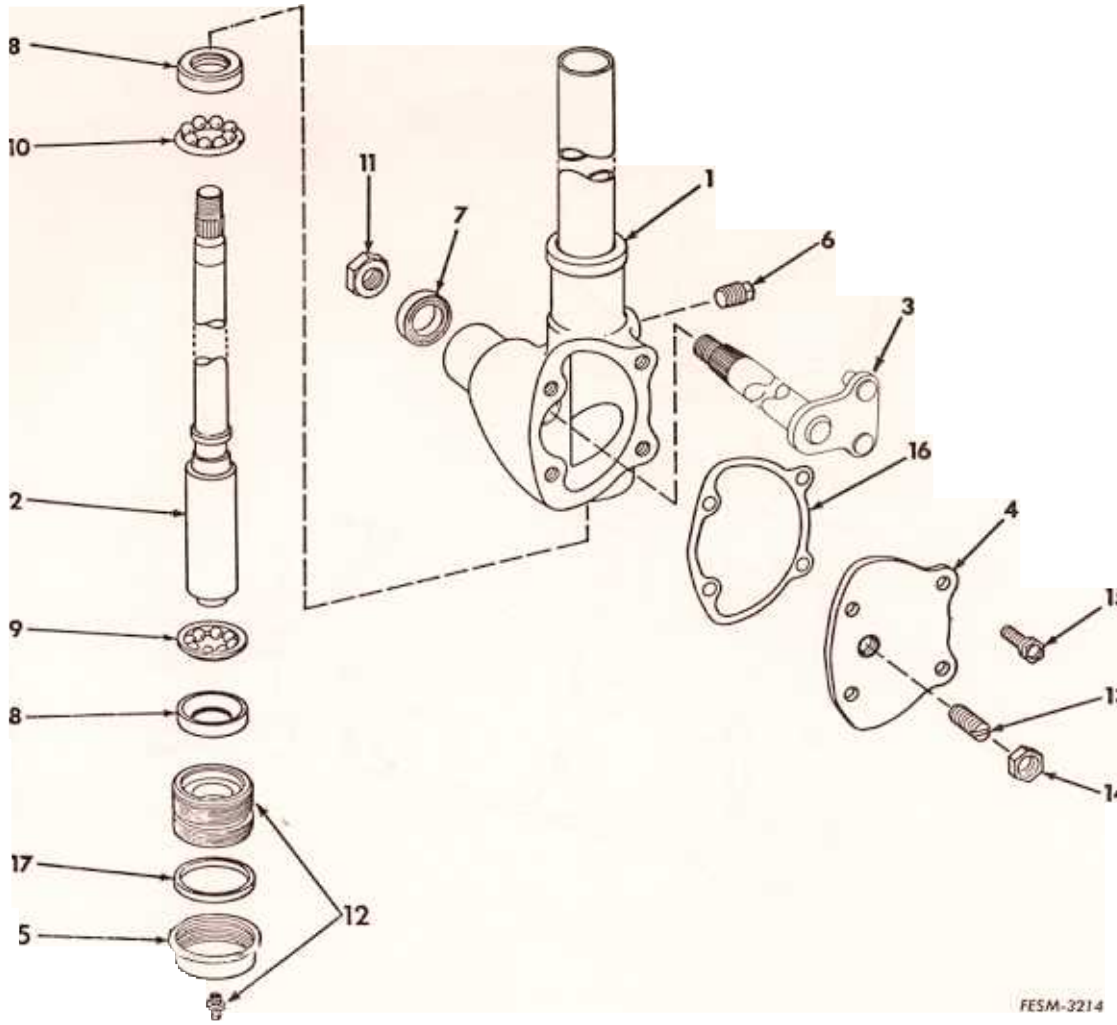
1. Steering wheel
2. Steering cap
3. Steering gear assembly
4. Steering gear support assembly
5. Steering lever support assembly
6. Drag link rod
7. Ball joint
8. Steering lever
9. Column upper bearing
10. Steering arm

Removal

1. Remove the steering cap (2) and nut. Using a puller, remove the steering wheel (1). Remove the dust seal and the column upper bearing (9).

2. Disconnect the drag link ball joint (7) from the steering arm (10).

3. Remove the cap screws in the steering gear support (4) and remove the steering gear assembly (3) from the tractor.



1. Housing and tube assembly
2. Cam and tube assembly
3. Lever and shaft assembly
4. Side cover
5. Lock nut
6. Pipe plug
7. Oil seal
8. Ball cup
9. Ball retainer
10. Retainer and ball assembly
11. Steering arm nut
12. Plug assembly
13. Adjusting screw
14. Adjusting screw lock nut
15. Cap screw
16. Side cover gasket
17. Seal

Disassembly

1. Remove the nut (11) securing the steering arm to the lever and shaft assembly (3). Using a puller, remove the arm from the shaft.

2. Remove the side cover (4).

3. Pull the lever and shaft assembly (3) out of the housing and tube assembly (1). Remove the oil seal (7) from the housing.

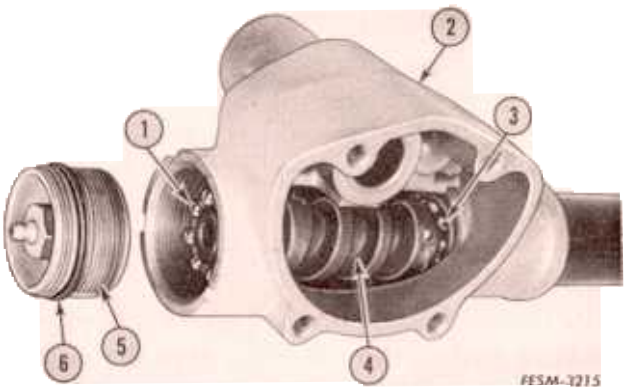
4. Bend the lock nut locking tab up and remove the lock nut (5).

5. Remove the plug assembly (12), ball cup (8) and retainer and ball assembly (9).

6. Remove the cam and tube assembly (2) from the housing.

7. Remove the second retainer and ball assembly (10) from the shaft. Remove the ball cup if it is to be replaced.

NOTE: Keep inner and outer retainer and ball assemblies identified for proper location as they are not interchangeable.



1. Retainer and ball assembly, outer
2. Housing and tube assembly
3. Retainer and ball assembly, inner
4. Cam
5. Plug assembly
6. Seal

Inspection and Repair

1. Wash all parts in cleaning solvent, then dry thoroughly.

2. Inspect the lever and shaft cam followers for wear and replace if necessary.

3. Inspect the bearings, ball cups and the cam and tube assembly for roughness and pitting.

4. Inspect the cam grooves for wear, roughness and galling. Replace the cam and tube assembly if necessary.

5. Inspect the housing for cracks and stripped threads.

6. Inspect the column upper bearing for wear or damage.

7. Be sure to install new gaskets and seals in reassembly.

Reassembly and Adjustments

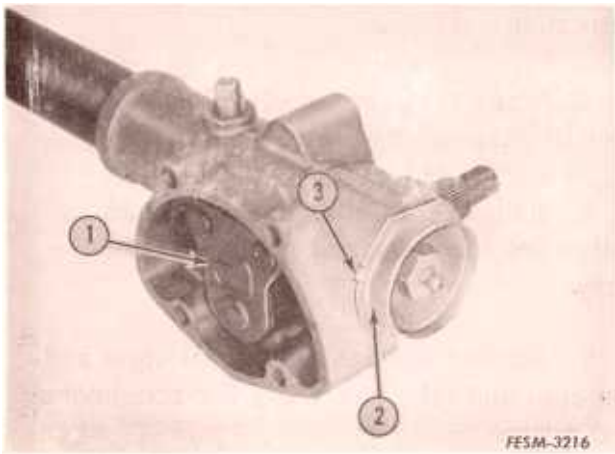
1. Thoroughly coat the ball bearings and ball cups with recommended chassis lubricant.

2. Install the retainer and ball assemblies (1 and 3) and the ball cups on the cam and tube assembly (4).

3. Thoroughly coat the cam (4) with recommended chassis lubricant and then install it in the housing and tube assembly (2).

NOTE: Be sure the ball cups are in the housing squarely and are not "cocked".

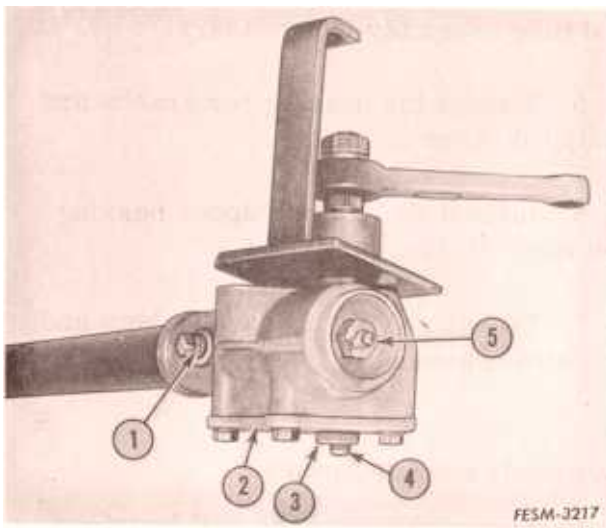
4. Install the plug assembly (5) and tighten until end play of the cam is removed but turns freely. Be sure to use a new seal (6).



5. Install the lock nut (2) and tighten securely. Stake the nut into a housing slot (3).

6. Install a new oil seal in the housing. Pack the housing with the recommended chassis lubricant (refer to Operator's Manual), and then install the lever and shaft (1) in the housing.

1. Lever and shaft assembly
2. Lock nut
3. Lock nut staked in housing slot

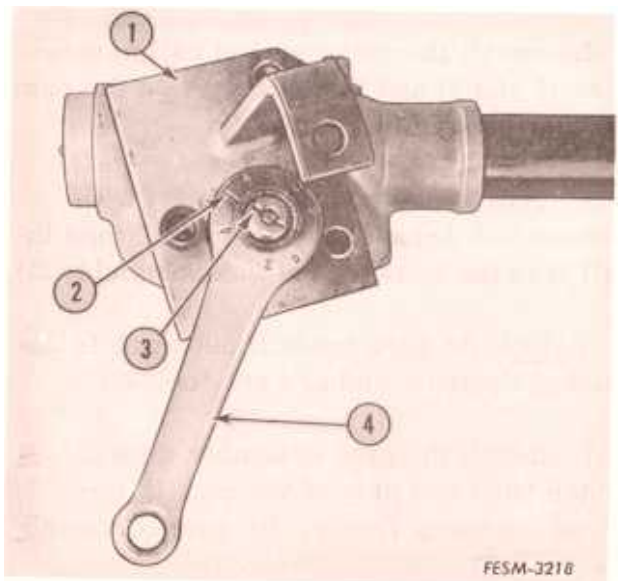


7. Install a new gasket and the side cover (2). Tighten the cap screws to 20 ft. lbs. torque.

8. Lubricate at the fitting (5) in the plug assembly slowly until lubricant begins coming out of the hole at the pipe plug.

9. "Center" the cam follower on the cam. Loosen the adjusting screw lock nut (3) and adjust the screw (4) inward to eliminate cam follower backlash. Tighten the lock nut securely. Turn the steering shaft full right and left to check for binding.

1. Pipe plug
2. Side cover
3. Adjusting screw lock nut
4. Adjusting screw
5. Fitting



10. Install the steering gear support (1) and then install the steering arm (4) on the lever and shaft assembly. Be sure the mark (2) on the steering arm is in line with the mark (3) on the shaft. Install the steering arm nut and tighten securely.

1. Steering gear support assembly
2. Steering arm mark
3. Shaft mark
4. Steering arm

11. Install the steering assembly in the tractor and tighten the steering gear support cap screws to 35 ft. lbs. torque. Be sure to install the spacers.

12. Install the column upper bearing, dust seal and steering wheel. Secure with the nut and tighten to 35 ft. lbs. torque.

13. "Center" the steering by turning the steering wheel full right and then turn full left while counting the number of turns. Turn the wheel to the right one-half of the above figure.

14. Adjust the drag link rod to place the front wheels in the straight ahead position and connect the rod to the steering arm. Install the lock nut and tighten securely.

15. Install the steering cap.

16. Adjust the front wheel toe-in to the specified 1/4 inch ± 1/16 inch (1/4 inch closer in front than in the rear) as follows:

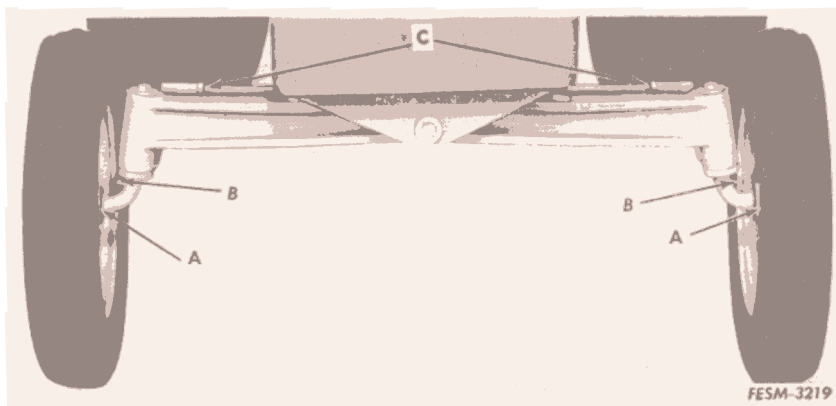
a. Place chalk marks at points "A" on each rim at hub height, and measure the distance between them.

b. Move the tractor forward a distance equal to one-half revolution of the front wheels. The chalk marks will now be at points "B".

c. Measure the distance between points "B". The distance between points "B" must be 1/4 inch ± 1/16 inch greater than at "A".

d. To adjust, disconnect the tie rod ball joints from the steering knuckle arms. Loosen the lock nuts "C" and turn the ball joints in or out as required. Be sure to make the tie rod adjustments equal, and be sure the steering knuckle arms stop on the axle.

e. Connect the tie rod ball joints to the steering knuckle arms. Tighten the lock nuts "C" securely.



Front Wheels and Bearings

Removal

1. Lock the brake and block the rear wheels. Jack up the front axle.

2. Remove the hub cap.

3. Remove the cap screw and flat washer from the outer end of the spindle.

4. Slide the wheel and bearings off the spindle.

NOTE: The bearings are a press fit in the wheel or hub and a slip fit on the spindle.

Disassembly

Wheel bearings can be driven from the wheel hub with a hammer and long drift punch. Drive from the inside toward the outside.

Inspection and Repair

1. Inspect the entire wheel and hub for wear or damage.

2. Inspect the bearings and seals and replace as necessary.

3. Bearing fit to wheel or hub must be tight. If not, replace the wheel.

Reassembly and Installation

1. If the bearings were removed, lubricate and press in new ones. Be sure force is directed to the outer race only.

2. Slide the wheel and bearing assembly over the spindle and secure with the cap screw and flat washer. Tighten the cap screw to 80 ft. lbs. torque.

3. Install the hub cap.

Front Axle

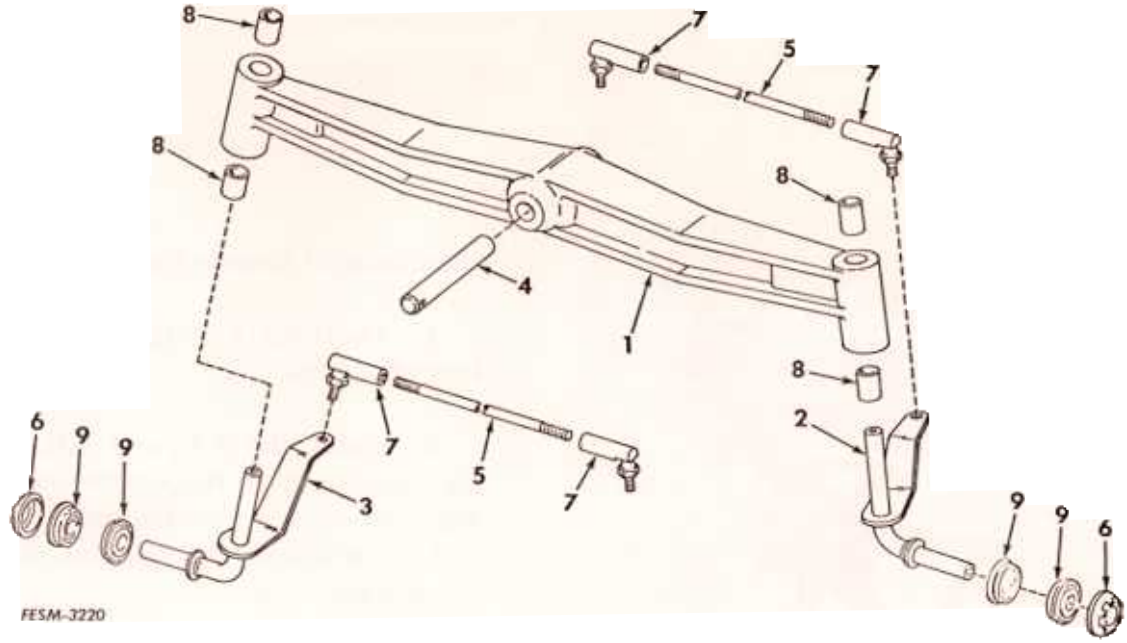
Steering Knuckle Removal

1. Lock the brake, jack up the front of the tractor and support it on a suitable stand.

2. Remove the front wheels.

3. Disconnect the tie rod ball joints (7) from the left and right steering knuckles (2 and 3).

4. Remove the cap screw and flat washer and remove the steering knuckle from the axle.



1. Front axle assembly
2. L.H. steering knuckle assembly
3. R.H. steering knuckle assembly
4. Front axle pivot pin
5. Tie rod
6. Hub cap
7. Ball joint
8. Bushing
9. Wheel ball bearing assembly

Removal of Front Axle

1. Disconnect the tie rod ball joints from the steering lever.

2. With the front of the tractor frame supported on a suitable stand, drive out the retaining pin from the front of the axle pivot pin (4).

3 Remove the pivot pin and then remove the front axle (1) from the tractor.

Inspection

Thoroughly clean all parts. Inspect all parts closely for wear or damage and replace as necessary.

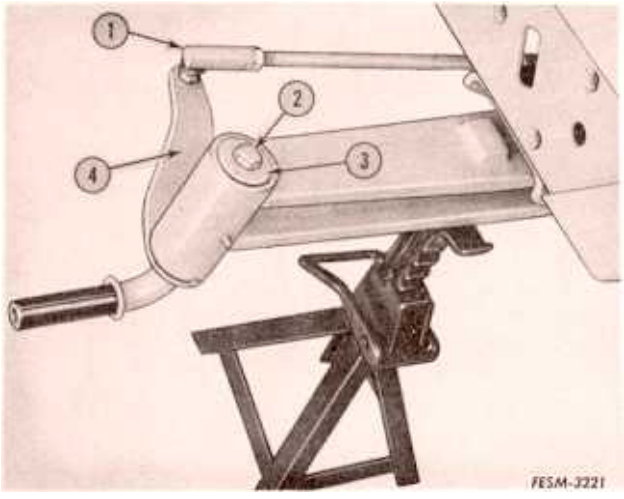
Installation of Front Axle

1. Apply chassis lubricant liberally to the axle pivot pin and its bore in the axle.

2. Position the axle in its support bracket channel. Align the pivot pin holes and insert the pin.

3. Align the retaining pin holes (through the pivot pin and front collar of the support bracket) and drive the retaining pin through both parts.

4. Connect the tie rod ball joints to the steering lever. Be sure to tighten the lock nuts securely.



1. Ball joint
2. Cap screw
3. Washer
4. Steering knuckle arm

Installation of Steering Knuckles

1. Thoroughly lubricate the steering knuckle shaft.

2. Install the R.H. and L.H. steering knuckles in their respective bores in the axle and secure with the cap screws (2) and flat washers (3). Tighten the cap screws securely.

3. Connect the tie rod ball joints (1) to the steering knuckle arms (4). Be sure to tighten the lock nuts securely.

4. Install the front wheels and check the toe-in adjustment. Refer to page 3-7.

Section 4

MAIN CLUTCH SHAFT AND ENGINE CLUTCH ASSEMBLY

Contents

NOTE: For Drive Belt Replacement, Refer to Section 8.

SPECIFICATIONS

(154 & 185 TRACTORS)
Clutch Springs

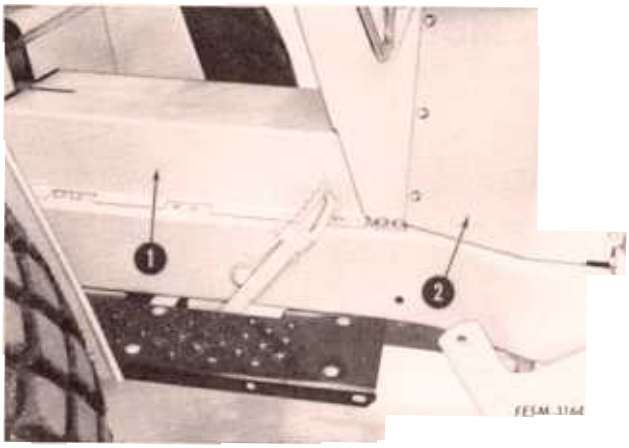
Number	3
Free length - inches	1.210
Test length - inches	.810
Test load - ft. lbs.	85-95

(184 TRACTOR)
Clutch Springs

Number	3
Free length - inches	1.440
Test length - inches	1.12
Test load - ft. lbs.	108-119

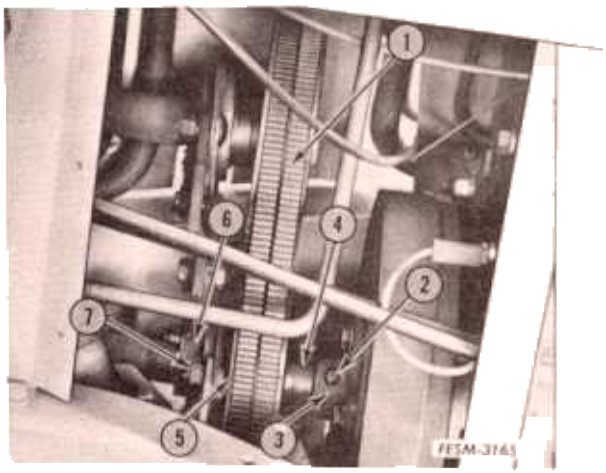
Main Clutch Shaft and Engine Clutch—
Serial No. U018709 and Below
(154 Tractors)

Removal and Disassembly



1. Remove the frame top cover (1) and pedestal side sheet sections (2).

1. Frame top cover
2. Pedestal side sheet sections



1. PTO drive belts
2. Pin (or nut and socket head bolt)
3. Clutch coupling
4. Main clutch shaft
5. Pulley
6. Bearing locking collar
7. Nut (2)

2. Drive out the pin (2) or remove the socket head bolt and nut from the clutch coupling (3).

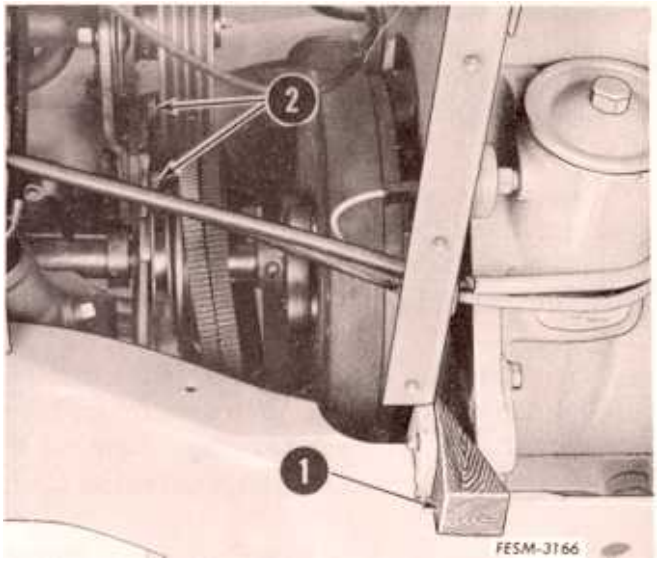
3. Loosen two cap screws on the shaft and pulley adjuster and loosen the PTO drive belt tension. Loosen four cap screws (2) securing the front main shaft bearing support to the frame (See Illust. on page 4-3). Remove the drive belts (1) from the top pulley.

4. Loosen the bearing locking collar (6).

5. Remove the nuts (7) from the bearing flange bolts.

6. Remove the clutch coupling cap screws.

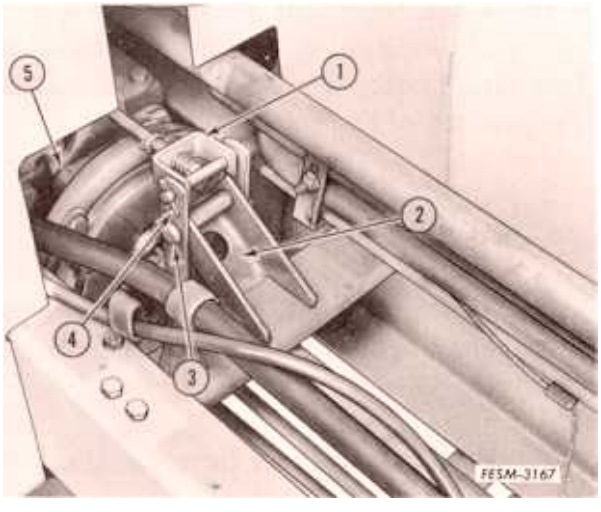
7. Slide the main shaft forward into the clutch coupling (3).



8. Remove six cap screws securing the engine to the frame (four in rear and two in front).

9. Move the engine forward approximately 1/2" and insert small wooden wedges (1) between the frame and engine to hold the engine forward.

1. Wooden wedge
2. Cap screw (two on each side)



10. Remove the clutch brake yoke (1) from the clutch release yoke (4).

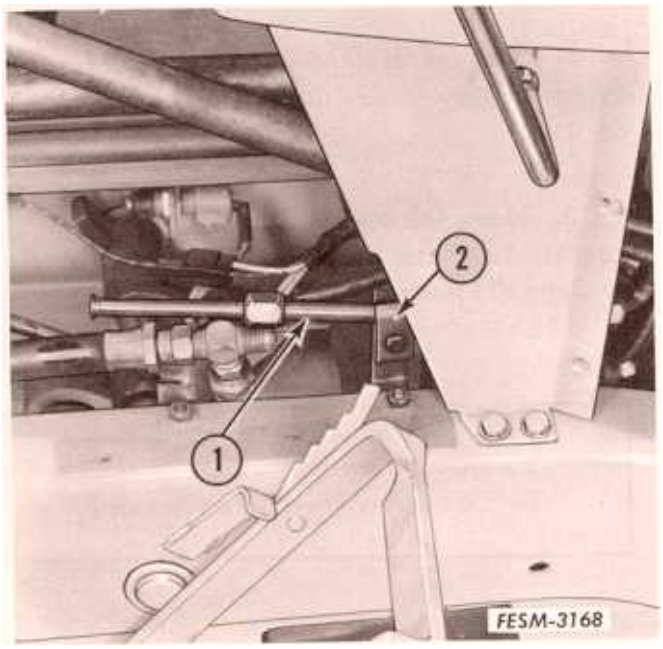
11. Remove the pin (3) securing the clutch release yoke (4) to the clutch release bracket (2).

12. Remove the pin securing the clutch release yoke to the clutch adjusting rod. Remove the release yoke.

13. Remove the bolts and nuts securing the clutch release bracket to the frame and remove the bracket.

1. Clutch brake yoke
2. Clutch release bracket
3. Pin
4. Clutch release yoke
5. Clutch brake assembly

14. Remove the clutch brake assembly (5) from the transmission case.



1. Hydraulic line
2. Clamp

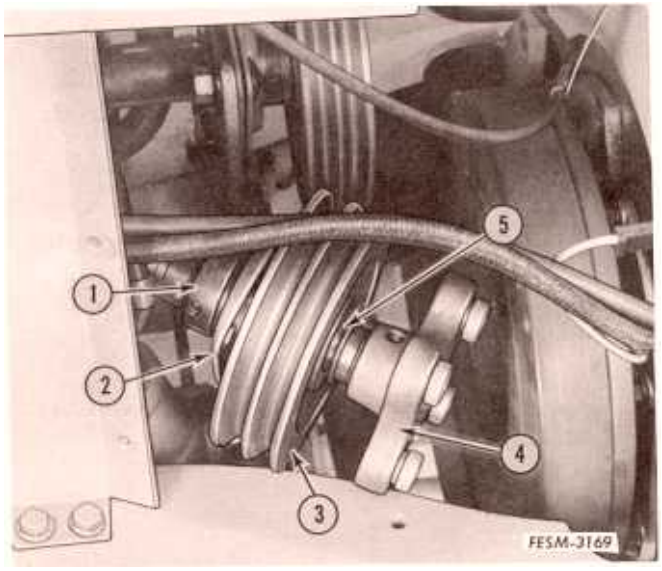
15. Remove the six cap screws in the clutch assembly. Move the pressure plate and clutch disc assembly forward on the shaft.

16. Remove the socket head bolt and nut or drive out the pin in the rear pressure plate hub. Move the pressure plate rearward on the transmission shaft.

17. Work the shaft out of position and remove the clutch driven disc assembly, pressure plate and release bearing. Remove the pressure plate from the transmission shaft.

18. If the clutch is to be serviced, remove the lever pivot pin and disassemble the release levers, pressure springs and lever brackets.

19. If the tractor is equipped with a hydraulic system, disconnect the hydraulic line (1). Loosen the clamp (2) and move the line out of the way.



20. Move the front of the shaft over the flywheel and remove the clutch coupling (4), snap ring (5) and pulley (3).

21. Remove the shaft from the tractor.

22. Remove the key from the shaft.

23. Remove the bearing flanges, bearing and bearing locking collar.

1. Locking collar
2. Bearing flange
3. Pulley
4. Clutch coupling
5. Snap ring

Inspection and Repair

Inspect the shaft for excessive wear. Pressure plate, bearings, pulley and clutch coupling must fit properly. Excessive clearances will result in failure. Replace the shaft and/or parts if necessary.

Check the front bearing for roughness of operation, damage or excessive wear and replace if necessary.

Check the bushing in the pressure plate for wear or damage. Replace if necessary.

Check the clutch disc facings and pressure plates for excessive wear. Replace if necessary.

Check the clutch pressure springs for breakage. Pressure spring specified free length is 1.210 inch. Test springs for compression. They must exert 85 to 95 lbs. at .810 inch after one compression to .690 inch. Replace any springs that do not meet specifications.

Reassembly and Installation

NOTE: To provide improved performance, it is recommended that the later model drive line components be installed.

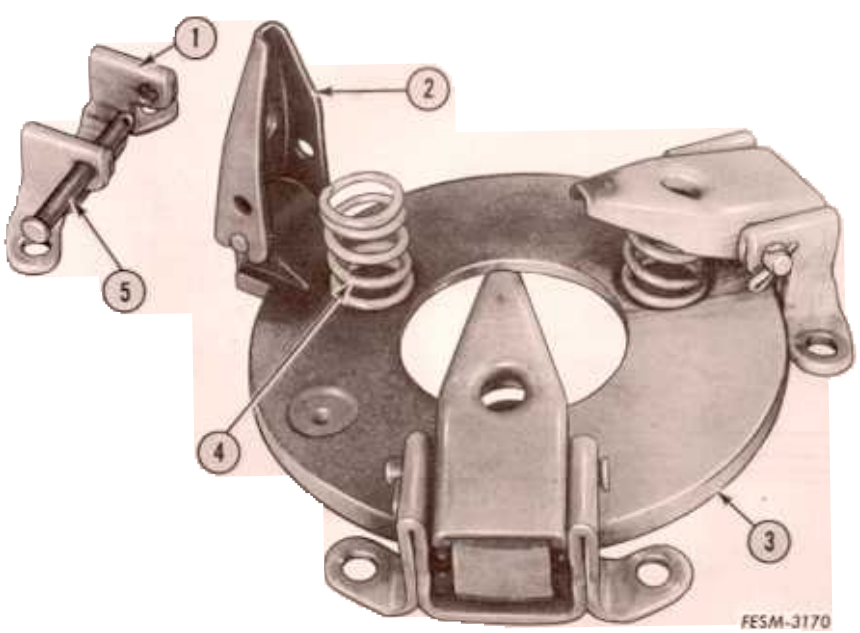
1. Install the bearing locking collar, bearing and bearing flanges on the shaft. Do not tighten the locking collar at this time.

2. Install the key on the shaft.

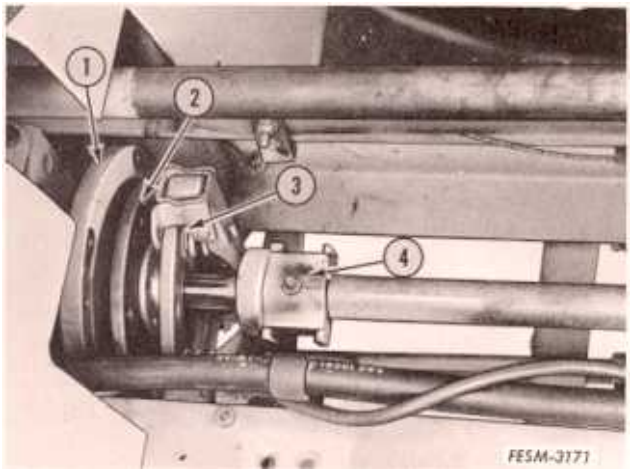
3. Install the shaft in the tractor.

4. Install the pulley, snap ring and clutch coupling on the shaft.

5. If the engine clutch was disassembled, assemble the release levers (2), pressure springs (4) and lever brackets (1) on the pressure plate (3) and install the lever pivot pin (5).



1. Lever bracket
2. Release lever
3. Pressure plate
4. Pressure spring
5. Lever pivot pin



1. Pressure plate
2. Clutch disc assembly
3. Pressure plate assembly
4. Release bearing

6. Install the rear pressure plate (1) on the transmission shaft.

7. Install the clutch release bearing (4), pressure plate (3) and clutch disc assembly (2) on the shaft.

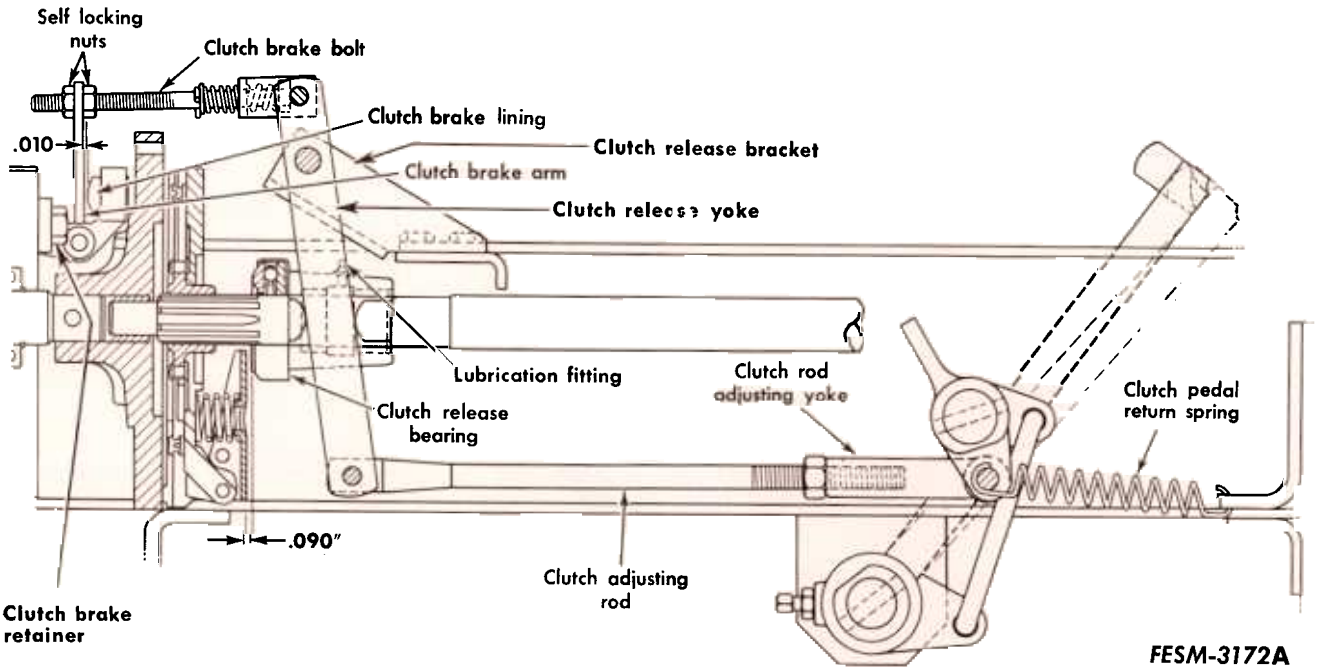
8. Install the socket head bolt and nut in the pressure plate hub and transmission shaft. Tighten the nut securely.

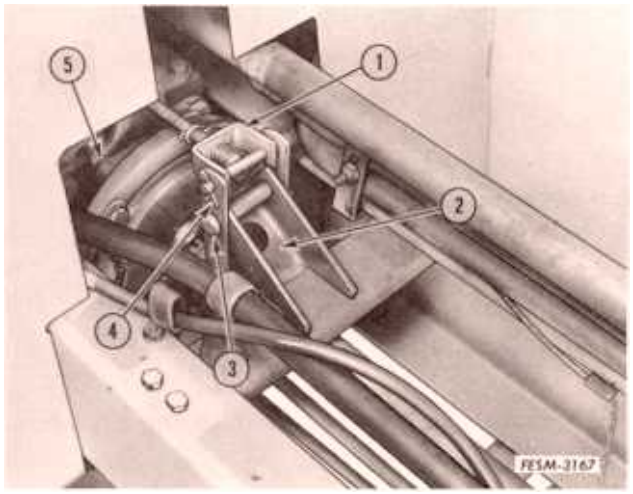
9. Install the six cap screws holding the clutch assembly together and tighten to 25 ft. lbs. torque.

10. Install the clutch brake retainer on the transmission case and tighten the cap screws to 80 ft. lbs. torque.

11. Install the clutch release bracket on the frame and tighten the nuts and bolts securely.

12. Install the clutch release yoke to the clutch adjusting rod and secure with the pin.





1. Clutch brake yoke
2. Clutch release bracket
3. Pin
4. Clutch release yoke
5. Clutch brake assembly

13. Install the pin securing the clutch release yoke (4) to the clutch release bracket (2).

14. Assemble the clutch brake yoke (1) to the clutch release yoke (4) and secure with the pin.

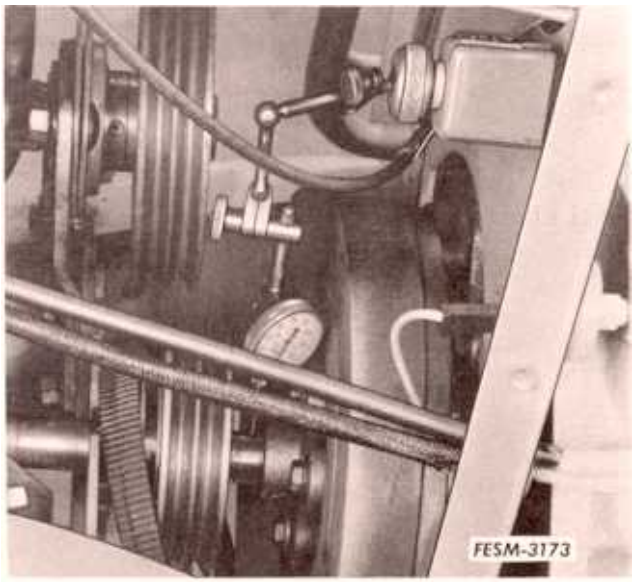
15. Install the belts on the lower pulley.

16. Move the engine rearward to its operating position. Install the six cap screws securing the engine to the frame and tighten them securely.

17. Slide shaft forward into the pilot hole in the coupling retainer, and install the four cap screws in the clutch coupling and tighten securely.

18. Install the bearing flange bolts and nuts. Tighten only snug.

19. Slide the shaft rearward and install the socket head bolt and nut and tighten securely.



If the engine flywheel does not have a 1 inch pilot hole, proceed with the following steps:

a. Install the cap screws in the clutch coupling and tighten until snug.

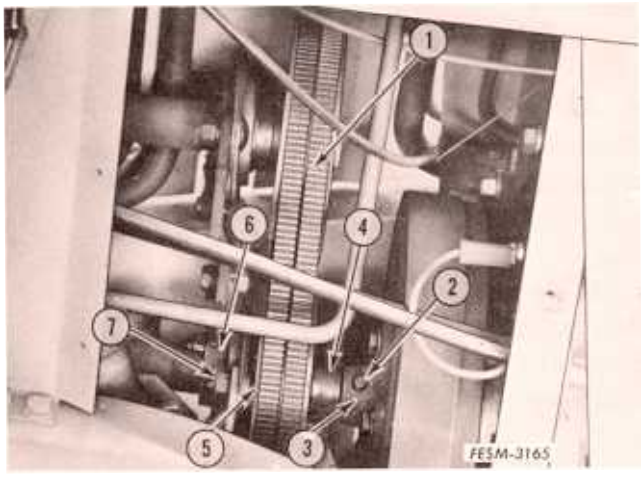
b. Install the nut and bolt in the clutch coupling.

c. Using a dial indicator, check the shaft run-out while cranking the engine. Be sure indicator reading is taken on smooth area of shaft.

NOTE: Removal of the spark plugs will make cranking of engine easier.

d. Tap the coupling in the direction required to reduce run-out to minimum possible.

NOTE: If minimum run-out of .004 inch cannot be obtained, replace the clutch coupling and/or shaft.



1. PTO drive belts
2. Pin (or socket head bolt and nut)
3. Clutch coupling
4. Main clutch shaft
5. Pulley
6. Bearing locking collar
7. Nut (2)

e. Securely tighten the cap screws in the clutch coupling (3).

f. Install the nut and bolt in the clutch coupling hub (3).

20. Securely tighten the bolts and nuts (7) in the bearing flanges.

21. Tighten the 4 cap screws securely in the cross member slotted holes.

22. Tighten the bearing locking collar (6).

23. Install the PTO drive belts (1) in the pulley grooves.

24. Tighten the drive belts enough to prevent slippage and then tighten the cap screws in the pulley adjuster.

NOTE: Do not over-tighten the belts.

25. Connect the hydraulic line (if equipped) and tighten the support clamp.

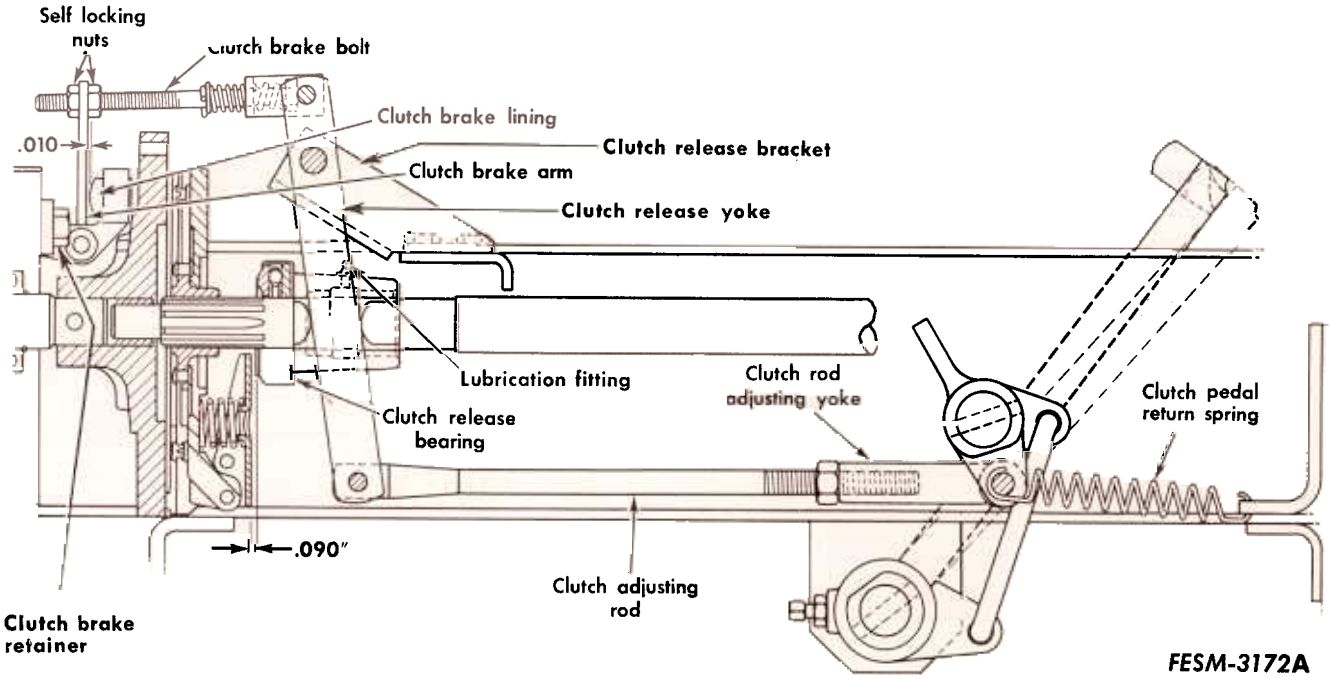
26. Adjust the clutch.

27. Install the frame top cover and pedestal side sheet assemblies.

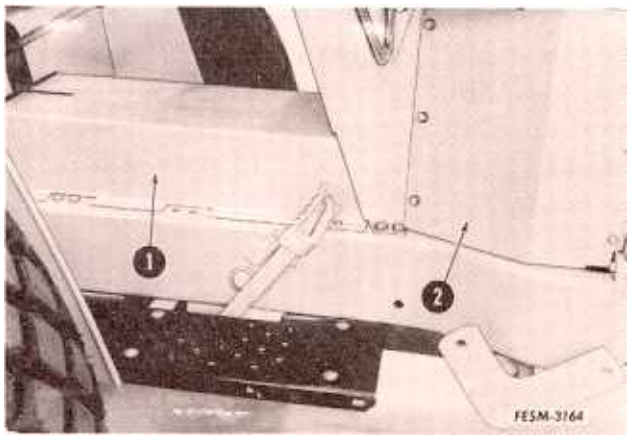
Adjustments

Remove the frame top cover. The clutch linkage should be adjusted to provide .090 inch clearance between the release fingers and the bearing. Adjust by loosening the two nuts on the clutch rod adjusting yoke and positioning the clutch adjusting rod to give the specified free travel. Retighten the nuts.

After adjusting the clutch pedal free travel, check the clearance between the clutch brake arm and the clutch brake lining. A clearance of .010 inch is specified. To adjust, loosen the self locking nuts on the clutch brake bolt. Adjust the clutch brake bolt to obtain the specified .010 inch clearance. Retighten the self locking nuts. Install the frame top cover.



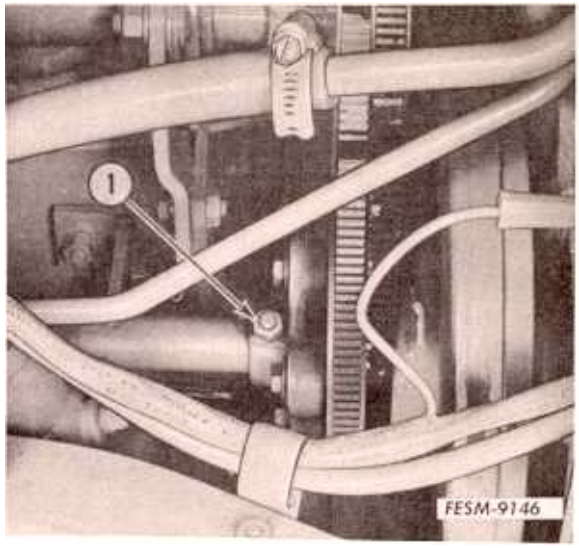
Main Clutch Shaft and Engine Clutch— Above Serial No. U018709 (154 & 185 Tractors)



Removal and Disassembly

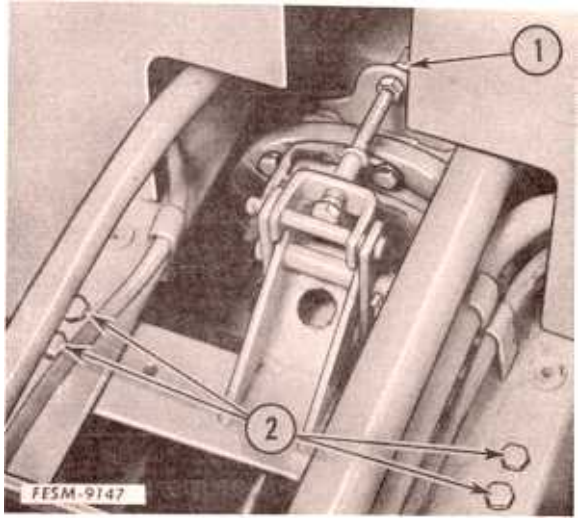
1. Remove the frame top cover (1) and pedestal side sheet sections (2).

1. Frame top cover
2. Pedestal side sheet sections



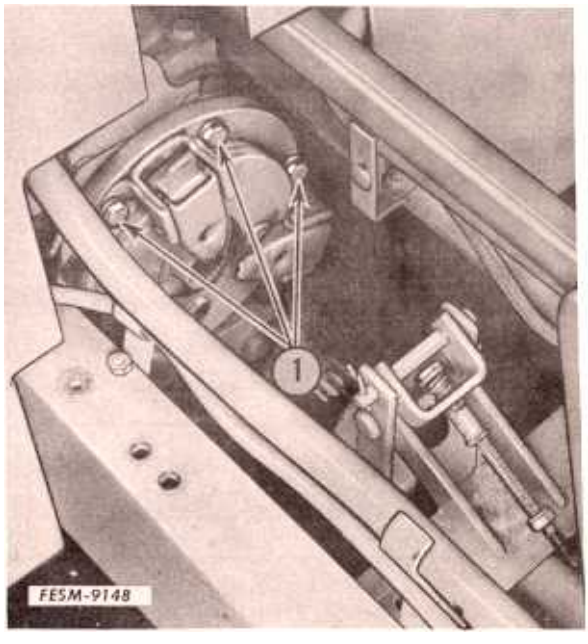
2. Remove the Allen head bolt from the clutch shaft coupling and slide the shaft ahead.

1. Allen head bolt



3. Remove the pin securing the clutch rod to the clutch release yoke. Remove the nut from the end of the clutch brake bolt. Remove the four bolts securing the clutch release bracket to the frame and slide the clutch release bracket ahead.

1. Clutch brake bolt nut
2. Clutch release bracket bolts



4. Remove the six bolts securing the pressure plate assembly to the input flywheel. Remove the pressure plate assembly and the clutch disc.

5. To remove the drive shaft, remove the four bolts from the front clutch shaft coupling. Slide the shaft ahead and remove the clutch release bearing. Lower the rear end of the shaft and slide it to the rear.

1. Pressure plate bolts

Inspection and Repair

Inspect the shaft for excessive wear. Pressure plate, bearings, pulley and clutch coupling must fit properly. Excessive clearances will result in failure. Replace the shaft and/or parts if necessary.

Check the bushing in the pressure plate for wear or damage. Replace if necessary.

Check the clutch disc facings and pressure plates for excessive wear. Replace if necessary.

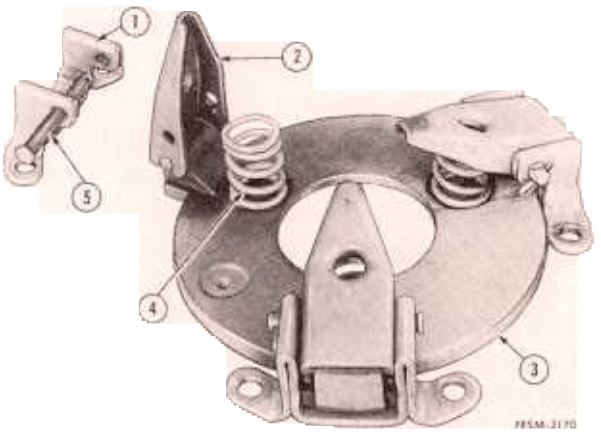
Check the clutch pressure springs for breakage. Pressure spring specified free length is 1.210 inch. Test springs for compression. They must exert 85 to 95 lbs. at .810 inch after one compression to .690 inch. Replace any springs that do not meet specifications.

Reassembly and Installation

1. Place the shaft in its approximate position inside the frame. Slide the front clutch shaft coupling onto the shaft.

2. Slide the shaft ahead and install the clutch release bearing and bracket assembly onto the shaft.

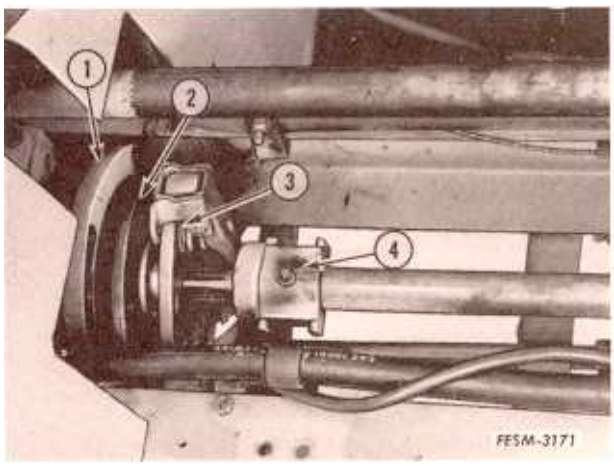
3. If the engine clutch was disassembled, assemble the release levers (2), pressure springs (4) and lever brackets (1) on the pressure plate (3) and install the lever pivot pin (5).



1. Lever bracket
2. Release lever
3. Pressure plate
4. Pressure spring
5. Lever pivot pin

4. Install the rear pressure plate (1) on the transmission shaft.

5. Install the socket head bolt and nut in the pressure plate hub and transmission shaft. Tighten the nut securely.



6. Install the pressure plate (3) and clutch disc assembly.

7. Install the six cap screws holding the clutch assembly together and tighten to 25 ft. lbs. torque.

8. Install the clutch release bracket on the frame and tighten the nuts and bolts securely.

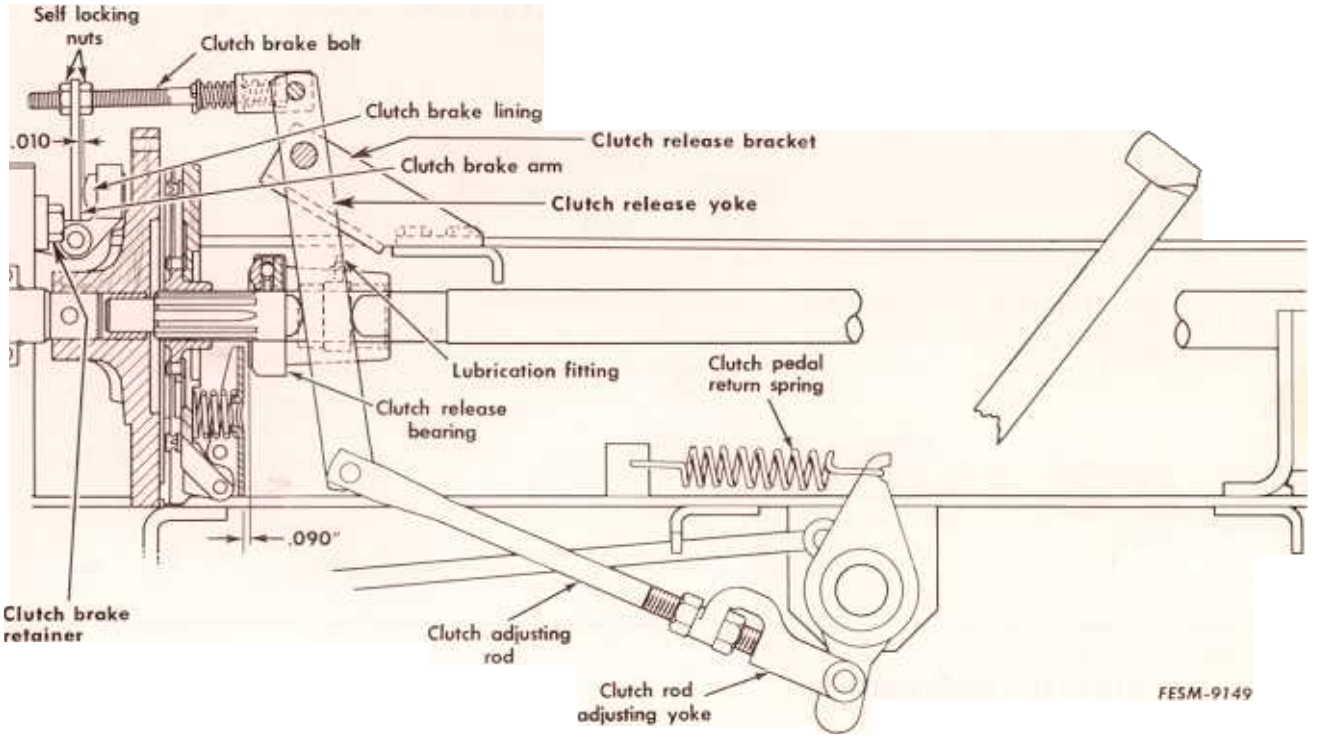
9. Install the clutch release yoke to the clutch adjusting rod and secure with the pin.

1. Pressure plate
2. Clutch disc assembly
3. Pressure plate assembly
4. Release bearing

Adjustments

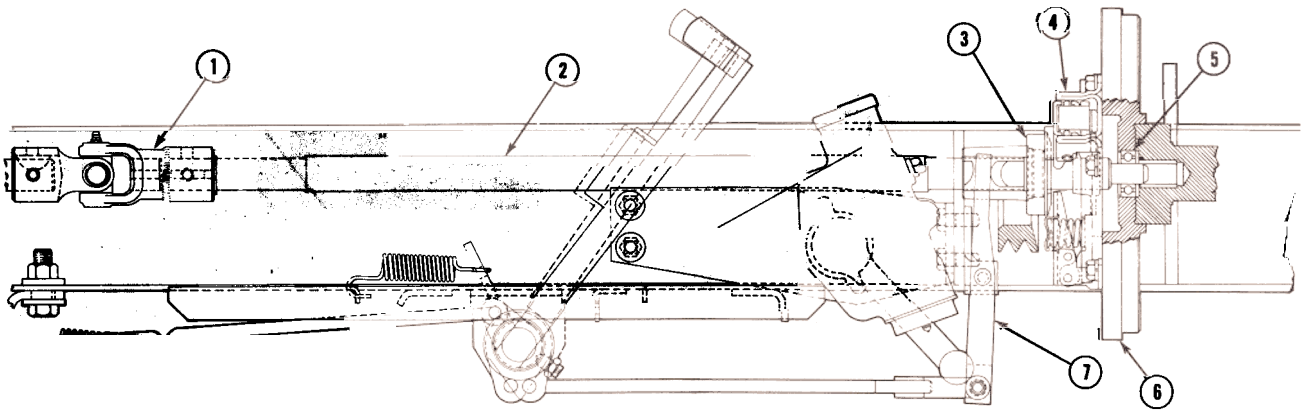
Remove the frame top cover. The clutch linkage should be adjusted to provide .090 inch clearance between the release fingers and the bearing. Adjust by loosening the two nuts on the clutch rod adjusting yoke and positioning the clutch adjusting rod to give the specified free travel. Retighten the nuts.

After adjusting the clutch pedal free travel, check the clearance between the clutch brake arm and the clutch brake lining. A clearance of .010 inch is specified. To adjust, loosen the self locking nuts on the clutch brake bolt. Adjust the clutch brake bolt to obtain the specified .010 inch clearance. Retighten the self locking nuts. Install the frame top cover.


Self locking nuts
Clutch brake bolt
Clutch brake lining
.010
Clutch release bracket
Clutch brake arm
Clutch release yoke
Lubrication fitting
Clutch pedal return spring
Clutch release bearing
.090"
Clutch brake retainer
Clutch adjusting rod
Clutch rod adjusting yoke
FESM-9149

MAIN CLUTCH SHAFT AND ENGINE CLUTCH

(184 Tractor)

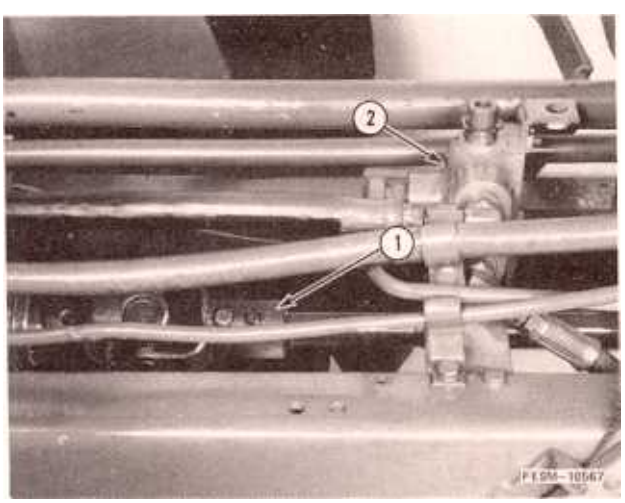


1. Main drive shaft knuckle
2. Main drive shaft
3. Clutch release bearing
4. Engine clutch assembly
5. Pilot bearing
6. Engine flywheel
7. Clutch release arm

Removal and Disassembly

1. Disconnect the battery cables from the battery.

NOTE: Remove the ground cable first to reduce electrical hazards.



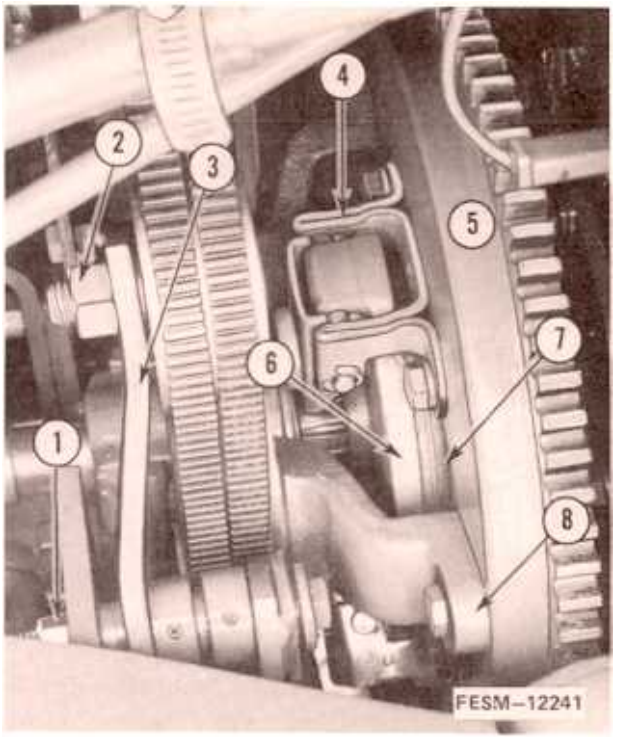
1. Main drive shaft knuckle
2. Hydraulic selector control valve

2. Remove the pedestal side sheets and the frame top cover.

3. Remove the set screws from the drive shaft knuckle. Move the snap ring forward from the groove. Slide the long end of the knuckle onto the shaft until the cross of the knuckle is against the end of the drive shaft and clear of the transmission or creeper input shaft.

Lift out the drive shaft when connected to the transmission and lower the drive shaft out from the tractor when connected to the creeper drive.

NOTE: If the tractor is equipped with a hydraulic selector control valve then it will have to be removed when the drive shaft connects to the transmission input shaft only.



1. Idler tension arm mounting bolt
2. Idler tension arm nut
3. Idler tension arm
4. Release lever assembly
5. Engine flywheel
6. Pressure plate
7. Clutch disk
8. Clutch drive pulley

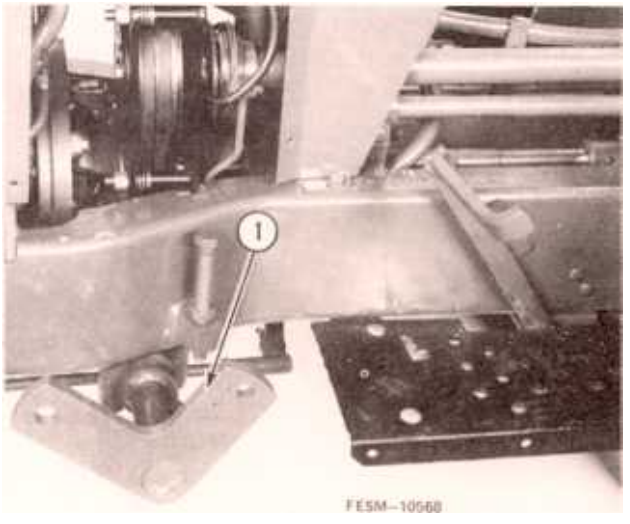
4. Relieve the clutch belt tension by pushing in on the idler tension arm nut with a 3/4 inch wrench and then slip the drive belts off the tension arm pulley.

5. Remove the idler pulley from the idler arm.

6. Remove the bolt securing the idler tension arm to the tractor frame and lower out the idler tension arm and the idler spring.

NOTE: Do not use any hand tools on the idler tension spring since this could damage the spring and result in early failure.

NOTE: Rotate the main drive clutch to obtain the necessary clearance for lowering the idler arm out of the frame.



1. Rockshaft

7. Remove the rockshaft from under the tractor.

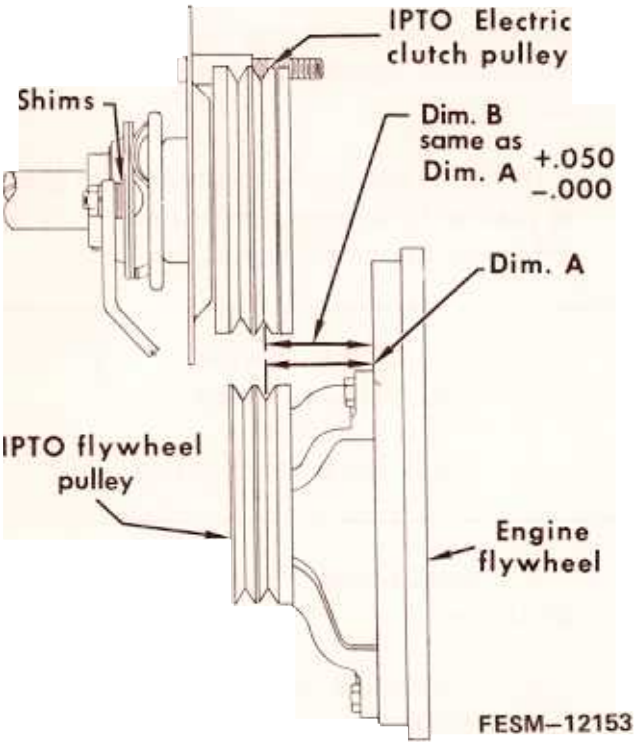
8. Disconnect the clutch release arm from the clutch release bearing. Remove the clutch release bearing.

9. Remove all the capscrews from both the clutch drive pulley and the pressure plate assembly. Then lower both the clutch pulley and pressure plate out of the tractor at the same time.

10. If necessary, remove the flywheel and press out the pilot bearing.

Inspection

Clean and inspect all parts. Replace worn or damaged parts.



1. If the engine clutch was replaced assemble the release levers, pressure springs and lever brackets on the new pressure plate.

2. Position both the clutch drive pulley and the pressure plate assembly against the flywheel and position in place with the existing drive shaft. Secure the clutch drive pulley and pressure plate to the flywheel with the capscrews.

3. Carefully remove the drive shaft.

4. With clutch pulley on flywheel, measure from flywheel to clutch drive pulley groove (Dim. A). Then measure from flywheel to corresponding location of IPTO clutch pulley groove (Dim. B). This dimension should be the same as dimension "A" + 1.3 mm (+.050 inch). If not, make the following adjustment.

5. Loosen the locking collar on rear bearing of power take-off shaft; then loosen the nuts mounting the front bearing to the support bracket and install shim washers until the required dimension is obtained. Tighten the bolts and recheck. Tighten locking collar on power take-off shaft rear bearing.

6. Install the clutch release bearing and release arm.

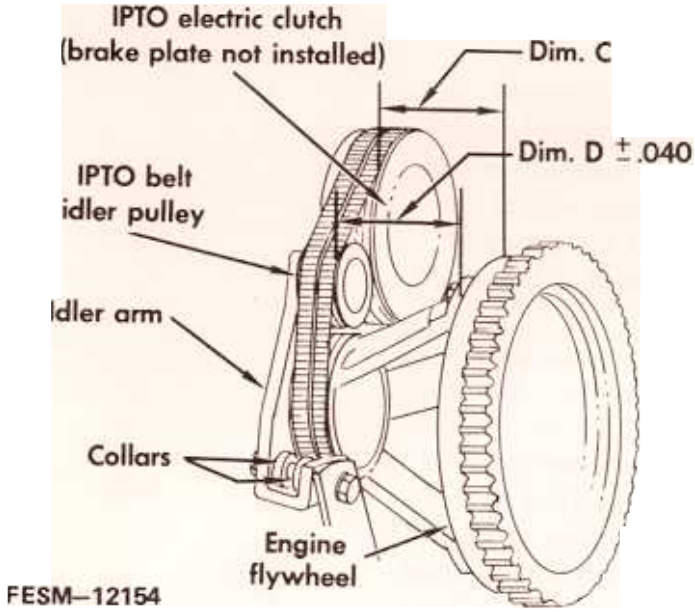
7. Apply "Never Seez Compound" to the keyway end of the drive shaft before installing the knuckle. Assemble the key in the shaft and slide the long end of the knuckle onto the shaft until the cross of the knuckle is against the end of the shaft.

8. Install the shaft back into the tractor drive clutch assembly. Slide the knuckle onto the transmission or creeper input shaft until it seats against the shaft shoulder. Position the snap ring in the shaft groove and slide the drive shaft back until the snap ring shoulders against the knuckle. Tighten the set screws over the shaft. Then tighten the set screws over the Woodruff keys.

9. Install the rockshaft.

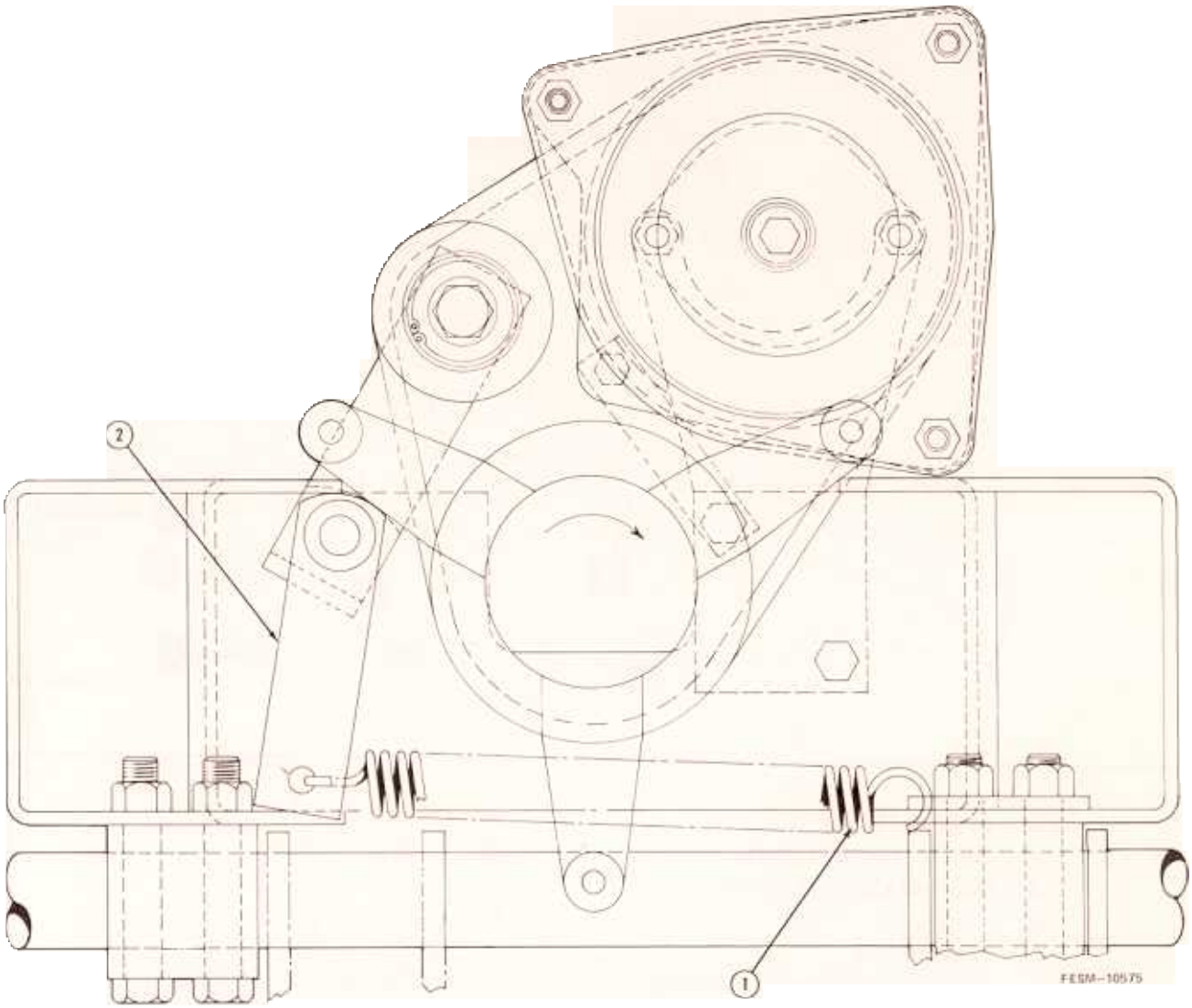
10. Install one end of the idler spring to the idler arm and the other end to the spring bracket under the tractor. Lift the idler arm up through the opening between the main drive clutch and the tractor frame and remount the idler arm.

11. Install the idler pulley on the idler arm and torque the pulley nut to standard specifications. Then reinstall the drive belts, making certain belts and pulleys are free of grease and oil.



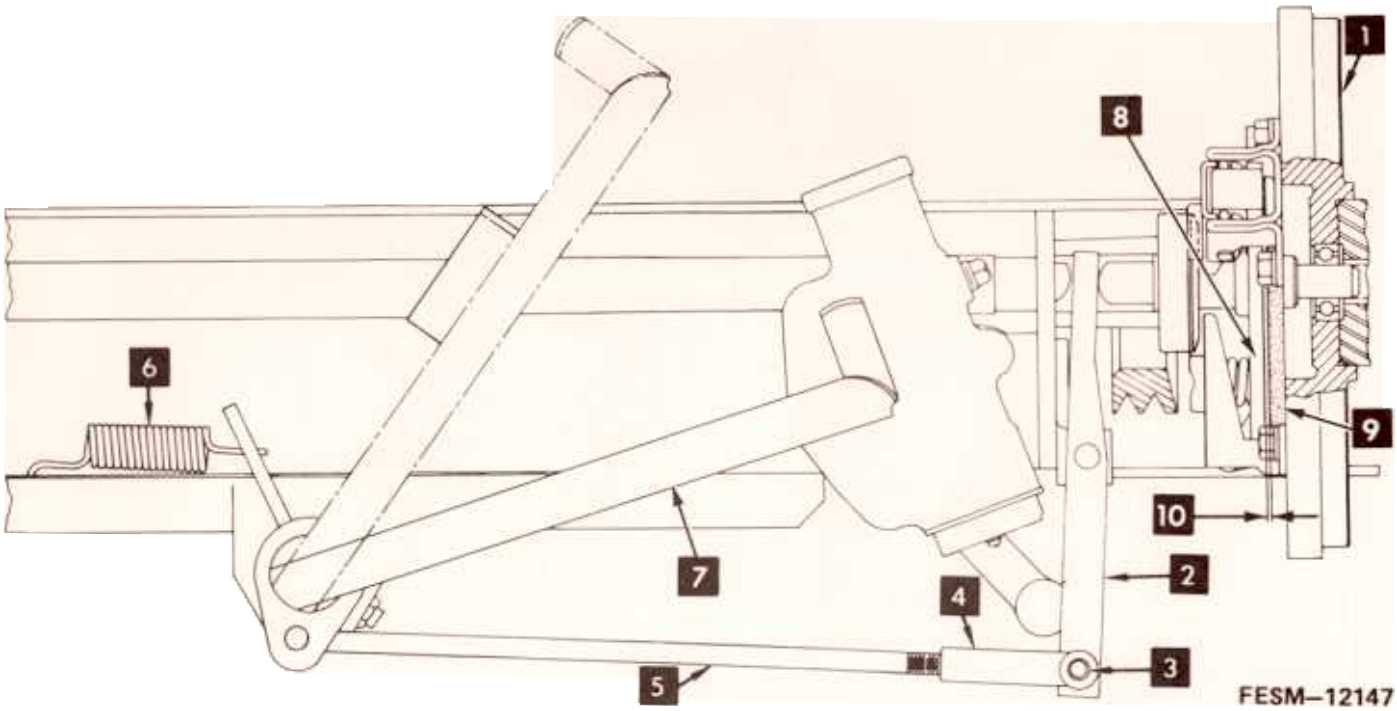
12. Measure from the forward edge of forward power take-off belt to face of flywheel at top of power take-off clutch pulley (Dim. C). Then measure from the forward edge of forward power take-off belt where the belt leaves the idler pulley to face of flywheel (Dim. D). Dimensions should be the same ± 1 mm (± .040 inch). If not, loosen the locking collars and slide the idler arm on the trunnion bushing until the above measurement is reached. After adjustment has been made, slide the locking collars against the inside surface of idler arm and tighten set screws to 20 inch lbs.

13. The clutch pedal must maintain a free travel distance of 28.5-31.7 mm (1-1/8-1-1/4 inch).



1. Idler spring
2. Idler arm

Main Clutch Adjustment



1. Engine flywheel
2. Clutch release lever
3. Headed pin and cotter
4. Clevis
5. Clutch rod
6. Clutch pedal return spring
7. Clutch pedal
8. Pressure plate
9. Clutch plate
10. Dimension is:
    38 to 51 mm
    (.015 to .020 inches)

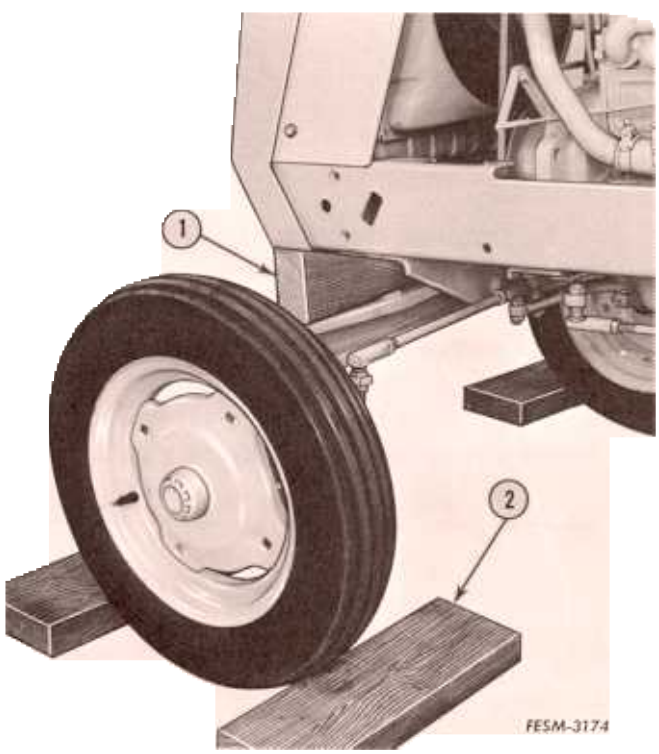
With the clutch depressed, check clearance between clutch plate and pressure plate. If clearance is less than 38 mm (.015 inch) or more than 51 mm (.020 inch), adjustment is necessary. To adjust, remove cotter pin and header pin, shorten or lengthen clutch rod by turning clevis until correct clearance is reached.

Section 5

SPLITTING AND RECOUPLING THE TRACTOR

CONTENTS

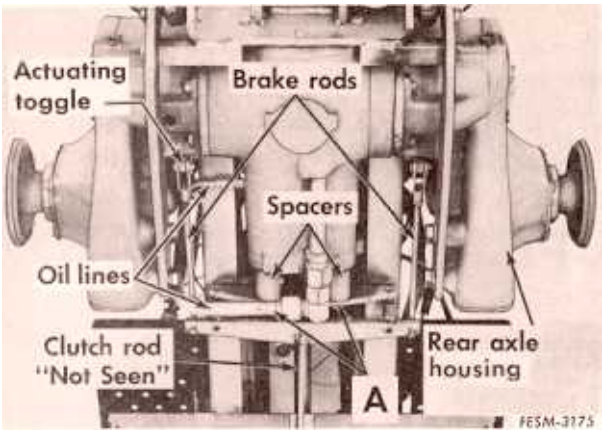
Splitting the Tractor



NOTE: Disconnect the battery ground strap from the battery.

1. Block the front wheels of the tractor so it can not move. Drive wooden wedges between the front axle and frame on each side to stabilize the tractor.

1. Wooden wedge
2. Front wheel blocks



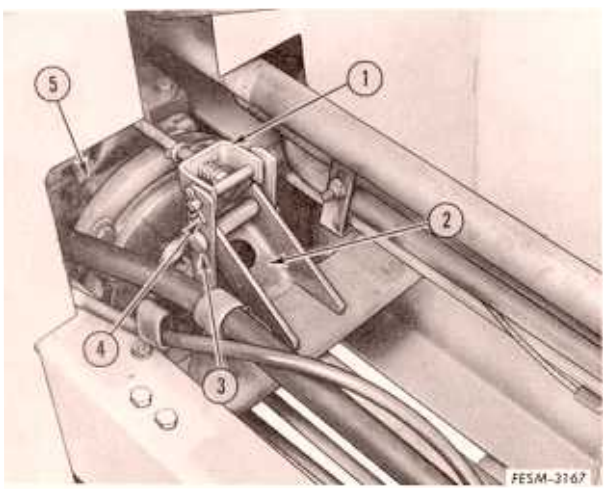
2. Remove the two cap screws (A) and spacers (no spacers w/creeper drive) securing the front of the transmission to the frame.

3. Disconnect the brake rods from the actuating toggles.

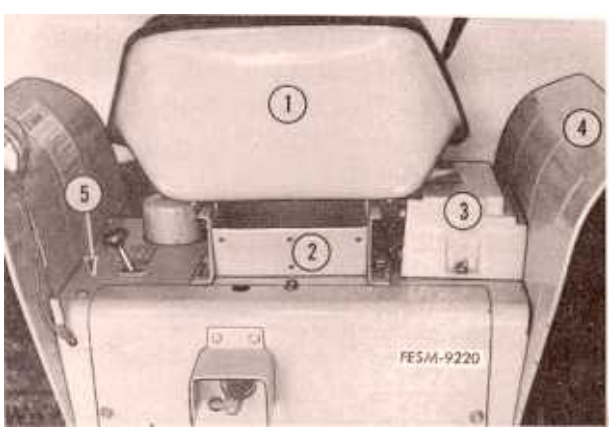
4. Disconnect the oil lines to the transmission and drain the Hy-Tran fluid.

5. Remove the shift lever knob.

6. Remove the frame top cover and the pin securing the clutch brake yoke (1) to the clutch release yoke (4).



1. Clutch brake yoke
2. Clutch release bracket
3. Pin
4. Clutch release yoke
5. Clutch brake assembly

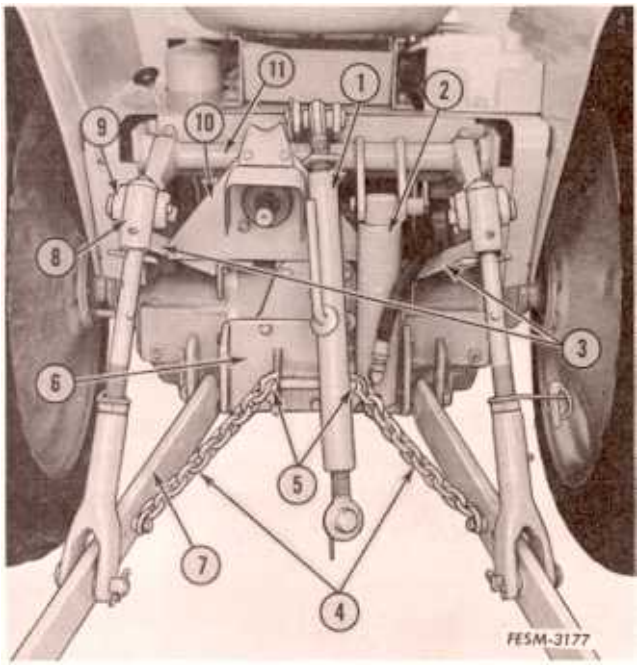


7. Remove the seat (1), and seat support assembly (2) as a unit.

8. Remove the battery (3).

9. Remove the fenders (4) and rear frame cover assembly (5) as a unit.

1. Seat
2. Seat support assembly
3. Battery
4. Fenders
5. Rear frame cover assembly



10. Remove the seat support sheet assemblies. If the tractor is equipped with three point hitch, remove the rockshaft support assembly as follows:

(a) Remove the pins from the upper and loser ends of the hydraulic cylinder (2).

(b) Remove the limiter chain shackle pins (5).

(c) Remove the lower link assemblies (7) from the link mounting plate assembly (6).

(d) Remove the rear shield braces (3).

(e) Remove the rockshaft support assembly.

1. Upper link assembly
2. Hydraulic cylinder
3. Rear frame shield braces
4. Limiter chains
5. Chain pins
6. Link mounting plate
7. Lower link assembly
8. Lift link swivel
9. Rockshaft arm swivel
10. Shield support
11. Rockshaft support assembly

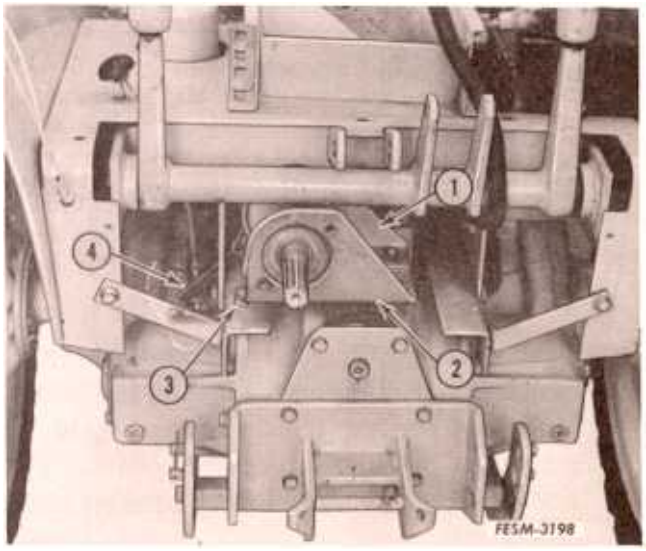
11. Remove the IPTO as follows:

(a) Remove the PTO rear shield and support and engage the PTO clutch.

(b) Remove the PTO brake support (1) and the shaft bearing mounting bracket support (2). Loosen the clutch cleat bracket cap screws (3).

(c) Disconnect the clutch control arm (4).

(d) Remove the PTO clutch assembly from the tractor.



1. Brake support
2. Shaft bearing mounting bracket
3. Clutch cleat bracket
4. Clutch control arm

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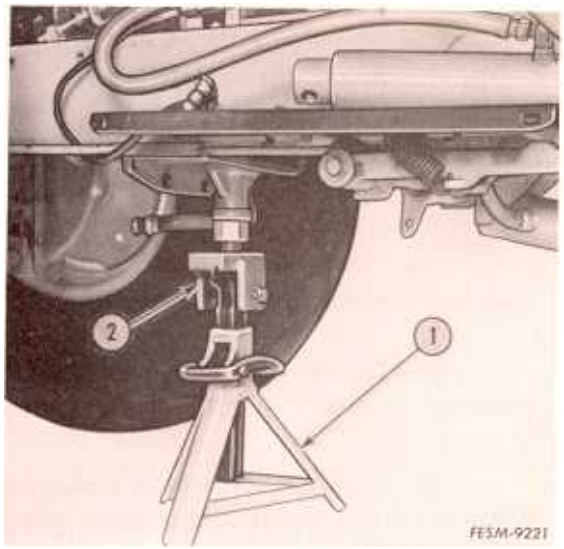
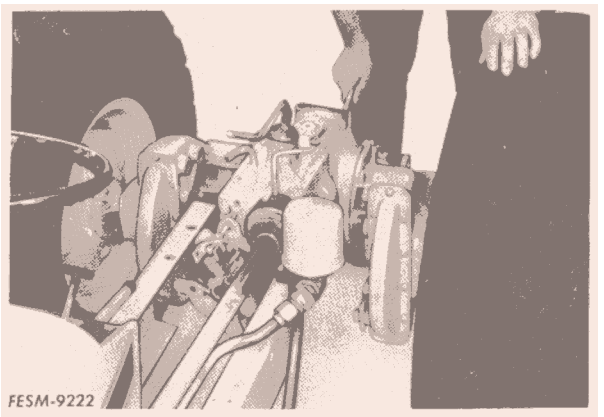


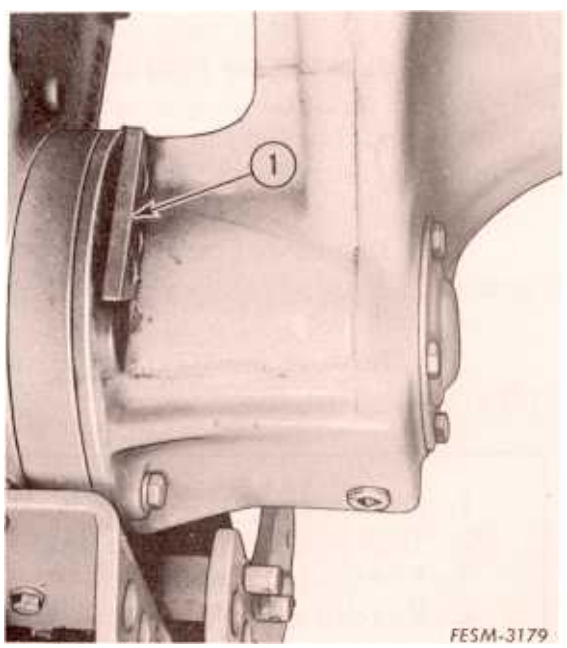
12. Support the frame of the tractor using one jack stand FES 142-4 with an adapter (2), FES 142-13 and remove the cap screws from both sides that secure the transmission case to the frame. Raise the rear of the frame to clear the axle housing.

1. Jack stand FES 142-4
2. Adapter FES 142-13



13. Fasten a crescent wrench to the drawbar or the link mounting plate assembly (three point hitch equipped) and move the assembly rearward.

Recoupling the Tractor



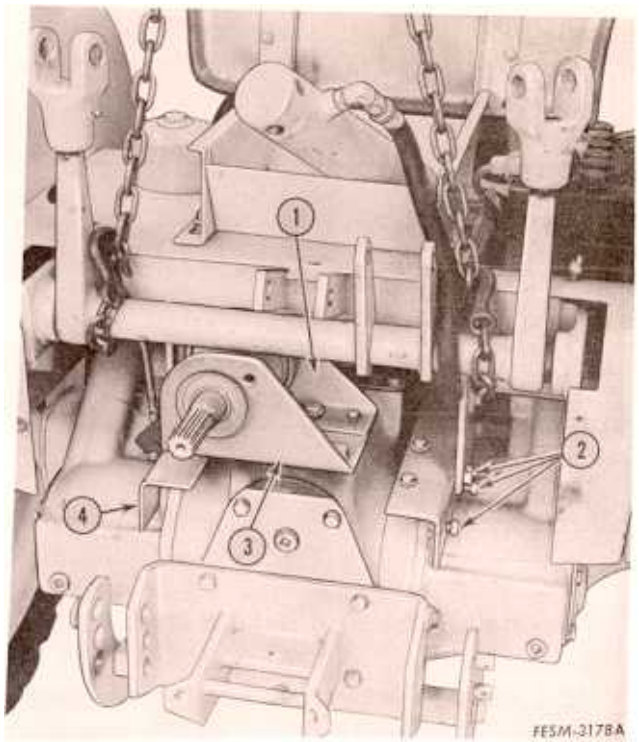
1. Be sure to install the reinforcement block (1) on the R.H. final drive assembly if it was removed.

2. Recouple the tractor by reversing the splitting procedure.

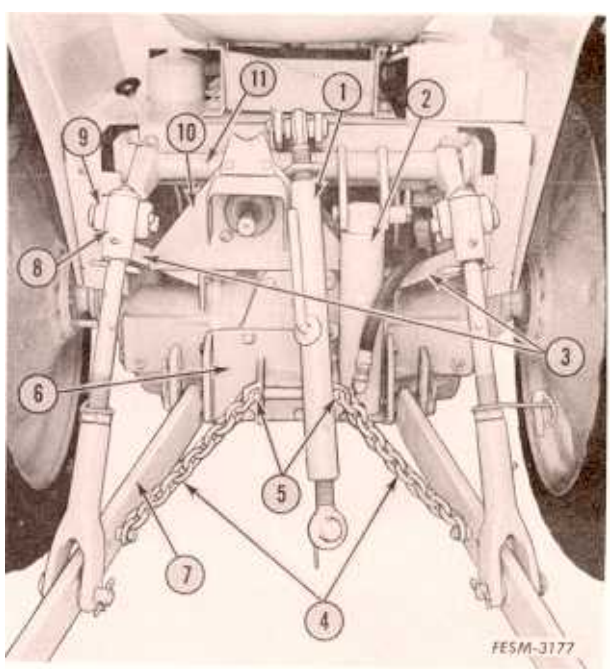
1. Reinforcement block

NOTE: When securing the transmission case to the frame, the two 1-3/8" cap screws go in the left side and the two 2-7/8" cap screws are used on the right side.

3. After filling the transmission to correct fluid level with Hy-Tran fluid, start and run the tractor for several minutes. Recheck the fluid level. Check and adjust the main clutch, brakes and IPTO unit.



1. PTO brake support
2. Cap screws
3. PTO shaft bearing mounting bracket
4. Cap screws (not shown)



2. Recouple the split sections of the tractor being sure the drive shaft splines mate with the transmission input splines.

3. Install the cap screws (2 and 4) securing the transmission case to the frame and tighten securely.

NOTE: The two 1-3/8" cap screws go in the left side and the two 2-7/8" cap screws are used on the right side.

NOTE: If Tractor is equipped with a creeper drive and PTO, install PTO clutch assembly. Refer to Section 8. Install fenders, seat, and seat support assembly.

4. If the tractor is equipped with independent power take-off, install the bearing mounting bracket support (3) and the PTO brake support (1).

5. Install the rear shield braces (3).

6. If the tractor is equipped with three point hitch, proceed as follows:

(a) Install the upper link assembly (1).

(b) Install the hydraulic cylinder (2) and secure the upper and lower ends with pins.

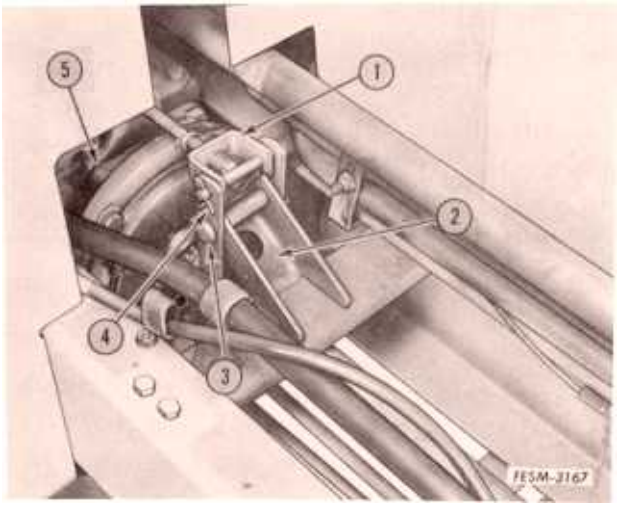
(c) Install the lower link assembly (7) and the lower link pins.

(d) Assemble the lift link swivels (8) to the rockshaft arm swivels (9).

(e) Install the limiter chains (4) and chain shackle pins (5).

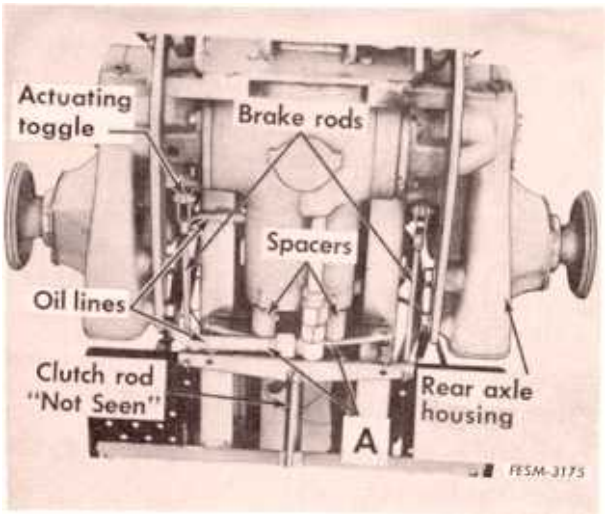
7. Install the rear PTO shield support (10) (if so equipped).

1. Upper link assembly
2. Hydraulic cylinder
3. Rear frame shield braces
4. Limiter chains
5. Chain pins
6. Link mounting plate
7. Lower link assembly
8. Lift link swivel
9. Rockshaft arm swivel
10. Shield support



8. Install the pin securing the clutch brake yoke (1) to the clutch release yoke (4).

1. Clutch brake yoke
2. Clutch release bracket
3. Pin
4. Clutch release yoke
5. Clutch brake assembly



9. Install the shift handle knob.

10. Install the two cap screws (A) and spacers securing the front of the transmission to the frame and tighten securely.

11. Connect the transmission oil lines.

12. Connect the brake rods to the actuating toggles.

13. Fill the transmission to the correct level with Hy-Tran fluid.

14. Connect the battery ground strap to the battery.

15. Adjust the clutch and brakes.

Section 6

TRANSMISSION AND DIFFERENTIAL

Contents

Specifications

Transmission

Type	Selective, sliding spur gears
Gears forward	3
Gears reverse	1

Countershaft gears (no. teeth)

Bevel pinion	10
Reverse speed gear	35
1st speed gear	39
2nd speed gear	36
3rd speed gear	26

Countershaft spacer lengths

Between front bearing and 3rd speed driven gear - inch	Beveled edge to bearing .848 to .852
Between 3rd speed driven gear and 2nd speed driven gear-inches	1.310 to 1.314
Between 2nd speed driven gear and 1st speed driven gear - inch	.310 to .314
Between 1st speed driven gear and reverse driven gear - inch	.686 to .890
Between reverse driven gear and rear bearing - inch	Beveled edge to bearing .690 to .694

Transmission - Continued

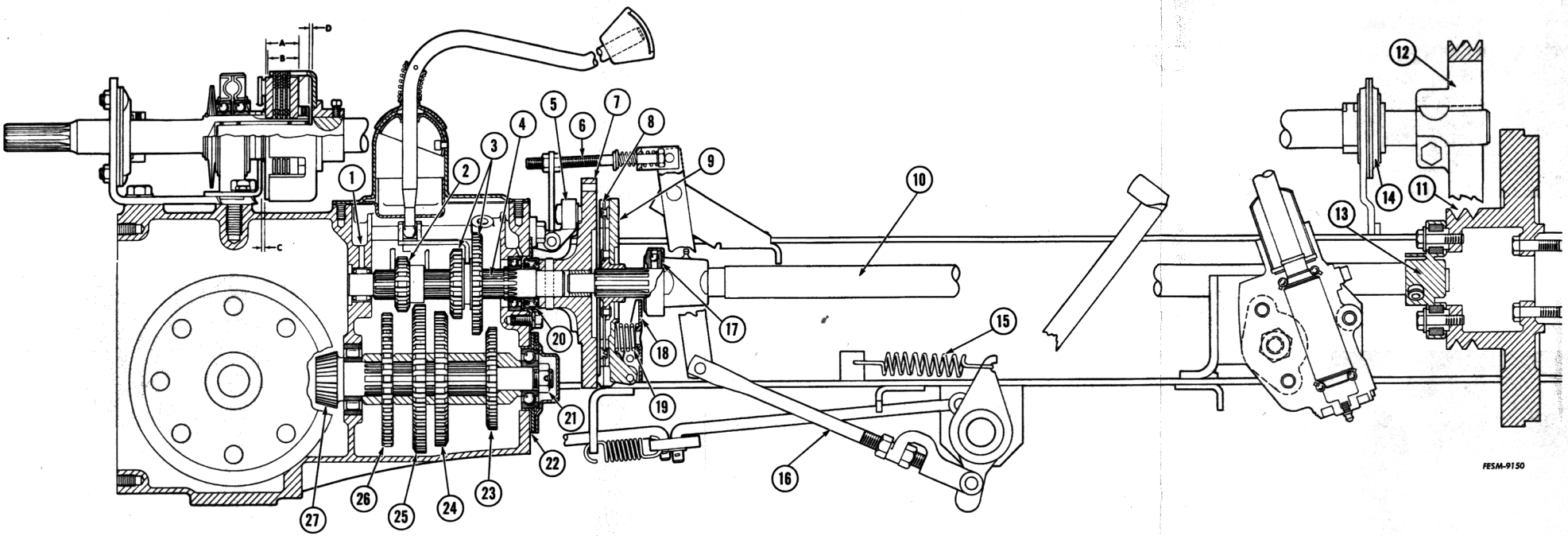
Countershaft OD	
For front bearing - inch . .	.7873 to .7876
For rear bearing - inches .	1.1803 to 1.1808
Spline and clutch shaft gears (no. teeth)	
1st and reverse speed sliding gear	 13
2nd and 3rd speed sliding gear	16 and 26
Spline and clutch shaft OD	
For front bearing - inch	.9842 to .9846
For rear bearing - inch	.8095 to .8099
Reverse idler shaft OD - inch	.610 to .611
Reverse idler gear bushing (installed and reamed) ID - inch . .	.6120 to .6130
Bearings	
Countershaft .	Ball - front
	Roller - rear
Spline and clutch shaft	Ball - front
	Needle - rear
Special torques	
Transmission countershaft nut	85 to 100 ft. lbs.

Differential

Type	Bevel gears and pinions
Number of pinions	2 (10 teeth)
Number of side gears	2 (16 teeth)
Bearings (2)	Tapered roller
Bevel pinion and drive gear backlash - inch	.003 to .005
Bevel pinion location	Integral part of countershaft
Drive gear location	In transmission case
Ratio (bevel pinion to drive gear)	10 to 46

General

Complete service of the transmission requires splitting the tractor, removal of the final drive assemblies and removal of the differential. The differential can be removed and replaced without disassembling the transmission, however the transmission countershaft must be removed when checking preload of the differential carrier bearings. The transmission and differential are therefore covered together.



Above Serial No. U018709

1. Oil passage
2. 1st & reverse speed sliding gear
3. 2nd & 3rd speed sliding gear
4. Spline and clutch shaft
5. Clutch brake assembly
6. Clutch brake adjusting bolt
7. Rear pressure plate assembly
8. Clutch driven disc assembly
9. Front pressure plate assembly
10. Main clutch shaft
11. PTO drive pulley
12. PTO driven pulley
13. Clutch coupling
14. Bearing
15. Clutch return spring
16. Clutch adjusting rod
17. Clutch release bearing
18. Release lever
19. Pressure spring
20. Shaft oil seal
21. Countershaft nut
22. Shims
23. 3rd speed gear
24. 2nd speed gear
25. 1st speed gear
26. Reverse speed gear
27. Countershaft and bevel pinion

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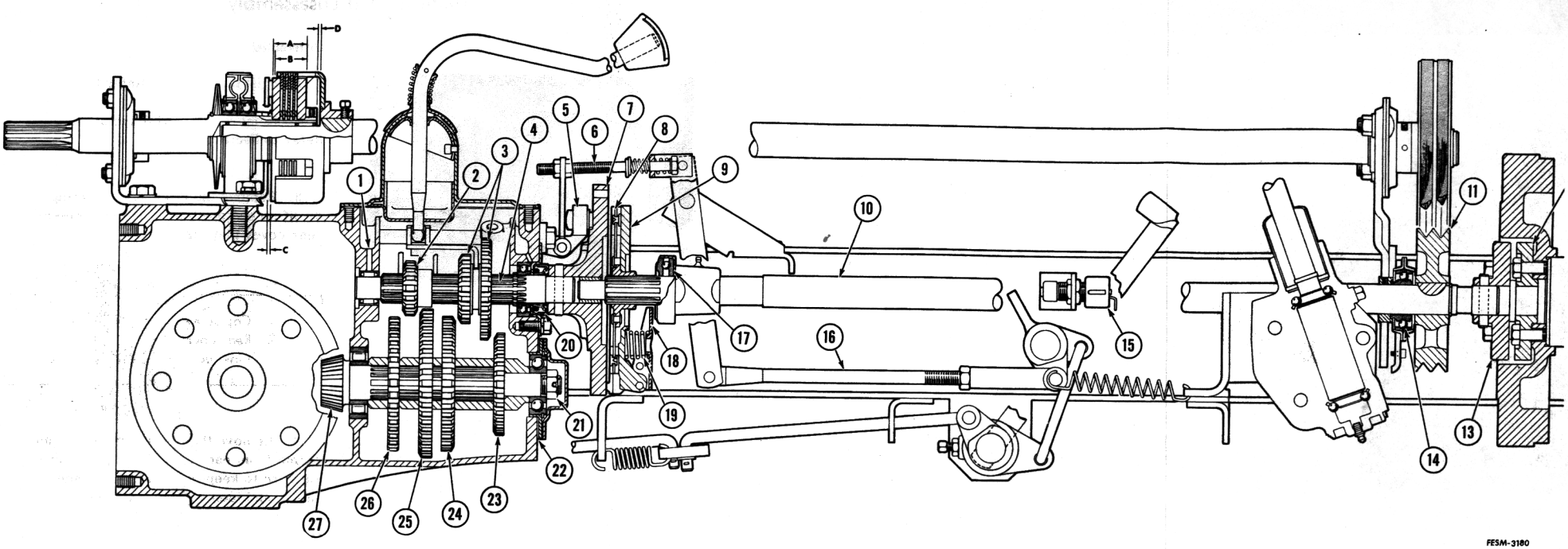

FESM-3180

Serial No. U018709 and Below.

1. Oil passage
2. 1st & reverse speed sliding gear
3. 2nd & 3rd speed sliding gear
4. Spline and clutch shaft
5. Clutch brake assembly
6. Clutch brake adjusting bolt
7. Rear pressure plate assembly
8. Clutch driven disc assembly
9. Front pressure plate assembly
10. Main clutch shaft
11. PTO drive pulley
12. Coupler retainer
13. Clutch coupling
14. Bearing
15. Neutral start switch
16. Clutch adjusting rod
17. Clutch release bearing
18. Release lever
19. Pressure spring
20. Shaft oil seal
21. Countershaft nut
22. Shims
23. 3rd speed gear
24. 2nd speed gear
25. 1st speed gear
26. Reverse speed gear
27. Countershaft and bevel pinion

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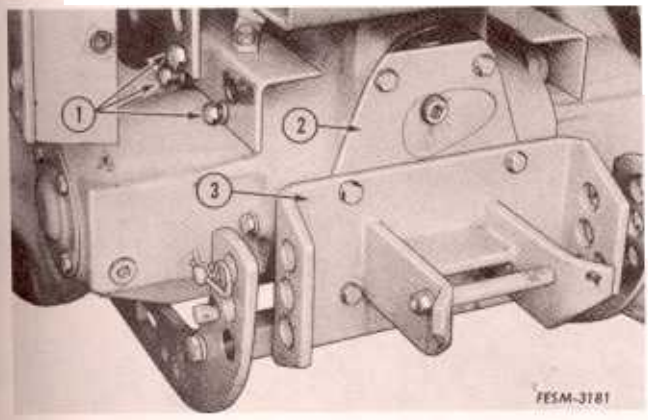
Removal and Disassembly

Differential



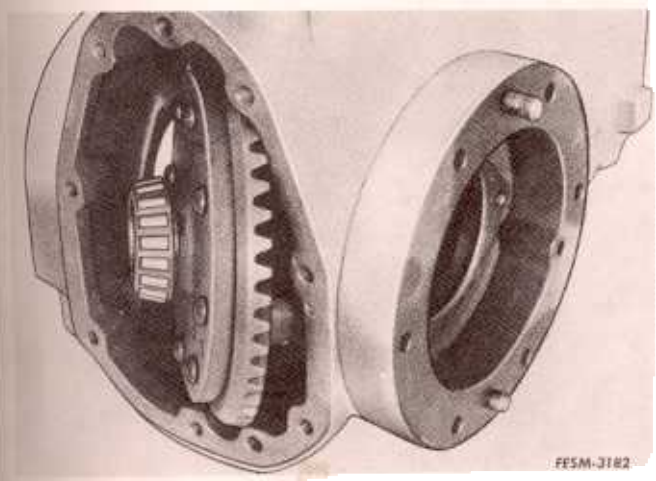
1. Split the tractor. Refer to Section 5.

2. Remove the final drive assemblies. Refer to Section 7.

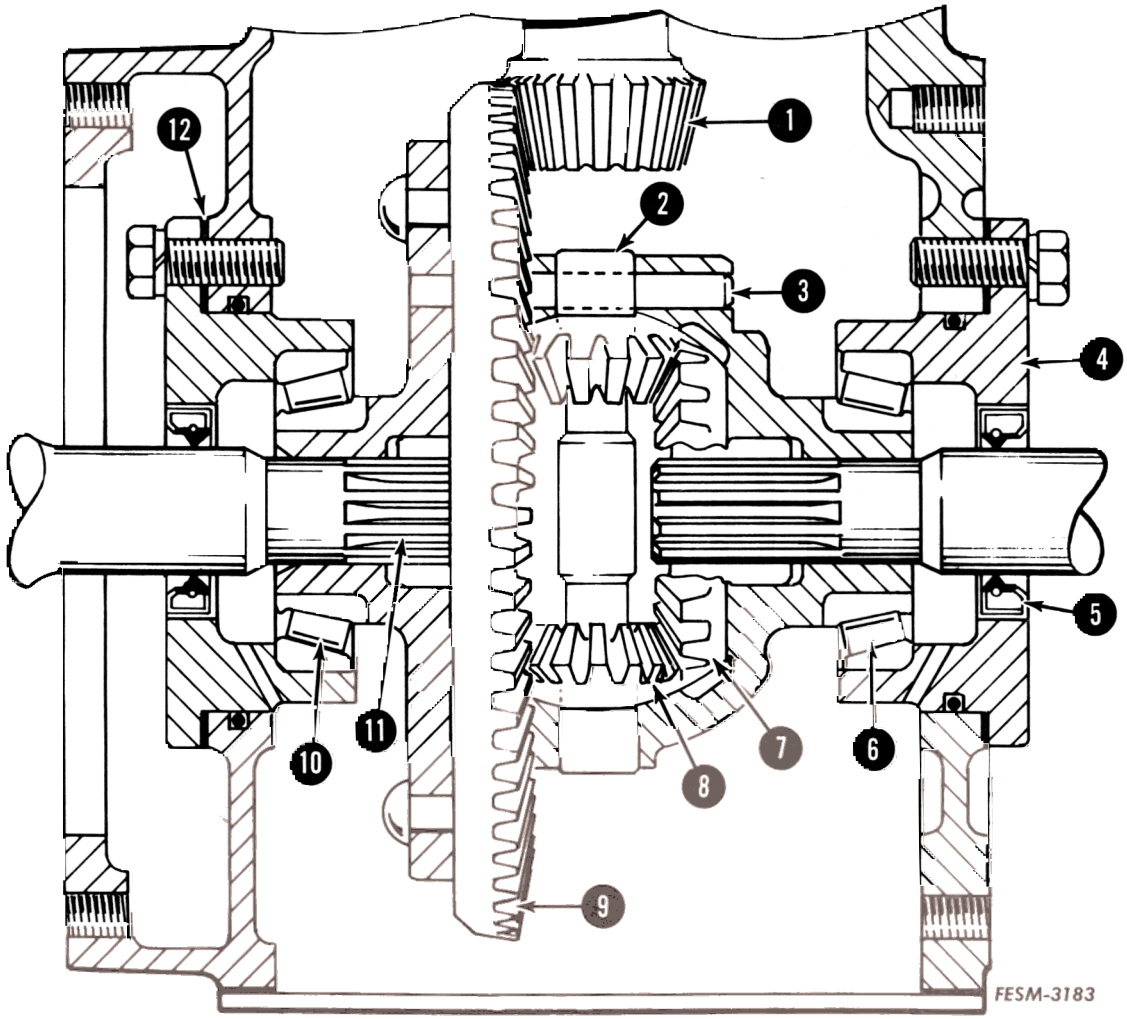
3. Remove the hitch link mounting plate (3) (if so equipped) and the transmission rear cover plate (2).

1. Cap screws (both sides)
2. Rear cover plate
3. Link mounting plate assembly

4. Remove the bearing retainers and shims from each side of the differential. Be sure to keep the shims with each retainer and identified for each side.



5. Turn the differential into position as shown and remove it from the transmission case. If the assembly will not clear the side of the transmission case, it will be necessary to remove the R. H. bearing cone.



1. Bevel pinion
2. Pinion shaft
3. Lock pin
4. Bearing retainer
5. Oil seal
6. R.H. bearing
7. Side gear (2)
8. Pinion (2)
9. Drive gear
10. L.H. bearing
11. Differential shaft
12. Shims

6. Drive out the pinion shaft lock pin (3) and remove the pinion shaft (2).

7. Remove the pinion gears (8) and side gears (7).

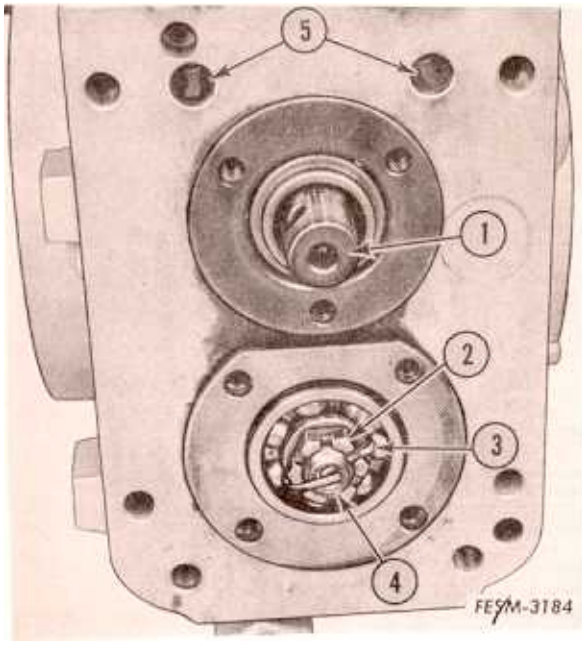
8. If the differential drive gear (9) requires separate replacement, press out the eight retaining rivets.

9. Remove the bearing cones (6 and 10) from the differential carrier if they are to be replaced.

10. Remove the bearing cups from the bearing retainers if replacement is necessary.

11. Remove the oil seals (5) from the bearing retainers (4).

Disassembly



Transmission

1. Remove the differential as previously described on page 6-4.

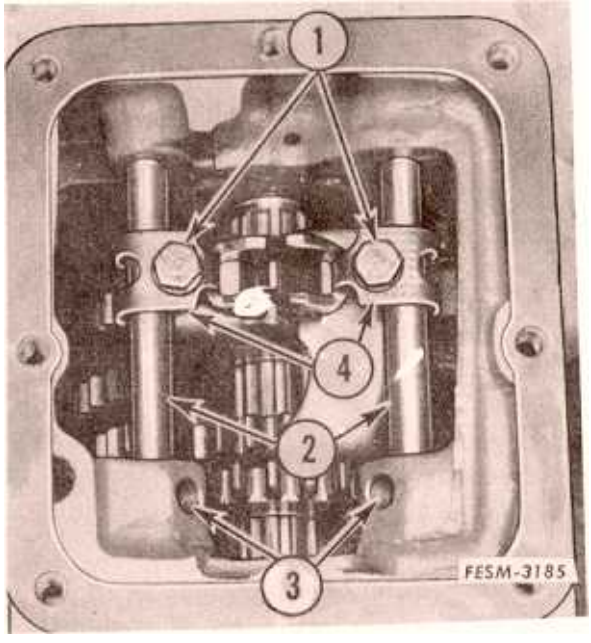
2. Remove the gear shift lever and cover assembly.

3. Remove the countershaft bearing retainer cap.

4. Remove the cotter pin (3) from the countershaft nut (2).

5. Shift the transmission into two gear speeds to lock the transmission, then remove the nut from the countershaft.

1. Spline and clutch shaft
2. Countershaft nut
3. Cotter pin
4. Countershaft
5. Shifter rod bores

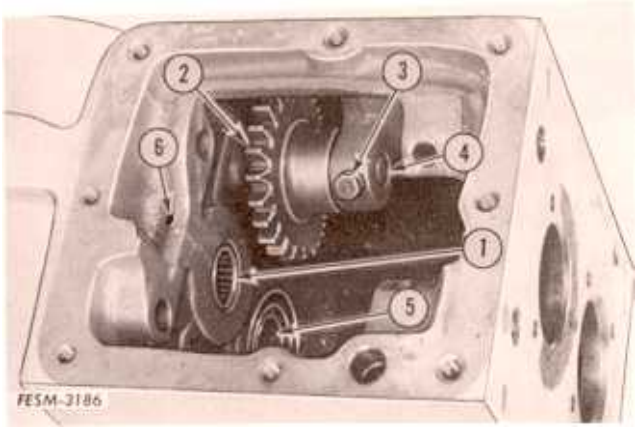


6. Shift the transmission into the neutral position and remove the shifter fork set screws (1).

7. Using a brass rod, drive the shifter rods (2) forward and out of the case, and remove the shifter forks (4).

CAUTION: Cover the shifter poppet ball holes (3) to prevent the balls and springs from flying out as the rods are removed.

1. Shifter fork set screws
2. Shifter rods
3. Poppet ball holes
4. Shifter forks



1. Spline and clutch shaft rear bearing
2. Reverse idler gear assembly
3. Set screw
4. Expansion plug
5. Countershaft rear bearing
6. Oil passage

8. Remove the countershaft bearing retainer and shims. Be sure to keep the shims with the retainer for use in reassembly.

9. Remove the spline and clutch shaft front bearing retainer and oil seal.

10. Move the spline and clutch shaft forward and out of the transmission case as the gears are removed. Keep the gears in correct order for proper reassembly.

11. Move the countershaft rearward and out of the transmission case as the gears and spacers are removed. Note the sequence of spacers and gears for reassembly.

12. To remove the reverse idler shaft and gear assembly, remove the set screw (3) and remove the shaft, reverse idler gear assembly (2) and expansion plug (4). Press the bushing out of the reverse idler gear if the bushing is to be replaced.

13. Remove the bearings (1 and 5) from the transmission case if they are to be replaced.

Inspection and Repair

1. Wash all parts in cleaning solvent and dry with compressed air. Do not spin bearings.

2. Check all bearings for looseness, wear, roughness, pitting and scoring, and replace if necessary.

3. Check the gears and shafts for wear and burrs. Remove any burrs with a fine stone.

4. Inspect the housing for cracks, restricted oil passages or raised places on its machine faces. Smooth off raised places with a file.

5. Be sure to install new oil seals, gaskets and O-rings.

6. Thoroughly lubricate all parts with Hy-Tran before reassembly.

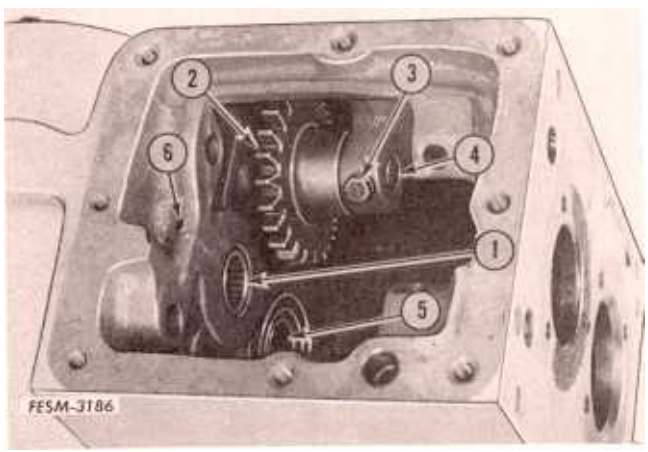
Reassembly and Installation

Transmission and Differential

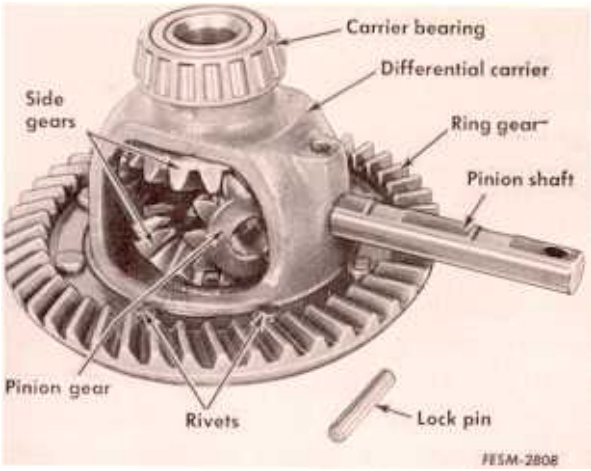
1. Be sure all bearings are thoroughly lubricated before reassembly.

2. Be sure to replace all gaskets, O-rings and oil seals.

3. Install new bearings (1 and 5) in the transmission case if they were removed. BE SURE the spline and clutch shaft rear bearing (1) is installed with its oil passage aligned with the oil passage (6) in the case.



1. Spline and clutch shaft rear bearing
2. Reverse idler gear assembly
3. Set screw
4. Expansion plug
5. Countershaft rear bearing
6. Oil passage

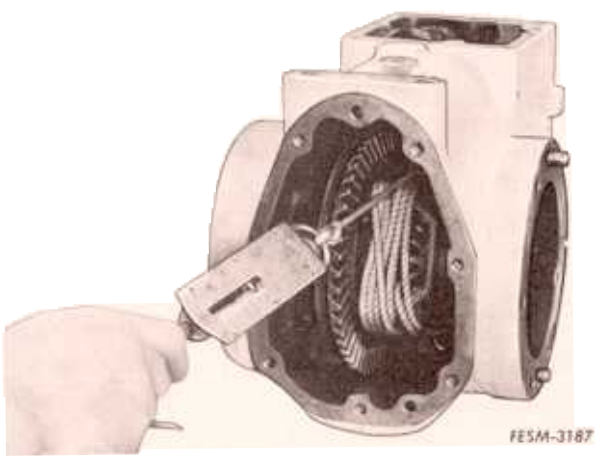


4. Assemble the side gears and the pinion gears in the differential case assembly.

5. Install the pinion shaft and drive the pinion shaft lock pin into place.

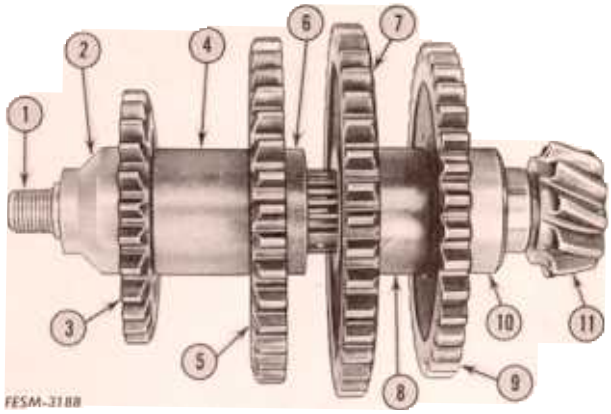
6. Install the differential assembly in the transmission case. The drive gear must be on the left with the teeth facing right.

7. Press the R. H. bearing on the differential carrier if it was removed during disassembly.



8. Be sure to install new O-rings and oil seals. Install the bearing retainers and shims. Install the cap screws and tighten to 45 ft. lbs. torque.

9. Check bearing preload before installing the transmission countershaft. Preload is correct when a steady pull of one to eight pounds is necessary to rotate the differential assembly.



1. Countershaft
2. Spacer
3. 3rd Speed gear
4. Spacer
5. 2nd Speed gear
6. Spacer
7. 1st Speed gear
8. Spacer
9. Reverse speed gear
10. Spacer
11. Bevel pinion

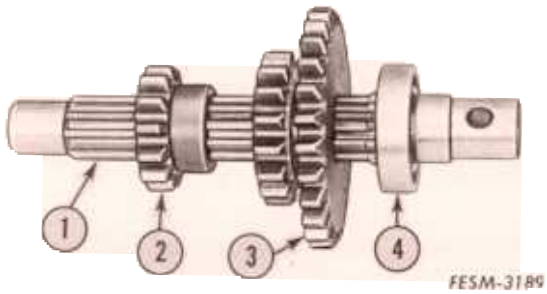
10. Add or remove an equal amount of shims on both bearing retainers to adjust for specified preload.

11. Remove the differential assembly being sure to keep the shims with each retainer and identified for each side.

12. Install the transmission countershaft, spacers, gears, front bearing, bearing retainer and shims and the countershaft nut. Do not torque nut at this time. Refer to Specifications for spacer lengths. Be sure to install a new O-ring and gasket.

13. If the reverse idler bushing is to be replaced, press the bushing into the gear until the edge is flush with the gear face. Ream the bushing to the specified I. D. of .612 to .613 inch.

14. Install the reverse idler shaft and idler gear assembly in the case. Install the set screw and tighten securely. Be sure to install a new expansion plug.

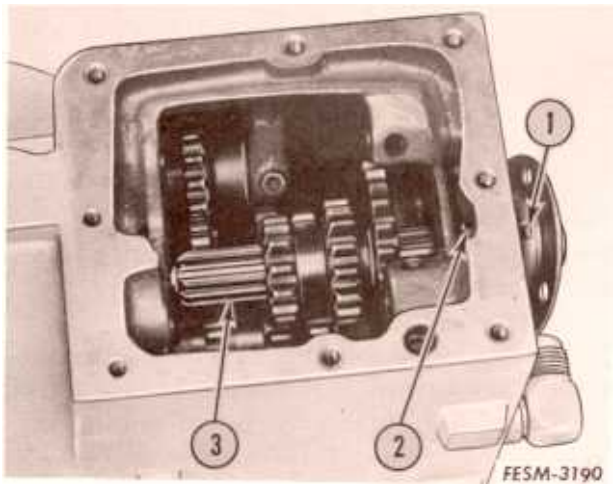


1. Spline and clutch shaft
2. 1st and reverse speed sliding gear
3. 2nd and 3rd speed sliding gear
4. Shaft front bearing

15. Install the spline and clutch shaft (1), bearing (4) and gears (2 and 3) in the transmission case.

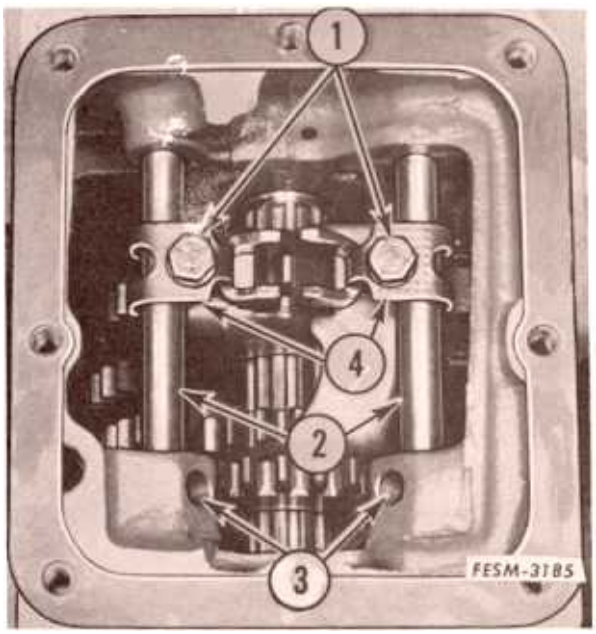
16. Install a new gasket and shaft oil seal on the clutch and spline shaft. Use a double lip neoprene seal, do not use a leather seal.

17. Install the cap screws and tighten to 25 ft. lbs. torque.



NOTE: Be sure the slot in the oil seal (1) is aligned with the oil passage (2) in the case.

1. Shaft oil seal slot
2. Oil passage
3. Spline and clutch shaft



1. Shifter fork set screws
2. Shifter rods
3. Poppet ball holes
4. Shifter forks

18. Install the gear shift poppet springs and balls in their bores (3).

19. Depress the springs and balls and install the shifter forks (4) and shifter rods (2).

20. Lock the forks in place with the set screws (1) and tighten securely.

21. Be sure to install new expansion plugs in the front shifter rod bores.

22. Shift the transmission into two speeds to lock the gears, and then tighten the countershaft nut to 85 to 100 ft. lbs. torque.

23. Install the cotter pin in the nut and countershaft. Install the bearing retainer cap and gasket and tighten the cap screws to 25 ft. lbs. torque.

24. Install the differential assembly in the case. The drive gear must be on the left with teeth facing right.

25. Install the R. H. carrier bearing if it was removed.

26. Keeping preload shim pack correct as previously established, install the bearing retainers and cap screws and tighten to 45 ft. lbs. torque.

27. Check the backlash between the drive gear and bevel pinion and the gear teeth bearing pattern as follows.

(a) Apply a thin coat of red lead or prussian blue to the bevel pinion teeth faces, then rotate the gears by hand and observe the bearing pattern.

Some deflection will occur under load. Allowance is made in gear design to prevent concentration of load on tooth edges.

(b) Hand testing and very light loads should provide a pattern as shown in Figure "B". When load and deflection increases the pattern will progress as in Figure "A".

(c) The desirable (no load) pattern in Figure "B" is the result of adjusting the differential drive gear lateral position to the specified range of .003" to .005" backlash.

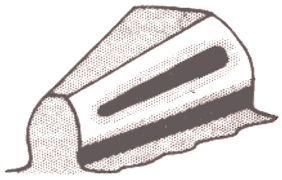


Figure A

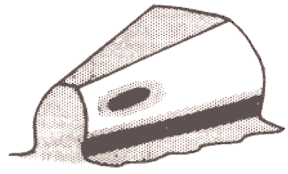
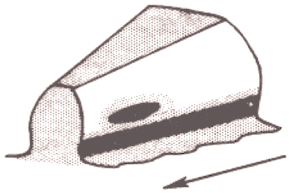


Figure B



FEA-63284 Figure C

Figure D

(d) Adjust the drive gear lateral position by removing shims from one side and installing the shims removed on the opposite side.

NOTE: Do not add or remove shims to change the total amount of shims in the previously established shim pack as this will change the bearing preload.

(e) Tooth bearing position from the root to the crown of the tooth is controlled by lateral position of the bevel pinion.

(1) If low tooth bearing position on the bevel pinion is indicated (as shown in Figure "C") the pinion must be adjusted towards the drive gear.

(2) If high tooth bearing position on the bevel pinion is indicated (as shown in Figure "D"), the pinion must be adjusted away from the drive gear.

(f) Adjust the bevel pinion by adding or removing shims between the bearing retainer and the transmission case.

NOTE: If it is necessary to move the bevel pinion in or out to correct "Root-to-crown" bearing, the drive gear must also be moved laterally to maintain the specified backlash.

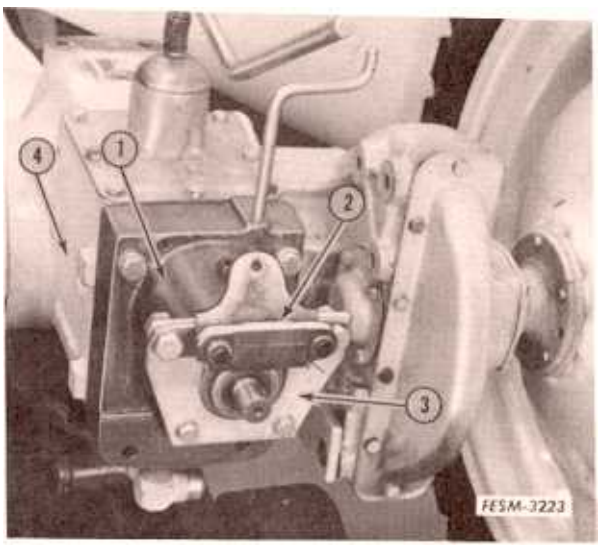
28. Install the final drive assemblies on the transmission case. Be sure the spacer is in place on the R. H. final drive. (Refer to Section 7.)

29. Install the gear shift lever and cover assembly.

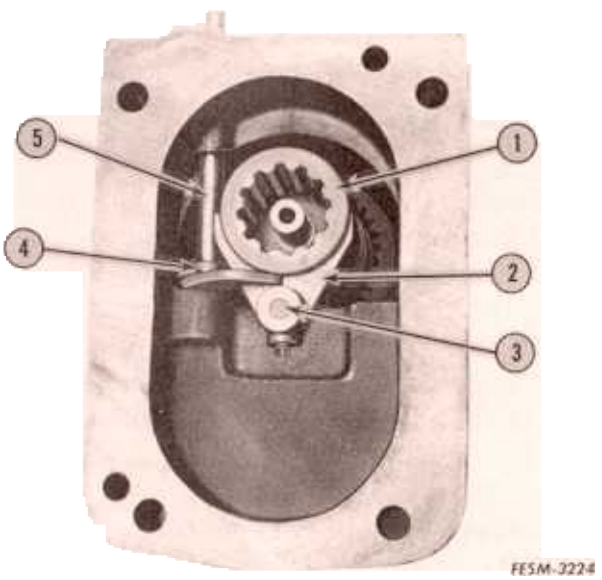
30. Install the transmission rear cover plate and the link mounting plate assembly (if equipped).

31. Recouple the tractor. Refer to Section 5.

Creeper Drive (154 & 185 Tractors)



1. Creeper drive housing
2. Clutch brake assembly
3. Clutch brake assembly support
4. Transmission case



1. Spindle drive sleeve
2. Shift fork
3. Shift fork spindle
4. Shift plate
5. Control lever

Removal

1. Remove as a unit, the fender and seat assembly, and if equipped with PTO, remove the PTO clutch assembly from the PTO drive shaft. Refer to Section 8.

2. Split the tractor. Refer to Section 5.

3. Support the transmission and place an oil drip pan under the creeper unit and drain the creeper lubricant.

4. Remove the engine clutch assembly from the shaft.

5. Remove the clutch brake assembly (2) and the clutch brake support (3) from the creeper housing (1).

6. Remove the cap screws securing the creeper unit (1) to the transmission case (4).

7. Pull the creeper forward and remove it from the transmission.

8. Drive out the pin and remove the splined coupling from the transmission shaft if it is to be serviced.

Disassembly

1. Drive the coiled spring pin out of the gear shift plate (4) and the control lever (5).

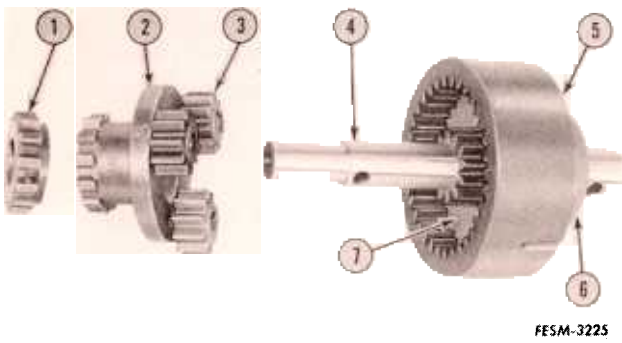
2. Remove the control lever and shift plate from the creeper assembly.

3. Remove the cap screw, poppet spring and ball from the case.

4. Remove the gear shift fork (2) and fork spindle (3) and the spindle drive sleeve (1).

5. Loosen the set screw and remove the shift fork spindle from the shift fork if service is necessary.

6. Press the main gear housing (5) out of the creeper housing.



FESM-3225

1. Direct drive spline gear
2. Low gear drive plate
3. Planet gear
4. Sun gear drive shaft
5. Main gear housing
6. Bearing retainer
7. Wear plate

7. Drive the coiled spring pin out and remove the direct drive spline gear (1) from the sun gear drive shaft (4).

8. Remove the low gear drive plate (2) and planet gears (3) from the shaft. Remove the planet gears.

9. Remove the outer retaining ring and then remove the bearing retainer (6) and wear plate (7) from the main gear housing (5).

10. Remove the snap ring holding the bearing in the bearing retainer and then remove the bearing and shaft from the bearing retainer.

11. Remove the oil seal from the bearing retainer.

12. Remove the bearing retaining ring and press the shaft out of the bearing.

Inspection and Repair

1. Inspect the sun gear drive shaft for oil seal groove wear, worn or chipped teeth on the gear and spline drive bushing wear on the rear end of the shaft.

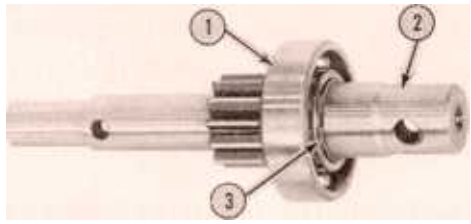
2. Check the splines and gear teeth for wear and chipping. Replace any damaged parts.

3. Inspect the ball bearing for pitting, scoring, wear and rough operation and replace if necessary.

4. Inspect the spline drive bushing for wear and damage. Install a new bushing in the spindle drive sleeve if replacement is necessary.

5. Check the housing for cracks.

Reassembly

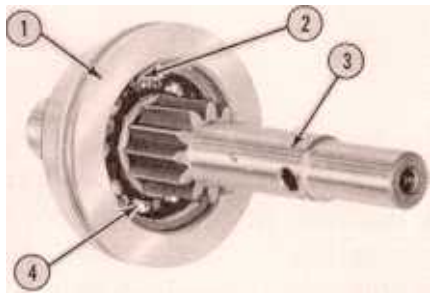


FESM-3226

1. Ball bearing
2. Sun gear drive shaft
3. Snap ring retainer

1. Press the ball bearing (1) on the sun gear drive shaft (2). Be sure the bearing bottoms against the gear shoulder. Install the snap ring retainer (3).

2. Install a new oil seal in the bearing retainer.

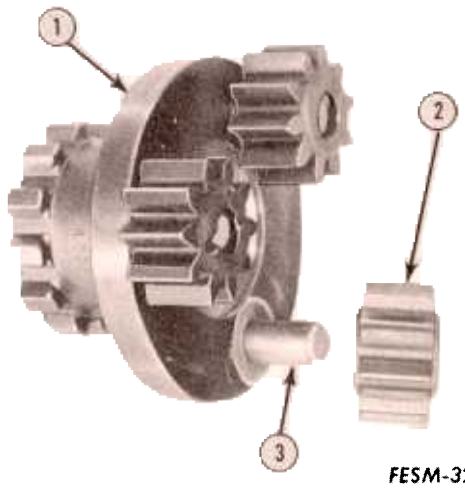


FESM-3227

1. Bearing retainer
2. Retaining ring
3. Shaft
4. Ball bearing

3. Press the shaft (3) and bearing (4) assembly in the bearing retainer (1). Be sure the assembly bottoms against the retaining shoulder. Install the snap ring retainer (2).

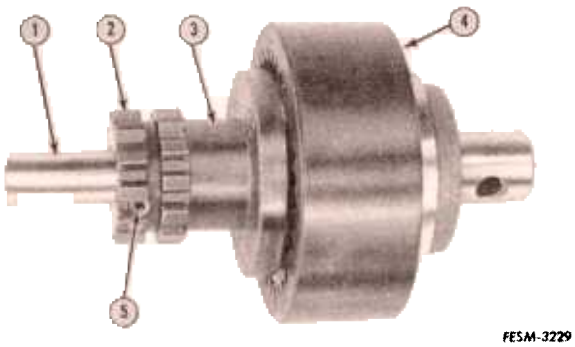
4. Install the wear plate (7) and then install the bearing retainer (6) and shaft assembly (4) in the main gear housing (5). Be sure to install a new O-ring on the bearing retainer. Install the outer retaining ring. (Refer to Illustration on page 6-14).



FESM-3228

1. Low gear drive plate
2. Planet gear
3. Planet gear pin

5. Install the planet gears (2) on the pins (3).

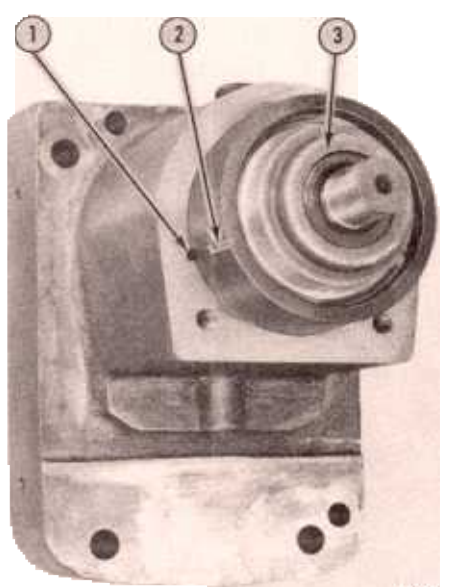


FESM-3229

1. Sun gear drive shaft
2. Direct drive spline gear
3. Low gear drive plate
4. Main gear housing
5. Coiled spring pin

6. Install the low gear drive plate (3) and planet gears on the shaft (1) and in the main gear housing (4).

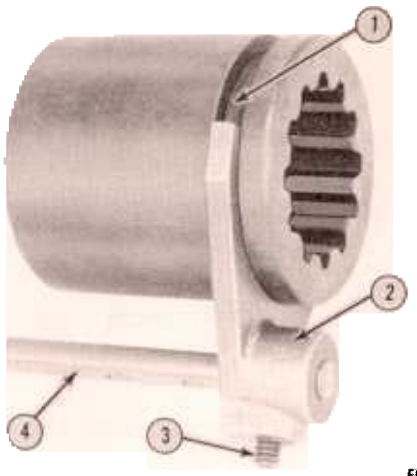
7. Install the direct drive spline gear (2) on the shaft (1) and drive the coiled spring pin (5) into its bore. Be sure the pin does not protrude above the gear hub.



FESM-3230

8. Align the slot in the main gear housing (2) with the slot in the creeper case (1) and press the main gear housing into the case until it is flush with the case. Drive the coiled spring pin into the hole made by the two slots.

1. Case slot
2. Main gear housing slot
3. Bearing retainer



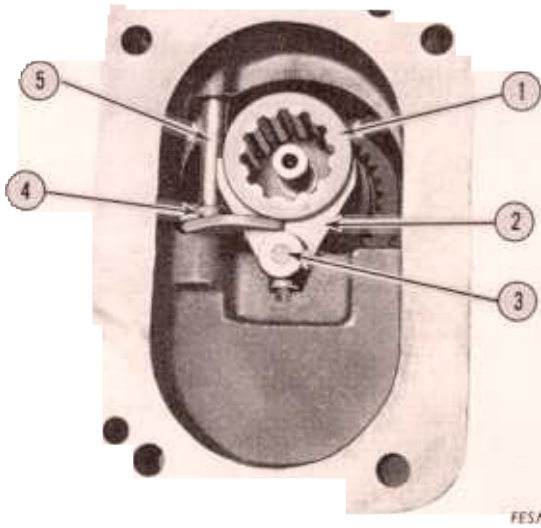
FESM-3231

1. Spindle drive sleeve groove
2. Shift fork
3. Set screw
4. Shift fork spindle

9. Install the shift fork spindle (4) in the shift fork (2), if it was removed, and tighten the set screw (3) securely.

10. Position the shift fork (2) in the spindle drive sleeve groove (1), and as a unit, slide the spindle drive sleeve and shift spindle into place on the direct drive spline gear and low gear drive plate gear.

11. Install the poppet ball and spring in the housing bore and then install the cap screw and tighten securely.



FESM-3224

12. Position the shift plate (4) on the shift fork (2). Install the control lever (5) in the housing and shift plate.

13. Align the holes in the control lever (5) and shift plate (4) and drive the coiled spring pin into the hole.

1. Spindle drive sleeve
2. Shift fork
3. Shift fork spindle
4. Shift plate
5. Control lever

Installation

1. Replace the transmission seal and the bearing retainer.

2. Install the splined coupling on the transmission shaft if it was removed. Drive the coiled spring pin into its bore.

3. Install a new gasket on the transmission case and then install the creeper on the case.

4. Install the cap screws securing the creeper unit to the transmission case and tighten to 80 ft. lbs. torque.

5. Install the clutch brake support and clutch brake assembly on the creeper housing.

6. Install the engine clutch assembly on the creeper shaft.

7. Fill the creeper drive with 1-1/2 pints of Hy-Tran Fluid.

8. Recouple the tractor. Refer to Section 5.

9. Install the PTO clutch assembly if it was removed.

10. Adjust the clutch brake and the PTO unit.

11. Install the fender and seat assembly.

Creeper Drive (184 Tractor)

Removal

1. Remove the drive shaft.

2. Remove the cross member.

3. Disconnect the brake linkage for single pedal brake.

4. Remove the creeper drive.

5. Service the creeper drive as outlined in the steps for the 154 & 185 tractor.

Installation

Installation is the reverse of the removal procedure.

Section 7

FINAL DRIVE AND BRAKES

CONTENTS

GSS-1408 (Rev. No. 1)

Printed in United States of America

Final Drive

Type	Spur gears
Location	Rear axle housings

Rear Axles

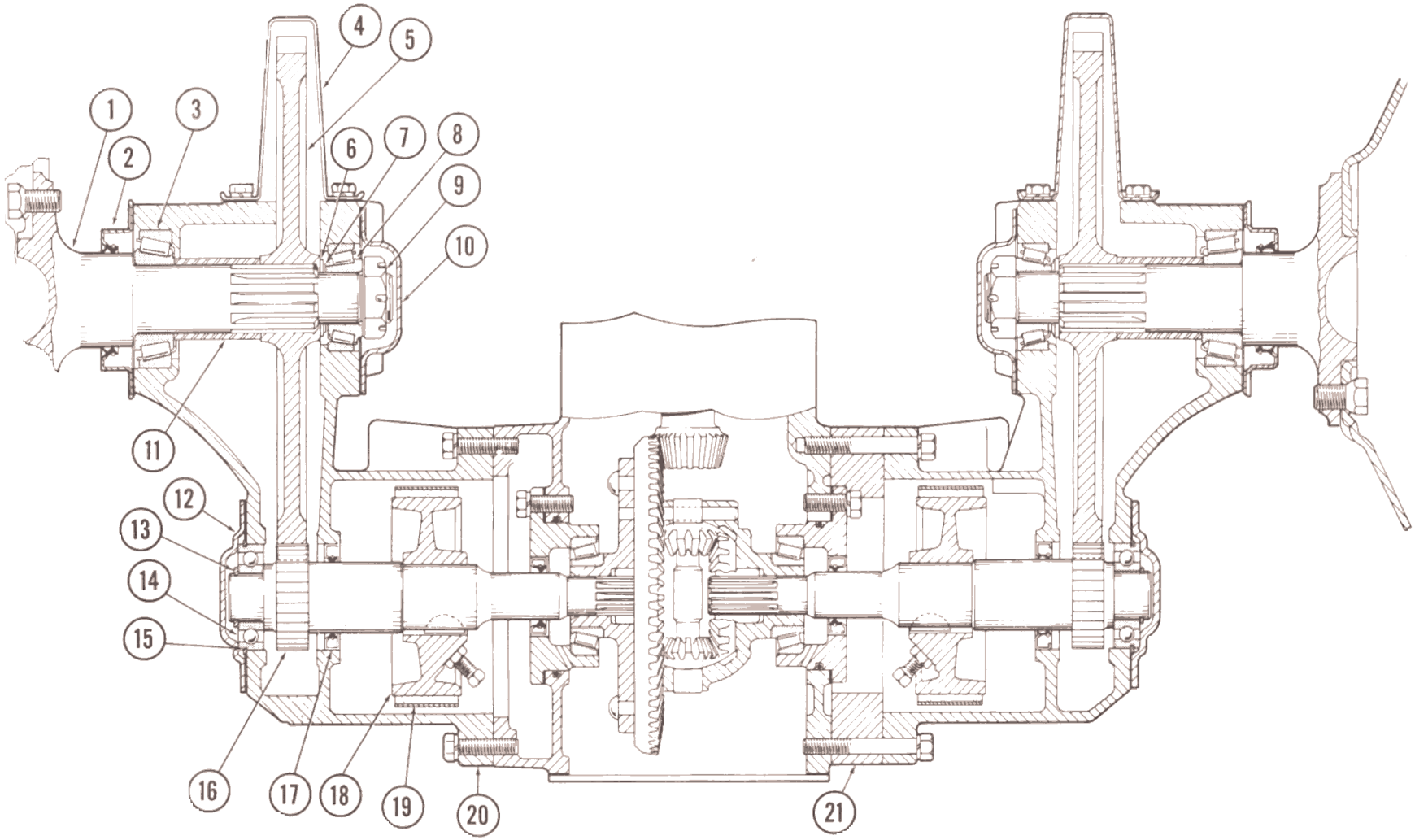
Bearings (2 each)	Tapered roller
Axle OD	
For outer bearing - inches	1.6260 to 1.6265
For inner bearing - inches	1.1905 to 1.1910
Bearing pre-load (oil seal not installed)	10 to 20 inch pounds
Oil seal	Lip inward

Differential Shafts

Bearings (1 each)	Ball
Shaft OD for bearing	1.1813 to 1.1810
Oil seal	Lip outward

Brakes

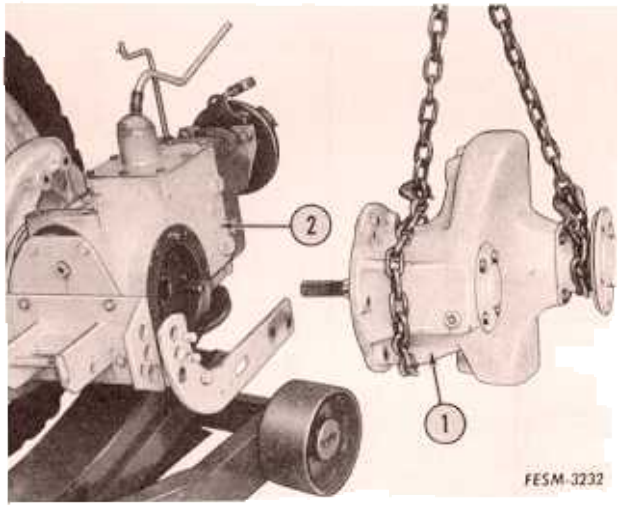
Type	External contracting drum brakes
Location	Differential shafts
Pedal free travel - inch	7/8



1. L. H. axle
2. Oil seal
3. Outer bearing
4. Housing pan
5. Drive gear
6. Drive gear spacer
7. Shims
8. Inner bearing
9. Axle nut
10. Bearing cap
11. Bearing spacer
12. Shaft bearing retainer
13. Bearing lock ring
14. Bearing
15. Bearing snap ring
16. Differential shaft and gear
17. Oil seal
18. Brake drum
19. Brake band
ne. L. H. rear axle housing
21. Rear axle axcer

Final Drive

REMOVAL – Final Drive



1. Final drive assembly
2. Transmission assembly

1. Split the tractor. Refer to Section 5.

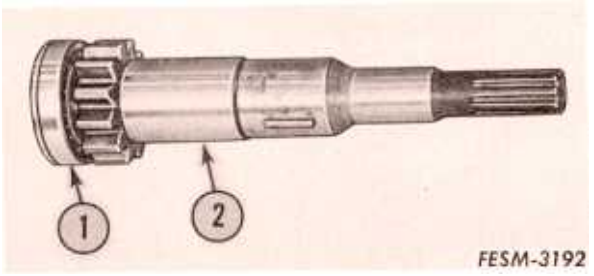
2. Remove the drain plugs in each rear axle housing and drain the lubricant.

3. Support the transmission and remove the rear wheels.

4. Remove the cap screws securing the rear axle housings to the transmission case.

5. Support the transmission and final drive assemblies and remove the assemblies from the transmission.

DISASSEMBLY – Differential Shaft



1. Bearing
2. Differential shaft

1. Remove the bearing retainer cap.

2. Loosen the lock nut and set screw securing the brake drum to the differential shaft and remove the brake assembly from the shaft.

3. Remove the differential shaft from the rear axle housing.

4. Remove the retaining ring and pull the ball bearing assembly (1) off the shaft (2).

5. Remove the oil seal from the housing.

DISASSEMBLY – Rear Axles

1. Remove the rear axle housing pan and gasket.

2. Remove the rear axle bearing cap.

3. Remove the cotter pin from the rear axle nut. Block the rear axle drive gear to prevent the shaft from turning and remove the nut.

4. Remove the cap screws securing the rear axle oil seal to the housing.

5. Press the rear axle out of the housing and remove the rear axle drive gear, spacers and shims. Be sure to retain the shims and spacers for use in reassembly.

6. Remove the outer bearing and remove the oil seal.

INSPECTION AND REPAIR – Final Drive

1. Wash all parts in cleaning solvent and dry with compressed air. Do not spin bearings.

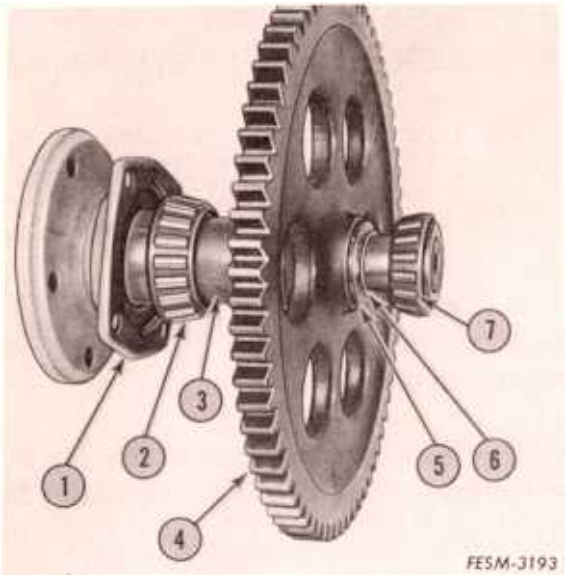
2. Check all bearings for looseness, wear, roughness, pitting and scoring, and replace if necessary.

3. Check all gears and shafts for wear and burrs. Remove any burrs with a fine stone.

4. Replace all gaskets and oil seals.

5. Check for any damaged or worn snap ring retainers, and replace if necessary.

6. Lubricate bearings and gears before reassembly.



1. Outer oil seal
2. Outer bearing
3. Spacer
4. Rear axle drive gear
5. Spacer
6. Shim
7. Inner bearing

NOTE: Install the rear axles before installing the differential shafts.

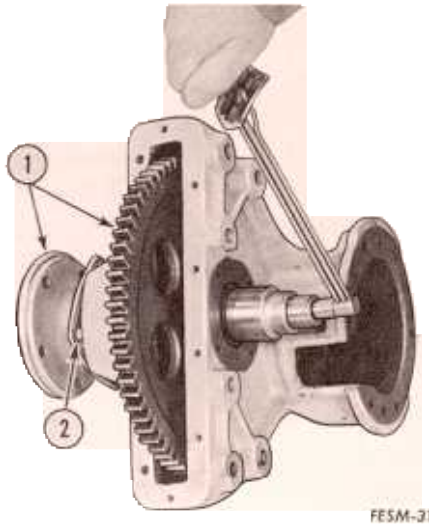
1. Be sure to replace the outer oil seals (1) and gaskets.

2. Press the outer bearing (2) on the rear axle. Be sure the bearing bottoms against the shoulder on the shaft.

3. Install the rear axle assembly in the housing. Be sure the spacers (3 and 5) and shims (6) are installed in the proper order.

4. Press the inner bearing (7) on the shaft.

5. Install the rear axle nut and tighten securely.



1. Rear axle assembly
2. Rear axle oil seal

6. Check for specified bearing pre-load as follows:

a. A drag torque of 10 to 20 inch pounds is necessary to rotate the rear axle assembly before the outer oil seal is bolted in place. Read rolling torque, not starting torque.

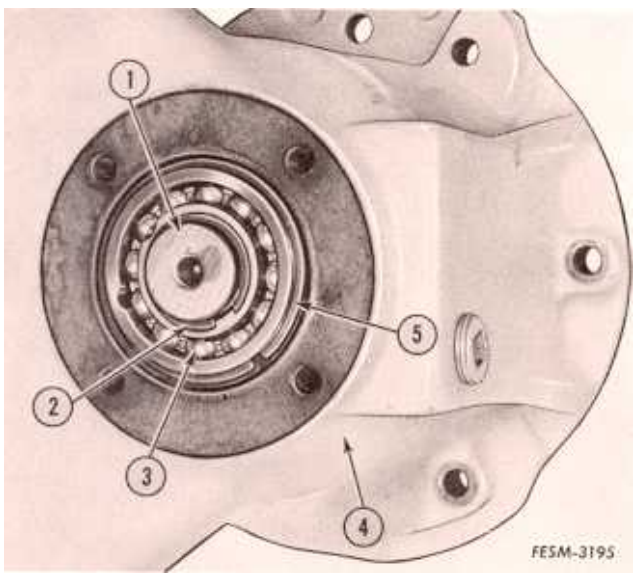
b. To adjust for specified pre-load, remove the rear axle assembly from the housing and add or remove shims.

7. Install the cotter pin in the rear axle nut.

8. Bolt the outer oil seal in place.

9. Install the bearing cap.

10. Install the axle housing pan and gasket.



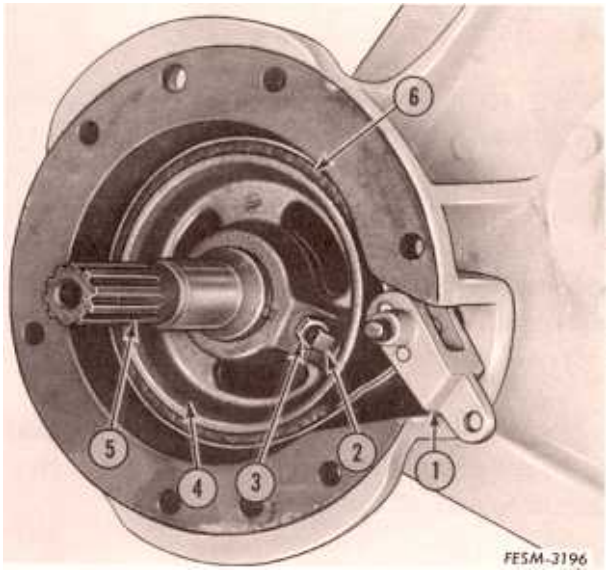
1. Differential shaft
2. Lock ring
3. Bearing
4. Rear axle housing
5. Snap ring

REASSEMBLY – Differential Shafts

1. Install a new oil seal.

2. Press the ball bearing assembly (3) on the shaft (1) and install the bearing lock ring (2).

3. Install the differential shaft (1) in the housing (4) and be sure the outside snap ring (5) is against the housing (4).



4. Align the brake drum keyway with the key on the differential shaft and install the brake drum (4) on the shaft (5). Tighten the set screw (2) and lock nut (3) securely.

5. Install the brake band (6) on the brake drum (4). Be sure the actuating toggles (1) are positioned correctly.

6. Install the bearing retainer cap.

1. Actuating toggles	4. Brake drum
2. Set screw	5. Differential shaft
3. Lock nut	6. Brake band

INSTALLATION - Final Drive

1. Be sure the spacer is on the R.H. final drive assembly and install the final drive assemblies on the transmission case.

2. Install the cap screws and tighten securely.

NOTE: The 2-7/8" long cap screws are used on the R.H. final drive assembly and the 1-7/8" long cap screws are used on the L.H. assembly. Apply sealer to the bolt in the 9 o'clock position on right side before installing.

3. Support the transmission and final drive assemblies and install the rear wheels. Tighten the lug bolts securely.

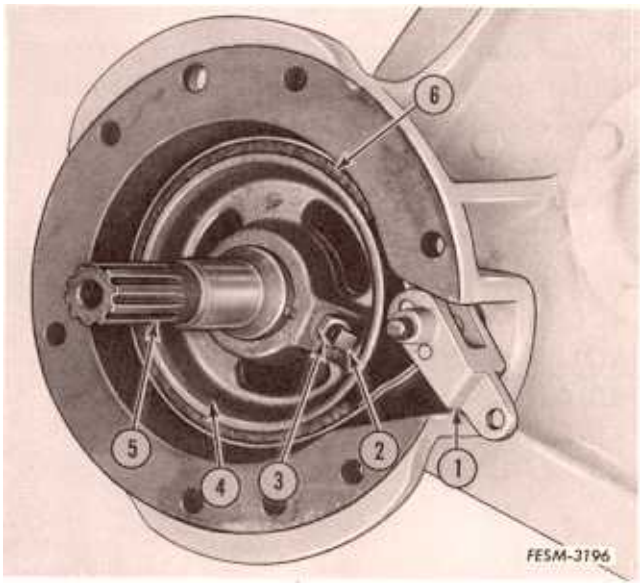
4. Fill the housings to the correct level with Hy-Tran fluid.

5. Recouple the tractor. Refer to Section 5.

Brakes

REMOVAL – Brakes

1. Split the tractor. Refer to Section 5.



2. Remove the final drive assemblies. Refer to page 7-4.

3. Remove the brake bands (6) from the brake drums (4).

4. Loosen the lock nut (3) and set screw (2) and remove the brake drum (4) from the differential shaft (5).

1. Actuating toggle
2. Set screw
3. Lock nut
4. Brake drum
5. Differential shaft
6. Brake band

INSPECTION AND REPAIR – Brakes

1. Inspect the brake band and drum for damage and excessive wear. Replace them if there is any doubt of their serviceability.

2. Inspect the control rods for wear at their connecting pivot points.

3. Check the pedal return spring ends for wear.

INSTALLATION – Brakes

1. Align the keyway in the brake drum with the key on the differential shaft and install the drum on the shaft. Tighten the set screw and lock nut securely.

2. Install the brake band on the drum.

3. Install the final drive assembly on the transmission case. Refer to page 7-8.

4. Recouple the tractor. Refer to Section 5.

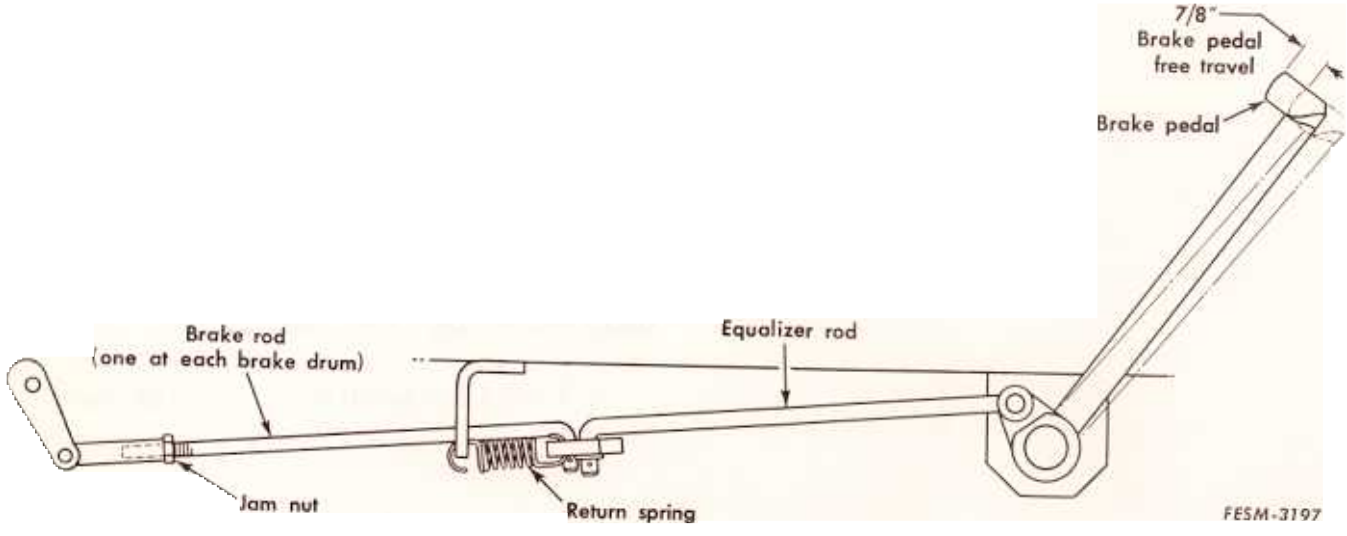
BRAKE ADJUSTMENT – Single Pedal Brakes

To adjust the brakes, jack up the rear end of the tractor. Loosen the jam nuts at the end of the brake rods and remove the cotter pins at the brake equalizer rod. Unhook the brake rods and turn them in or out of the clevises. The brakes should not drag before they take hold. Adjust the brake linkage so there is brake pedal free travel, by hand, of approximately 7/8 inch.

It is very important to have the brakes equalized. To check the equalization of the brakes, jack up both rear wheels so they will turn freely, block the tractor securely and then start the engine. Shift the gears to third speed and engage the clutch; while the wheels are turning, apply the brakes. Application of the brakes should slow down both wheels at the same time and also reduce the speed of the engine.

CAUTION: AVOID HIGH SPEED THROTTLE SETTINGS THAT MIGHT CAUSE THE TRACTOR TO SLIP OFF OF THE BLOCKING.

If one wheel stops and the other wheel continues to revolve when the brakes are applied, adjust the brake rod on the wheel that stops so both wheels stop simultaneously when the brakes are applied.



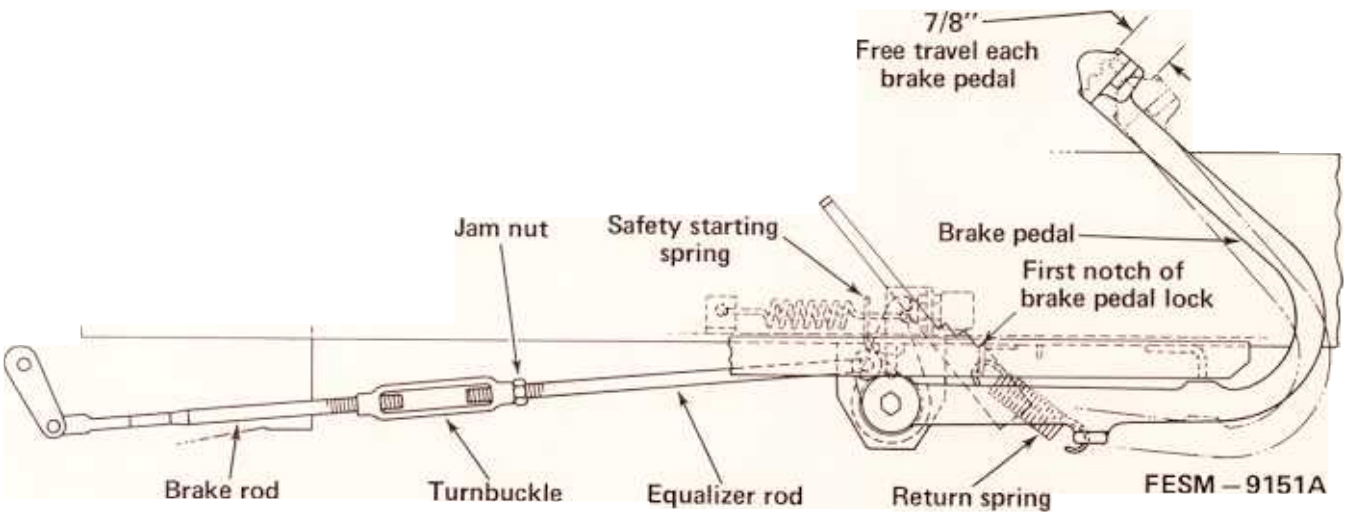
Single pedal brakes.

To check the brakes for proper adjustment, latch the pedals together, engage the first or second notch of the brake pedal lock against the platform, place the transmission in first gear, and set the engine at low idle. Release of the clutch should stall the engine without moving the tractor.

To adjust the brakes, jack up the rear end of the tractor. Loosen the jam nuts at the end of the equalizer rods and turn the turnbuckles in or out. Brakes are properly adjusted when each wheel drags slightly when turned.

It is very important to have the brakes equalized. To check the equalization of the brakes, jack up both rear wheels so they will turn freely, block the tractor securely and then start the engine. Shift the gears to third speed and engage the clutch; while the wheels are turning, lock the brake pedals together so they operate in unison, and apply the brakes. Application of the brakes should slow down both wheels at the same time and reduce the speed of the engine.

If one wheel stops and the other wheel continues to revolve when the brakes are applied, adjust the turnbuckle on the wheel that stops just enough so both wheels stop simultaneously when the brakes are applied.



Two pedal brakes.

Section 8

INDEPENDENT POWER TAKE–OFF AND MOWER

Contents

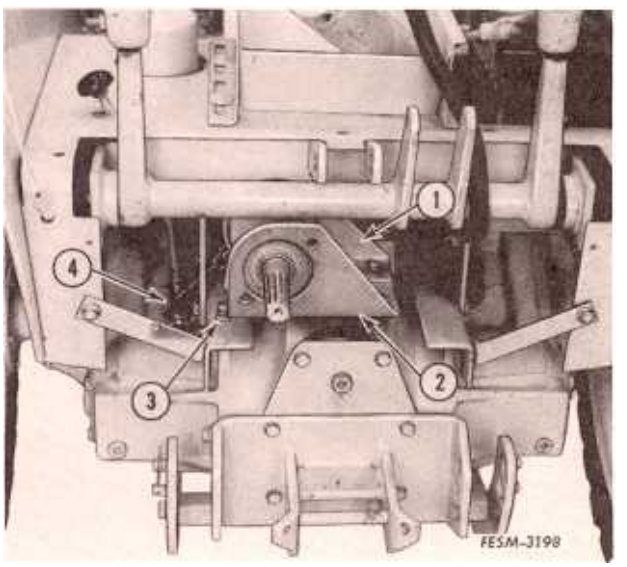
Checks Before Removal

(154 & 185 Tractors)

Check the tension on the drive belts. See page 8-11.

Engage the PTO unit and secure the PTO drive shaft to prevent it from turning. A torque wrench is applied to the rear PTO shaft using a 15/16 inch socket plus two 1/8 inch Allen wrenches between splines. The PTO clutch assembly must withstand a minimum of 80 ft. lbs. torque before any slippage occurs.

Removal



1. Brake support
2. Bearing mounting bracket support
3. Clutch cleat bracket
4. Clutch control arm

IPTO Clutch Assembly

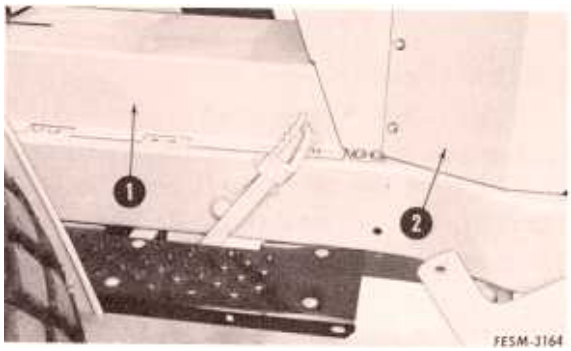
1. Remove the PTO rear shield and support.

2. Remove the PTO brake support (1) and the shaft bearing mounting bracket support (2). Loosen the clutch cleat bracket cap screws (3).

3. Disconnect the clutch control arm (4).

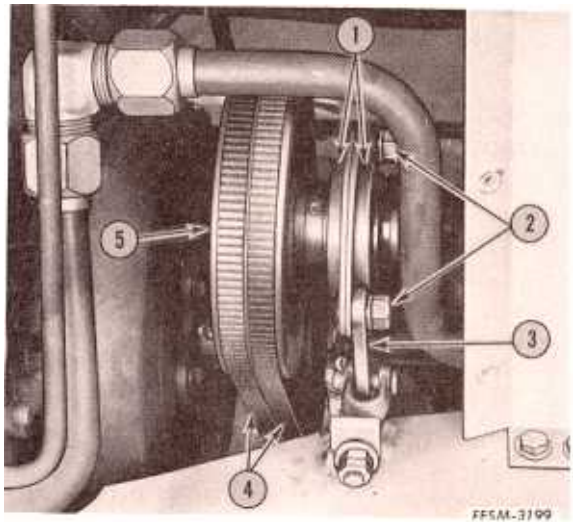
4. Remove the PTO clutch assembly from the tractor.

NOTE: Tractors equipped with a 3 pt. hitch will require removal of the rock-shaft to remove the clutch assembly.

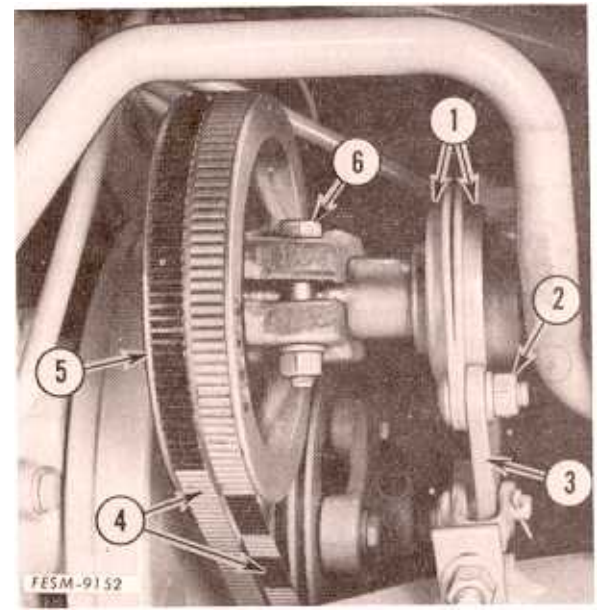


1. Remove the frame top cover (1) and pedestal side sheet sections (2).

1. Frame top cover
2. Pedestal side sheet sections (2)



U018709 and Below.



Above U018709.

1. Bearing flanges
2. Nuts
3. Shaft and pulley adjuster
4. PTO drive belts
5. PTO driven pulley
6. Pulley retaining bolt

2. Loosen the cap screws on the shaft and pulley adjuster (3) and release the belt tension and remove the belts (4) from the upper pulley (5).

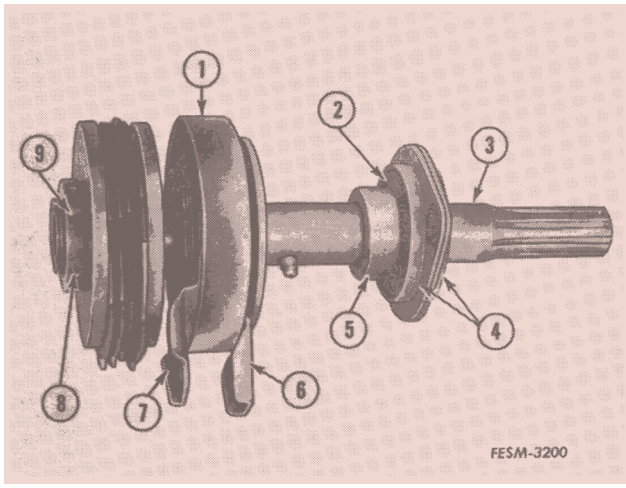
3. Remove the bolts and nuts (2) securing the bearing flanges (1) to the adjuster (3).

4. Remove the pulley retaining ring or bolt.

5. Pull the drive shaft out of the pulley and remove the pulley.

6. Remove the shaft from the tractor.

IPTO Clutch Assembly



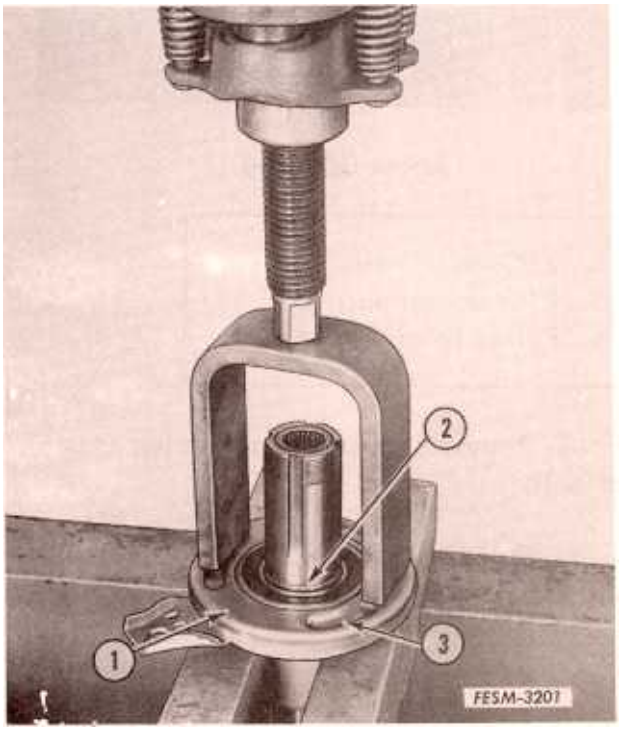
1. Cam cover
2. Rear ball bearing
3. PTO shaft
4. Bearing flanges
5. Locking collar
6. Stationary cam
7. Actuating cam
8. Set screw
9. Lock nut or snap ring

1. Loosen the bearing locking collar (5) and remove the PTO shaft rear ball bearing (2), locking collar (5) and bearing flanges (4).

2. Remove the set screw (8) in the lock nut (9) or snap ring and shims from the shaft. Be sure to keep the shims for use in reassembly.

3. Remove the clutch assembly components from the PTO shaft (3) being sure to note their position for reassembly.

4. Remove the cam cover (1), and then remove the actuating cam (7) and balls.

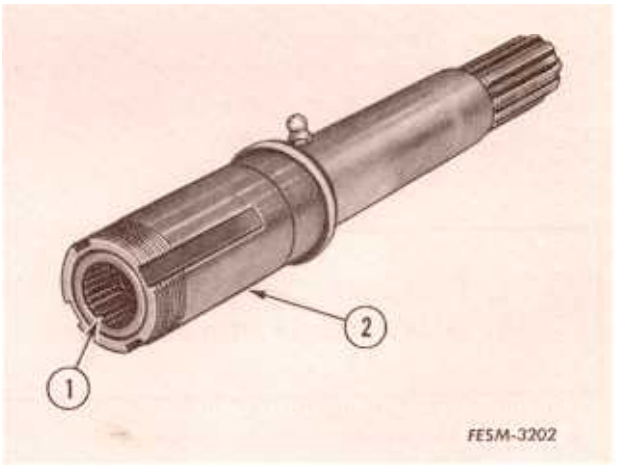


1. Stationary cam
2. Snap ring retainer
3. Ball slots

5. Compress the load spring and remove the snap ring retainer (2).

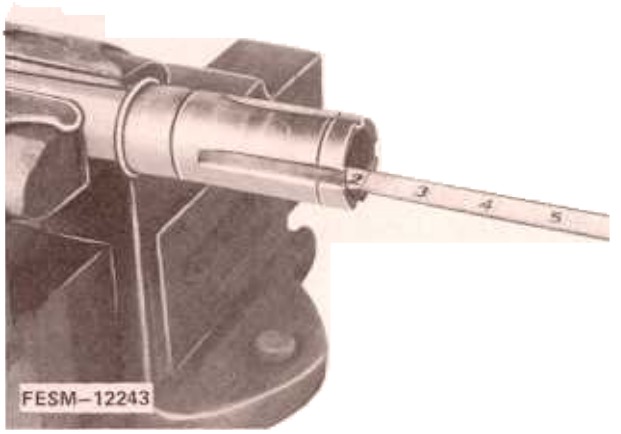
6. Carefully release the load spring pressure and remove the stationary cam and the load spring from the shaft.

7. Press the cam bearings out of the cams if they are to be replaced.

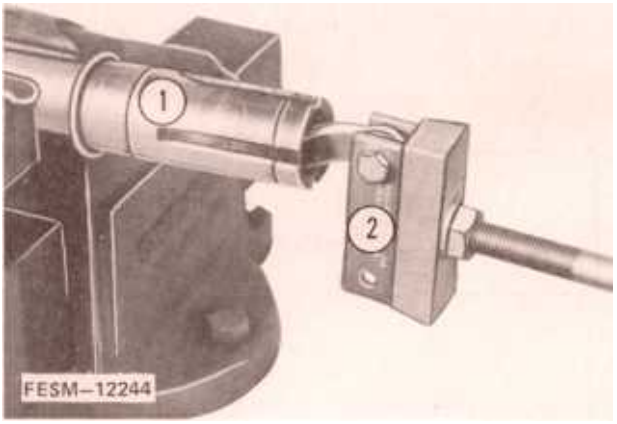


8. If needle bearings are to be replaced, remove the outermost bearing using a slide hammer with two legs.

1. Needle bearings (2)
2. PTO shaft



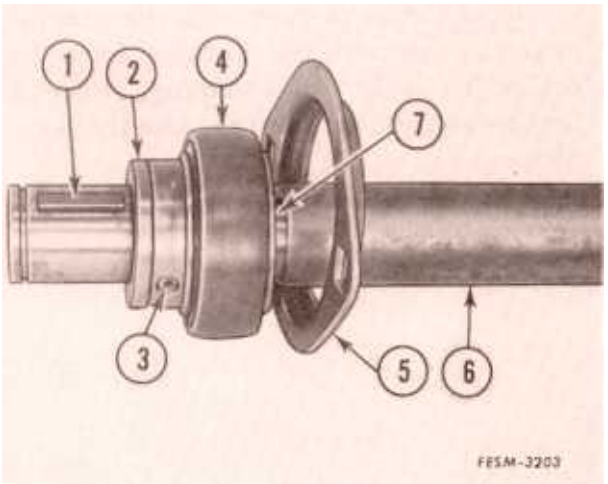
NOTE: Before removing the second bearing, measure the distance from the end of the shaft to the bearing. Record this measurement for reassembly purposes.



9. To remove the innermost bearing, use a slide hammer with only one appropriate length leg as shown.

1. PTO shaft
2. Slide hammer with one leg

IPTO Drive Shaft



1. Key
2. Spacer
3. Set screw
4. Front ball bearing
5. Bearing flange
6. PTO drive shaft
7. Snap ring (not shown)

1. Remove the key (1) from the shaft.

2. Remove the spacer (2) from the shaft.

3. Loosen the set screws (3) in the drive shaft front bearing and remove the bearing.

4. Remove the set screws from the drive cup assembly and remove it from the drive shaft.

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Inspection and Repair

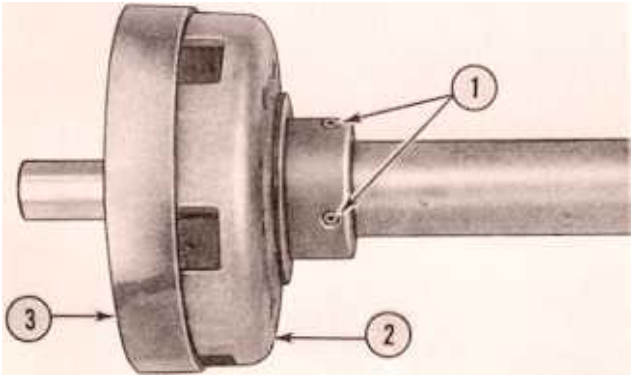
1. Inspect all bearing for wear or damage and replace if necessary.

2. Inspect the clutch assembly for any worn or damaged components and replace as necessary (disk pack repair kit is available through service parts).

3. Inspect the PTO drive shaft and rear shaft for damage or excessive wear and replace if necessary.

4. Replace snap rings that are worn or damaged.

Reassembly and Installation



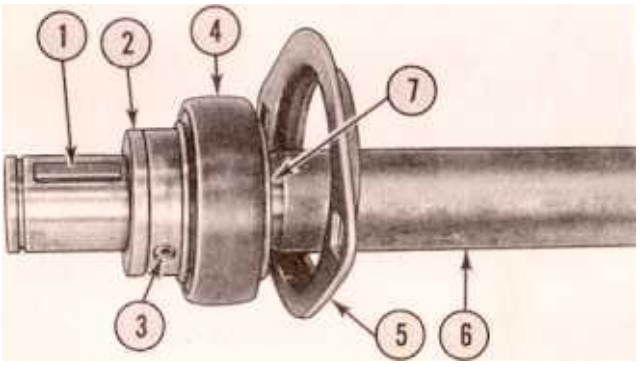
FESM-3204

IPTO Drive Shaft

1. Install the key and the drive cup assembly (2) on the drive shaft and tighten the set screws (1) securely.

2. Install the cam cover (3) on the drive cup (2) if it was removed. Use rubber cement to hold the cover in position.

1. Set screws
2. Drive cup assembly
3. Cam cover



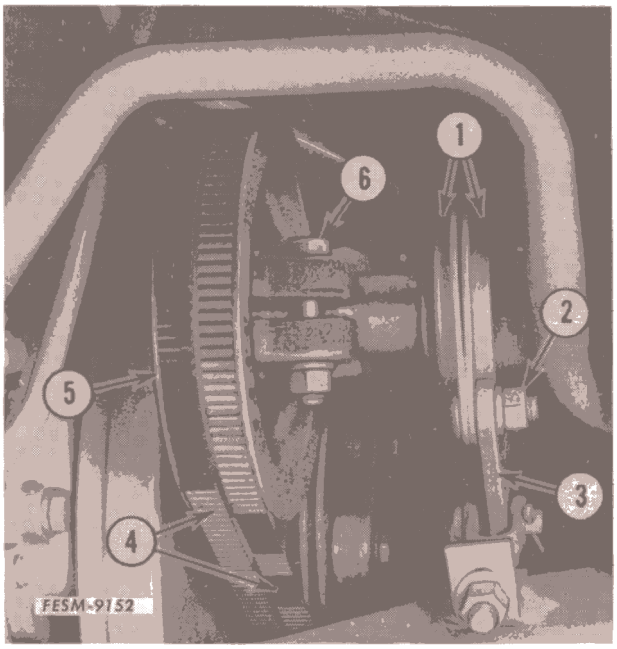
FESM-3203

3. Install the rear snap ring (7), bearing flange (5), front ball bearing (4), spacer (2) and Woodruff key (1) on the shaft.

4. Position the bearing (4) against the rear snap ring (7) and securely tighten the bearing set screw (3).

5. Install the PTO drive shaft assembly in the tractor.

1. Woodruff key
2. Spacer
3. Set screw
4. Ball bearing
5. Bearing flange
6. PTO drive shaft
7. Rear snap ring (not shown)

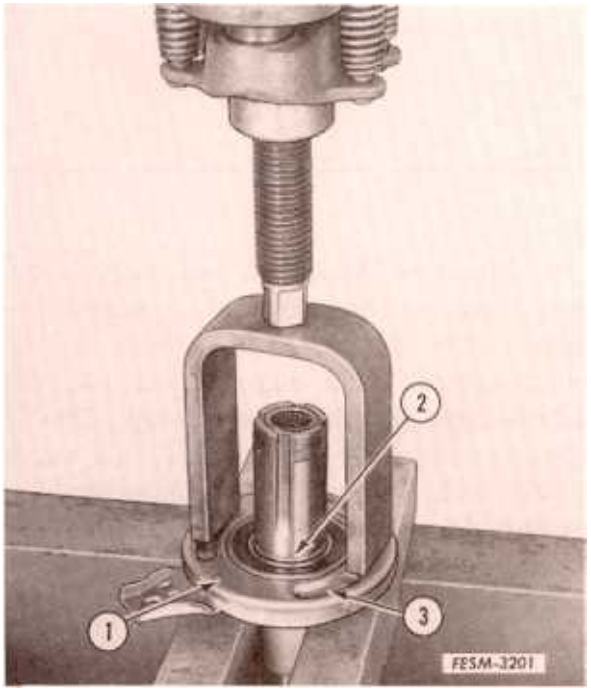


6. Install the second bearing flange (1) on the shaft. Place the PTO driven pulley (5) in position and move the drive shaft into it. Install the retaining snap ring or bolt.

7. Install the cap screws and nuts (2) securing the bearing flanges (1) to the adjuster (3). Tighten nuts (2) only finger tight at this time.

8. Install the belts (4) on the pulley and tighten only enough to remove the slack. Do not tighten to operating tightness at this time.

1. Bearing flanges
2. Nuts
3. Shaft and pulley adjuster
4. PTO drive belts
5. PTO driven pulley
6. Pulley retaining bolt



1. Stationary cam
2. Snap ring retainer
3. Ball slots

IPTO Clutch Assembly

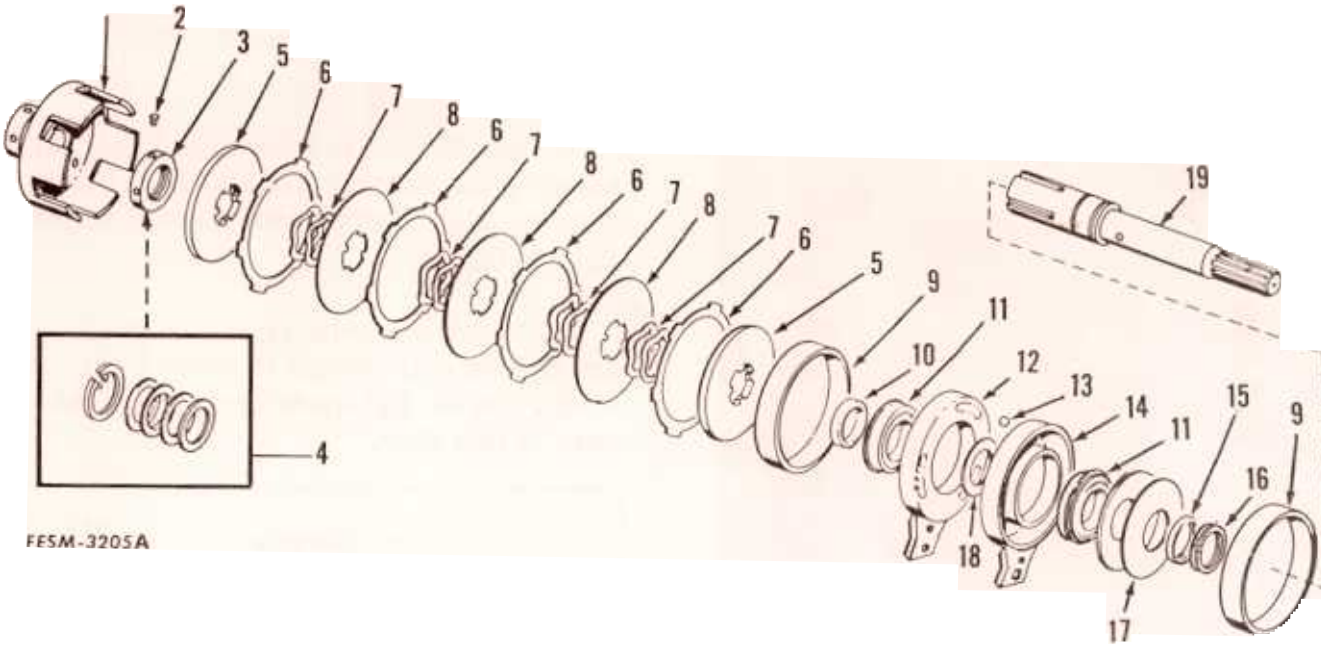
1. If the needle bearings inside the PTO shaft have been removed, new bearings must be installed.

2. Press new cam bearings into the cams if they were removed. Be sure the snap ring around the bearing bottoms against the cam body.

3. Install the load spring and stationary cam on the shaft.

4. Compress the load spring and install the snap ring retainer (2).

5. Be sure to grease the cam ball slots and balls. Install the balls in the stationary cam ball slots (3) and then install the actuating cam on the shaft.



1. Drive cup	7. Wave spring	14. Stationary cam
2. Set screw	8. Separator disc	15. Retainer
3. Lock nut	9. Cam cover	16. Snap ring
4. Shims and snap ring (later models)	10. Spacer	17. Load spring
5. Pressure plate	11. Cam bearing	18. Snap ring
6. Friction disc	12. Actuating cam	19. PTO shaft
	13. Ball	

6. Install the cam cover (9) around the cams. Use rubber cement to hold the cover in place.

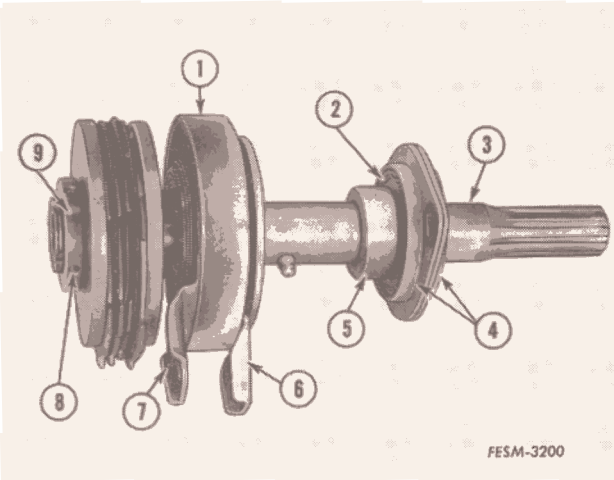
7. Install the spacer (10) on the shaft and then install the pressure plate (5), friction discs (6), wave springs (7), and separator discs (8) as shown.

8. Install the shims and snap ring (4) or the lock nut (3). Do not tighten the set screw at this time.

IMPORTANT: The following adjustment must be made before installing the PTO clutch assembly on the tractor.

9. Measure the clutch assembly in the disengaged position "A" (refer to cross section of PTO, page 8-10). Move the acutating cam to the engaged position "B" and measure the clutch assembly. The difference in the two measurements must be .050 inch. Adjust by tightening or loosening the lock nut or by installing shims between the snap ring and the pressure plate. When proper adjustment has been made, install and tighten the set screw.

NOTE: Use caution when tightening the locking set screw. OVER TIGHTENING will result in distortion of the needle bearings.

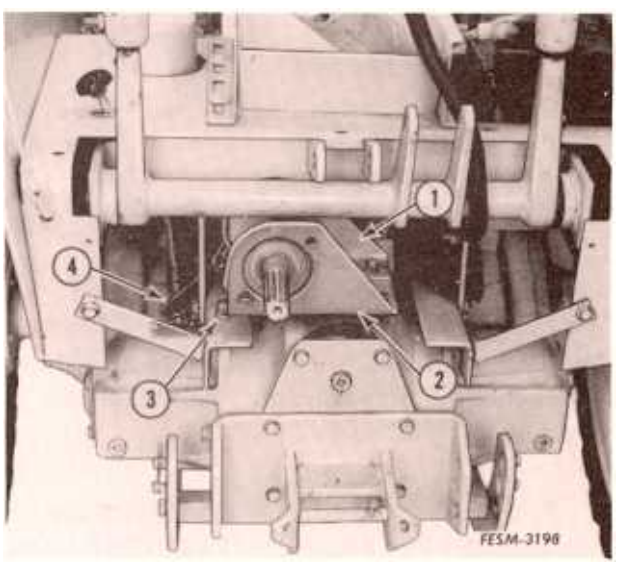


10. Install the bearing flanges (4), locking collar (5) and shaft ball bearing (2). Do not tighten the locking collar at this time.

1. Cam cover	6. Stationary cam
2. Ball bearing	7. Actuating cam
3. PTO shaft	8. Set screw
4. Bearing flanges	9. Lock nut or snap ring
5. Locking collar	

11. Install the clutch unit in the drive cup. Be sure the clutch cleat pin mates with the stationary cam.

NOTE: If the clutch cleat pin fits tightly in the bottom of the slot in the stationary cam, shims must be installed under the clutch cleat bracket. Failure to do this will result in misalignment of the PTO shafts.



12. Connect the clutch control arm (4) to the actuating cam.

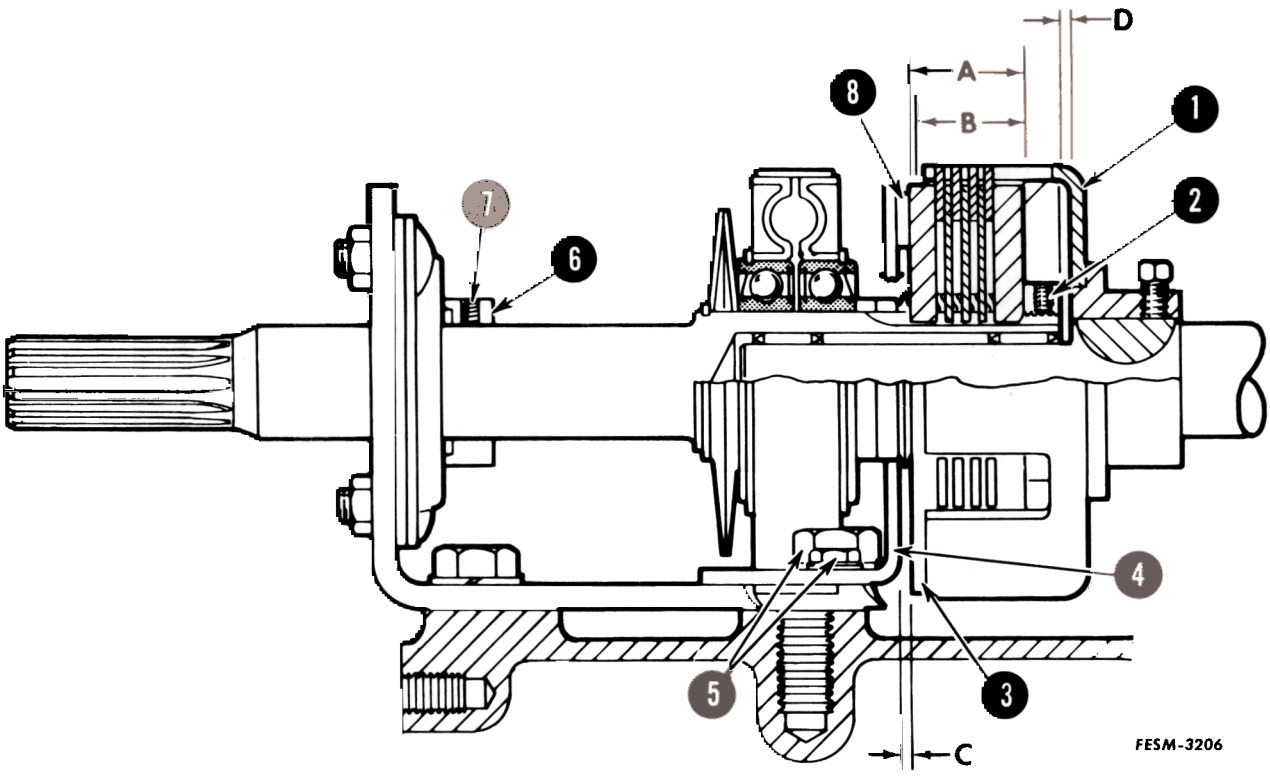
13. Install the shaft bearing mounting bracket support (2) and the brake support (1) on the transmission case.

14. Tighten the front bearing flange nuts securely.

15. Install and securely tighten the rear bearing flange bolts and nuts.

1. Brake support
2. Shaft bearing mounting bracket
3. Clutch cleat bracket
4. Clutch control arm

IPTO Adjustments



1. Drive cup
2. Lock nut or snap ring
3. Pressure plate
4. PTO brake support
5. Cap screws
6. Locking collar
7. Set screw
8. Brake friction pad

(Refer to cross section of PTO)

NOTE: Measurements "A" and "B" are taken with the PTO assembly removed from the tractor. Refer to page 8-2.

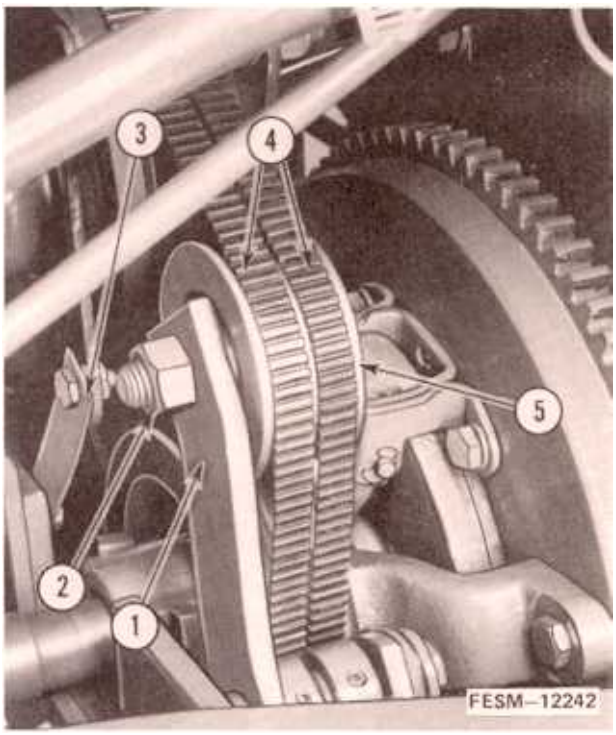
Measure the clutch assembly in the disengaged position "A". Move the actuating cam to the engaged position "B" and measure the clutch assembly. The difference in the two measurements must be .050 inch. Adjust by tightening or loosening the lock nut (2) or by installing shims between the snap ring and the pressure plate.

NOTE: Use caution when tightening the lock nut set screw. OVER TIGHTENING will result in distortion of the idler shaft needle bearings.

Install the PTO clutch unit on the tractor.

1. Disconnect the battery cables from the battery.

NOTE: Remove the ground cable first to reduce electrical shorting hazards.



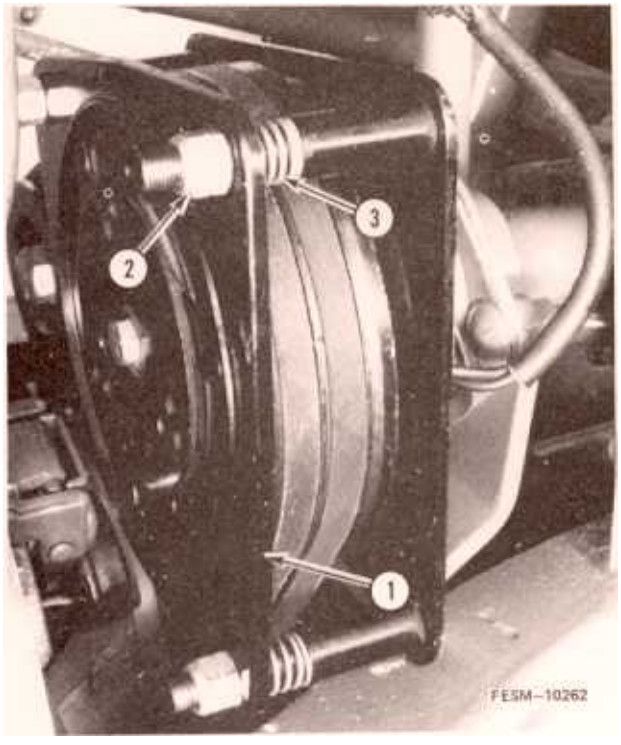
1. Idler tension arm
2. Idler tension arm nut
3. Anchor strap
4. Clutch belts
5. Idler tension pulley

2. Remove the pedestal side sheets, frame top cover and rear frame cover.

NOTE: Tractors without a three point hitch will have the rear frame cover.

3. Relieve the clutch belt tension by pushing in on the idler tension arm nut with a 3/4 inch wrench and then slip the drive belts off the tension arm pulley.

4. Disconnect the anchor strap at the PTO clutch assembly.

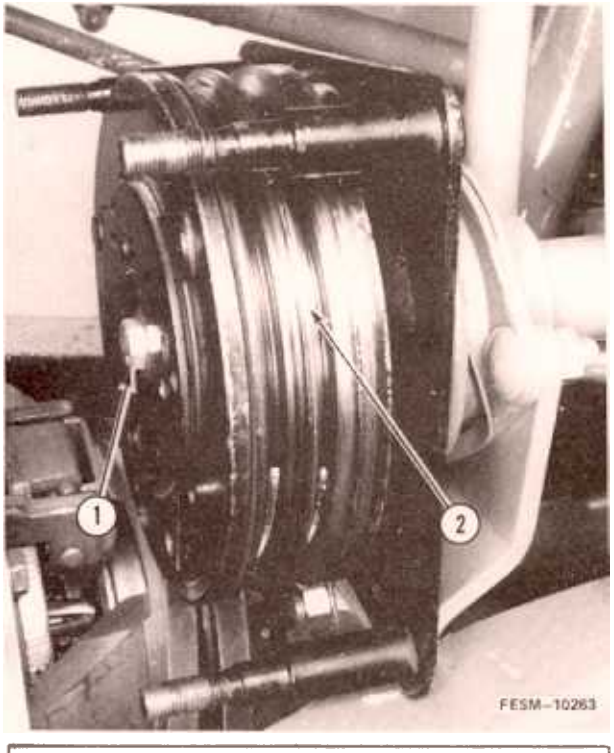


1. Brake plate
2. Lock nuts (3)
3. Brake plate springs (3)

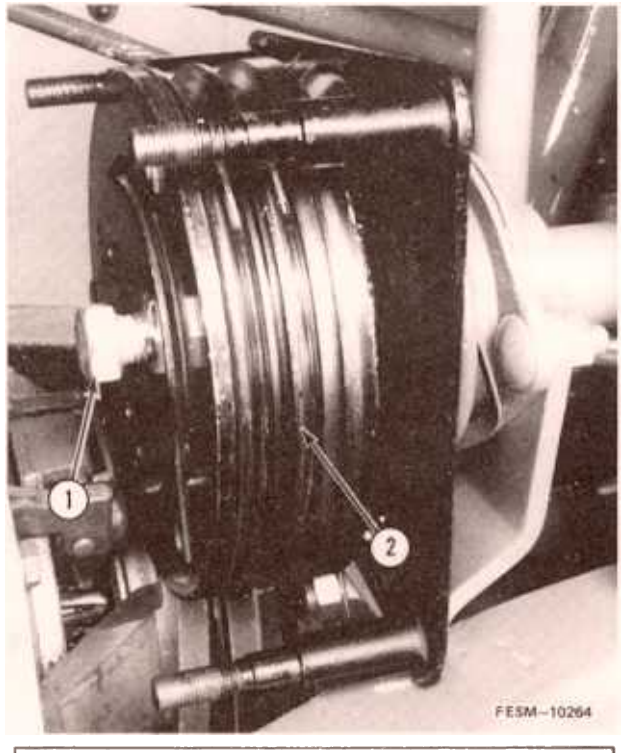
5. Remove the PTO clutch brake plate lock nuts and remove the brake plate assembly and springs and slip off the drive belts.

6. Disconnect the electrical terminal.

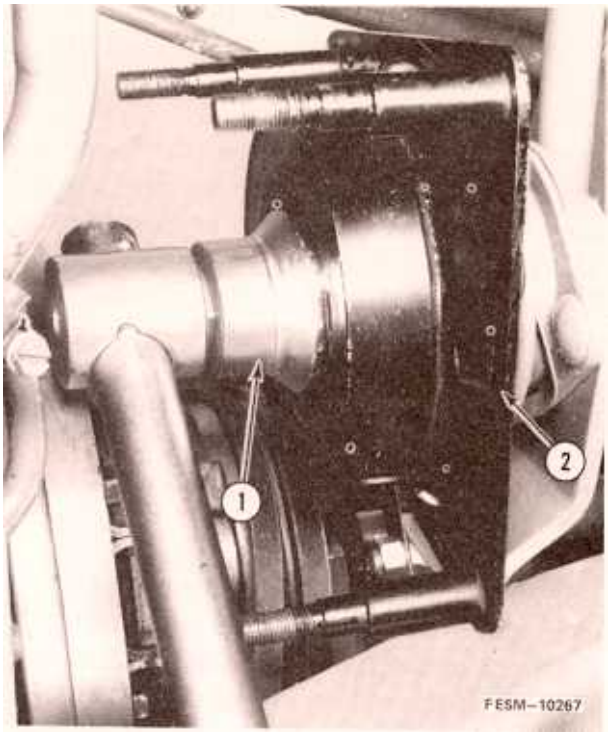
7. Remove the 5/16 x 1-1/4 inch capscrew from the pulley assembly and install in its place a 5/8 x 1 inch capscrew. Tighten down the 5/8 x 1 inch capscrew approximately one and a half turns to loosen the pulley assembly. Then remove the 5/8 x 1 inch capscrew and slide the pulley assembly off the keyway end of the PTO shaft.



1. Capscrew (5/16 x 1-1/4 inch)
2. Pulley assembly

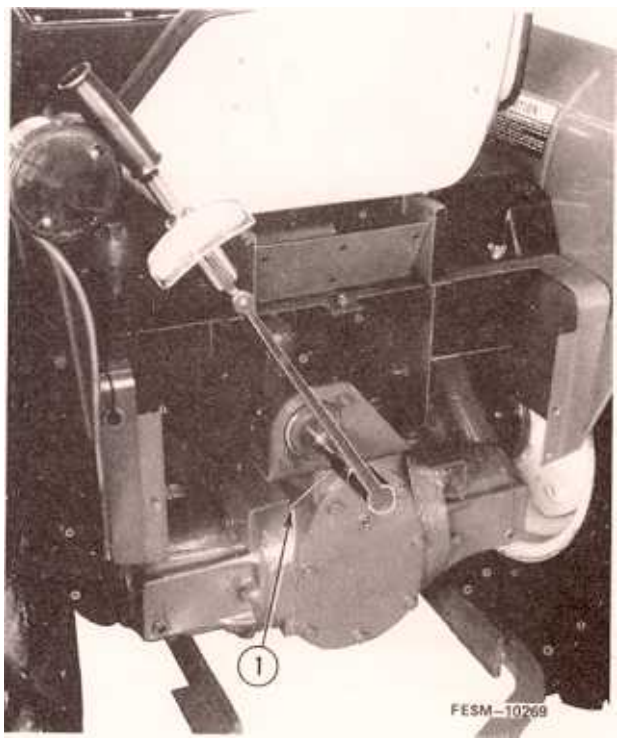


1. Capscrew (5/8 x 1 inch)
2. Pulley assembly



1. Socket (1-5/8 inch)
2. Field assembly

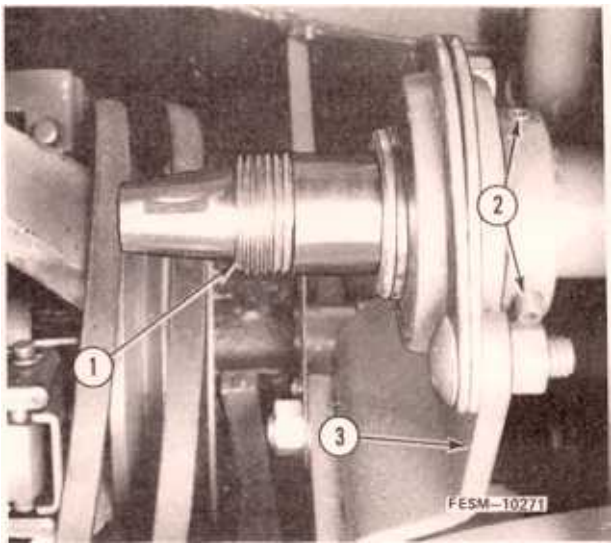
8. Install a breaker bar and 1-5/8 in. socket to the LH threaded field bearing nut and secure to the tractor frame with twine or wire.



1. Allen wrench (1/8 inch)

9. Install at the spline end of the PTO shaft a 15/16 inch socket and a 1/8 inch allen wrench between the socket points and shaft spline end.

10. Turn the PTO shaft clockwise and remove the field bearing jam nut, field assembly and clutch spacer spring.



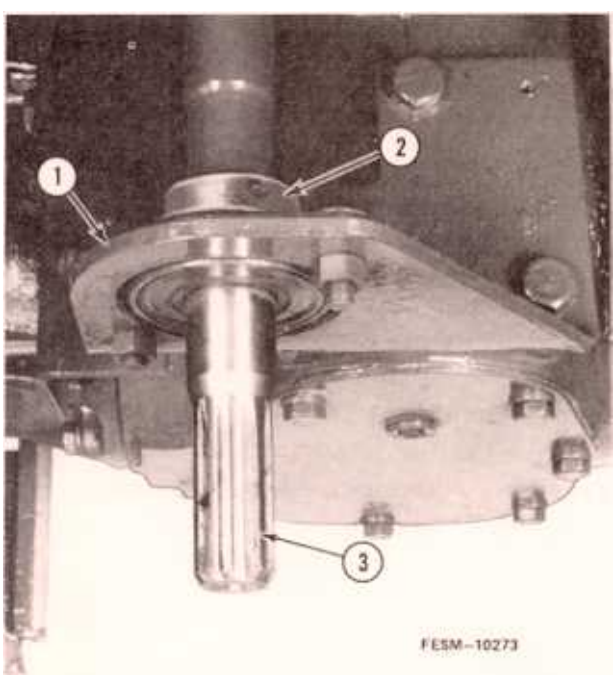
1. PTO shaft (threaded end)
2. Set screws (2)
3. Front bearing bracket

11. Remove the two set screws from the bearing collar at the keyway end of the PTO shaft.

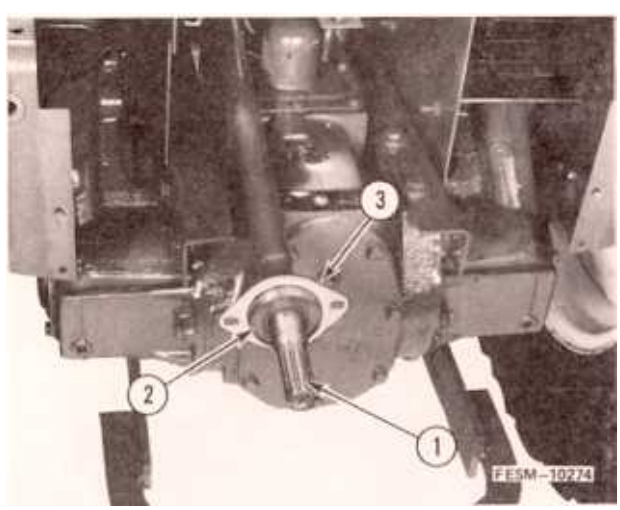
NOTE: Bearings on the PTO shaft are not interchangeable. The bearing on the keyway end of the shaft is secured to the shaft with a collar and two set screws. Tighten the set screw in the counterbore of the shaft first.

The bearing on the spline end of the shaft is retained by a lock collar and should be installed to position as illustrated.

12. Remove the PTO bracket at the rear end of the tractor and pull the PTO shaft out of the front bearing. If the rear bearing at the spline end of the PTO shaft requires replacement remove the lock collar and pull off bearing.



1. Rear bearing bracket
2. Lock collar
3. PTO shaft (spline end)



1. PTO shaft (spline end)
2. Rear bearing
3. Bearing flange

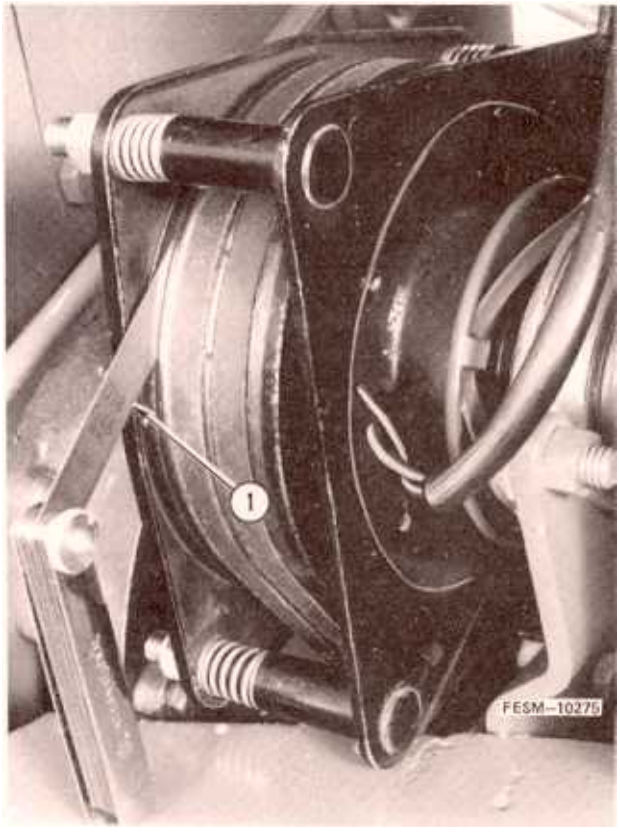
Inspection

Clean and inspect all parts. Replace parts as required.

1. Before installing the PTO shaft bearings apply "Never Seez Compound" to both ends of the PTO shaft.

2. Install the bearing flanges and bearing on the threaded end of the PTO shaft. Make certain the bearing is against the shaft shoulder then tighten the first set screw into the shaft counterbore and then tighten the second set screw.

3. Install the PTO shaft in the tractor and loosely assemble the front bearing flanges to the front bearing bracket.



1. Feeler gauge

4. Install the lock collar and the rear bearing to the spline end of the PTO shaft and loosely assemble the bearing flanges to the rear bearing bracket. Lock the rear bearing collar in the direction of PTO shaft rotation.

IMPORTANT: Check alignment between IPTO idler pulley and IPTO clutch pulley, making certain specifications are met. (Refer to Main Clutch Shaft and Engine Clutch - 184 Tractor - Reassembly and Installation.)

5. After the PTO shaft has been preassembled into the tractor, complete tightening of the bearing flanges.

6. Install the clutch spacer spring and field assembly and torque the field jam nut to 47-54 N·m (35-40 ft. lbs.).

NOTE: Position the high points of the clutch spacer spring against the bearing flange and not on the carriage bolt heads.

7. Align the clutch pulley assembly to the shaft keyway and torque the capscrew to 25-27 N·m (19-21 ft. lbs.).

NOTE: Make certain belts and pulleys are free of grease and oil.

8. Air gap for the PTO clutch must be set between .51-.38mm (.015-.020 inch).

9. Make certain that the idler tension arm pulley nut is torqued to standard specifications.

10. Make certain to reconnect the anchor strap.

DRIVE BELT REPLACEMENT

Removal

1. Disconnect the battery cables from the battery.

NOTE: Remove the ground cable first to reduce electrical shorting hazards.

2. Remove the frame top cover and the pedestal side sheet sections.

3. Remove the set screws from the drive shaft knuckle. Move the snap ring forward from the groove. Slide the long end of the knuckle onto the shaft until the cross of the knuckle is against the end of the drive shaft and clear of the transmission or creeper input shaft.

Lift out the drive shaft when connected to the transmission and lower the drive shaft out from the tractor when connected to the creeper drive.

NOTE: If the tractor is equipped with a hydraulic selector control valve then it will have to be removed when the drive shaft connects to the transmission input shaft only.

4. Relieve the clutch belt tension by pushing in on the idler tension arm nut with a 3/4 inch wrench and then slip the drive belts off the idler arm pulley.

5. Disconnect the clutch release arm from the clutch release bearing and remove the clutch release arm bearing from the clutch assembly.

6. Replace the drive belts.

Installation

1. Install the release bearing and release arm.

NOTE: Grease fitting on the bearing is positioned to the LH side of the tractor.

2. Apply "Never Seez Compound" to the keyway end of the drive shaft before installing the knuckle. Assemble the key in the shaft and slide the long end of the knuckle onto the shaft until the cross of the knuckle is against the end of the shaft.

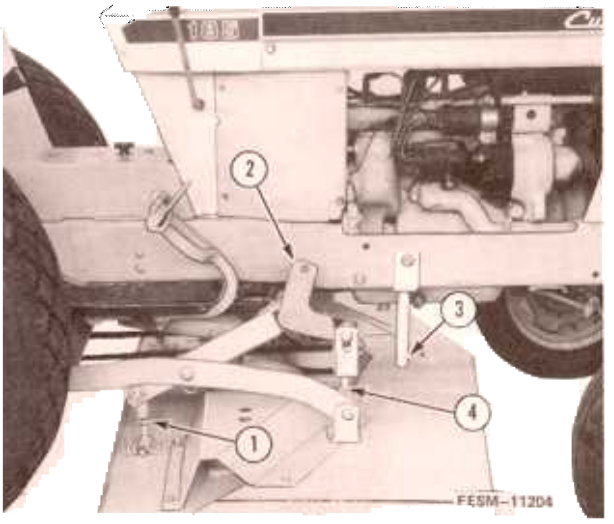
3. Install the shaft back into the tractor drive clutch assembly. Slide the knuckle onto the transmission or creeper input shaft until it seats against the shaft shoulder. Position the snap ring in the shaft groove and slide the drive shaft back until the snap ring shoulders against the knuckle. Then tighten the set screws over the shaft first then tighten the set screws over the Woodruff keys last.

NOTE: Grease release bearing with IH 251 grease. DO NOT OVER GREASE.

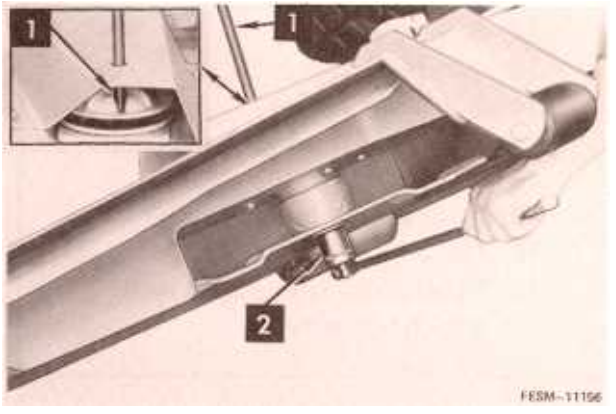
NOTE: Do not allow oil or grease to contact the drive belts.

Mower Spindle Assembly

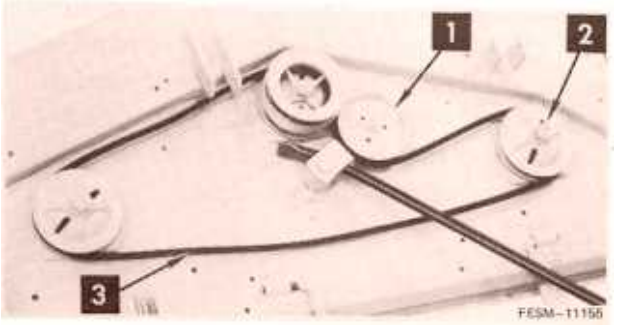
CAUTION! Disengage the tractor power take-off and stop the engine when working on the mower.



1. Rear adjustable link
2. Rockshaft
3. Mower limiter/stop
4. Front adjustable clevis



1. Pin—25.4 mm (1/2 inch) diameter
2. Removing blade nut



CAUTION! Never look into the discharge opening when the blades are in motion.

Removal

1. Lower the mower housing to the ground.

2. Remove the rear adjustable links from the mower housing.

3. Pull the pins out of the center frame at the mower housing.

4. Raise the 3 point hitch and slide the mower out from under the tractor.

5. Place the mower on a suitable work-bench and remove the blade and blade nut as follows.

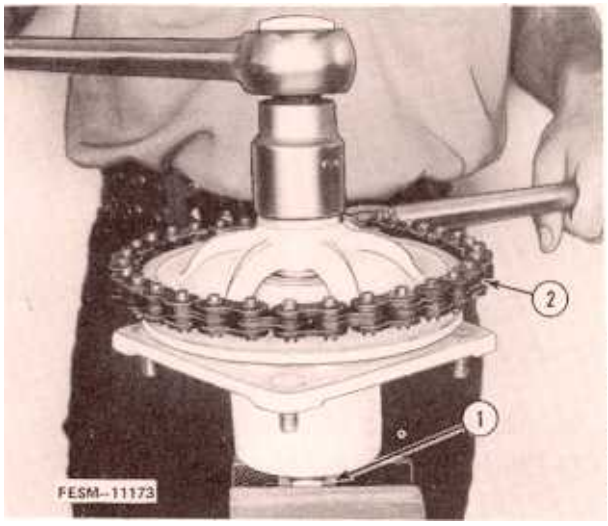
A hole is provided in the pulley hubs and through the belt shields to keep the spindle from rotating when blade nuts are removed. This is accomplished by inserting a 1/2 inch diameter pin through the hole in the shield and pulley hub as shown.

6. Remove the deck drive belt as shown.

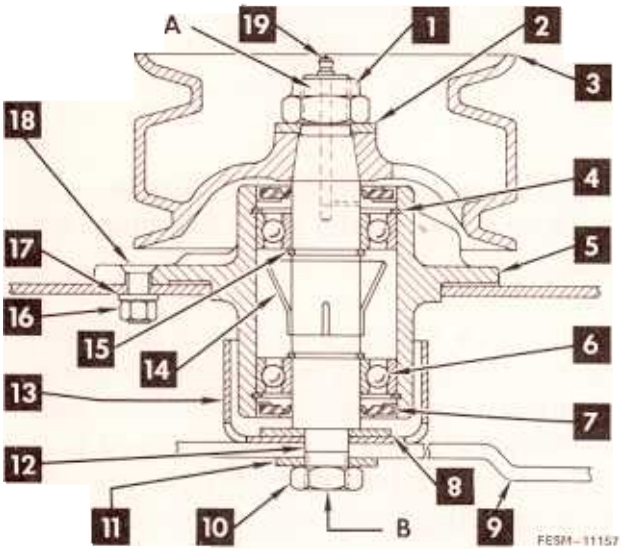
7. Remove the 4 hex nuts securing the spindle assembly under the mower housing and pull off the spindle assembly.

8. Place the blade nut back on the spindle shaft and secure the spindle shaft in a soft jawed vise.

1. Spring-loaded idler
2. Outer pulley
3. Deck drive belt



1. Blade nut
2. Chain wrench



Disassembly

1. Attach a chain wrench around the pulley and remove the 7/8 inch lock nut as illustrated.

NOTE: Do not wrap the chain wrench around the inside pulley groove.

2. Remove the seals and snap rings to accomplish complete disassembly. (Refer to the cross section drawing.)

1. 7/8 inch Lock nut
2. Spindle pulley washer
3. Pulley
4. Internal snap ring (2 req'd)
5. Spindle housing
6. Spindle bearing (2 req'd)
7. Grease seal (2 req'd)
8. Support disk
9. Blade
10. Jam nut
11. Flat washer, 12 ga.
12. Spindle shaft
13. Anti-wrap cup
14. Lubricant slinger
15. External snap ring (2 req'd)
16. Hex nut (4 req'd)
17. Lock washer (4 req'd)
18. No. 3 Plow bolt, 3/8 x 1 inch
19. Lubrication fitting 3/16 inch straight drive type

Reassembly

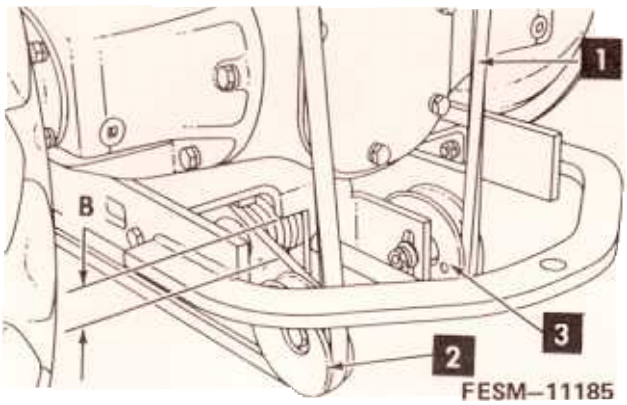
1. Reassemble in the reverse order of the removal procedure.

2. Tighten lock nut "A" from 129 to 156 N·m (95 to 115 ft. lbs.) of torque.

3. Tighten nut "B" holding the mower blade to the spindle from 95 to 122 N·m (70 to 90 ft. lbs.) torque.

When replacing the blades, be sure they are assembled on the anti-wrap cups so the cutting edges are in the direction of rotation with the wind wings pointed upward and the nuts tightened 95 to 122 N·m (70 to 90 ft. lbs.) torque.

Drive Belt Tension



1. Main drive belt
2. Spring-loaded idler
3. Adjustable idler pulley

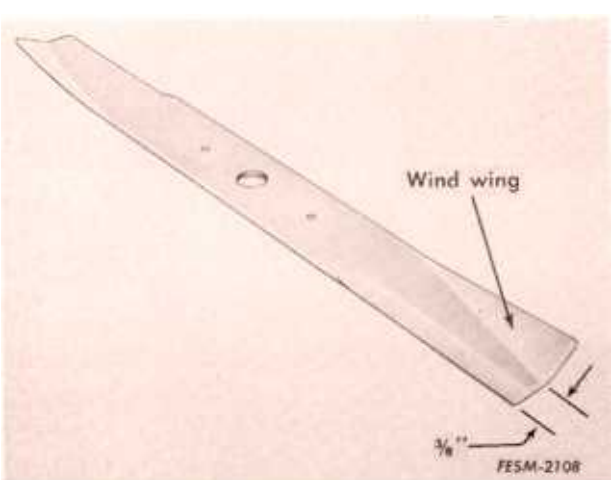
The drive belt tension is to be adjusted with the mower housing in the down position. Never tighten the drive belt when the mower is in a raised position, to do so may damage the idlers, belt or tractor power take-off. The spring-loaded idler will keep the proper tension on the belt at any cutting height.

The belt tension should be initially set by positioning the idler arm approximately 6.35 mm (1/4 inch) from the idler support bracket as shown at "B". Readjust for proper tension by using the adjustable idler pulley so that the idler arm is 6.35 mm (1/4 inch) from the idler support bracket.

When the adjustable idler has reached the end of the slot and the distance from the idler arm and idler support bracket becomes greater than 19 mm (3/4 inch), then replace the belt.

Blade Care

CAUTION! Use care when sharpening blades to prevent personal injury.



The cutting blade must be kept sharp at all times. The blade can be removed from the mower and sharpened on a grinding wheel.

Sharpen the ends evenly at a 25^{o} angle (same as when new) so the blade remains balanced. However, if the cutting edge of the blade is within 9.55 mm (3/8 inch) of the wind wing, it is recommended that a new blade be installed. New blades are available at your International Harvester dealer.

Section 9

HYDRAULIC LIFT AND THREE-POINT HITCH

CONTENTS

GSS-1408 (Rev. No. 1)

Printed in United States of America

PUMP

Rated engine speed	2200 rpm
Pump delivery at rated engine speed	2.5 gpm @ 1600 psi
Reservoir (transmission case) capacity	7 qts.
Ball check spring	
Assembled length - inch	.382
Assembled load - lbs.	.069 ± .010

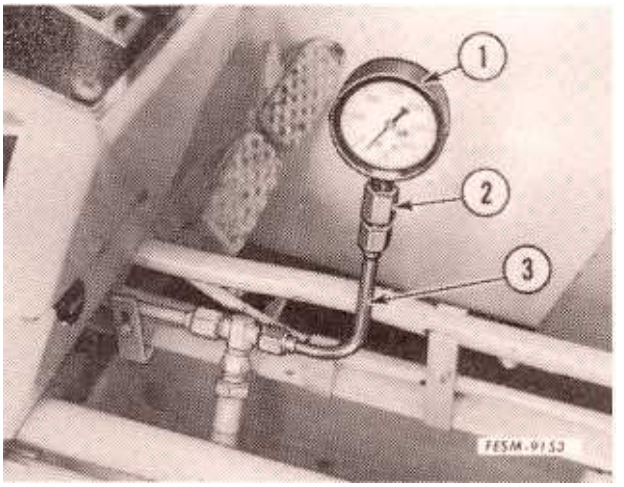
VALVES

Control valve	
Type	Single acting
Circuit Relief Valve	
Serial No. U018709 and below-non-adjustable, service complete valve - psi	1550-1600
Above serial No. U018709 - adjustable - psi	1500-1600

HYDRAULIC CYLINDER

Type	Single acting
Piston OD - inches	1.7466 - 1.7480
Cylinder ID - inches	1.749 - 1.752
Length of stroke - inches	5

Hydraulic Lift



1. Gauge (FES 1-2)
2. Adapter (FES 94-3)
3. Tube connector (FES 94-2)

Checking the Hydraulic System

1. Check all fittings, lines and connections for leaks. Repair as necessary.

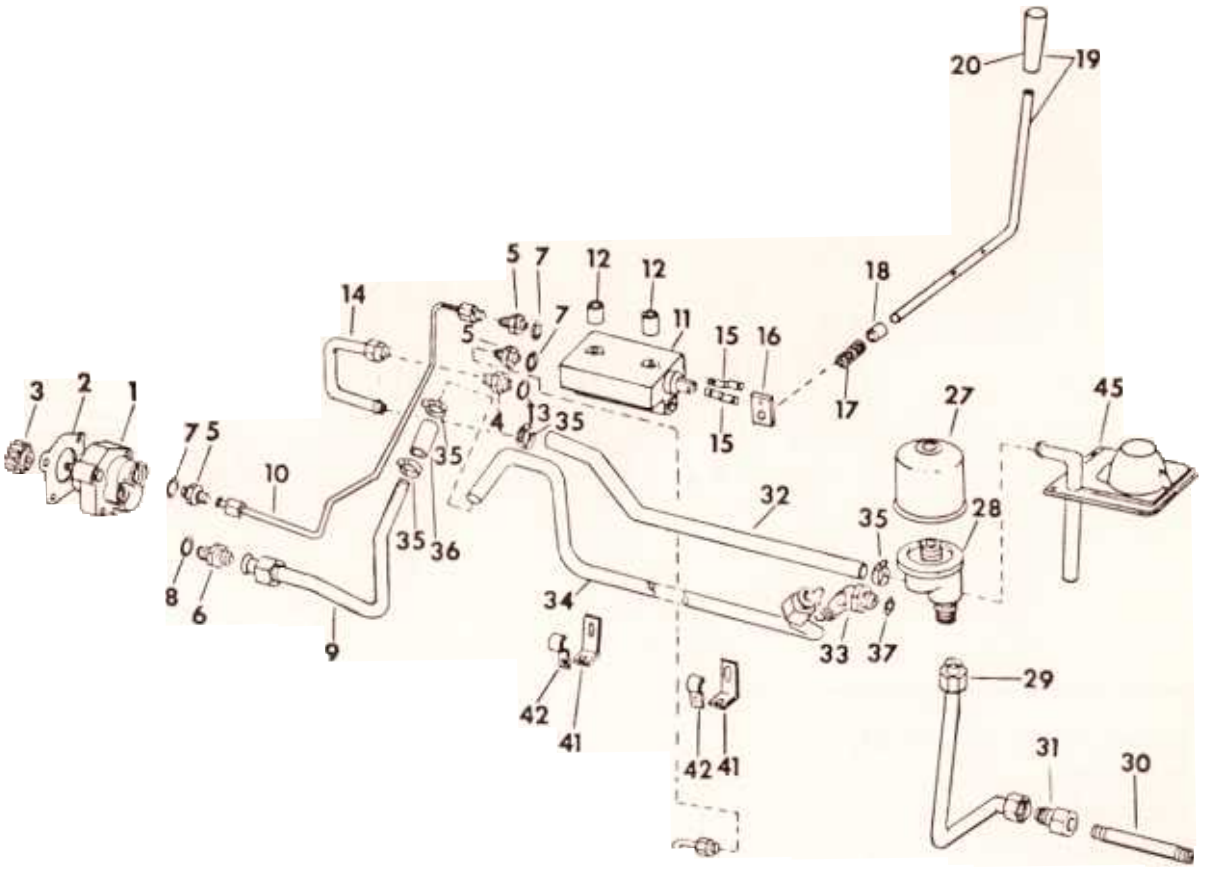
2. Fill the transmission housing to the specified level with Hy-Tran.

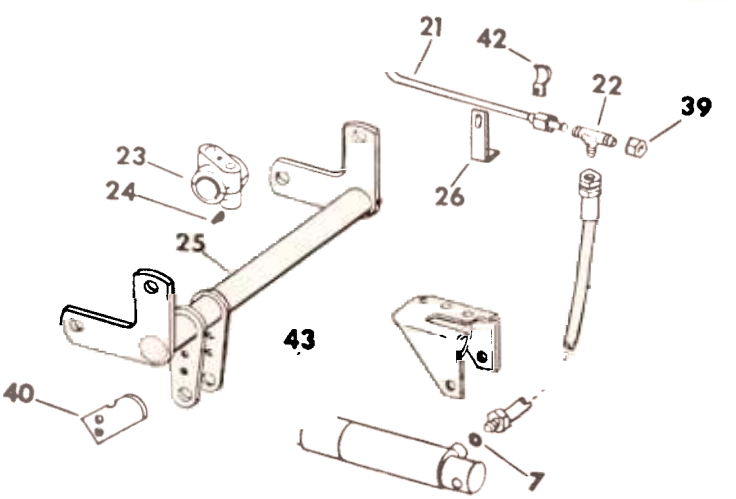
3. Remove the frame top cover. Install a 3000 psi gauge (FES 1-2) in the tee fitting using a tube connector (FES 94-2) and adapter (FES 94-3).

4. Start the engine and warm up to operating temperature. Check the specified circuit relief valve opening pressure. If the pressure will not build to specified psi, the circuit relief valve or the pump is at fault.

GSS-1408 (Rev. No. 1)

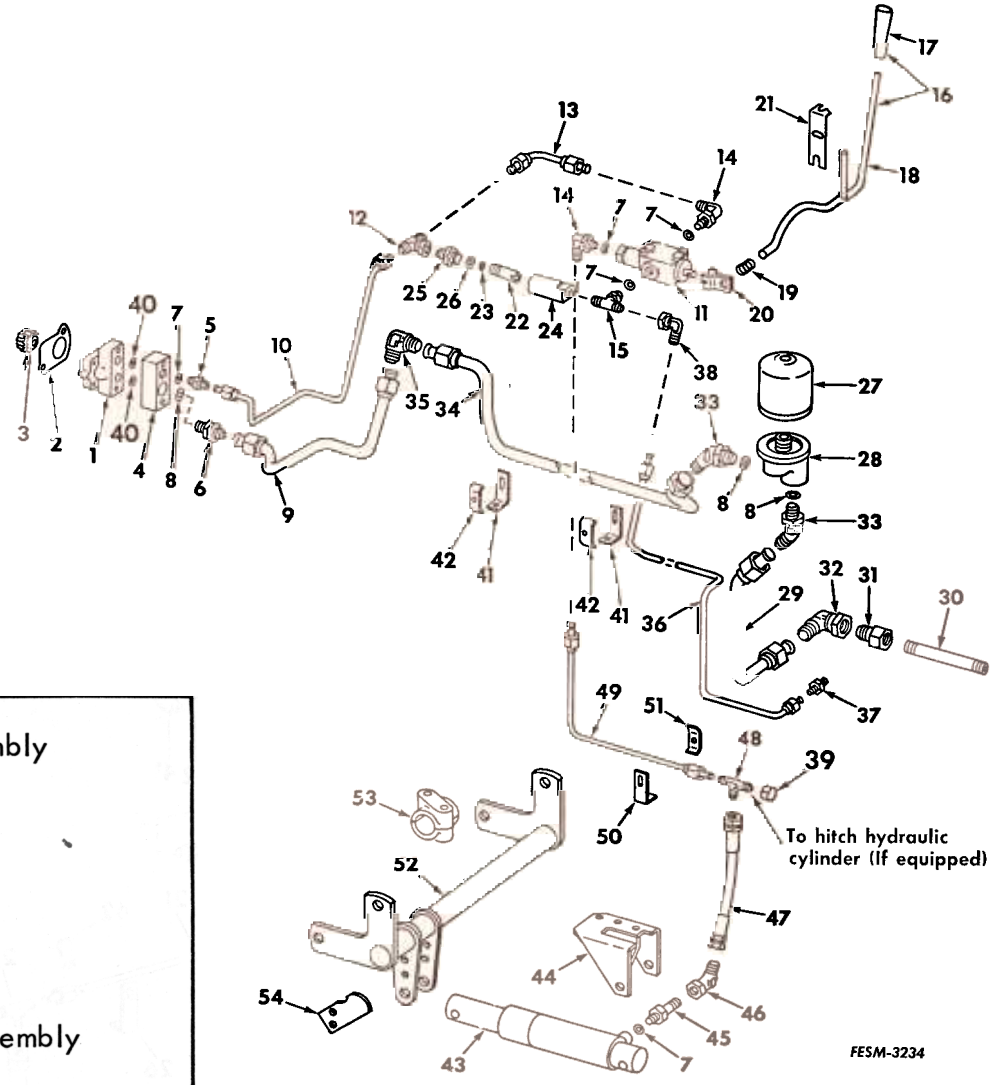
Printed in United States of America





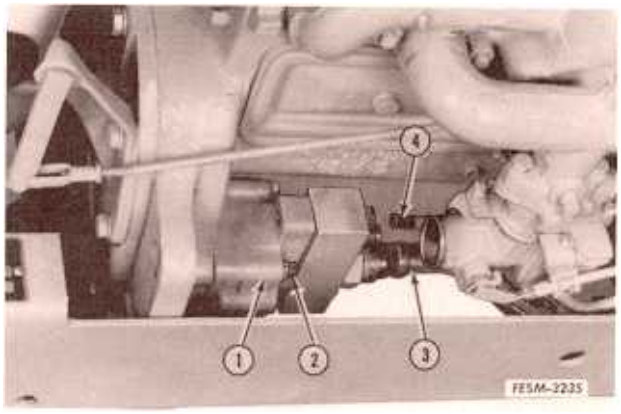
FESM-9154

1. Hydraulic pump assembly
2. Gasket
3. Pump drive gear
4. Union
5. Union
6. Union
7. O-ring
8. O-ring
9. Suction tube
10. Pressure tube
11. Valve assembly
12. Spacer
13. O-ring
14. Return tube
15. Valve operating bar
16. Valve lever
17. Spring
18. Spacer
19. Handle
20. Handle grip
21. Tube
22. Tee
23. Rockshaft bearing
24. Lube fitting
25. Rockshaft
26. Tube support
27. Filter
28. Filter base
29. Tube
30. Nipple
31. Connector
32. Return hose
33. Elbow
34. Suction tube
35. Clamp
36. Suction hose
37. O-ring
38. Hose
39. Cap
40. Rockshaft stop
41. Support
42. Clamp
43. Hydraulic cylinder
44. Cylinder bracket
45. Gear shift housing cover



1. Hydraulic pump assembly
2. Pump gasket
3. Pump drive gear
4. Pump flange
5. Connector
6. Connector
7. O-ring
8. O-ring
9. Suction short tube assembly
10. Pressure long tube assembly
11. Single acting control valve assembly
12. Tee
13. Pressure short tube assembly
14. Elbow
15. Tee
16. Valve handle
17. Grip
18. Handle assembly
19. Valve handle spring
20. Control valve operating bar assembly
21. Valve handle locator
22. Circuit relief valve assembly
23. O-ring
24. Circuit relief valve housing
25. Connector
26. O-ring
27. Oil filter
28. Oil filter base
29. Oil filter suction tube assembly
30. Nipple
31. Connector
32. Elbow
33. Elbow
34. Suction long tube assembly
35. Elbow
36. Return tube assembly
37. Connector
38. Elbow
39. Cap
40. O-ring
41. Tube clamp support
42. Tube clamp
43. Hydraulic cylinder
44. Cylinder mounting bracket
45. Union
46. Elbow
47. Hydraulic hose assembly
48. Tee
49. Hydraulic cylinder tube assembly
50. Tube clamp support
51. Tube clamp
52. Rockshaft assembly
53. Rockshaft bearing assembly
54. Rockshaft stop bar

Hydraulic Pump



1. Hydraulic pump
2. Allen head cap screw (2)
3. Short tube suction assembly
4. Long tube pressure assembly

NOTE: Thoroughly clean the pump and lines before removal to prevent dirt from entering the hydraulic system.

1. Disconnect the hydraulic lines (3 & 4) from the hydraulic pump flange.

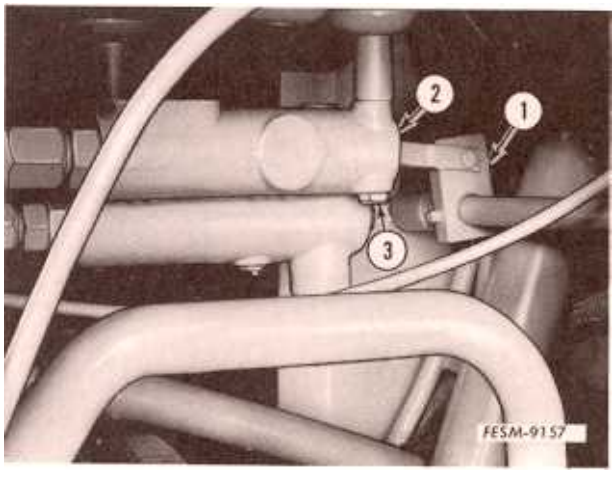
2. Remove the two Allen head cap screws (2) and remove the pump from the tractor.

3. Disassemble the pump and inspect for worn or damaged parts.

NOTE: An O-ring and gasket service package is available for pump service. If the pump requires more than this package for proper service, it will be necessary to replace the pump with a new assembly.

4. Install the pump assembly on the tractor. Be sure to use a new gasket. Tighten the cap screws securely and install the hydraulic lines.

Control Valve



1. Operating bar assembly
2. Control valve
3. Cap screws

NOTE: Cover the PTO drive belts to prevent oil from getting on them.

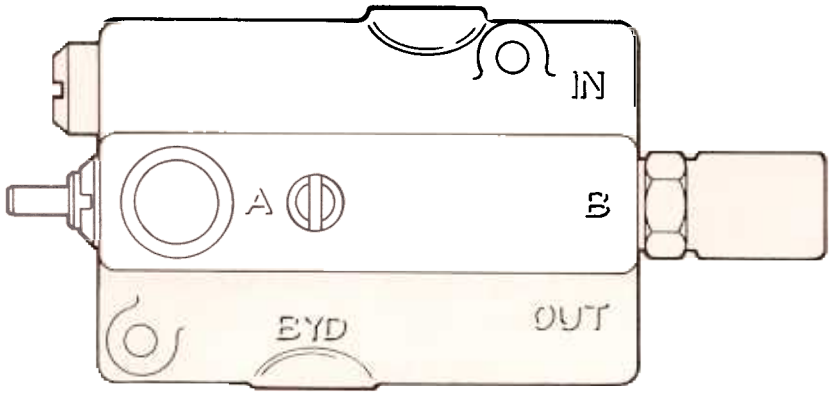
1. Remove the cotter pin and disconnect the operating bar assembly (1).

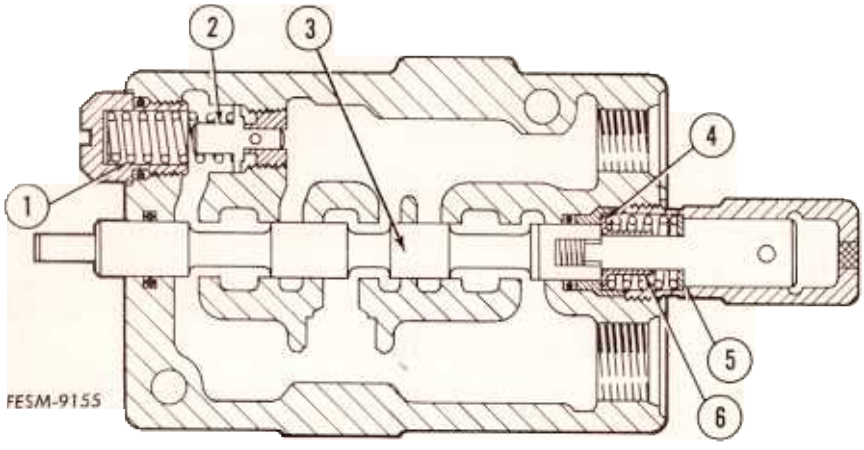
2. Disconnect the hydraulic lines to the control valve (2) and remove the two cap screws (3) securing the valve to the pedestal assembly. Remove the valve from the tractor.

3. Disassemble the valve and inspect for worn or damaged parts.

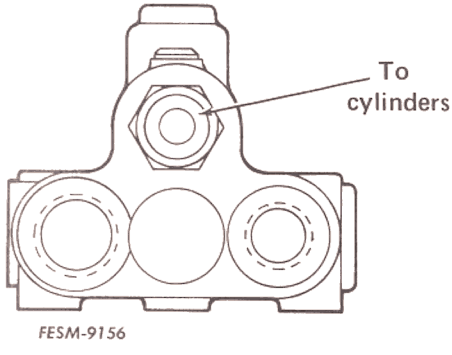
NOTE: An O-ring and seal package is provided for service. If this package will not provide proper service, it will be necessary to replace the valve with a new assembly.

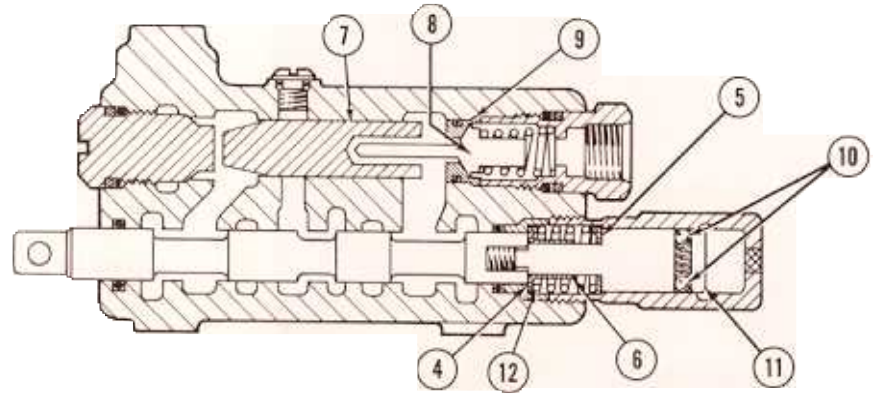
4. Install the control valve on the tractor and connect the hydraulic lines.





1. Poppet spring
2. Poppet, circuit relief
3. Valve spool
4. Inner washer
5. Outer washer
6. Spacer
7. Plunger
8. Unloading poppet
9. Seat
10. Ball
11. Detent cap
12. Spring

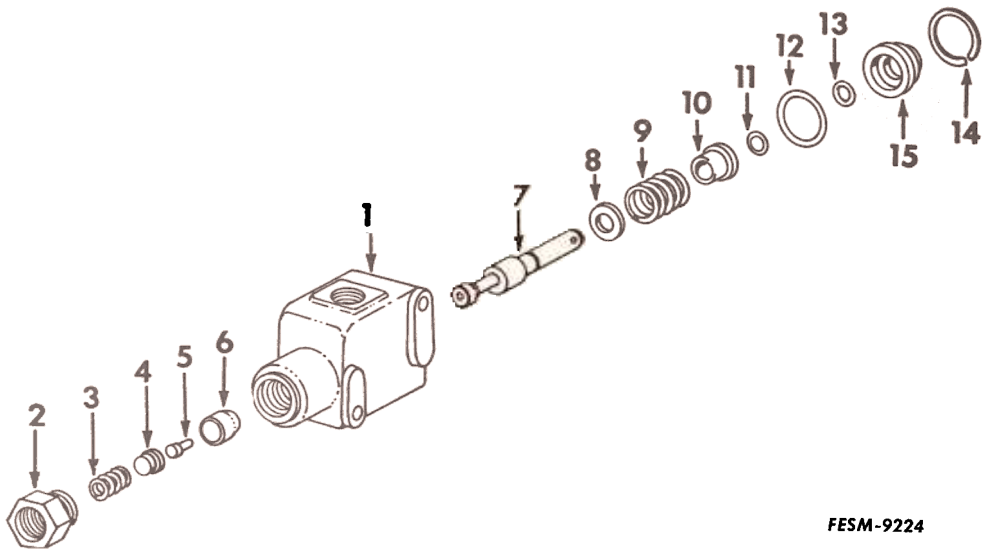




Hydraulic control valve cross section.

Above Serial No. U018709

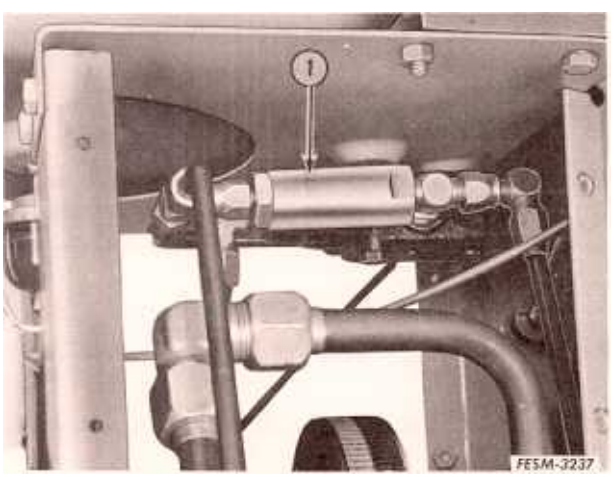
Disassemble the valve and inspect for wear or damage. Seal kits are available for service.



1. Valve body	6. Poppet	11. Snap ring
2. Plug	7. Valve spool	12. O-ring
3. Spring	8. Washer	13. O-ring
4. Cap	9. Spring	14. Guide
5. Plunger	10. Deep washer	15. Retaining ring

Serial No. U018709 and below.

CIRCUIT RELIEF VALVE

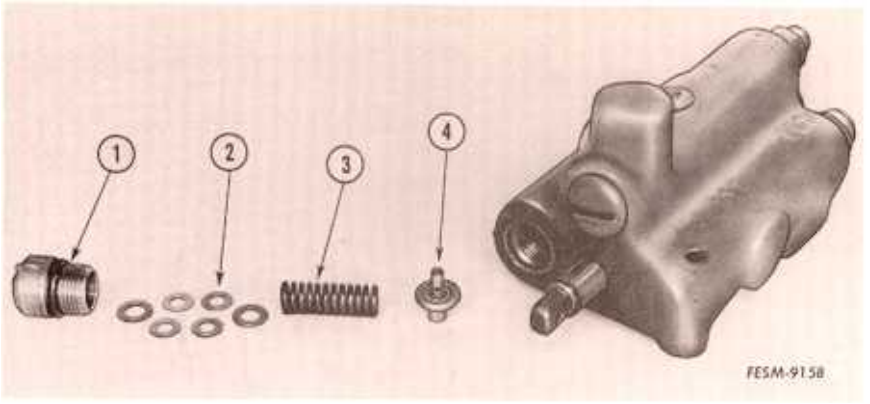


Cub 154 Serial No. U018709 and below.

The circuit relief valve is separate from the control valve. It is non-adjustable and must be replaced if defective.

NOTE: When replacing the valve, cover the PTO belts to prevent oil from getting on them.

1. Circuit relief valve

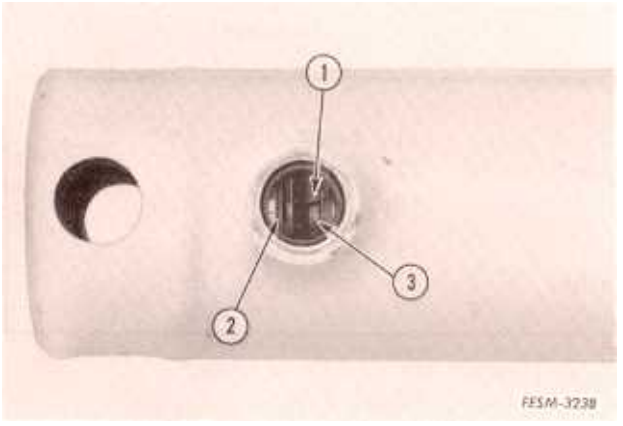


1. Cap
2. Shims
3. Spring
4. Relief poppet

Cub 185 and Cub 154 above Serial No. UO18709.

The circuit relief valve is integral with the control valve. Circuit relief pressure may be adjusted by adding or removing shims.

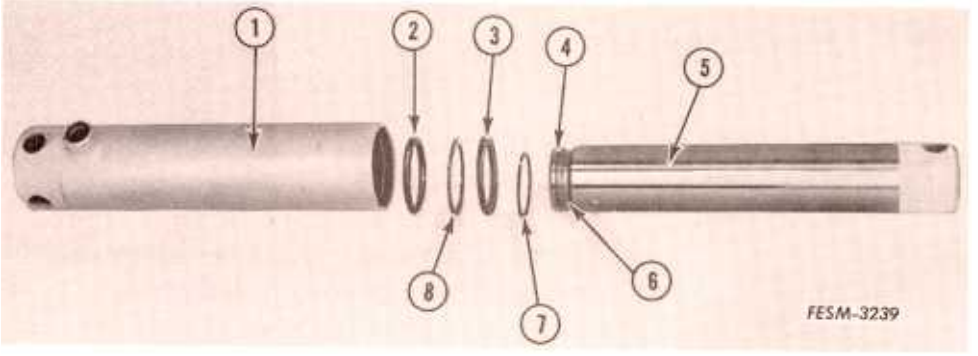
NOTE: When servicing the valve, cover the PTO belts to prevent oil from getting on them.



Hydraulic Cylinder (Cessna)

1. Remove the retaining ring (1) from its groove (2) and into the large groove (3).

1. Retaining ring
2. Retaining ring groove
3. Large piston groove



1. Body assembly
2. O-ring
3. Oil seal
4. Retaining ring groove
5. Piston rod
6. Large groove
7. Retaining ring
8. Back-up washer

2. Pull the piston rod (5) out of the body assembly (1).

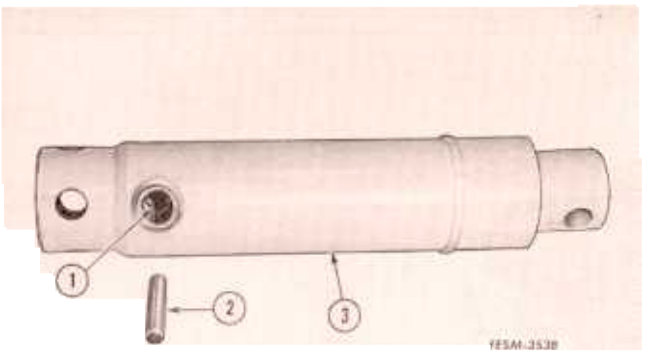
3. Remove the oil seal (3), back-up washer (8) and O-ring (2).

4. Check the piston rod and body for wear or damage and replace as necessary.

5. Install a new O-ring (2) and back-up washer (8) in the body.

6. Press a new oil seal (3) in place in the body (1).

7. Install the retaining ring (7) in the large piston rod groove (6). Install the rod (5) in the body (1) and then move the retaining ring (7) into its correct groove (4).

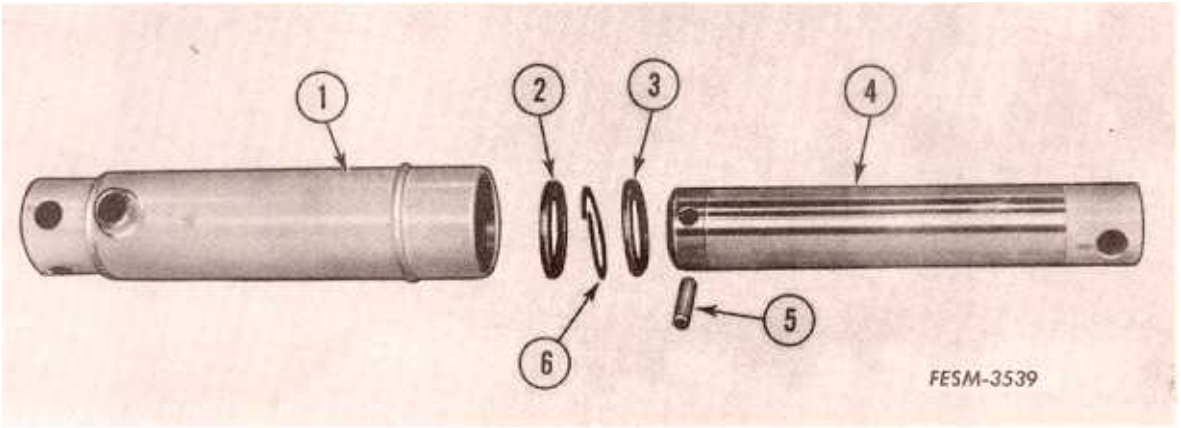


Hydraulic Cylinder (IH)

1. Remove the cylinder assembly from the tractor.

2. Position the piston so the stop pin is aligned with the cylinder port (1). Turn the cylinder (3) so the port (1) is pointing downward, and the pin (2) will fall out.

1. Cylinder port
2. Stop pin
3. Cylinder body



3. Remove the piston (4) from the cylinder body (1).

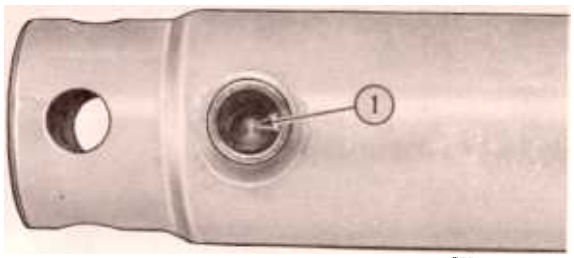
4. Remove the piston rod wiper (3), piston rod bracket washer (6) and quad ring (2) from the cylinder body (1).

5. Check the piston rod and cylinder body for wear or damage and replace as necessary.

6. Install a new piston rod bracket washer (6) and quad ring (2) in the cylinder body (1).

1. Cylinder body
2. Quad ring
3. Piston rod wiper
4. Piston rod
5. Stop pin
6. Piston rod bracket washer

7. Press a new piston rod wiper (3) in the body being sure the lip points outward.

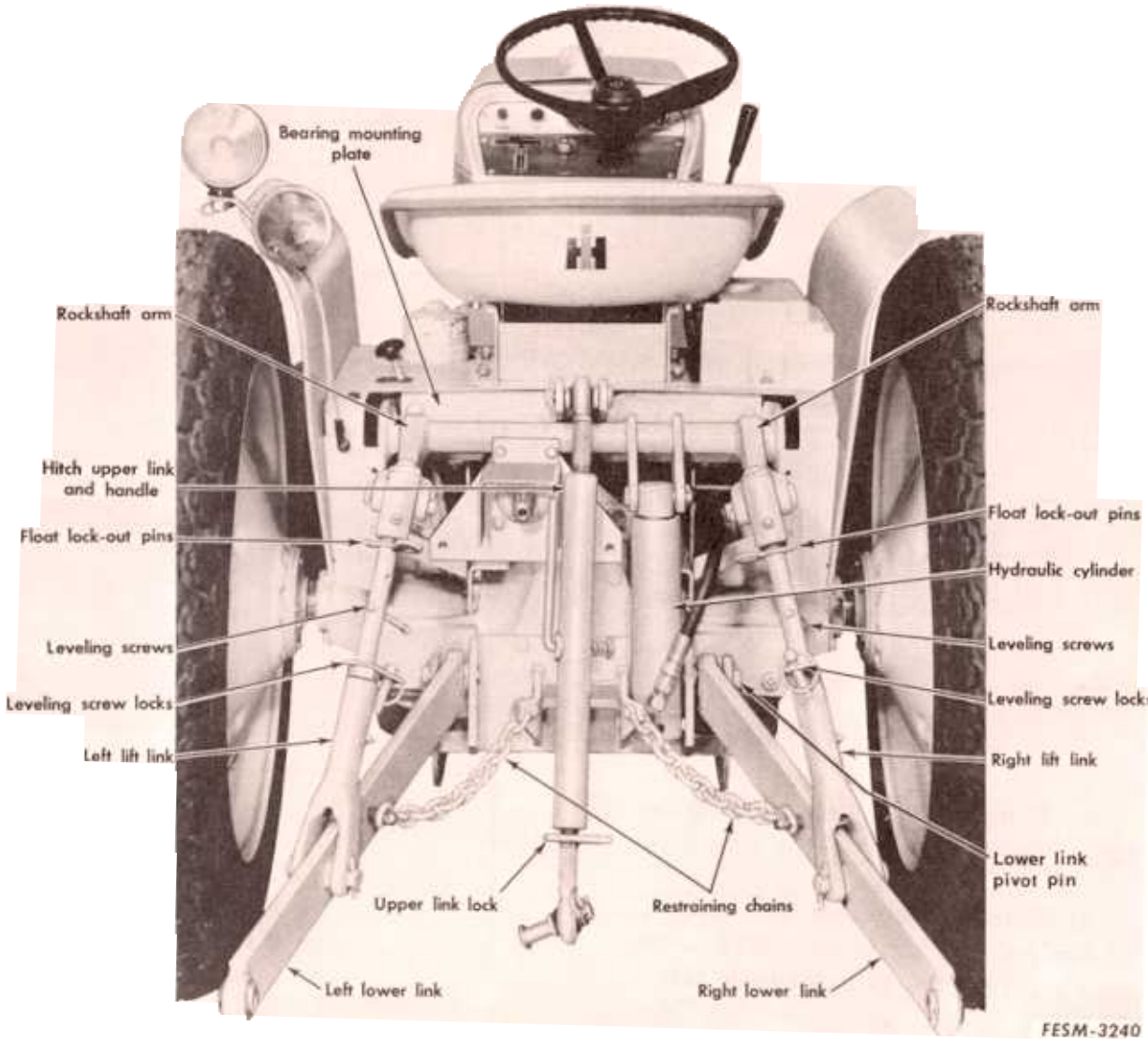


FESM-3540

8. Lubricate the piston with Hy-Tran and then install it in the cylinder body. Align the stop pin bores with the cylinder port and install the stop pin (1).

9. Install the cylinder assembly on the tractor.

1. Stop pin



FESM-3240

Removal

Detach the restraining chains and remove the pins in the lower links to remove the lower links.

To remove the upper link, remove the quick-attachable cotter pin and pin from the upper link bracket.

To remove the rockshaft arm, detach the hydraulic cylinder from the rockshaft and remove the four bolts from the bearing mounting plates.

Reassembly is the reverse of disassembly.

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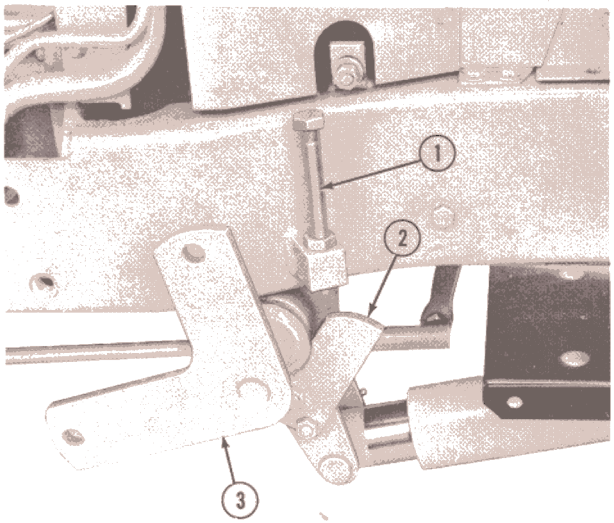
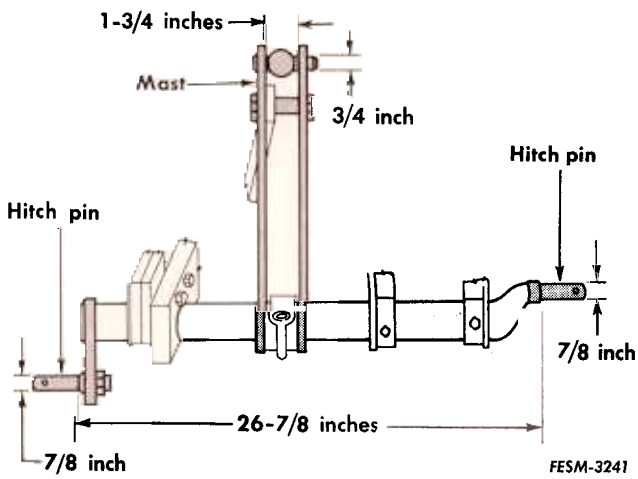
The adjusting screw located at the left rockshaft arm controls the height or depth of equipment mounted on the tractor.



FESM-3242

1. Adjusting screw
2. Stop bar
3. Rockshaft arm



FESM-3241

Lift Links and Leveling Screws

The lift links are used to raise or lower the hitch lower links. The lift links can be adjusted from 16-3/8 inches to 18-7/8 inches, with a nominal length of 17-5/8 inches. The left and right lift links incorporate leveling screws which can be turned to obtain the desired position of the hitch sockets relative to one another. The desired working range or lift range can be obtained by adjusting both leveling screws. Leveling screw locks are provided to prevent the leveling screws from working down when operating equipment in the field.

NOTE: The height of lift can be varied by repositioning the lower link pivot pins in one of the three vertical holes in the lower mounting plate.

Hitch Upper Link

The hitch upper link can be shortened or lengthened with the handle on the hitch upper link. Rotate the handle perpendicular to the upper link and turn clockwise or counterclockwise to the desired length. After adjusting, rotate the handle back to the parallel position and tighten the upper link lock. The upper link can be adjusted from 19 inches to 28 inches.

Adjust the length of the upper link according to the instructions for the equipment being used.

The category 1 designation means that the hitch lower links are spaced to fit equipment hitching pins spaced 26-7/8 inches between the shoulders, the swivel sockets in the ends of the lower hitch links are the correct size to fit the 7/8 inch diameter equipment hitching pins, and the swivel socket on the hitch upper link is the correct size to fit the 3/4 inch hitching pin in the 1-3/4 inch space on the equipment mast.

Section 10

ELECTRICAL

Contents

Complete Overhaul and Testing information is covered in GSS-1052-C.

SPECIFICATIONS
154 & 185 TRACTORS

Motor Generator

Delco Remy No.	Rotation Viewing Drive End	Brush Spring Tension	Field Current (80° F)		Cold Output (80° F)		
			Amps	Volts	Amps	Volts	AV-RPM
1 101 693	CW	22 – 26	1.5 – 1.6	12	15	14	3590
1 101 698	CW	22 – 26	1.5 – 1.6	12	12	14	4950

Voltage Regulator

Delco Remy No.	Circuit	Polarity Battery Ground	Cut Out Relay			Voltage Regulator	
			Air Gap In.	Point Opening In.	Closing Voltage Range	Air Gap In.	Voltage Range
1 118 991	A	N	.020	.020	11.8 – 14.0	.075	13.6 – 14.5

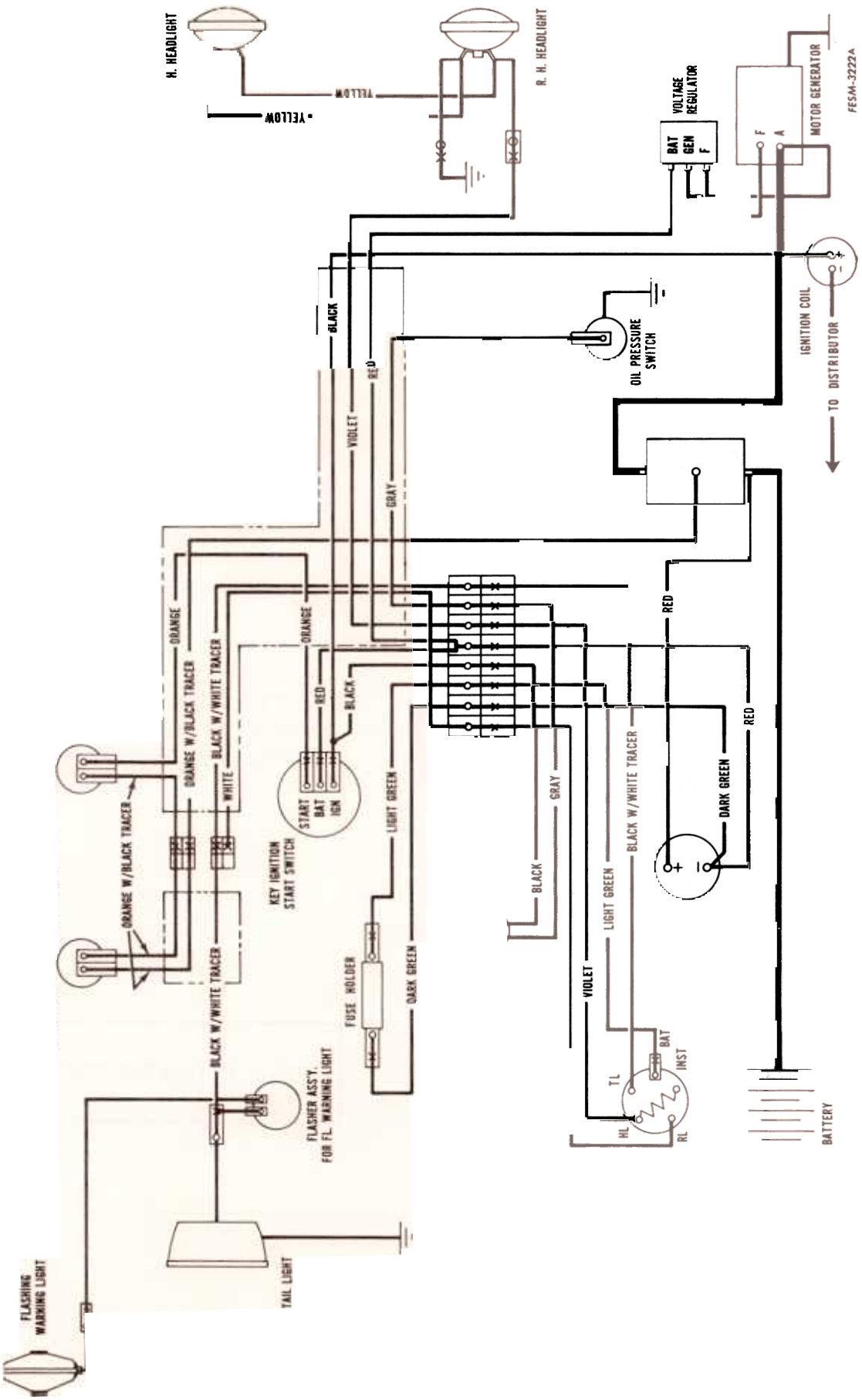
Distributor

Symbol or Code	Rotation Viewing Drive End	Degrees Of Automatic Spark Advance At Various Engine RPM's						
		400	800	1200	1600	1800	2000	2200
D	CCW	0 – 1	4 – 8	10 – 14	15 – 16	–	–	–

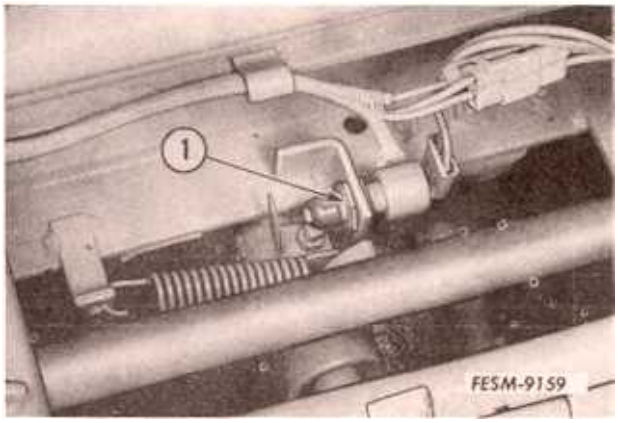
Electric IPTO Clutch

Voltage	Resistance	Current
12 D.C.	2.60	4.61 Amps

154 & 185 TRACTORS



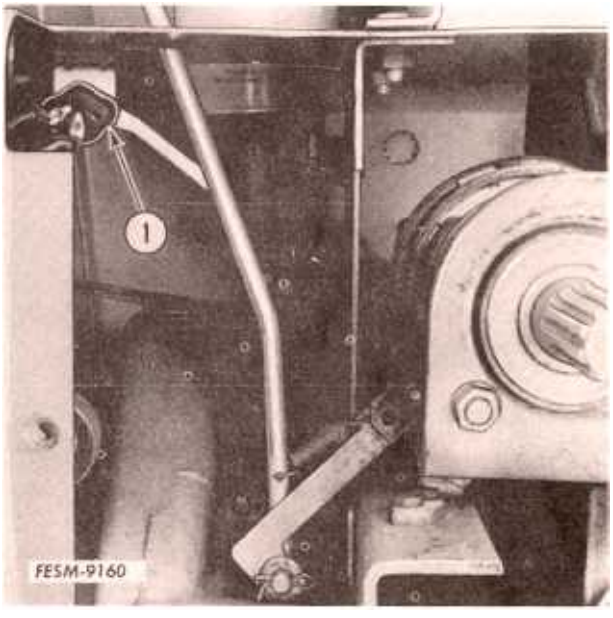
SAFETY STARTING CIRCUIT
154 & 185 TRACTORS



1. Safety starting switch

The safety starting circuit on early production tractors consisted of a main clutch safety starting switch. Later production tractors are equipped with safety starting switches on both the main clutch and the PTO.

The main clutch must be disengaged to activate the main clutch safety starting switch. The switch is adjustable and should be positioned so that the activating arm depresses the switch just far enough to make contact but not bottomed out against the end.



The PTO safety starting switch is spring loaded to complete the circuit as long as the PTO is disengaged.

1. PTO safety starting switch

SPECIFICATIONS
184 TRACTOR

Alternator

Delco Remy No.	Ground	Rotation Viewing Drive End	Field Current 80° F		Cold Output At Specified Voltage				Rated Hot Output (Amps)
			Amps	Volts	Amps	Approx. RPM	Amps	Approx. RPM	
1 100 588	N	CW	4.0 – 4.5	12	22	2000	33	5000	37
1 102 920	N	CW	4.0 – 4.5	12	25	2000	38	5000	42

Cranking Motor

Delco Remy No.	Rotation Viewing Drive End	No Load Test				
		Volts	Amps		RPM	
			Min.	Max.	Min.	Max.
1 109 352	CW	9	60	85	6800	10300

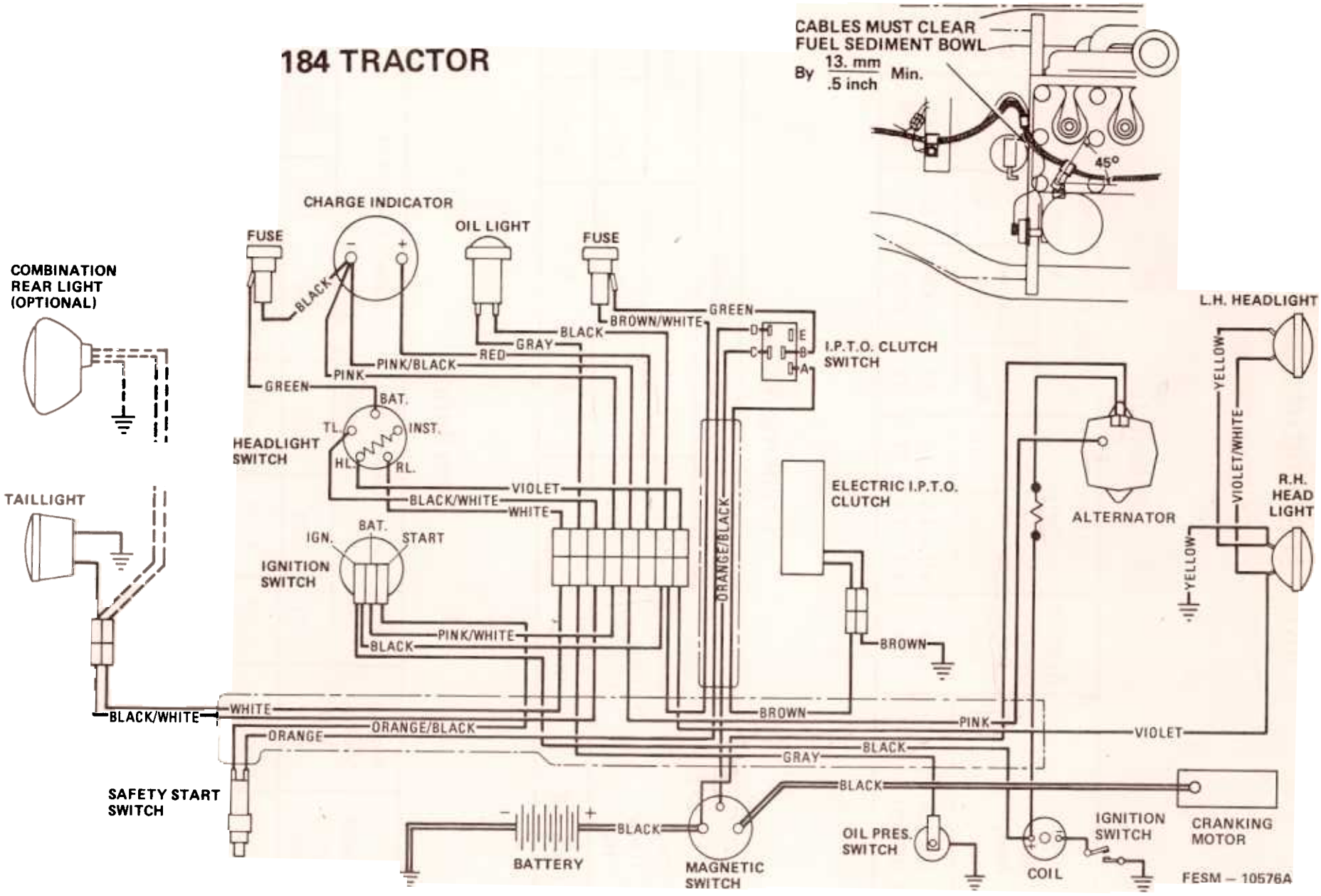
Distributor

Symbol or Code	Rotation Viewing Drive End	Degrees of Automatic Spark Advance At Various Engine RPM's						
		400	800	1200	1600	1800	2000	2200
D	CCW	0 – 1	4 – 8	10 – 14	15 – 16	–	–	–

Electric IPTO Clutch

Voltage	Resistance	Current
12 D.C.	2.60	4.61 Amps

184 TRACTOR


CABLES MUST CLEAR FUEL SEDIMENT BOWL By 13. mm / .5 inch Min.
45°
CHARGE INDICATOR
OIL LIGHT
FUSE
FUSE
COMBINATION REAR LIGHT (OPTIONAL)
BLACK
GRAY
BLACK
BROWN/WHITE
GREEN
RED
PINK/BLACK
PINK
GREEN
I.P.T.O. CLUTCH SWITCH
BAT.
TL.
INST.
HL.
RL.
HEADLIGHT SWITCH
L.H. HEADLIGHT
YELLOW
VIOLET/WHITE
R.H. HEAD LIGHT
YELLOW
VIOLET
BLACK/WHITE
WHITE
ELECTRIC I.P.T.O. CLUTCH
ALTERNATOR
TAILLIGHT
IGN.
BAT.
START
IGNITION SWITCH
ORANGE/BLACK
PINK/WHITE
BLACK
BROWN
BLACK/WHITE
WHITE
ORANGE
ORANGE/BLACK
BROWN
PINK
VIOLET
GRAY
BLACK
BLACK
SAFETY START SWITCH
BLACK
BATTERY
MAGNETIC SWITCH
OIL PRES. SWITCH
COIL
IGNITION SWITCH
CRANKING MOTOR
FESM – 10576A

SAFETY STARTING CIRCUIT
184 TRACTOR

If the clutch pedal safety start switch requires replacement, proceed as follows:

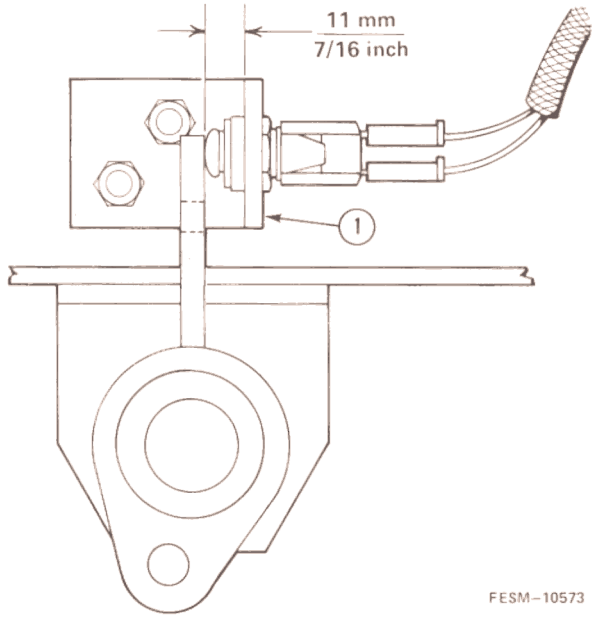
1. Install the new switch into the bracket assembly.

2. Thread the rubber boot onto the switch and lock in place with the jam nut.

NOTE: Turn the rubber boot onto the safety switch approximately three turns.

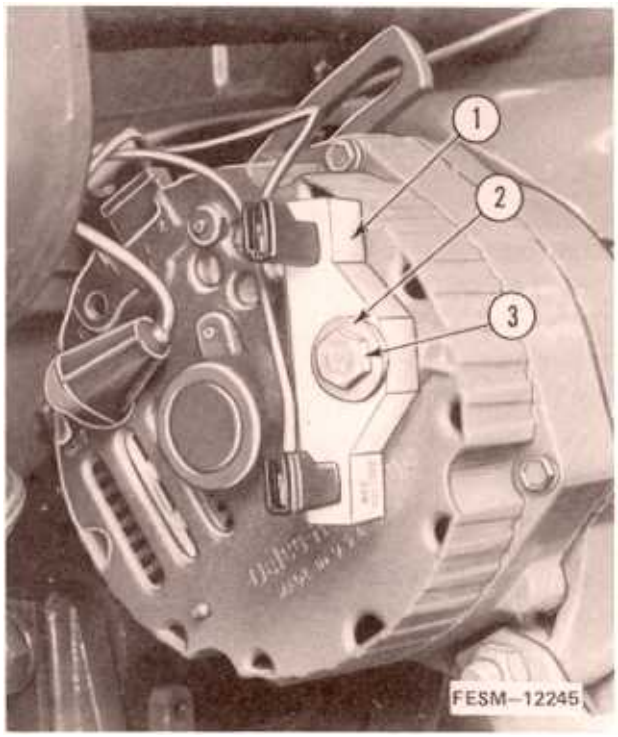
Adjustment

Position the safety start switch bracket so that when the clutch pedal is fully depressed a distance of 11 mm (7/16 inch) between the clutch pedal bracket and the safety start switch bracket exists.



1. Adjustable switch bracket

RESISTOR UNIT
184 TRACTOR



The resistor unit on the 184 tractor models, serial no. U046614 and above, requires a longer bolt and a plain washer instead of a lockwasher. The plain washer should be located between the bolt head and the resistor unit. Torque should not exceed 9-11 N·m (80-100 in. lbs.) to reduce the possibility of breakage of the ceramic resistor.

1. Resistor unit
2. Plain washer
3. Bolt, 5/16 x 1-1/4 inch

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