



FERGUSON

SHOP MANUAL

Models

■ TE20

■ TO20

■ TO30

- The preferred line of tractor repair manuals for over 40 years
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SHOP MANUAL

FERGUSON

Models TE20, TO20 and TO30

Tractor serial number stamped on instrument panel name plate.

Engine serial number stamped on engine name plate which is located on distributor side of engine.

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CONDENSED SERVICE DATA

GENERAL

TRACTOR MODEL	TE20	TO20	TO30	TRACTOR MODEL	TE20	TO20	TO30
Engine Make	Cont.	Cont.	Cont.	Pistons Removed From:	Above	Above	Above
Engine Model	Z120	Z120	Z129	Main Bearings, Number of	3	3	3
Cylinders	4	4	4	Main Bearings, Adjustable?	No	No	No
Bore—Inches	3 3/16	3 3/16	3 1/4	Rod Bearings, Adjustable?	No	No	No
Stroke—Inches	3 3/4	3 3/4	3 7/8	Cylinder Sleeves	Wet	Wet	Wet
Displacement—Cubic Inches	119.7	119.7	129	Forward Speeds	4	4	4
Compression Ratio	6.1	6.1	6.5	Generator Make	Lucas	D-R	D-R
Compression Ratio	5.08	5.08	8.0	Starter Make	Lucas	D-R	D-R

TUNE-UP

Firing Order	1, 3, 4, 2	1, 3, 4, 2	1, 3, 4, 2	Spark Plug Make	AC or Champion		
Valve Tappet Gap—Inlet & Exhaust	13H	13H	13H	Model for Gasoline	86 Comm. or 8 Comm.		
Exhaust Tappet Gap When Fitted With Rotators	13H	13H	13H	Electrode Gap	.025	.025	.025
Inlet Valve Face & Seat Angle	45	45	30	Carburetor Make	Marvel Schebler		
Exhaust Valve Face Angle	45	45	44	Model	TSX361A	TSX361A	TSX458
Exhaust Valve Face Angle When Fitted With Rotators	44	44	44	Float Setting	9/32	9/32	9/32
Exhaust Seat Angle	45	45	45	Fuel Level	15/32	15/32	15/32
Ignition Distributor Make	Lucas	D-R	D-R	Engine Low Idle rpm	400	400	400
Ignition Distributor Model	D3A4	1111722	1111740	Engine High Idle rpm	2200	2200	2200
Breaker Gap	.015	.022	.022	Engine Loaded rpm (Belt)	2000	2000	2000
Retarded Timing Degrees	7°B	7°B	6°B	Engine Loaded rpm (Drawbar)	1750	1750	1750
Full Advanced Timing Degrees	27-31°B	29-33°B	30-34°B	Belt Pulley No Load rpm	1493	1493	1493
Flywheel Mark Indicating:				Belt Pulley Loaded rpm	1358	1358	1358
Retarded Timing	(1)	7°	6°	PTO No Load rpm	800	800	800
Full Advanced Timing	(4)	29-33°	30-34°	PTO Loaded rpm	727	727	727

(1) Tractors prior to serial 36152, top center is indicated by a straight line on the crankshaft pulley, or two punch marks on the flywheel. Tractors after serial 36151, an "O" mark on flywheel indicates top center. (4) Flywheel is not marked; 12 starter ring gear teeth before TDC indicates the 29 degree advance position.

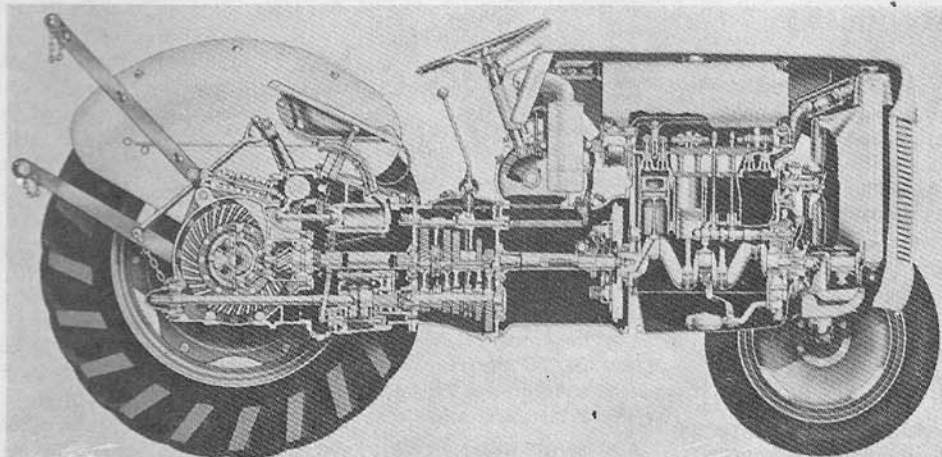
SIZES—CAPACITIES—CLEARANCES

(Clearances in thousandths)

Crankshaft Journal Diameter	2.250	2.250	2.250	Main Brgs., Diam. Clearance	1.5-2.5	1.5-2.5	1.5-2.5
Crankpin Diameter	1.937	1.937	1.937	Rod Brgs., Diam. Clearance	1.5-2.5	1.5-2.5	1.5-2.5
Camshaft Journal Dia., Front	1.809	1.809	1.809	Piston Skirt Clearance	1.2-1.7	1.2-1.7	1.2-1.7
Camshaft Journal Dia., Center	1.7462	1.7462	1.7462	Crankshaft End Play	3-7	3-7	3-7
Camshaft Journal Dia., Rear	1.6838	1.6838	1.6838	Camshaft Bearing Clearance	2.5-4.5	2.5-4.5	2.5-4.5
Piston Pin Diameter	.8592	.8592	.8592	Camshaft End Play	3-7	3-7	3-7
Valve Stem Diameter, Inlet	.3145	.3145	.3145	Cooling System—Gallons	2.5	2.5	2.5
Valve Stem Diameter, Exhaust	.3128	.3128	.3128	Crankcase Oil—Quarts	(2) 5.0	(2) 5.0	(2) 5.0
Compression Ring Width	1/8	1/8	1/8	Trans. & Diff.—Quarts (3)	24.0	24.0	24.0
Oil Ring—Width	3/16	3/16	3/16	Belt Pulley—Quarts	0.35	0.35	0.35

(2) Six quarts required when oil filter element is renewed.

(3) Includes hydraulic lift system.



MODEL TO30

FRONT AXLE

The front wheel tread of this tractor can be varied from 48 to 80 inches, in increments of 4 inches, without re-adjusting or changing the steering. It also permits one wheel to be spaced differently without affecting the wheel alignment.

AXLE ASSEMBLY

1. Axle main member complete with wheels can be removed as a unit by disconnecting both radius rods (3—Fig. F3) from transmission case, and steering drag links (4) from spindle arms. Support the engine and remove hood (bonnet) and radiator. Remove front axle pivot pin retaining screw and remove front axle pivot pin by prying same forward and out of axle.

Toe-in of 0-1/4 inch is adjusted by varying the length of the drag links (4).

AXLE PIVOT PIN BUSHING

2. Located in the axle main member is a renewable, presized, split type steel bushing, which should be installed with the split portion facing up.

To renew bushing (31—Fig. F1), remove hood, jack up the engine and unbolt the axle support. Remove the two radiator retaining bolts and raise engine and radiator high enough to permit removal of axle pivot pin. Remove pivot pin retaining screw. Remove the pivot pin by prying same forward and out of axle and drop support away from axle.

Pivot Pin Dia.....1.7475
 Reject If Smaller Than.....1.700
 Pivot Pin Bushing I. D.....1.7624
 Reject If Larger Than.....1.790

SPINDLE BUSHINGS

3. Each axle spindle support (1—Fig. F1) contains two split type, steel backed Clevite bushings which should be final sized after installation to an inside diameter of 1.249-1.250. Desired clearance of the spindles (24) in these bushings is 0.003 to 0.005 inch. Bushings for one side can be renewed after removing the front wheel, and front axle spindle (24) as an assembly.

The steering spindles are not interchangeable and can be identified by looking at the wheel axle end. If the keyway for key (19) for the steering spindle arm is to the right of the wheel axle center, it is a right hand spindle. If the keyway is to the left, it is a left hand spindle.

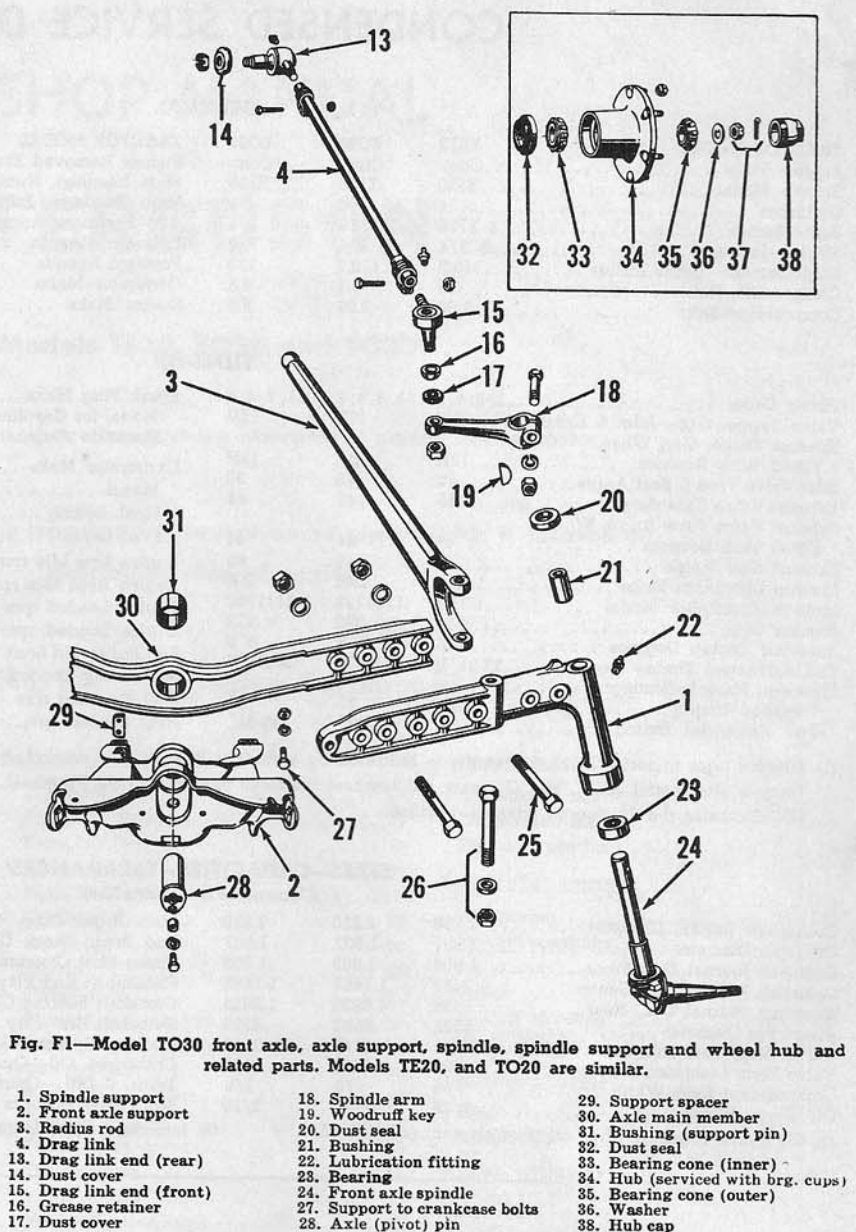


Fig. F1—Model TO30 front axle, axle support, spindle, spindle support and wheel hub and related parts. Models TE20, and TO20 are similar.

- | | | |
|---------------------------|--------------------------------|-----------------------------------|
| 1. Spindle support | 18. Spindle arm | 29. Support spacer |
| 2. Front axle support | 19. Woodruff key | 30. Axle main member |
| 3. Radius rod | 20. Dust seal | 31. Bushing (support pin) |
| 4. Drag link | 21. Bushing | 32. Dust seal |
| 13. Drag link end (rear) | 22. Lubrication fitting | 33. Bearing cone (inner) |
| 14. Dust cover | 23. Bearing | 34. Hub (serviced with brg. cups) |
| 15. Drag link end (front) | 24. Front axle spindle | 35. Bearing cone (outer) |
| 16. Grease retainer | 25. Support to crankcase bolts | 36. Washer |
| 17. Dust cover | 26. Dust cover | 38. Hub cap |
| | 27. Support to crankcase bolts | |
| | 28. Axle (pivot) pin | |

STEERING GEAR

On the TE20 the rear portion of the steering gear unit forms the transmission case cover, whereas on the TO20 and TO30, the steering gear unit is separate from the transmission cover.

The TE and TO tractors steering gear internal parts are interchangeable. The housings, however, are different. A TO steering gear assembly can be used on the TE by the addition of the TO transmission cover.

4. MINOR ADJUSTMENT. To reduce end play in column shaft (5—Fig. F2) of the pinion and twin sec-

tor type steering gear unit; remove steering wheel, dust shield (15), spring (17), and cork seal (16). Loosen tab type lock washer and lock nut (1). Turn adjusting nut and adjust column shaft bearings to a slight pre-load.

4A. Adjust mesh of each sector by means of screw (12) to obtain minimum backlash without binding. Ordinarily this should eliminate all backlash, but if excessive backlash exists after screw (12) is turned as far as it will go, it will be necessary to R&R the gear unit as outlined in paragraph 6, and reset the sectors as outlined under MAJOR ADJUSTMENT paragraph 5.

4B. If for any reason it is necessary to retune sectors (6) to the pinion, proceed as follows: Disconnect the drag links from the steering gear arms. Move one steering gear (sector) arm forward and the other steering gear arm rearward. Lower both arms together so that the sectors engage the pinion simultaneously. To check the timing, both arms should be parallel, and inclined approximately 15 degrees

to the rear when the steering gear is in the mid-position.

5. **MAJOR ADJUSTMENT.** To remove excessive backlash from gear when same cannot be eliminated by screw adjustment (12) proceed as follows: Remove steering gear unit from tractor, paragraph 6. Adjust column end play as outlined in paragraph 4. After removing steering housing plate (9), back off the screws (12) 6 to 8

turns. Loosen one sector clamp bolt (18 or 19). Push sector arm and shaft toward center of steering gear housing and move sector into full mesh with pinion; then lock the sector in this position with the sector clamp bolt. Repeat this procedure for the other sector. Inner ends of sector arm and shaft are supported by inner bushing (7).

With the above adjustment completed, turn each thrust screw (12) in until same contacts back face of sector, thereby removing unnecessary backlash from sector and pinion. Check for binding throughout the entire range of steering gear arm travel.

Retune the sectors to the pinion as outlined in paragraph 4B under **MINOR ADJUSTMENT.**

6. **R&R GEAR UNIT.** To remove steering gear unit from tractor, proceed as follows: Remove battery, air cleaner oil cup and fuel tank. Disconnect oil gauge line at gauge, and wires at generator, coil and starter switch. Remove choke control, and governor linkage from the throttle rod. Disconnect the steering gear arm drag links and remove the cap screws retaining steering gear housing to transmission case. Also, remove cap screws retaining battery carrier to clutch housing. Lift the steering gear housing and instrument panel as an assembly from the tractor.

7. **OVERHAUL.** To disassemble steering gear unit, first remove cap screws retaining upper housing (4) to lower housing (14). Remove steering wheel, dust shield, spring, retainer, cork seal, steering shaft nuts and lock

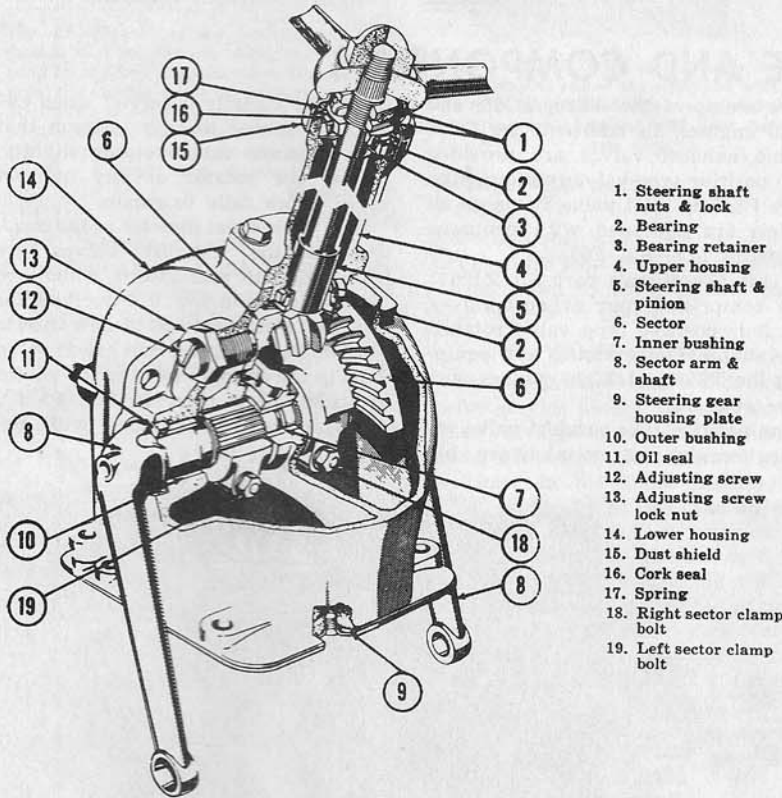


Fig. F2—Models TO20 and TO30 steering gear assembly. TE20 is similar.

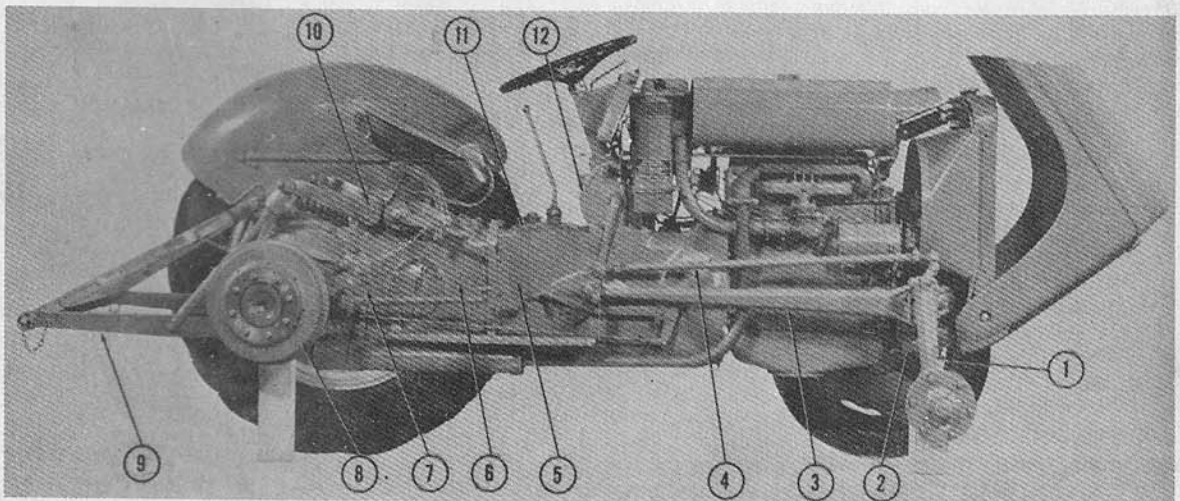


Fig. F3—Model TO20 tractor, right side view. TE20, and TO30 are similar.

washer. Bump pinion and shaft out of housing. The two taper roller bearing assemblies can now be renewed.

Remove steering housing plate. Remove clamp bolt and nut from sector gears to release the steering gear arms.

On the TE20, the sectors are interchangeable while the steering gear arms are marked right or left on inner end of shaft.

On the TO20 and TO30, the sectors are interchangeable. Steering gear

arms can be identified as being right or left, by viewing the splined end when the arm is pointing downward. If the blind spline is toward the right, the steering gear arm is right-hand. If the blind spline is toward the left, it is a left-hand arm.

Steering gear arm oil seals (11) of treated leather should be installed with the lip facing inward.

The three steering gear arm bushings (7 & 10) are provided presized

for service, and if carefully installed they will require no sizing after installation. The solid bronze inner bushing (7) which has an inside diameter of 1.1275-1.1290 provides a clearance of 0.0015-0.0065 inch. The Cleviste steel backed outer bushings (10) which have an inside diameter of 1.3120-1.3135 provide a clearance of 0.001-0.0035 inch.

Adjust steering gear unit as outlined in paragraphs 4, 4B, and 5.

ENGINE AND COMPONENTS

R & R ENGINE WITH CLUTCH

10. To remove the engine and clutch assembly, first drain the cooling system. Remove hood and disconnect battery cable at starter. Disconnect distributor and generator wires at engine. Support transmission and engine separately. Disconnect radiator hoses, carburetor choke rod, carburetor fuel line, governor linkage at instrument panel and governor, and manifold to exhaust pipe clamp bolts. Remove fuel tank. Remove air cleaner to carburetor tube and hoses. Disconnect front end of radius rod and mating drag link from one side of tractor. Remove bolts retaining the axle support to engine and swing front axle assembly away from engine. Remove cap screws retaining the engine to the transmission housing and separate engine from transmission housing.

CYLINDER HEAD

The cylinder head as used on the TE20, and TO20 engines is not interchangeable with the TO30 head.

11. To remove this unit, it is necessary to first remove the gas tank and governor to carburetor rod. Remove hand control to governor linkage at the front of cylinder head. Drain cooling system and remove upper radiator hose. Disconnect exhaust pipe from manifold and choke control from carburetor. Loosen carburetor to air cleaner tube hose. Remove manifold and carburetor assembly from engine. Remove valve cover, rocker arms and shaft assembly, and cylinder head hold down nuts. Tighten the cylinder head hold down nuts to 70-75 ft. lbs. torque. Adjust rocker arm adjusting screws to provide a .015C or .013H valve clearance for both inlet and exhaust valves.

VALVES AND VALVE SEATS

12. Tappets should be set cold to .015, or .013 hot when the engine is running. Valve stem caps (5—Fig. F6) are used on both the inlet and exhaust

valve stems of the TE20, TO20, and TO30 engines. In addition, the TO30 engine exhaust valves are provided with positive type valve rotators, Figs. F7 & F8. The inlet valve stems on all models are equipped with neoprene oil guards (15—Fig. F6).

A kit (Ferguson's part No. Z120T-140) comprising four exhaust valves, and four positive type valve rotators is available for servicing and equipping the TE20 and TO20 engines with valve rotators.

The positive type exhaust valve rotators require no maintenance but

should be visually observed when engine is running to make certain that each exhaust valve rotates slightly. Renew the rotator of any exhaust valve which fails to rotate.

Inlet valves seat directly in the head, whereas the exhaust valves are equipped with seat inserts which are also available in the .010 oversize for service. Interference fit of new inserts is 0.003. Reface valves and reseat valve seats in the cylinder head to the values as listed. Also, refer to Fig. F5 for data on engines equipped with rotators.

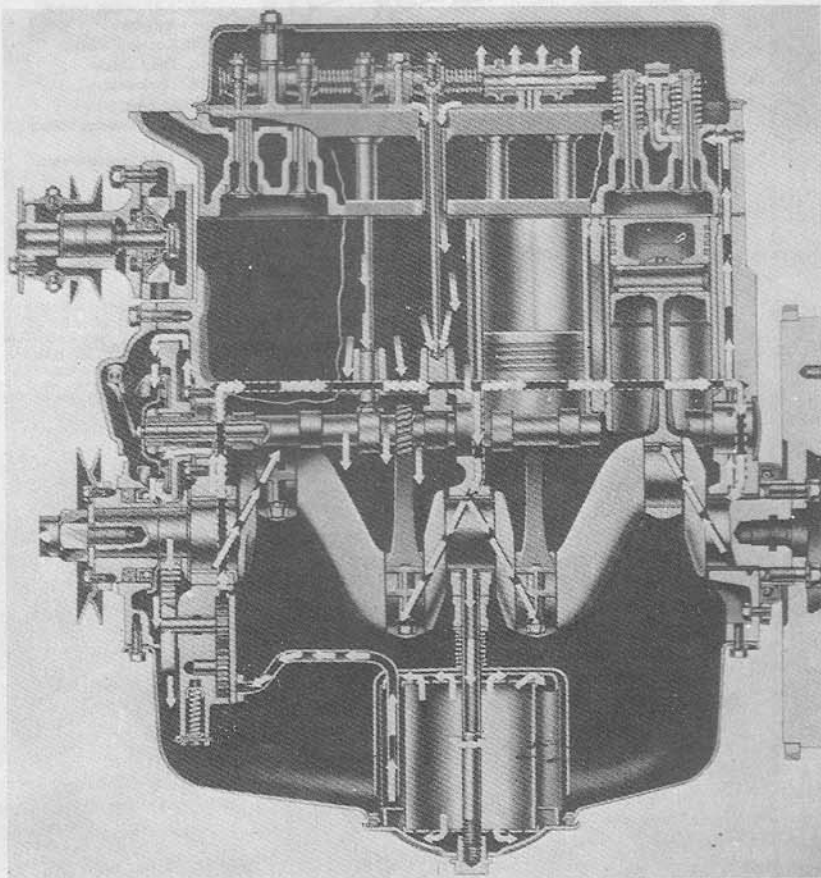


Fig. F4—Models TE20 and TO20 engine.

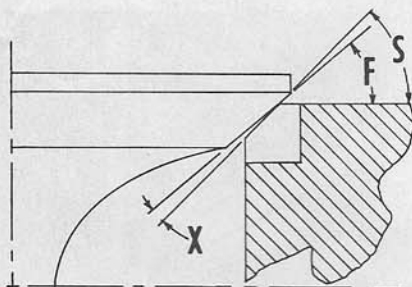


Fig. F5—Illustrating the principle of valve face to seat interference angle as sometimes used to improve exhaust valve life. In every case, the smaller angle 44 degrees is ground on the valve face (F), and the larger angle 45 degrees on the valve insert seat (S). This setup is used on engines equipped with exhaust valve rotators.

	TE20	TO20	TO30
Inlet Valve Face Angle	45	30	30
Inlet Valve Seat Angle	45	30	30
Exhaust Valve Face Angle:			
Engines Without Rotators			
(F)	45	45	45
Engines With Rotators			
(F)	44	44	44

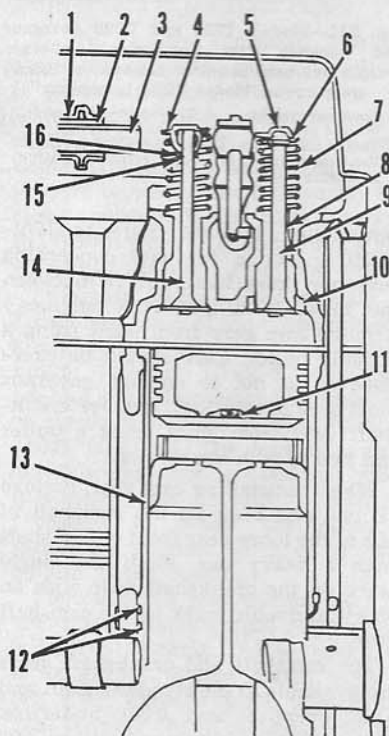


Fig. F6—Models TE20 and TO20 engine valve arrangement. Note valve stem caps (5) which are used on both inlet and exhaust valve stems. Positive type exhaust valve rotators are supplied for service.

- 1. Rocker arm
- 2. Rocker arm bushing
- 3. Rocker arm shaft
- 4. Spring retainer
- 5. Valve stem cap
- 6. Spring retainer lock
- 7. Valve spring
- 8. Valve guide
- 9. Exhaust valve
- 10. Valve seat insert
- 11. Piston pin bushing
- 12. Sealing rings
- 13. Cylinder sleeve
- 14. Inlet valve
- 15. Inlet valve stem oil guard
- 16. Inlet valve stem oil guard gasket

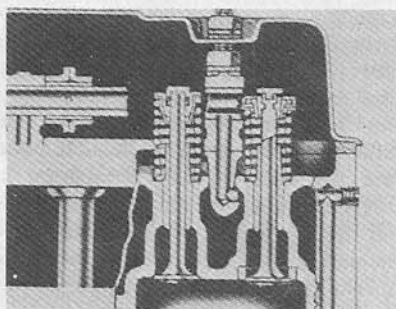


Fig. F7—Model TO30 engine valve arrangement. Exhaust valves are equipped with positive type rotators and valve caps, and the inlet valves are equipped with only the valve stem caps.

Exhaust Valve Seat Angle (S) 45 45
 Desired seat width is 5/64 inch; recut if wider than 7/64 inch. Seats may be narrowed by using 15 and 75 degree cutters or stones.

VALVE GUIDES

13. The presized inlet and exhaust valve service guides are interchangeable. Valve guides having a machined spiral groove in their bore, Fig. F9, are used in the TO30 engines. The TO30 valve guides are used in servicing the TE20 and TO20 engines.

Guides should be pressed or driven into the cylinder head, using a piloted drift 0.002 smaller than bore of guide, until port end of guide measures 1 1/8 inches to gasket surface of cylinder head on the TE20 and TO20 engines, or 1 1/8 inches on the TO30. Desired clearance of the inlet valve stem in the guide is 0.001-0.003; of exhaust valve stem, 0.0025-0.0045.

VALVE SPRINGS

14. Inlet and exhaust valve springs are interchangeable. The valve springs are coated with a non-corrosive material and should be installed with the dampening (closely wound end) coils next to the cylinder head. Each spring should require 96-104 lbs. pressure to compress it to a height (valve open) of 1 3/4 inches. They should require 47-53 lbs. pressure to compress them to a height (valve closed) of 1 3/8 inches.

VALVE TAPPETS

15. Mushroom type tappets (cam followers) operate directly in machined bores of the cylinder block. Tappets are furnished only in standard size and should have a clearance of 0.0005-0.0025 in block bores. Any tappet can be removed after removing the oil pan, rocker arms and shafts assembly, ignition distributor, timing gear cover and camshaft.

The TE20, TO20, and TO30 valve tappets are interchangeable. Adjust rocker arm adjusting screws to provide .015 cold, or .013 hot gap for both inlet and exhaust valves.

VALVE ROCKER ARMS

16. Rocker arms and shafts assembly can be removed after removing fuel tank, valve cover, two cap screws and two special rocker shaft support retaining studs. The rocker arms, being right and left hand assemblies, are not interchangeable. Renew the arm, if either the babbitt lined steel backed bushing or valve stem contact button is worn. The rocker arm shaft is assembled with the radial drilled oil holes facing the valve springs. Desired clearance between the new rocker arm and a new shaft is 0.001-0.003. If clearance between rocker arm bushing and shaft exceeds 0.006, renew the rocker arm and/or shaft. The TE20, TO20,

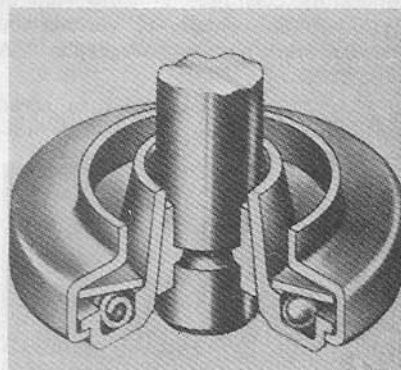


Fig. F8—Rotacap positive type valve rotators as installed in the TO30 engines. Similar rotators are available for servicing the TE20 and TO20 engines.

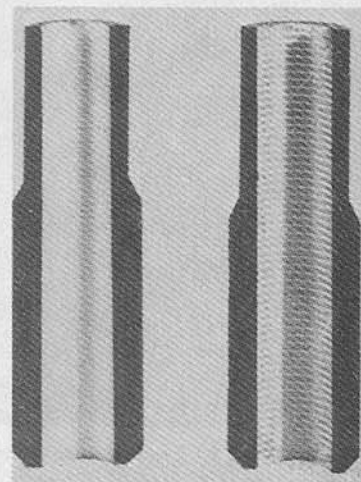


Fig. F9—Left view: Straight bore valve guides as used in the TE20 and TO20 engines. Right view: Spiral grooved valve guides as used in the TO30 engine. TO30 guides are used in servicing the TE20 and TO20 engines.

and TO30 rocker arms and shafts, and push rods are interchangeable.

Adjust rocker arm adjusting screws to provide .015 cold, or .013 hot gap for both inlet and exhaust valves.

VALVE TIMING

17. Number one cylinder inlet valve opens at top center. Valves are correctly timed when the single mark on crankshaft gear is meshed with an identical double mark on camshaft gear.

To check valve timing when engine is assembled, adjust number one inlet rocker arm adjusting screw to 0.020. Insert a .005 feeler gage between the number 1 inlet valve stem and rocker arm. Crank engine over slowly until a slight resistance occurs when trying to withdraw the feeler gage. At this time, top center mark should be in register within 1/4 inch on flywheel or 1/8 inch on crankshaft pulley. Reset inlet valve operating clearance to 0.015 cold or .013 hot. See details of various top center markings in paragraphs 17A and 17B.

17A. TE20 tractors prior to serial 36152, two methods are used to indi-

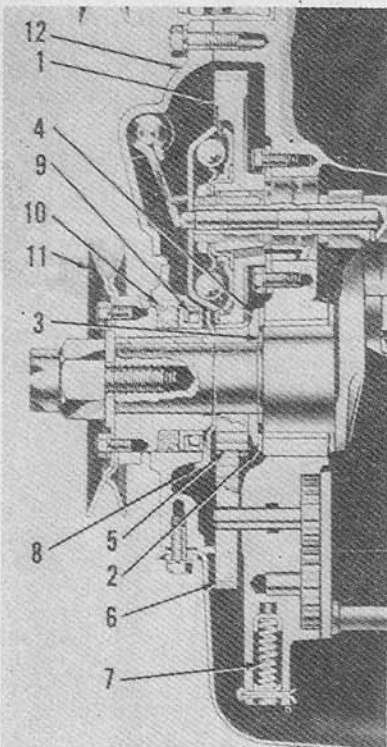


Fig. F10—Model TO30 engine crankshaft front oil seal and governor installation. Models TE20 and TO20 are similar. Shims (3) control crankshaft end play.

- | | |
|------------------------|-----------------------|
| 1. Camshaft gear | 7. Oil relief valve |
| 2. Thrust washer | 8. Oil slinger |
| 3. Shims | 9. Oil seal |
| 4. Thrust plate | 10. Felt seal |
| 5. Crankshaft gear | 11. Crankshaft pulley |
| 6. Oil pump drive gear | 12. Timing gear cover |

cate the top center position of numbers 1 and 4 pistons. On some of this group, the TC point is when a line on the crankshaft pulley indexes with a line on the timing gear cover. On others, the TC point is when the two punch marks on the flywheel are in register with identical punch marks on the flywheel housing starter motor mounting pad. In the latter case, the marks cannot be seen until the starter motor is removed from the engine.

17B. TE20 tractors after serial 36151 and on all TO20 and TO30 tractors, flywheels are stamped with a zero or "DC" mark indicating top center and with additional stamped lines from one to 30 or 35 degrees in one degree increments. The letters and degree lines index with a pointer or notch at the flywheel inspection port located on the distributor side of engine.

TIMING GEAR COVER

The TE20, TO20, and TO30 engine timing gear cover is interchangeable.

18. Although it is possible to renew the crankshaft oil seal felt (10—Fig. F10) and treated leather seal (9) without removing the timing gear cover, our suggestion is to remove the cover, which entails little additional work. To remove the timing gear cover, remove the hood, disconnect one drag link connection from steering gear arm and mating radius rod from one side of tractor. Disconnect upper and lower radiator hose connections. Support tractor under forward part of transmission. Remove bolts retaining front axle support to front of engine and swing axle and front end assembly away from engine. Remove fan blades, crankshaft starting jaw and crankshaft pulley (11). Remove the three forward oil pan retaining cap screws and loosen all other pan screws to permit removal of timing gear cover. Disconnect governor linkage and remove cap screws retaining timing gear cover to engine.

The treated leather oil seal (9) should be installed with the lip facing the crankshaft gear.

TIMING GEARS

19. Timing drive consists of two helical gears. To remove either gear first remove timing gear cover. On TE20, TO20 and some TO30 engines equipped with a flyweight type governor, remove governor cup, and four screws retaining governor weight assembly to camshaft gear. On all models, remove camshaft gear retaining nut. The Novi governor weight unit (ball type), Fig. F13, on TO30 engines

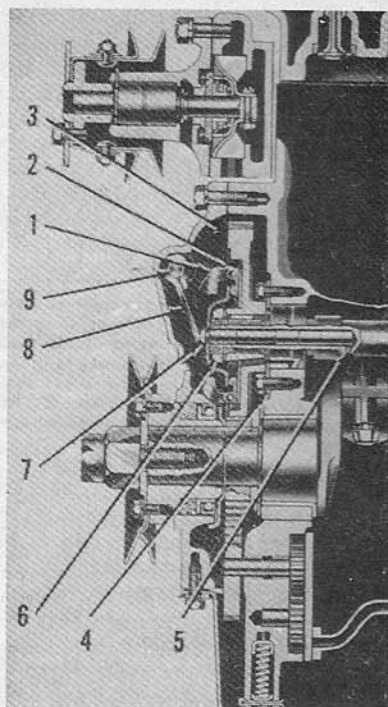


Fig. F11—Models TE20 and TO20 governor and camshaft gear installation. Governor weight overhaul requires removal of timing gear cover. Model TO30 is similar.

- | | |
|--------------------|------------------------------------|
| 1. Governor weight | 7. Governor cup and shaft assembly |
| 2. Weight plate | 8. Operating fork |
| 4. Thrust plate | 9. Governor operating fork shaft |
| 5. Vent opening | |
| 6. Retaining nut | |

can now be removed. (Refer to GOVERNOR section for data concerning governor interchangeability between the TE20, TO20 and TO30 engines.) Remove cam gear from shaft using a suitable puller. Care should be exercised so as not to damage governor shaft bore in camshaft. Remove crankshaft gear from shaft using a puller and two 3/8 inch cap screws.

When reinstalling cam gear, remove oil pan and buck-up the camshaft at one of the lobes near front end of shaft with a heavy bar. Mesh the single mark on the crankshaft gear with an identical double mark on the camshaft gear.

The camshaft and crankshaft gears are available in the standard, 0.001 and 0.002 oversize, and 0.001 undersize. Both gears are stamped either "S" (Standard), "O" (Oversize), "U" (Undersize) and the amount, to indicate the size. The TE20, TO20, and TO30 engine timing gears are interchangeable.

The original installation size is stamped on the front face of the cylinder block in the vicinity of the cam gear, or on timing gear cover gasket surface. When renewing gears on an

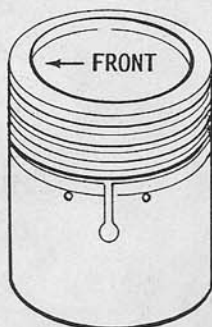


Fig. F12—Install piston and connecting rod assemblies so that stamped arrow on piston head faces forward, and the oil spray hole (lower end of rod) faces away from camshaft side of engine.

engine stamped plus one, use one standard gear and one 0.001 oversize gear. Recommended backlash of camshaft to crankshaft gear is 0.002.

Tighten cam gear retaining nut to 70-80 ft. lbs. torque.

CAMSHAFT

The TE20 and TO20 engine camshaft is not interchangeable with the camshaft as used in the TO30 engine.

20. To remove camshaft, first remove the camshaft gear, as outlined in preceding paragraph. Remove the ignition distributor, rocker arms and shaft assembly and engine oil pan. Remove push rods and block up or support tappets (cam followers). Remove camshaft thrust plate (4—Fig. F11) from front of cylinder block and withdraw the shaft from the engine.

Camshaft journals ride directly in 3 machined bores of the cylinder block. Shaft journal sizes are: Front 1.8090-1.8095; center 1.7460-1.7465; rear 1.6835-1.6840. Recommended clearance of camshaft journals in their bores is 0.0025 to 0.0045. The maximum permissible clearance is 0.007 and when it exceeds this amount, it will be necessary to renew the camshaft and/or the cylinder block, or to make up and install bushings.

Camshaft end play is controlled by the copper plated thrust plate which is 0.147-0.149 thick. Desired end play is 0.003-0.007. Renew thrust plate if end play exceeds 0.008. Check the vent opening (5) in camshaft which is located directly behind the number one cylinder exhaust cam. If the opening is obstructed it will be impossible to obtain satisfactory operation of the governor.

ROD AND PISTON UNITS

21. Piston and connecting rod assemblies are removed from above after

removing cylinder head and oil pan. Pistons and rods are installed with the rod correlation marks facing the camshaft. Replacement rods are not marked and should be installed with the oil spray hole (lower end of rod) facing away from camshaft side of engine. Tops of pistons are stamped with the word "Front" and an arrow, Fig. F12. Install pistons so that the arrow points to the timing gear end of engine.

Tighten the connecting rod cap screws to 40-45 ft. lbs. torque.

PISTONS, SLEEVES AND RINGS

22. Aluminum alloy, cam ground pistons are supplied only in the standard size and are available only in a sleeve and piston kit comprising a piston, piston pin, rings and sleeve. Recommended piston skirt clearance is .0012-.0017. Piston clearance is checked with a spring scale pull of 5-10 lbs., using a 0.002 x 1/2 inch feeler gage. Wear limit of worn pistons and sleeves is when a 0.005 x 1/2 inch feeler gage requires less than a 5-10 lbs. pull on the spring scale to withdraw it.

With the piston and connecting rod assembly removed from the cylinder block, use a suitable puller to remove the sleeve. Before installing the wet type sleeve, clean all cylinder block sealing surfaces. The top of the sleeve should extend 0.002-0.0045 above the top surface of the cylinder block. If this standout is in excess of 0.0045, check for foreign material under sleeve flange. Excessive standout will cause water leakage at cylinder head gasket. To facilitate installation of sleeves, use a lubricant (palm oil or vaseline) on the two neoprene sealing rings.

There are three compression rings and one oil control ring per piston. Recommended end gap for all rings is 0.010-0.017. Recommended side clearance for all compression rings is 0.003-0.005; for the oil control ring, 0.002-0.0035.

PISTON PINS

23. The 0.8591-0.8593 diameter float-ign piston pins are retained in piston bosses by snap rings and are available in standard and 0.003 oversize. The bushing in the upper end of connecting rod has a very thin wall and if sized by reaming, do so only with a fluted type, taking very light cuts. Be sure oil hole in bushing registers with oil hole in top end of the connecting rod and clean same thoroughly after sizing the bushing. Pin should be fitted to a .0002-.0006 clearance in the rod and a minus .0001 to plus .0003 clearance in the piston.

CONNECTING RODS AND BEARINGS

The TE20, TO20, and TO30 engine connecting rods and bearings are interchangeable.

24. Connecting rod bearings are of the shimless, non-adjustable, slip-in precision shell type. When installing new bearing shells, be sure that the projection engages milled slot in rod and cap and the rod and rod cap correlation marks are aligned. Replacement rods are not marked and should be installed with the oil spray hole facing away from camshaft side of engine. Bearings are available in 0.002, 0.010 and 0.020 undersize, as well as standard.

Crankpin diameter1.9365-1.9375
Running clearance0015- .0025
Renew if clearance exceeds0045
Side clearance005 - .011
Renew if side clearance exceeds014
Rod length C to C6.375
Cap screw torque 40-45 ft. lbs.

CRANKSHAFT AND BEARINGS

25A. Crankshaft is supported on 3 shimless, non-adjustable, slip-in, precision type main bearings, renewable from below without removing the crankshaft. The rear main bearing cap

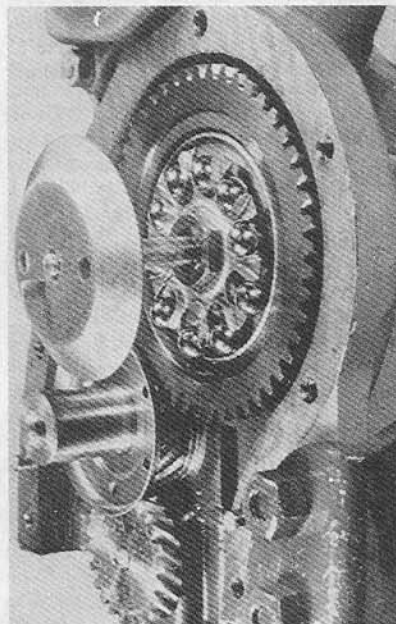


Fig. F13—Model TO30 engine timing gears and Novl governor (ball type) assembly installation. Reinstall governor shaft and upper race assembly so that the projection on the front face of the race is at the 8 o'clock position as shown.

contains packing on each side of the filler block to prevent oil leakage into the clutch housing. This packing is in addition to the separate crankshaft rear seal (3—Fig. F15). To remove the rear main bearing cap and filler block, first remove the two cap screws (4—Fig. F15) which retain the crankshaft rear oil seal retainer to the bearing cap and then remove two bearing cap retaining cap screws.

Bearings are available in standard, .002, .010 and .020 undersizes. The TO30 crankshaft main bearing shells are being provided for servicing the TE20 and TO20 engines. The bearing shells are similar except that the TO30 number one shells do not have an end flange to take crankshaft thrust. Refer to Fig. F14. When installing the TO30 bearing shells in a TE20 or TO20 engine, it will be necessary to remove the crankshaft so as to install a crankshaft end play control thrust washer (Ferguson's part No. Z129C-202) which takes the place of the bearing shell flange. The crankshaft as used in the TE20, and TO20 engines is not interchangeable with the TO30 engine crankshaft.

25B. Crankshaft end play is controlled by shims (3—Fig. F10 or F14) located at forward portion of number one journal and should be checked with all parts in place, including the crankjaw which should be tightened. Recommended end play is 0.003-0.007. Adjust end play when it exceeds 0.012. To make adjustment (remove shims to decrease end play) remove crankshaft gear.

25C. To remove crankshaft it is necessary to remove engine, clutch, flywheel, rear oil seal, timing gear cover, oil pan, and main bearing caps.

Check the crankshaft journals for wear, scoring and out-of-round condition against the values listed below:
 Journal diameter 2.249 -2.250
 Running clearance0015-.0025
 Cap screw torque85-95 ft. lbs.

CRANKSHAFT REAR OIL SEAL

26. Crankshaft rear oil seal of treated leather (3—Fig. F15) is contained in a one piece retainer and serviced only as an assembly. To renew the seal, first separate the engine from the transmission case as outlined in paragraph 72, and remove the flywheel and oil pan. Remove the three seal retainer to crankcase cap screws and the two seal retainer to rear main bearing retaining cap screws.

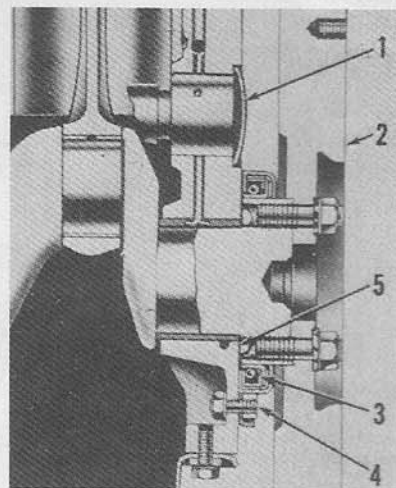


Fig. F15—Models TE20, TO20, and TO30 engine crankshaft rear oil seal of treated leather. To renew oil seal, separate engine from transmission and remove flywheel and oil pan.

- 1. Welch plug
- 2. Crankshaft rear oil seal & retainer
- 3. Crankshaft rear oil seal & retainer
- 4. Cap screw
- 5. Rear main bearing cap & filler block

FLYWHEEL

27. To remove flywheel, separate the engine from transmission case as outlined in paragraph 72, then remove the clutch unit from flywheel. The starter ring gear can be renewed after removing the flywheel. To install a new ring gear, heat same to 500 deg. F. and install on flywheel with beveled end of teeth facing timing gear end of engine. One flywheel mounting bolt hole is off center.

On models TO20 prior 10282, the ring gear is mounted to the flywheel from the rear. If ring gear requires renewal where this construction is found, it will be necessary to install

the later type TO flywheel and ring gear assembly. (Ferg. Part No. Z-120C4020).

FLYWHEEL TIMING MARKS

TE20 Prior 36152

28. On TE20 tractors prior to 36152, two methods are used to indicate the top center position of number one and 4 pistons. On some of this group, the TC point is when a line on the crankshaft pulley indexes with a line on the timing gear cover. On others, the TC point is when the two punch marks on the flywheel are in register with identical punch marks on the flywheel housing starter motor mounting pad. In the latter case, the marks cannot be seen until the starter motor is removed from the engine.

TE20 After 36151 - TO20-TO30

28A. On TE20 tractors after 36151 and on all TO20 and TO30 tractors, the flywheel is stamped with an "O" or "DC" mark indicating top center and with additional stamped lines from one to 30 or 35 degrees in one degree increments. The letters and degree lines index with a pointer or notch at the flywheel inspection port located on the distributor side of engine.

OIL PUMP

The oil pump as used in the TO30 is interchangeable with the TE20 and TO20 pumps.

29. Gear type pump, shown in Fig. F16, is bolted to bottom of number one main bearing cap and is gear driven from crankshaft pinion. Pump is accessible after oil pan is removed.

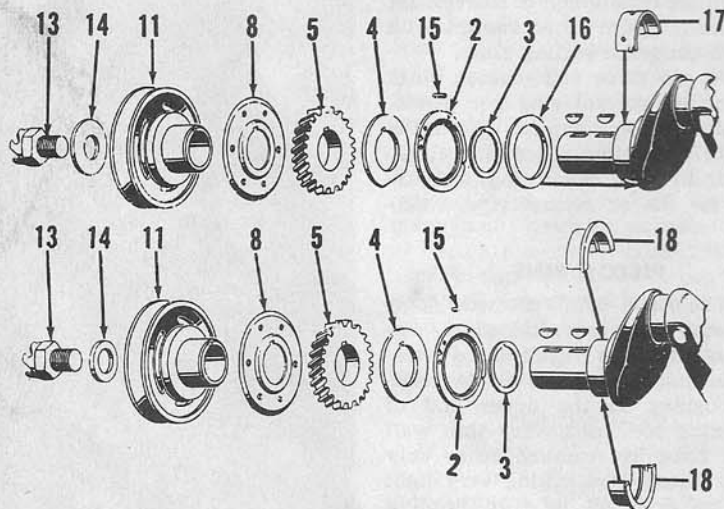


Fig. F14—Crankshaft end play is controlled with shims (3), which are accessible after removing the crankshaft gear (5). Top view: Model TO30 installation. Thrust washer (16) is used because the number one main bearing shell (17) does not have a flange. Bottom view: Models TE20 and TO20 installation.

- 2. Thrust washer
- 3. Shims
- 4. Thrust plate
- 5. Crankshaft gear
- 8. Oil slinger
- 13. Crankshaft starting jaw
- 15. Thrust washer pin
- 16. Thrust washer
- 17. No. 1 Main bearing shell (TO30)
- 18. No. 1 Main bearing shell (TE20 & TO20)

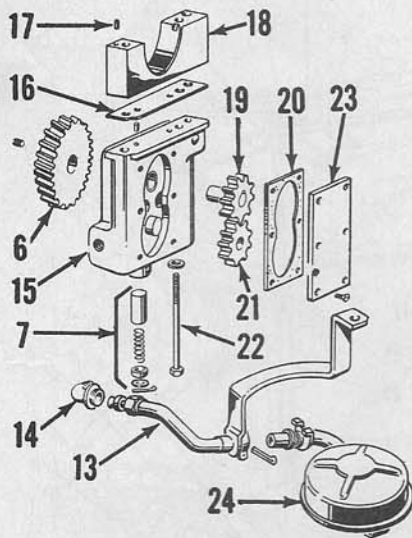


Fig. F16—Model TO30 engine oil pump which is bolted to the lower side of the No. 1 main bearing cap. TE20, and TO20 oil pumps are similar in construction.

- | | |
|----------------------|----------------------------|
| 6. Pump drive gear | 18. No. 1 main bearing cap |
| 7. Relief valve | 19. Gear and shaft assy. |
| 13. Inlet tube | 20. Gasket |
| 14. Inlet tube elbow | 21. Pump idler gear |
| 15. Oil pump body | 22. Body cover |
| 16. Shim | 23. Body cover |
| 17. Dowel pin | 24. Strainer assy. |

Shims interposed between pump body and main bearing cap are varied to obtain the desired 0.005 - 0.010 backlash between the crankshaft pinion and the aluminum gear on the pump shaft.

Check the pump internal gears for backlash, which should not exceed 0.007. The recommended diametral clearance between the gears and pump body is 0.003 - 0.004. Gear side clearance should not exceed 0.0035 - 0.0065. A lead gasket, 0.007 thick, is placed between pump body and cover to control side clearance (end play). Pre-sized pump shaft bushings are available for service and have a running clearance of 0.0035 - 0.0065.

RELIEF VALVE AND FILTER

30. Plunger type relief valve (7—Fig. F16) is located in oil pump body and can be adjusted with spacers inserted under the spring so as to maintain a pressure of 20 - 30 psi at 2200 engine rpm. At idle speed, pressure should not be lower than 15 psi. The plunger type valve should fit in its bore with a 0.003 - 0.005 clearance. The relief valve spring should have a free length of 2 inches and should check 8±¼ pounds at a working length of 1 3/8 inches.

On models TE20, and TO20 to renew oil filter, remove center plug and hand hole cover from the oil pan and withdraw the filter element. On model TO30, the oil filter is externally mounted on the right or manifold side of the engine.

CARBURETOR

40. Carburetor is a Marvel-Schebler TSX312 for the TE20. On early production TO20 models, a model TSX361 is used. Later production TO20 models have a TSX361A which is also being supplied for servicing the TE20 and early TO20 models. The TO30 model is equipped with a TSX458 carburetor.

Carburetor must be removed to set the fuel level. Float should be set to 9/32 inch when measured from bowl cover gasket surface to nearest edge of float. The idle mixture screw controls the flow of air in the idle system, and turning the screw towards its seat richens the idle mixture. Approximate setting is 7/8 turn open. Power range is controlled by a power jet needle, which reduces fuel flow and leans the mixture when turned in towards its seat. Approximate setting is 1 3/8 turns open. Idle speed stop screw should be adjusted to permit the engine to idle at 400-500 rpm.

Specification data are as follows:

Marvel-Schebler TSX 312

Repair kit	286-853
Gasket set	16-592
Inlet needle and seat.....	233-536
Idle jet	49-165
Power jet	49-196
Nozzle	47-257
Venturi	46-448
Float & lever assembly.....	30-600

Marvel-Schebler TSX 361

Repair kit	286-853
Gasket set	16-592
Inlet needle and seat.....	233-536
Idle jet	49-165
Power jet	49-191
Nozzle	47-257
Venturi	46-448
Float & lever assembly.....	30-600

Marvel-Schebler TSX 361A

Repair kit	286-853
Gasket set	16-592
Inlet needle and seat.....	233-536
Idle jet	49-285
Power jet	49-191
Nozzle	47-257
Venturi	46-448
Float & lever assembly.....	30-600

Marvel-Schebler TSX 458

Repair kit	286-975
Gasket set	16-634
Inlet needle and seat.....	233-536
Idle jet	49-101-L
Power jet	43-632
Nozzle	47-384
Venturi	46-476
Float & lever assembly.....	30-600

GOVERNOR

All TE20 engines, early production TO20 engines, and TO30 engines within the following serial number range: 333437 to 334669, and 334699 to 334742 are equipped with a Novi cast flyweight type governor. Later production TO20, and all TO30 engines which are not within the preceding engine serial number range are equipped with a Novi ball type governor. Refer to Fig. F13, or F18.

The TO30 ball type governor unit can be installed on all TE and TO engines, which were originally equipped with a flyweight type, providing a shim type washer (approximately 1/16 inch thick—Ferguson's part No. 12CH-208) is inserted between the cam gear hub and the governor driver (balls, cage, and cup) assembly.

The adjustment procedure (paragraphs 50 & 50A) and a major portion of the removal and reinstallation procedures (paragraph 51) are the same for both types of governors.

50. MINOR ADJUSTMENT. Warm up engine and adjust carburetor mixture. Disconnect governor to carburetor rod (16—Fig. F19) at carbure-

For and adjust engine idle speed stop screw to obtain 400-500 rpm. Reconnect governor to carburetor rod.

Engine rpm can be checked at the power take-off shaft. To find the power take-off rpm which is equivalent to the engine rpm, multiply desired engine rpm by 0.36.

Back out bumper spring adjusting screw (9) located on front face of timing gear cover. Start engine and open hand throttle to wide open position. Desired engine speed of 2100-2200 rpm can be obtained by loosening the "U" bolt (2) and rotating same on throttle rod (1) until the correct engine speed is reached. Retighten "U" bolt. With engine operating at full throttle, turn bumper screw (9) in until speed just begins to increase; then lock the adjustment.

The following table provides data for checking engine speeds at either the PTO or Belt Pulley.

Engine	PTO	Pulley
400	145	270
500	181	338
2000	727	1358
2100	763	1425
2200	800	1493

50A. MAJOR ADJUSTMENT. This adjustment will cover the control linkage if same has been disassembled, or renewed. With the throttle rod (1—Fig. F19 or F20) and butterfly valve in carburetor in the wide open position, adjust carburetor rod (16) to provide $\frac{1}{8}$ inch over-travel. Disconnect linkage (15) at (5) and remove.

Set hand control lever to wide open position (against steering post), then move same approximately 65 degrees

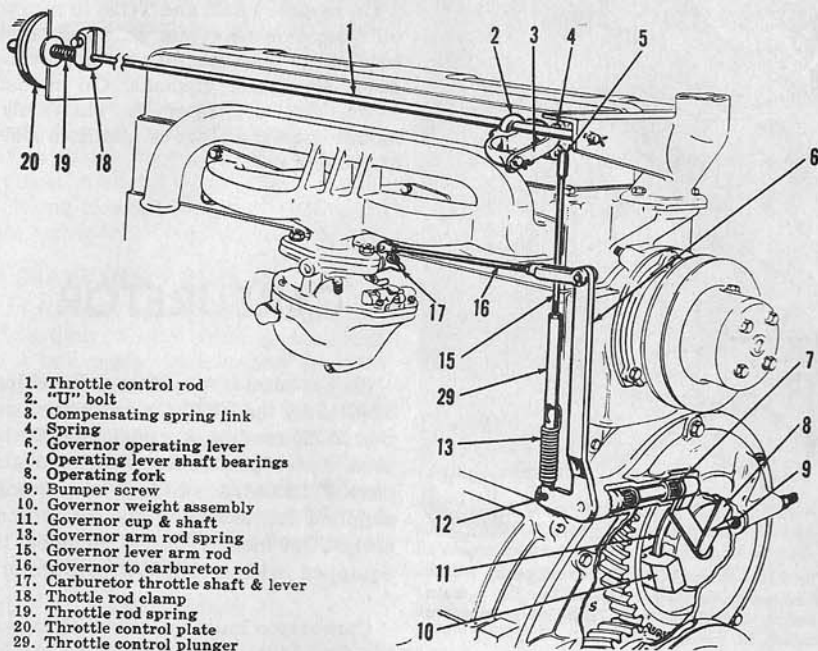


Fig. F19—Models TE20, TO20, and TO30 governor control linkage installation. Governors of the flyweight type as illustrated are used on all TE20 models, on early TO20 and some TO30 engines. Later TO20 and nearly all TO30 models are equipped with Novi ball type governors.

to the idle position and observe if governor compensating spring link is contacting the throttle control rod. If governor compensating spring link (3) is not contacting the throttle rod, loosen the "U" bolt (2) and rotate link (3) until same just touches the throttle rod (1). Retighten "U" bolt.

Reinstall linkage (15) and with the hand control in idle position, remove governor arm spring (13). Adjust length of rod (15) by loosening the lock nut and rotating the rod in the plunger (29) until bottom of plunger just contacts the governor lever (6) and holds it in the idle position. Reconnect spring and retighten locknut.

Make adjustments for engine speed as listed in MINOR ADJUSTMENT. If the hand throttle tends to creep, prevent same by loosening throttle rod

clamp (18) and compressing spring (19) to increase the friction on plate (20) which is located under instrument panel. If this does not remove the throttle creep, renew the cork washer (25).

51. R&R AND OVERHAUL. First step in the removal of the governor is to remove timing gear cover as outlined in paragraph 18. The governor operating fork and lever assembly, bearings, and/or oil seal, Fig. F21, located in the timing gear cover can be renewed at this time. On the flyweight type governor as used on TE20, and early production TO20 and some TO30 models, remove four screws retaining weight assembly to camshaft gear.

On the Novi ball type governor as used on later production TO20 and TO30 models, remove the camshaft gear retaining nut so as to release the governor driver (balls, cage and cup) assembly.

The governor thrust cup shaft (shaft and upper race assembly) (7) has a 0.002-0.004 clearance in the camshaft. It should be renewed if this clearance exceeds 0.006 or if cup is worn at the weight contact surface. The weight assembly should be renewed if the hinge pins indicate wear on the flyweight type governor.

Caution: Check the 5/32 inch diameter vent opening in the camshaft shown at (5—Fig. F11). Vent is located behind the heel of number one cylin-

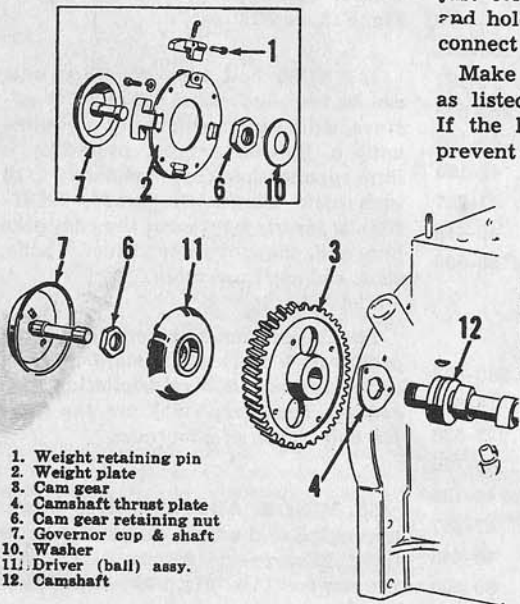


Fig. F18—Novi ball type governor as used on some TO20 and TO30 engines. Inset shows the flyweight type governor as used on early production TO20 and some TO30 and all TE20 engines.

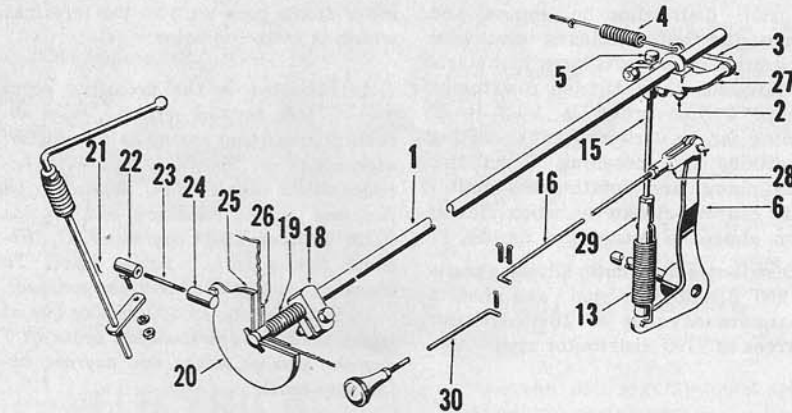


Fig. F20—Governor linkage and related parts.

- | | | |
|-------------------------------------|--------------------------------|---------------------------------|
| 1. Throttle control rod | 15. Governor lever arm rod | 24. Ball joint |
| 2. "U" bolt | 16. Governor to carburetor rod | 25. Washer (cork) |
| 3. Compensating spring link | 18. Throttle rod clamp | 26. Washer (steel) |
| 4. Governor compensator spring | 19. Throttle rod spring | 27. Governor rocker linkage |
| 5. Ball joint | 20. Throttle control plate | 28. Carburetor control rod yoke |
| 6. Governor operating lever | 21. Hand control lever | 29. Throttle control plunger |
| 13. Throttle control plunger spring | 22. Ball joint | 30. Choke control rod |
| | 23. Throttle control link rod | |

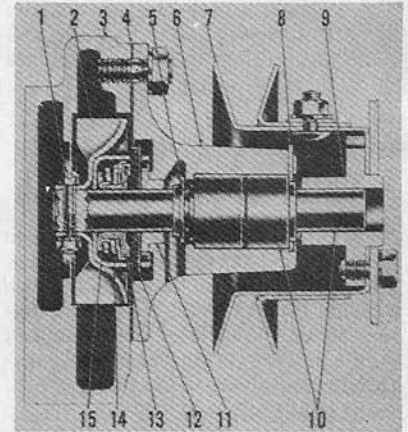


Fig. F22B—Models TE20, TO20, and TO30 engine water pump. Bearings and shaft (10) are renewed as an assembly. Seal seat (11) is not serviceable. Refer to Fig. F22A for legend to callouts.

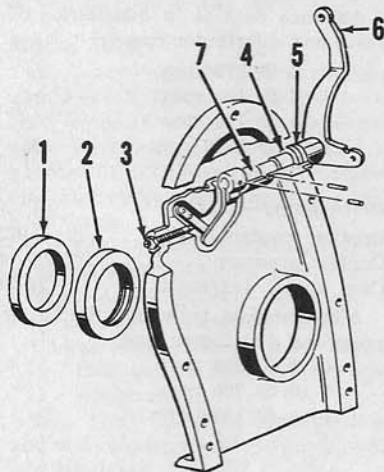


Fig. F21—Timing gear cover, and governor operating lever and fork assembly.

- | | |
|----------------------------------|---|
| 1. Felt seal | 5. Dust seal |
| 2. Oil seal | 6. Governor control lever & shaft assy. |
| 3. Bumper spring adjusting screw | 7. Needle bearing |
| 4. Oil seal | |

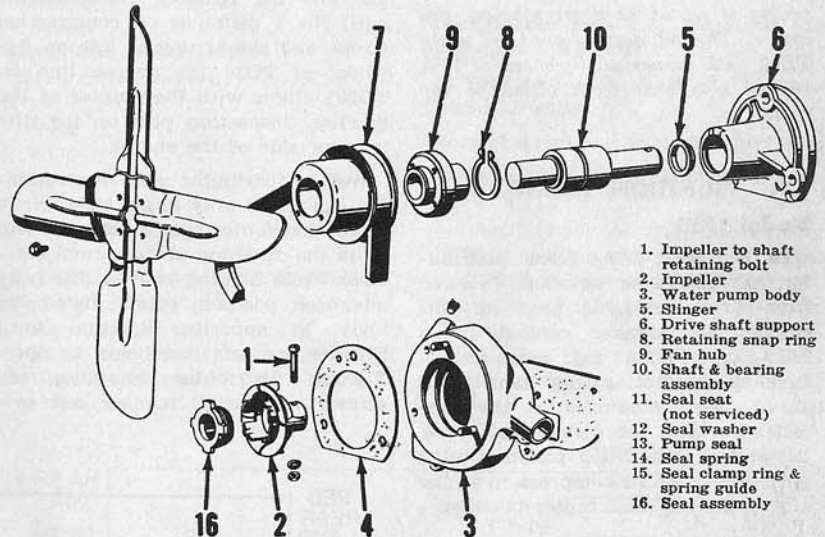


Fig. F22A—Water pump—exploded view. Seal assembly (16) consists of a carbon washer, rubber bellows, reinforcing ring and spring.

- | |
|-------------------------------------|
| 1. Impeller to shaft retaining bolt |
| 2. Impeller |
| 3. Water pump body |
| 5. Slinger |
| 6. Drive shaft support |
| 8. Retaining snap ring |
| 9. Fan hub |
| 10. Shaft & bearing assembly |
| 11. Seal seat (not serviced) |
| 12. Seal washer |
| 13. Pump seal |
| 14. Seal spring |
| 15. Seal clamp ring & spring guide |
| 16. Seal assembly |

der exhaust cam and is drilled to the thrust cup shaft bore.

When reinstalling the Novi governor shaft and upper race assembly, position same so that the lip (stamped projection) is at the 8 o'clock position as shown in Fig. F13.

COOLING SYSTEM

RADIATOR

55. Radiator filler neck on models TE20, and TO20 is fitted with a 4 lbs. pressure cap which raises the coolant boiling point to 224 deg. F. at 7 lbs. pressure cap which raises the coolant boiling point to 232 deg. F. is used on TO30 models.

Drain cooling system. Remove hood and grille assembly and disconnect upper and lower radiator hose connections. Remove radiator tie rod and loosen the two cap screws retaining radiator to front axle support. Remove radiator by withdrawing same forward.

THERMOSTAT

56. Thermostat is located in engine water outlet (hose). Thermostat starts to open at 155-165 deg. F. and is fully opened at 185-195 deg. F.

WATER PUMP AND FAN

57. To remove pump, first drain system and remove lower hose. Remove

fan blade and pulley retaining cap screws and fan belt. Fan blades may be renewed at this time. Remove three nuts retaining drive shaft support (6—Fig. F22A, or F22B) to pump body and remove assembly (seal, impeller and shaft). Pump body can be removed after removing pump body to engine retaining stud nuts.

57A. To disassemble pump, proceed as follows: Remove bolt (1) retaining impeller to pump shaft and remove impeller and pump seal assembly. Remove snap ring (8) and press shaft and bearing assembly (10) toward front and out of shaft support.

Pump seal seat (11) is not available for service and should be resurfaced

with a piloted cutter or a new support installed if seat is worn or scored. The shaft and prelubricated bearings are serviced as an assembly.

IGNITION SYSTEM

Ferguson TE20 tractor is equipped with a model D3A4 Lucas distributor. Model TO20 tractor is equipped with a model 1111722 Delco-Remy distributor. Model TO30 tractor is equipped with a model 1111740 Delco-Remy distributor.

All models use the Champion 8 Commercial or AC 86 Commercial spark plug with an electrode gap setting of 0.025.

The TO20 distributor (D-R 1111722) can be used on the TE20 engine if the TO distributor high tension leads are installed and if the fully advanced timing is set at 32 degrees before top center. The 32 degree point on early TE20 with unmarked flywheels is 13 3/4 starter ring gear teeth ahead of top center.

IGNITION TIMING

Model TE20

60. A 6 volt, D3A4 Lucas distributor, of clockwise rotation (viewed from drive end), is used on this engine. Set breaker contacts to a 0.015 gap (45±4 deg. cam angle). Breaker contact spring tension is 22 oz. when measured at the contacts. To time the distributor, crank the engine until No. 1 piston (timing gear end) is on its compression stroke and in the top dead center position.

On TE20 tractors prior to serial 36152, two methods are used to indicate the top center position of number one and four pistons. On some of this group, the TC point is when a line on the crankshaft pulley indexes with a line on the timing gear cover. On others, the TC point is when two punch marks on the flywheel are in register with identical punch marks on the flywheel housing starter motor mounting pad. In the latter case, the marks cannot be seen until the starter motor is removed from the engine.

On TE20 tractors after serial 36151, the flywheels are stamped with a zero mark indicating top center and with additional stamped lines from one to 30 degrees. These zero and degree lines index with a pointer at the flywheel inspection port which is located on the distributor side of engine.

Install distributor to engine and rotate distributor housing clockwise until breaker contacts have just started to open, then tighten distributor clamp. Firing order is 1-3-4-2. Timing can be varied to suit operating conditions by loosening distributor body clamp and rotating distributor body counter-clockwise, when viewed from above, to retard the timing.

Distributor automatic advance starts at 200 distributor rpm and has a maximum advance of 16 distributor degrees at 1100 distributor rpm.

Models TO20-TO30

61. The 6 volt Delco-Remy distributor models 1111722 (TO20), and 1111740 (TO30) are of counter-clockwise rotation when viewed from the rotor end.

Set breaker contacts to a .022 gap. To time the ignition, crank engine until No. 1 piston is on compression stroke and the 32 degree line on flywheel of TO30 (31 degree line on TO20) aligns with the pointer at the flywheel inspection port on the distributor side of the engine.

Install distributor with the retaining cap screw only finger tight. Next, rotate distributor cam as far as it will go in the direction of its normal rotation. While holding cam in this fully advanced position, rotate distributor body in opposite direction until breaker contacts just begin to open. Tighten distributor retaining cap screws and install number one cyl-

inder spark plug wire in the terminal which is over the rotor.

As indicated in the preceding paragraphs, this method sets the fully advanced or running timing of the distributor which on the TO30 will vary between 30-34 degrees BTC depending on fuel and engine condition and on the TO20 between 29-33 degrees BTC. Recheck timing with a timing light. To check action of the distributor governor, operate the engine at 400 rpm or less at which time the spark should occur at 7 degrees, plus or minus two degrees, before top center.

Distributor test data are as follows:

Delco-Remy—1111722

Breaker contact gap.....0.022
Contact pressure17-21 oz.
Cam angle, degrees.....25-34

Advance data is in distributor degrees and distributor rpm.

0- 2 @ 275 rpm
5- 7 @ 400 rpm
8-10 @ 700 rpm
11-13 @ 1000 rpm

Delco-Remy—1111740

Breaker contact gap.....0.022
Contact pressure17-21 oz.
Cam angle, degrees.....25-34

Advance data is in distributor degrees and distributor rpm.

0- 2 @ 250 rpm
8-10 @ 750 rpm
12-14 @ 1000 rpm

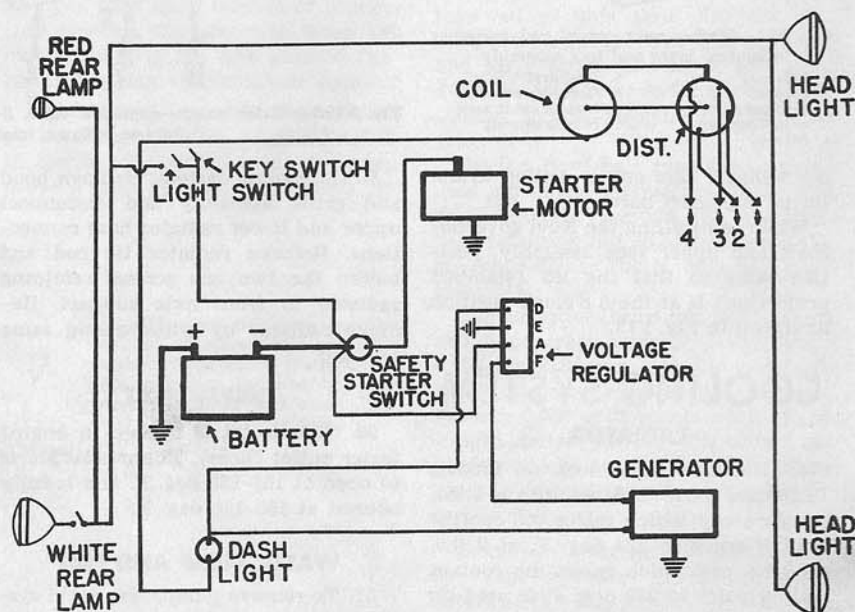


Fig. F24—Model TE20 tractor electrical wiring diagram.

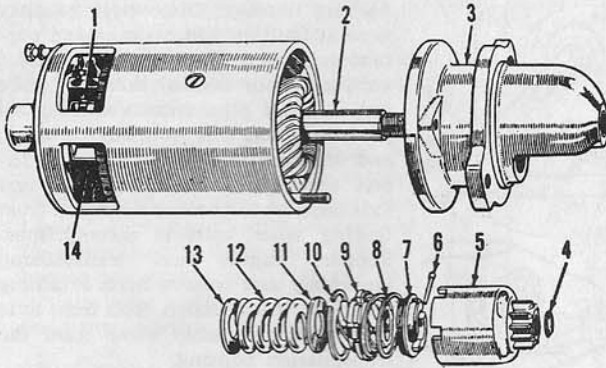


Fig. F25—Model TE20 tractor Lucas starting motor and drive.

1. Brush spring
2. Armature
3. Drive housing
4. Snap ring
5. Drive pinion
6. Dowel
7. Friction disc
8. Spring
9. Starter drive
10. Snap ring
11. Drive spring washer
12. Drive spring
13. Drive spring washer
14. Brush

ELECTRICAL SYSTEM

GENERATOR AND REGULATOR

The TO20 or TO30 tractor generator and voltage regulator can be used on the TE20 tractors if the TO20 or TO30 wiring harness is also used.

Model TE20

65. Tractor model TE20 is equipped with a 6 volt, shunt wound, two brush type, model C-45X, Lucas generator, with the charging rate controlled by a model RF-97 Lucas voltage regulator unit and current resistance unit of a fixed value.

The following specifications and test data apply to the Lucas generator:

- Brush spring tension—22-25 oz.
- Field draw—2.5 amps @ 7 volts
- Charge rate—11 amps @ 6.5 volts at 1000 engine rpm or 1600 generator rpm.

65A. The following specifications and test data apply to the Lucas voltage regulator:

- Cutout closes at—6.3 - 6.7 volts
- Cutout air gap—.016 - .020 with .008 gage in back
- Point opening—.002 - .006 with .030 gage in top gap
- Start of charging rate—1000 generator rpm or 625 engine rpm
- Voltage regulator adjustment:
 - 7.9 - 8.3 volts @ 50° F.
 - 7.8 - 8.2 volts @ 60° F.
 - 7.7 - 8.1 volts @ 86° F.
 - 7.6 - 8.0 volts @ 104° F.

Models TO20-TO30

66. The TO20 is equipped with a 6 volt, third brush type, model 1101404 or 1100509 Delco-Remy generator with charging rate controlled by a two unit type, model 1118308 Delco-Remy voltage control regulator. The TO30 is equipped with a model 1100529 Delco-Remy generator and a model 1118308 or 1118291 Delco-Remy combined current and voltage control regulator.

Generator and regulator test specifications are as follows:

Generator Model 1100509 or 1100529
Brush spring tension.....16 oz.
Field draw

Volts6.0
Amperes2.5-2.72
Output (Hot)
Volts6.0
Amperes16-19
Rpm2500

Generator Model 1101404
Brush spring tension.....16 oz.
Field draw

Volts6.0
Amperes2.6-2.9
Output (Hot)
Volts6.9-7.1
Amperes11-13
Rpm2000

Regulator Model 1118291 or 1119308
Cut-out relay
Air gap, inches.....0.020
Point gap, inches.....0.020
Closing voltage (range).....5.0-7.0
Adjust to6.4

Voltage regulator
Air gap, inches.....0.075
Voltage range6.6-7.2
Adjust to6.9

STARTING MOTOR

67. The TE20 is equipped with a 6 volt model M418GV139-O Lucas starter. Disassembly, overhaul and/or testing procedure is similar to the model 1109457 Delco-Remy starter as used on tractor models TO20 and TO30.

The following specifications and test data apply to the Lucas starting motor:

- Lock torque test—9.25 lbs. ft. at 520 amps and 2.8 volts
- At 1000 rpm—4.0 lbs. ft. at 300 amps and 2.9 volts
- Normal cranking rpm—180-200 rpm
- Brush spring tension—32-40 ounces

Specifications of the Delco-Remy 1109457 starting motor used on TO20 and TO30 tractors are as follows:

- Brush spring tension.....24-28 oz.
- No load test
Volts5.7
Max. amperes90
Rpm5900

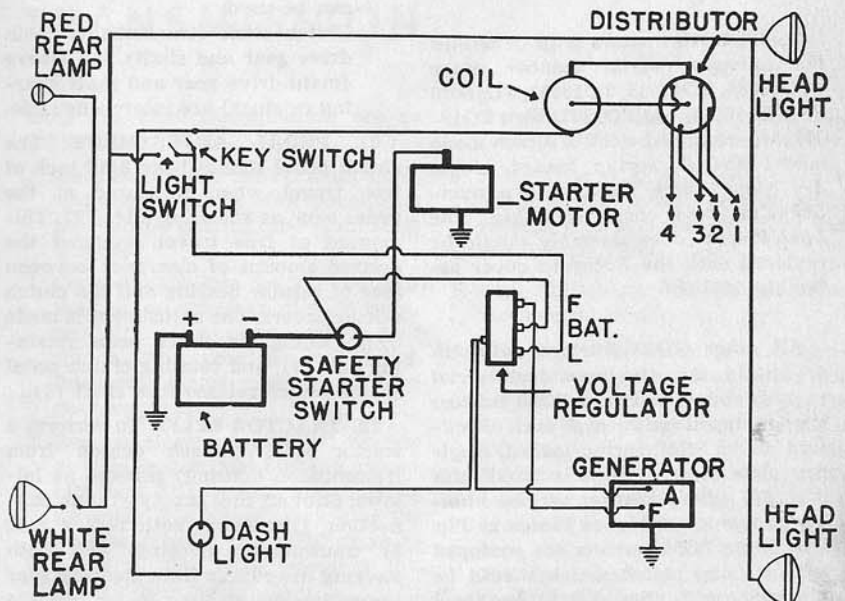


Fig. F26—Model TO20 tractor electrical wiring diagram. TO30 is similar.

Lock test

Volts	3.3
Max. amperes	540
Torque, ft.-lbs.	11.5

STARTING MOTOR SWITCH

The TO20 or TO30 starting motor switch can be installed on the TE20 tractor if a TO20 or TO30 link, which connects the switch to the transmission reverse shift rail is also used.

68. On both the TE and TO tractor models, the starting motor switch is located in the forward portion (forward of the steering gear unit) of the transmission housing clutch compartment. The switch is connected to the forward end of the reverse shifter rail and is actuated by moving the transmission shifter lever in a direction opposite to the reverse gear position.

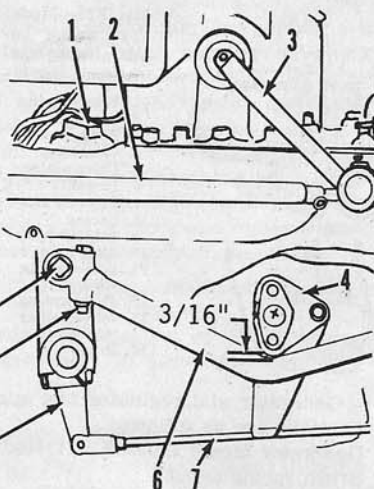


Fig. F27—Models TE20, TO20, and TO30 clutch pedal adjustment. Loosen retaining bolt (9) and rotate clutch pedal (6) on clutch release fork shaft (5).

- | | |
|--------------------------|------------------------------|
| 1. Starting motor switch | 5. Clutch release fork shaft |
| 2. Drag link | 6. Clutch pedal |
| 3. Steering gear arm | 7. Brake rod |
| 4. Radius rod ball pivot | 8. Brake shaft lever |
| | 9. Retaining bolt |

70. **INTERCHANGEABILITY.** The following data applies to the use of TO20 and TO30 clutch and components for use in servicing the TE20 tractor:

1. Release fork shaft (TO7510), and release fork (TO7515) as a unit can service the TE20 tractor shaft (1303), and fork (4127).
2. Release bearing, release bearing hub, and release bearing spring are the same in all models.
3. The complete clutch cover assembly, and complete driven plate can be used.
4. Clutch shaft (transmission main drive gear and shaft) and sleeve (main drive gear and shaft bearing retainer) are interchangeable.

71. **PEDAL ADJUSTMENT.** The clutch pedal should have 3/16 inch of free travel when measured at the pedal stop, as shown in Fig. F27. This amount of free travel produces the desired amount of clearance between face of release bearing and the clutch release levers. The adjustment is made by loosening the clutch pedal retaining bolt (9), and rotating clutch pedal (6) on clutch release fork shaft (5).

72. **TRACTOR SPLIT.** To perform a tractor split (detach engine from transmission housing) proceed as follows: Shut off fuel supply at tank connection. Disconnect both radius rods at transmission housing, and both steering drag links from steering gear arms. Remove starting motor and the bolts retaining the fuel tank to rear

support bracket. Disconnect primary wire at ignition coil, voltage and current regulator wires at the regulator unit, governor control linkage, choke rod, exhaust pipe from manifold, oil pressure gauge line from engine block, and air cleaner from carburetor. Insert blocks between front axle and axle support to prevent assembly from tipping when split is accomplished. Support engine and transmission separately and remove bolts retaining engine to transmission. Roll front axle and engine assembly away from the transmission housing.

Reconnect the engine to the transmission housing by reversing the preceding procedure.

73. **R&R CLUTCH.** To remove the clutch unit, first perform a tractor split (disconnect engine from transmission housing) as outlined in paragraph 72.

The clutch unit can now be removed from the flywheel after removing 6 cap screws retaining clutch cover assembly to engine flywheel. When reinstalling clutch, the long hub of the lined plate should be installed away from the flywheel.

The clutch release fork (53—Fig. F 31) and bearing (58) can be removed after performing a tractor split. If the clutch shaft (integral with the transmission main drive gear shaft), or main drive gear and shaft bearing

CLUTCH

The clutch in the TE20 tractor is a 9 inch Borg & Beck model 9A6, spring loaded, single dry plate (full ring type lining) fitted with a number 46664 cover assembly, as shown in Fig. F28. This clutch is manufactured by the Borg-Warner Corp. of England.

Model TO20 tractors with or within the following serial number range (TO15634, TO15635, TO16052, TO16076 thru TO16311, and TO18571 thru TO19319) are equipped with a 9 inch Long model 9NC-C, spring loaded, single dry plate clutch fitted with a number CM-12464 cover assembly. The Long clutch cover assembly should be replaced with the Rockford cover assembly 165267.

All other TO20 tractors not with or within the aforementioned serial number range, and most TO30 tractors are equipped with a 9 inch Rockford model 9RM, spring loaded, single dry plate clutch which is fitted with a 165267 (Borg-Warner service number) cover assembly, as shown in Fig. F29. Some TO30 tractors are equipped with a Long clutch which should be replaced with the Rockford clutch unit.

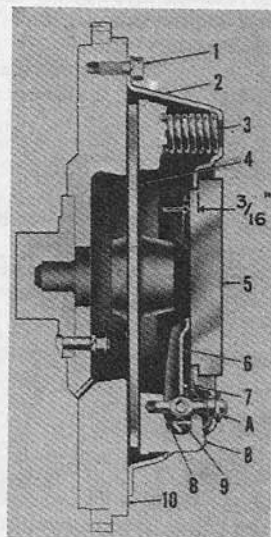


Fig. F28—Model TE20, Borg & Beck model 9A6 clutch. Adjust release levers to 3/16 inch measurement as shown.

- | | |
|--|---------------------------------------|
| (A) Release lever height adjusting nut | 5. Release lever height gage |
| (B) Release lever eyebolt | 6. Release lever |
| 3. Pressure spring | 7. Anti-rattle spring (release lever) |
| 4. Driven plate | 8. Pressure plate |
| | 9. Release lever strut |

(39) require overhauling, it will be necessary to remove the transmission top cover and the main drive gear and shaft bearing retainer (37) as outlined in paragraph 82.

74. OVERHAUL. Caution must be exercised when adjusting the release lever height, as the Rockford and Long clutches have a different setting than the Borg & Beck unit. The following paragraphs 74A, 74B, and 74C contain data pertaining to the clutch assembly pressure spring changes.

74A. BORG & BECK CLUTCH. On TE20 tractors prior to serial 1000, the clutch pressure springs are painted red for identification and should be renewed if any of them show less than 180 lbs. at 1½ inches working height.

On TE20 tractors after serial 999, the clutch pressure springs are painted green for identification. The springs should be renewed if any of them show less than 105 lbs. at 1 11/16 inches.

74B. LONG CLUTCH. The TO30 Long clutch cover assemblies are fitted with 6 orange painted springs which should check 170-180 lbs. at 1 9/16 inches.

The TO20 Long clutch cover assemblies are fitted with 6 brown springs which should check 145-153 lbs. at 1 9/16 inches.

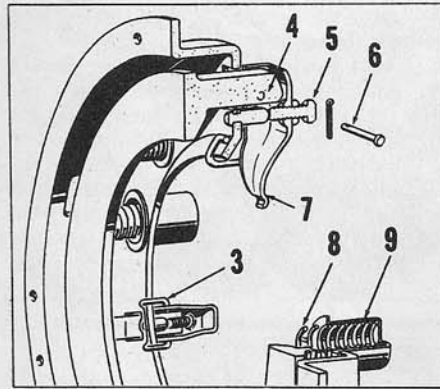


Fig. F29—Rockford model 9RM clutch as used in the TO tractors.

- | | | |
|-------------------------|----------------------------------|------------------------|
| 1. Driven plate | 4. Pressure plate | 7. Release lever |
| 2. Cover assembly | 5. Release lever adjusting screw | 8. Pressure spring |
| 3. Release lever spring | 6. Release lever pivot pin | 9. Pressure spring cup |

74C. ROCKFORD CLUTCH. Some of the 165267 (Borg-Warner service number) clutch cover assemblies are fitted with either 6 brown painted (Rockford No. M505-0) springs, or 6 lavender painted (Rockford No. M505-3A) springs, or a combination of 3 brown and 3 lavender painted springs. On a model TO30 clutch cover originally fitted with 6 lavender springs, assemble cover assembly with

3 lavender springs and 3 brown springs placed alternately. For model TO20 cover assemblies, use either 6 brown springs, or 3 brown and 3 lavender springs placed alternately.

Springs which are painted brown (M505-0) should check 140-150 lbs. at 1 13/16 inches working height. Springs which are painted lavender (M505-3A) should check 180-190 lbs. at 1 13/16 inches working height.

TRANSMISSION

Except for differences in the type of cover, the first and third speed gears, main shaft and countershaft, and the housing material, the TE20 transmission is similar to the TO20 and TO30 transmission. On the TE20, the rear portion of the steering gear unit forms the transmission cover, whereas on the TO20 and TO30, the steering gear unit is separate from the transmission cover. On the TE20, all of the floating gears ride on bronze bushings; on the TO20 and TO30 the main shaft first gear and countershaft third speed gear ride on needle roller bearings as shown in Fig. F35.

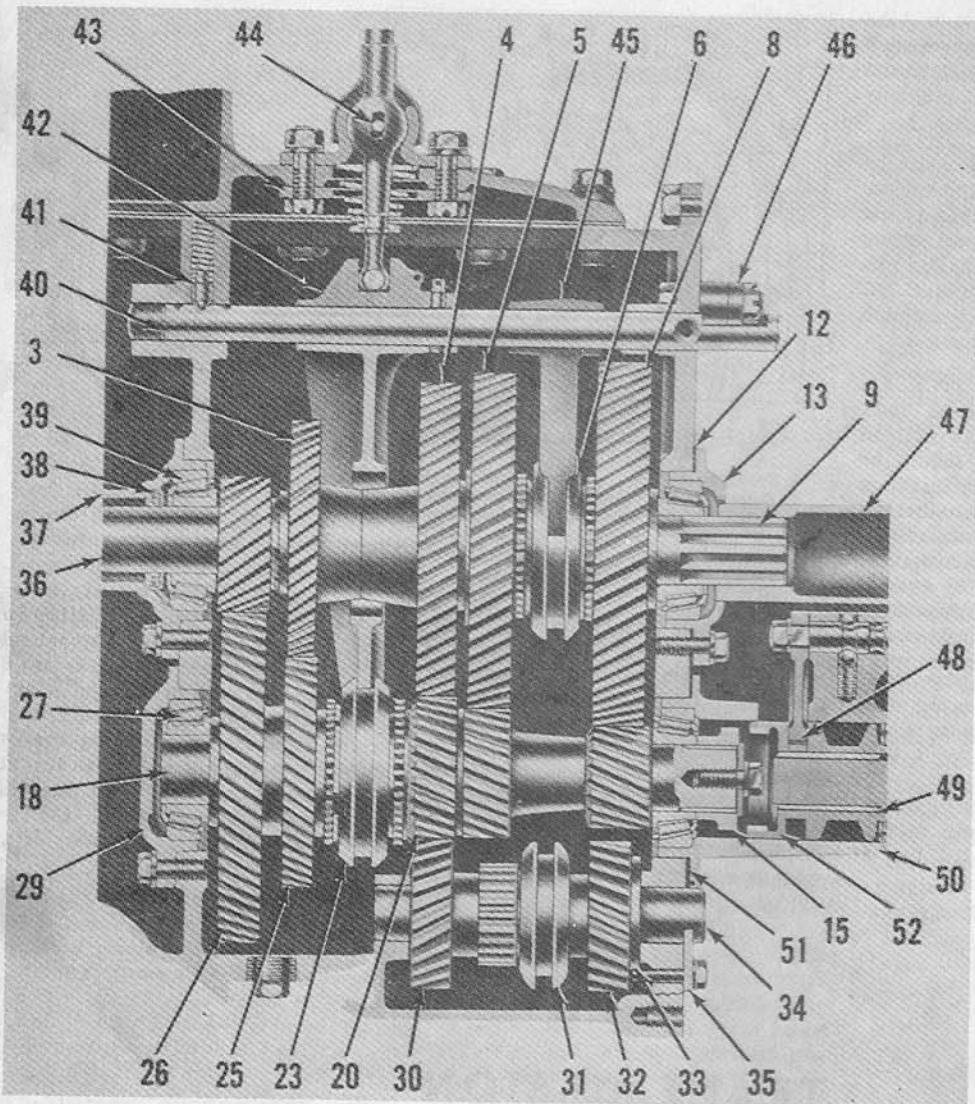
79. INTERCHANGEABILITY. Combinations of TO20 or TO30 transmission parts which can be used in serv-

icing the TE20 transmissions are as follows:

1. Main Shaft—use the TO main shaft, first gear needle bearing spacer, first gear needle bearing, and main shaft first gear.
2. Countershaft—use the TO countershaft, countershaft third gear, countershaft connector, third gear spacer, third gear needle bearing, third gear thrust washer, and third gear snap ring.
3. Reverse Gear—use the TO reverse gear, idler gear and bushing assembly, and driver gear and bushing assembly. Method of lubricating the reverse gear in the TO20 as compared to the TE20 warrants this change over combination.
4. Shifter-Rails—use the TO first and

second rail, third and fourth rail, reverse rail, and shifter lock screw.

5. Shifter Forks & Selectors—use the TO first and second gear selector, reverse gear selector, and third and fourth gear fork.
6. Gear Shift Lever—All parts are interchangeable.
7. Complete Transmission—the complete TO transmission assembly can be used on the TE tractor if the following parts are included: TO2220-A combined brake pedal, TO2221-A brake arm, TO2792-A brake cross shaft, and 25-09-100 Woodruff keys. The foregoing parts and the original TE brake pedal and cross shaft can be omitted if a bushing is machined to fit the small diameter of the TE brake cross



- 3. 4th gear
- 4. 3rd gear
- 5. 2nd gear
- 6. Sliding coupling
- 8. 1st gear
- 9. Main shaft
- 12. Shims
- 13. Main shaft bearing (carrier)
- 15. PTO clutch hub
- 18. Countershaft
- 20. Countershaft 3rd gear
- 23. Countershaft coupling
- 25. Countershaft 4th gear
- 26. Countershaft gear
- 27. Bearing
- 29. Bearing carrier
- 30. Reverse drive gear
- 31. Sliding reverse coupling
- 32. Reverse idler
- 33. Thrust washer
- 34. Reverse gear shaft
- 35. Reverse shaft lock plate
- 36. Main drive gear & shaft (clutch or input shaft)
- 37. Transmission main gear & shaft bearing retainer
- 38. Oil seal
- 39. Bearing
- 40. Shifter rail
- 41. Shifter rail detent
- 42. 3rd & 4th gear fork
- 43. Gear shift lever cup
- 44. Gear lever pin
- 45. 1st & 2nd shifter fork
- 46. Shifter rail stop
- 47. Drive shaft sleeve (bevel pinion)
- 48. PTO shifter fork
- 49. PTO shaft engaging collar
- 50. Bearing support (carrier)
- 51. Shims
- 52. PTO clutch sleeve

Fig. F30—Models TO20, and TO30 Transmission assembly—left side sectional view. Shims (12) and (51) control bearings adjustment of their respective shafts. Model TE20 is similar. Refer to Figs. F33 and F34.

shaft. The bushing dimensions are—Length, $1\frac{1}{8}$ inches; inside diameter, 1.001-1.0025; and outside diameter, 1.4955-1.4970.

8. Transmission Top Cover—use the TO transmission cover, and TO steering gear housing.

80. **BASIC PROCEDURE.** Only the transmission shafts are carried in the transmission case. Although most transmission repair jobs involve overhaul of the complete unit there are infrequent instances where the failed or worn part is so located that the repair work can be completed safely without complete disassembly of the transmission. In effecting such localized repairs, time will be saved by observing the following as a general

guide. Refer to Figs. F30, F31, F32, F33, and F34.

80A. *Shifter Rails.* Shifter rails are accessible for overhaul after removing the control cover, detaching the rear axle center housing from the transmission case, and removing starter switch control linkage from forward end of reverse rail. Removal of the reverse fork requires removal of the main shaft and countershaft. Removal of the third and fourth speed fork requires removal of the main shaft.

80B. *Main Shaft and Countershaft Bearings.* Main shaft and countershaft bearings can be adjusted after removing the control cover and detaching the rear axle center housing from the transmission case.

80C. *Main Drive Gear Shaft.* The main drive gear & shaft (36) which is integral with the clutch shaft can be removed after removing the transmission shifter control cover and performing a tractor split as outlined in paragraph 72. The main shaft pilot bearing can also be renewed at this time.

80D. *Main Shaft & Countershaft.* Main shaft (9) and countershaft (18) can be removed for overhaul after removing transmission shifter control cover and separating the rear axle center housing from the transmission. Main shaft and countershaft front bearing cup renewal necessitates a tractor split as outlined in paragraph 72.

81. R&R ASSEMBLY. To remove transmission from tractor, first separate the engine from transmission as outlined in CLUTCH section, paragraph 72.

Separate the transmission case from rear axle center housing as follows: Disconnect the brake rods. Remove the two platforms, one from each side of the transmission case, and exhaust pipe and muffler. Remove power take-off shaft by removing four retaining cap screws from rear face of rear axle center housing and withdraw assembly rearward. Remove pto shifter and cover plate. Support transmission case and rear axle center housing assembly separately and remove the bolts which attach these assemblies. Transmission unit may now be removed by withdrawing same forward until the sleeve (47—Fig. F30), connecting the transmission main shaft and main drive bevel pinion shaft, is free.

OVERHAUL. Data on overhauling the various components of the transmission are outlined in the following paragraphs.

82. MAIN DRIVE GEAR (CLUTCH) SHAFT. Transmission main drive gear and shaft (integral with clutch shaft) Fig. F31, can be overhauled after performing a tractor split, as outlined in paragraph 72, and removing transmission shifter control cover. Remove the two clutch release bearing springs (59) and the brake cross shaft. Remove cap screws from main drive gear bearing carrier (37—Fig. F30 or F31) and withdraw assembly forward and out of transmission case. The transmission main shaft pilot bearing (1—Figs. F33 & F34) main drive gear and shaft bearing (39—Fig. F31) and oil seal (38) of neoprene or treated leather can be renewed at this time.

If it becomes necessary to adjust the main shaft bearings after renewing the pilot bearing, separate the transmission case from rear axle center housing, as shown in Fig. F36. Adjust main shaft bearings to the desired preload as outlined in paragraph 84, by means of shims (12) interposed between outer rear wall of transmission case and main shaft bearing carrier (13).

83A. SHIFTER RAILS & FORKS. Shifter rails can be overhauled after detaching transmission case from rear axle center housing, and removing transmission shifter control cover.

To remove shifter rails, proceed as follows: Disconnect starter switch linkage from forward end of reverse

gear rail (left outer rail 67—Fig. F32). Remove cap screws retaining starter switch to transmission case. Lift up the switch and remove linkage pin. Remove rail stop plate (46) from rear wall of transmission case and retaining set screws (70) from shifter forks and selectors. Withdraw rails rearward and at the same time note the location of the detents (41) and interlocking pins (66).

83B. First and second gear fork (45) can be removed while removing the shifter rail (68). Removal of the third and fourth gear fork (42) requires removal of the shifter rails as outlined in the preceding paragraph and removal of the transmission main shaft (9). Reverse gear fork (73) can be removed after removing the shifter rails, transmission main shaft and the countershaft.

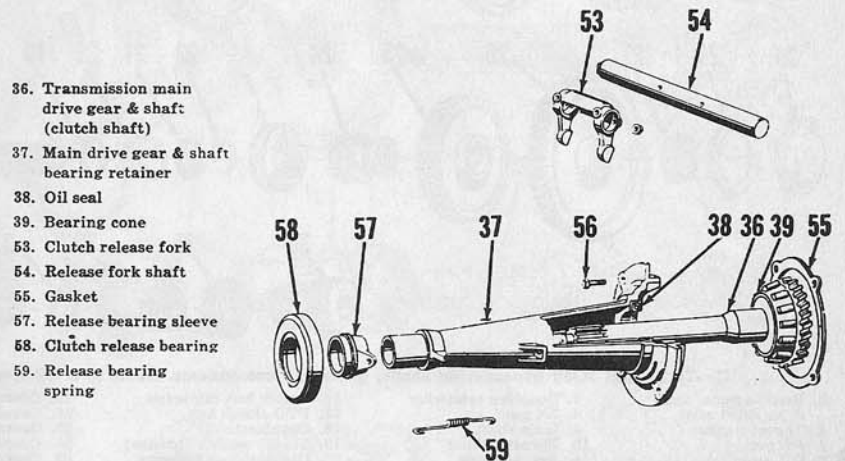


Fig. F31—Models TO20, and TO30 main drive gear and shaft (clutch shaft). Overhaul of this shaft and components requires detaching transmission from engine. TE20 is similar.

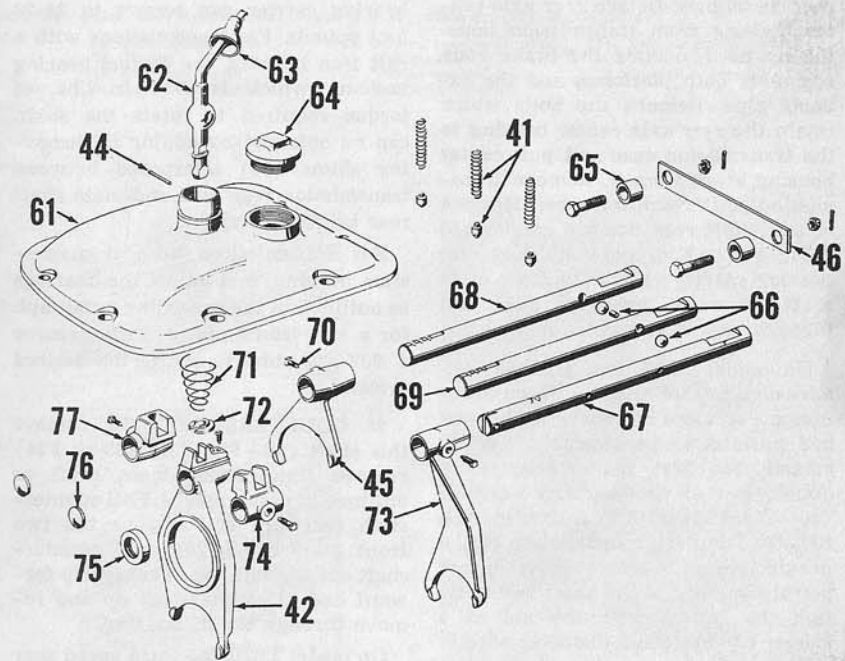


Fig. F32—Models TO20, and TO30 transmission cover, shifter rails and forks. Model TE20 is similar except for transmission cover which is integral with the steering gear housing.

- 41. Detents & springs
- 42. 3rd & 4th fork
- 44. Gear lever pin
- 45. 1st & 2nd fork
- 46. Shifter rail stop
- 61. Transmission top cover
- 62. Shift lever
- 63. Shift lever cover
- 64. Spacer
- 65. Interlocking pin & ball
- 66. Reverse rail
- 67. Reverse rail
- 68. 1st & 2nd rail
- 69. 3rd & 4th rail
- 70. Set screw
- 71. Shift lever spring
- 72. Spring seat
- 73. Reverse gear fork
- 74. Reverse fork selector
- 75. Oil seal (reverse rail)
- 76. Expansion plug
- 77. 1st & 2nd fork selector

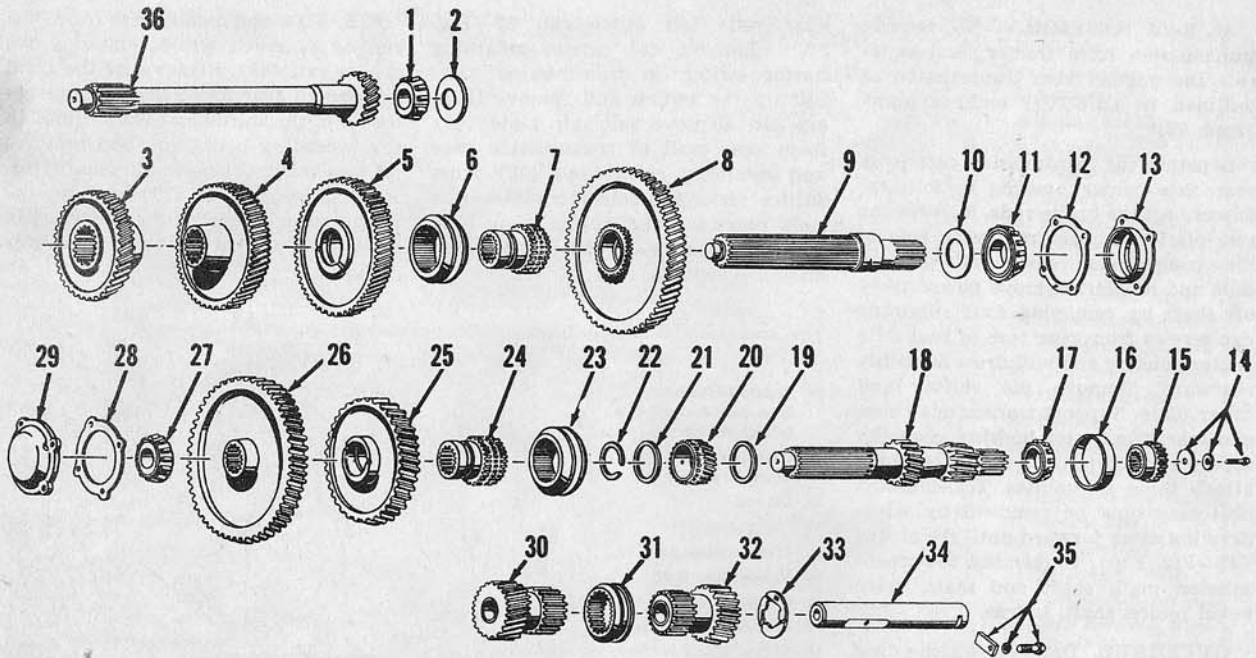


Fig. F33—TO20, and TO30 transmission shafts, gears and components. Gears (8 & 20) rotate on needle bearings. Refer to Fig. F35.

- | | | | | |
|---|-----------------------|----------------------------|---------------------------|---|
| 1. Bearing cone, main drive shaft pilot | 7. Coupling connector | 14. Clutch hub cap screw | 23. Countershaft coupling | 31. Sliding reverse coupling |
| 2. Thrust washer | 8. 1st gear | 15. PTO clutch hub | 24. Coupling connector | 32. Reverse idler |
| 3. 4th gear | 9. Main shaft | 16. Countershaft | 25. Countershaft 4th gear | 33. Thrust washer |
| 4. 3rd gear | 10. Thrust washer | 17. Thrust washer (bronze) | 26. Countershaft gear | 34. Reverse gear shaft |
| 5. 2nd gear | 11. Bearing cone | 18. Countershaft 3rd gear | 27. Gasket | 35. Reverse shaft lock plate |
| 6. Sliding coupling | 12. Shims | 19. Thrust washer (bronze) | 28. Bearing carrier | 36. Main drive gear & shaft (clutch or input) |
| | 13. Bearing carrier | 20. Snap ring | 29. Reverse drive gear | |

84. MAIN SHAFT. To remove this shaft (9—Fig. F30, F33 or F34), proceed as follows: Detach rear axle center housing from transmission housing by disconnecting the brake rods, removing both platforms and the exhaust pipe. Remove the bolts which retain the rear axle center housing to the transmission case and pull center housing away from it. Remove transmission shifter control cover. Remove countershaft rear bearing carrier (50—Fig. F30 or F36) and main shaft rear bearing carrier (13). Withdraw main shaft rearward, removing gears out through top of transmission housing.

On model TE20, first gear (8) rotates on a bronze bushing. Worn bushings are serviced by renewing the gear and bushing as an assembly. On TO models, the first gear rotates on a double row of needle roller bearings (80—Fig. F35) with 52 rollers in each row. To facilitate reinstallation of the needle roller bearings apply heavy petroleum jelly to the shaft and position the rollers with the aid of a rubber band or small diameter wire.

The cup for the main shaft front (pilot) bearing is integral with the main drive gear & shaft (clutch shaft) (36—Fig. F30, F33, or F34). If the cup is damaged it will be necessary to renew the main drive gear and shaft as outlined in paragraph 82.

To adjust main shaft bearings to a slight preload, first torque tighten the bearing carrier cap screws to 24-28 foot pounds. For transmissions with a cast iron housing, the correct bearing preload, which is 7-12 In.-Lbs. of torque required to rotate the shaft, can be obtained by adding or removing shims (12) interposed between transmission rear wall and main shaft rear bearing carrier.

For transmissions with a magnesium housing, first adjust the bearings as outlined in the preceding paragraph for a cast iron housing; then, remove a .002-.003 shim to obtain the desired preload.

85. COUNTERSHAFT. To remove this shaft (18—Fig. F30, F33 or F34) remove transmission main shaft as outlined in paragraph 84. Pull countershaft rearward and remove the two front gears (25 & 26) from countershaft out through top opening. Tip forward end of countershaft up and remove through top of housing.

On model TE20, the third speed gear (20) rotates on a bronze bushing. Worn bushings are serviced by renewing the gear and bushing as an assembly. On TO models, the third speed gear rotates on a double row (38 rollers in each row) of needle rollers.

If the cup for the forward bearing (27) is damaged it is usually necessary to remove the carrier (29) which necessitates "splitting the tractor" at the front face of the transmission case. Procedure for "splitting" is outlined in paragraph 72.

To facilitate reinstallation of the needle roller bearings, apply heavy petroleum jelly to shaft bearing surface and install one bronze thrust washer and one steel spacer. Install the first row of 38 rollers and secure same with a rubber band or small diameter wire. Install the second spacer and second row of 38 rollers, securing same with a rubber band. Install the third steel spacer. Carefully slide gear over bearings and remove rubber bands or small diameter wire. Install the second bronze thrust washer and snap ring.

To adjust countershaft bearings to a slight preload, first torque tighten the bearing carrier cap screws to 24-28 foot pounds. For transmissions with a cast iron housing, the correct bearing preload, which is 7-12 In.-Lbs. of torque required to rotate the shaft, can be obtained by adding or removing shims (51—Fig. F36) interposed between transmission rear wall and countershaft rear bearing carrier.

For transmissions with a magnesium housing, first adjust the bearings as outlined in the preceding paragraph

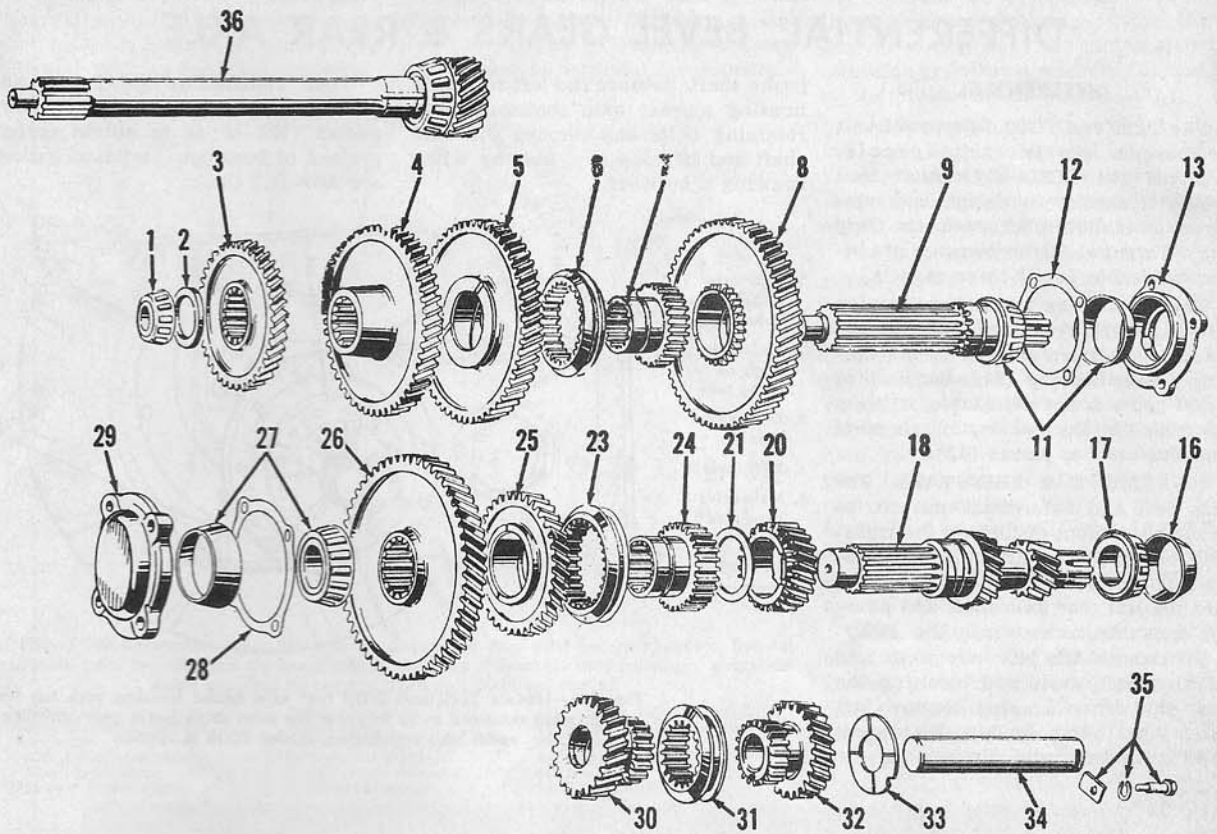


Fig. F34—TE20 transmission shafts, gears, and components. Gears (8 & 20) rotate on bronze bushings.

- | | | | | |
|---|----------------------------|------------------------|------------------------------|---|
| 1. Bearing cone, main drive shaft pilot | 9. Main shaft | 26. Countershaft gear | 31. Sliding reverse coupling | 35. Reverse shaft lock plate |
| 2. Thrust washer | 12. Shims | 28. Gasket | 32. Reverse idler | 36. Main drive gear & shaft (clutch or input) |
| 3. 4th gear | 13. Bearing carrier | 29. Bearing carrier | 33. Thrust washer | |
| 4. 3rd gear | 18. Countershaft | 30. Reverse drive gear | 34. Reverse gear shaft | |
| 5. 2nd gear | 20. Countershaft 3rd gear | | | |
| 6. Sliding coupling | 21. Thrust washer (bronze) | | | |
| 7. Coupling connector | 23. Countershaft coupling | | | |
| 8. 1st gear | 24. Coupling connector | | | |
| | 25. Countershaft 4th gear | | | |

for a cast iron housing; then, remove a .002-.003 shim to obtain the desired preload.

86. REVERSE GEAR AND SHAFT. First step in overhauling this assembly is to remove the transmission main shaft and countershaft as outlined in paragraphs 84 and 85. Remove reverse shaft positioning lock and capscrew (35—Fig. F33 or F34). Withdraw shaft (34) rearward and remove gears and thrust washer through top of housing. The reverse drive gear (30) and idler gear (32) rotate on bronze bushings. Worn bushings are serviced by renewing the gear and bushing as an assembly.

Reinstall the bronze thrust washer (33) with the grooved side facing the reverse idler gear (32). Install shifter collar (31) with side marked "F" facing the reverse drive gear (30) or front of tractor. Reinstall reverse shaft positioning lock and cap screw.

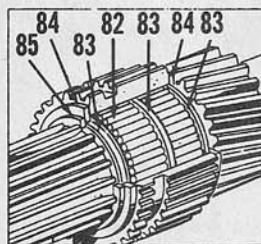
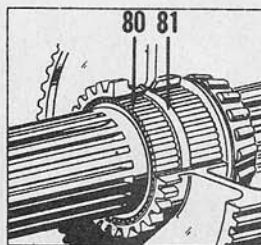


Fig. F35—Models TO20, and TO30 main shaft first gear and countershaft third gear needle bearings installation. Similar gears in model TE20 rotate on bronze bushings.

- | | |
|---|---|
| 80. 1st gear needle bearings (each row contains 52 rollers) | 82. 3rd gear needle bearings (each row contains 38 rollers) |
| 81. Spacer (steel) | 83. Spacer (steel) |
| | 84. Washer (bronze) |
| | 85. Snap ring |

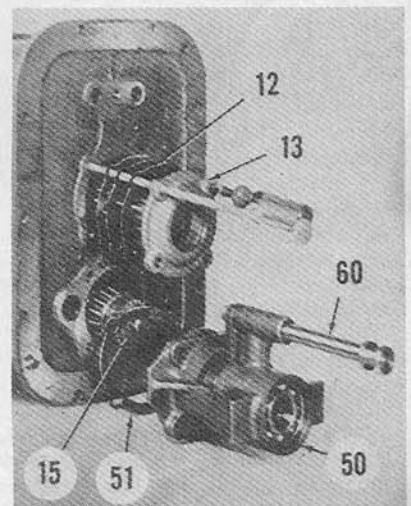


Fig. F36—Rear face of TO transmission housing showing shims (12) for adjusting the main shaft bearings and shims (51) for adjusting the countershaft bearings.

- | | |
|---------------------|----------------------|
| 12. Shims | 50. Bearing support |
| 13. Bearing carrier | 51. Shims |
| 15. PTO clutch hub | 60. PTO shifter rail |

DIFFERENTIAL, BEVEL GEARS & REAR AXLE

DIFFERENTIAL

The TE20 and TO20 differential unit components are interchangeable; whereas the TO30 differential unit which is similar in design and construction is slightly larger in size. Only the differential carrier bearings are interchangeable in all three models.

The main drive spiral bevel pinion (1—Fig. F37), ring gear (15) and differential unit are carried in the rear axle center housing (31). Backlash of bevel gears is not adjustable, it being controlled by the meshing of axle parts and thickness of gasket (12).

90. REMOVE & REINSTALL. The ring gear and differential unit can be removed without disturbing the transmission or power lift unit, after removing both rear wheel and tire units, and the left rear axle shaft and housing assembly, as shown in Fig. F38.

To remove the left axle shaft and housing unit, drain and block up the rear axle center housing. Remove left rear wheel and fender. Disconnect master brake pedal linkage at the

brake shaft. Remove the left rear axle housing to rear axle center housing retaining bolts and remove the axle shaft and housing as a unit by withdrawing it outward.

When reinstalling axle shaft and housing unit use only one standard gasket (12) so as to obtain correct preload of bearings. Standard gaskets are .009-.012 thick.

1. Rear axle center housing
2. Hydraulic pump oil outlet tube
3. Differential case
4. PTO cover
5. Main drive bevel ring gear
6. PTO shift cover location

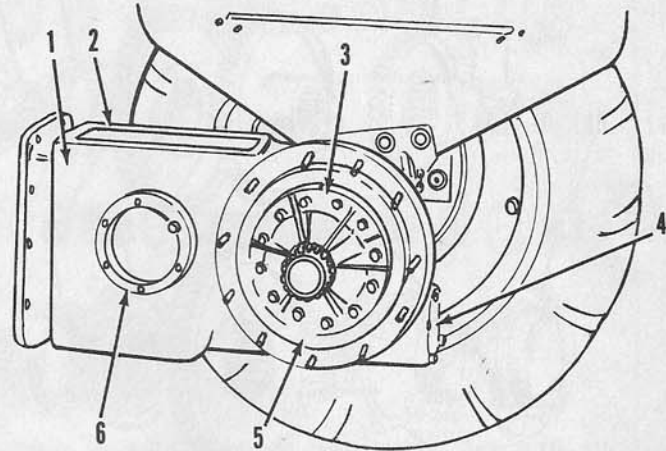


Fig. F38—Models TE20 and TO20 rear axle center housing with left rear axle housing removed so as to show the main drive bevel gear and differential unit installation. Model TO30 is similar.

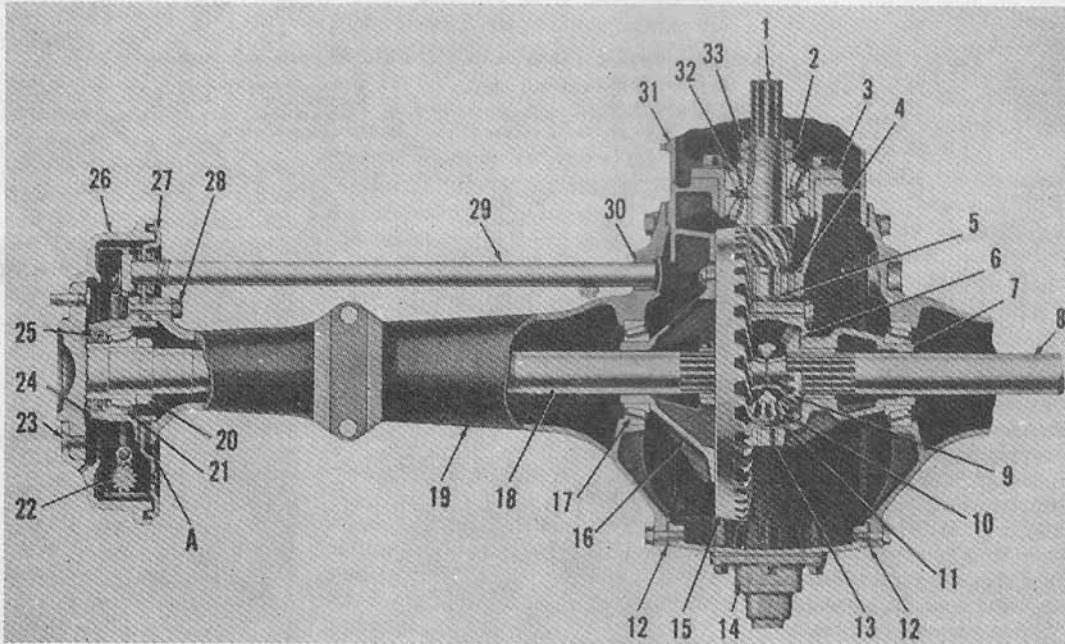


Fig. F37—Model TO20 main drive bevel pinion and ring gear, differential unit and wheel axle shafts and housings assemblies. Bevel pinion (1) and ring gear (15) are available only as matched pairs. Model TE20 is similar except for the brakes, Fig. F45.

- | | | | | |
|---|--|--|--|--|
| <ol style="list-style-type: none"> A. Shims 1. Main drive bevel pinion & shaft 2. Pinion bearing adjusting nut washer 3. Main drive bevel pinion bearing carrier 4. Main drive bevel pinion pilot brg. 5. Snap ring | <ol style="list-style-type: none"> 6. Side gear thrust washer 7. Differential case (right half) 8. Wheel axle shaft 9. Differential side gear 10. Differential pinion 11. Thrust washer 12. Gasket (0.009-.012 thick) | <ol style="list-style-type: none"> 13. Differential spider 14. PTO shaft outer bearing carrier 15. Bevel ring gear 16. Differential case (left half) 17. Differential carrier bearing 18. Wheel axle shaft 19. Wheel axle shaft housing | <ol style="list-style-type: none"> 20. Collar 21. Axle shaft bearing 22. Brake adjusting screw 23. Brake drum retaining screw 24. Wheel axle shaft retainer 25. Oil seal 26. Brake drum 27. Brake back plate | <ol style="list-style-type: none"> 28. Wheel axle retainer nut 29. Brake shaft 30. Brake shaft bushing 31. Rear axle center housing 32. Main drive bevel pinion bearing 33. Pinion bearing adjusting nut |
|---|--|--|--|--|

91. **OVERHAUL.** To disassemble differential unit, first place correlation marks on both halves of the differential case to insure correct reassem-

bly. Remove the eight retaining bolts and separate the case. Differential pinions (10), spider (13) and side gears (9) can now be removed. Recommend-

ed backlash of 0.003-0.008 between the differential pinions and the side gears is controlled by the copper plated steel side gear thrust washers (6) and/or the pinion thrust washers (11).

If differential case (carrier) bearing cups require renewal, it is advisable to first remove the wheel axle shafts from their sleeve assemblies to obtain clearance for a puller.

On TE20, and TO20, and some TO30 models the bevel ring gear is riveted to the two-piece differential case. On other TO30 models, special heat treated bolts and nuts are used. The preferred method of removing the rivets is to drill them out. For service, special heat treated bolts and nuts instead of rivets are being supplied for attaching the ring gear to the case on all models. Tighten bolts to 83-88 Ft.-Lbs. torque. Check trueness of ring gear back face by mounting the unit in a lathe. Total runout should not exceed 0.002.

Tooth contact (mesh pattern) and backlash positions of the crown-shaved main drive bevel gears are fixed and non-adjustable. Neither the pinion nor ring gear are furnished separately, but only as a matched set.

MAIN DRIVE BEVEL GEARS

Pinion and ring gear are available only as matched pairs. The TE20 and TO20 pinion and ring gear as well as their components are interchangeable; whereas, the TO30 pinion and ring gear are slightly larger in size. Neither the mesh position nor the backlash of the bevel gears is adjustable.

92A. **BEVEL PINION.** The straddle mounted, main drive spiral bevel pinion (1—Fig. F37 or F41) may be removed and bearings (32) may be overhauled without disturbing the main drive bevel ring gear and differential unit.

To remove the bevel pinion from the tractor first drain the transmission and rear axle center housings. Separate the rear axle center housing from the transmission as follows: Disconnect the brake rods. Remove the two platforms, one from each side of the transmission case, and exhaust pipe and muffler. Remove power take-off shaft by removing four retaining cap screws from rear face of the rear axle center housing and withdrawing assembly rearward. Support transmission case and rear axle center housing separately and remove the bolts which attach these assemblies. Roll rear axle center housing rearward until the sleeve connecting the transmission main shaft

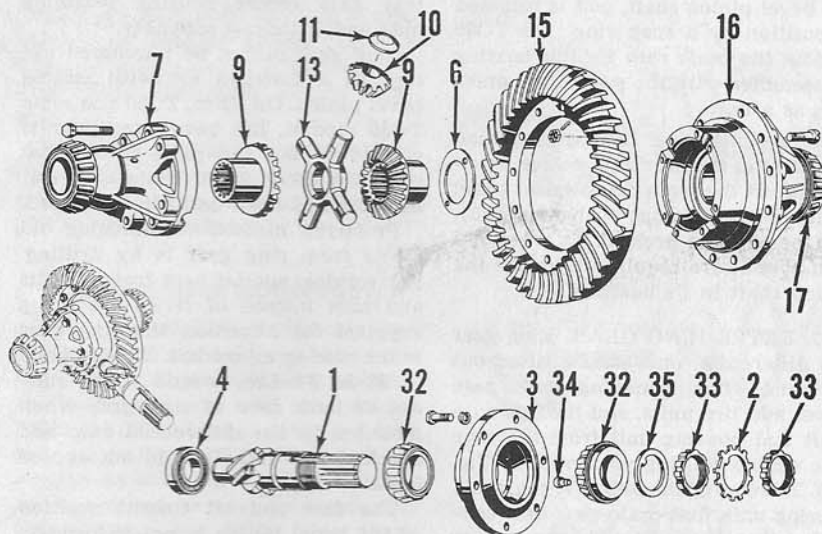


Fig. F39—TO30 differential, main drive bevel pinion and ring gear and components. Special heat-treated bolts for attaching the bevel ring gear to the differential case instead of rivets are being supplied for service. TE20 and TO20 are similar.

- | | | |
|--|-----------------------------------|-----------------------------------|
| 1. Bevel pinion | 7. Differential case (right half) | 16. Differential case (left half) |
| 2. Pinion bearing adjusting nut washer | 9. Differential side gear | 17. Differential carrier bearing |
| 3. Bearing sleeve (carrier) | 10. Differential pinion | 32. Pinion bearing |
| 4. Pinion pilot bearing | 11. Pinion thrust washer | 33. Adjusting nut |
| 6. Side gear thrust washer | 13. Differential spider | 34. Lock pin |
| | | 35. Thrust washer |

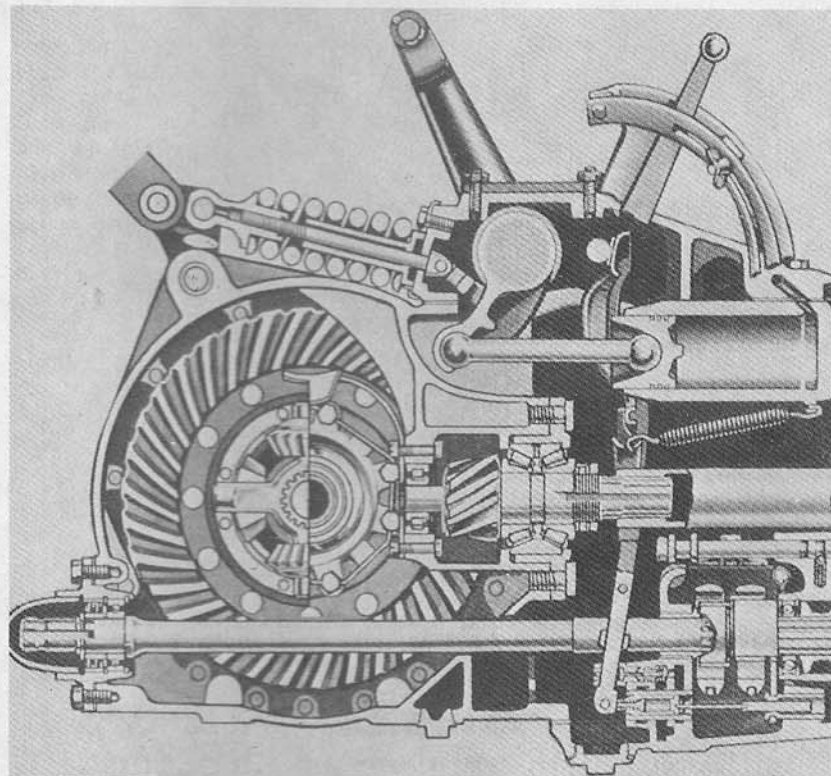


Fig. F40—Model TO30 differential, main drive bevel ring gear and pinion, hydraulic lift pump, lift (rock shaft) cover, and power take-off shaft assemblies are located in the rear axle center housing—right sectional view. TE20 and TO20 are similar

and main drive bevel pinion shaft is free. Remove hydraulic pump unit and hydraulic lift cover unit.

Remove six cap screws retaining the pinion bearing sleeve (3) to the center housing. Pinion and bearing sleeve assembly can be removed by using a suitable puller threaded into the end of the pinion shaft, or where provided, by threading two cap screws into the tapped holes of the pinion bearing sleeve flange.

92B. Main drive bevel pinion and shaft can be removed from the bearing sleeve after removing the two nuts (33) and pressing the bevel pinion and shaft out of the bearing sleeve. On the TE20, and TO20, the bearing sleeve contains two bearing cups which are available for service. However, on the TO30, the bearing sleeve and one-piece bearing cup are not serviced separately and must be purchased as an assembly if either the sleeve or the cup requires renewal. The pinion

shaft pilot bearing (4) can be removed by using a suitable puller. On the TE20, and TO20 models, the inner race for this bearing is a press fit on the bevel pinion shaft, and is retained in position by a snap ring. On TO30 models, the inner race for this bearing is assembled with the rollers and outer race as a unit.

Before installing the bevel pinion assembly in the rear axle center housing, adjust the main drive spiral bevel pinion shaft bearings with nuts (33), to a perceptible preload, or when 6-8 inch pounds are required to rotate the pinion shaft in its bearings.

93. BEVEL RING GEAR. Ring gear and differential unit can be lifted out by hand after removing both rear wheel and tire units, and the left axle shaft and housing unit from the rear axle center housing as shown in Fig. F38. To remove the left axle shaft and housing unit, first drain rear axle center housing. Block up and support rear

portion of tractor. Remove fender, rear tire and wheel assembly. Disconnect master brake pedal linkage at the brake shaft. Remove axle housing to rear axle center housing retaining nuts and withdraw assembly.

Ring gear cannot be purchased except as a matched set with mating bevel pinion. On TE20, TO20 and some TO30 models, the bevel ring gear is riveted to the two-piece differential case. On other TO30 models, special heat treated bolts and nuts are used.

Preferred method of removing old rivets from ring gear is by drilling. For service, special heat treated bolts and nuts instead of rivets are being supplied for attaching the ring gear to the case on all models. Tighten bolts to 83-88 Ft.-Lbs. torque. Total run-out of back face of ring gear when mounted to the differential case and checked in a lathe should not exceed 0.002.

The fore and aft (mesh) position of the bevel pinion is not adjustable.

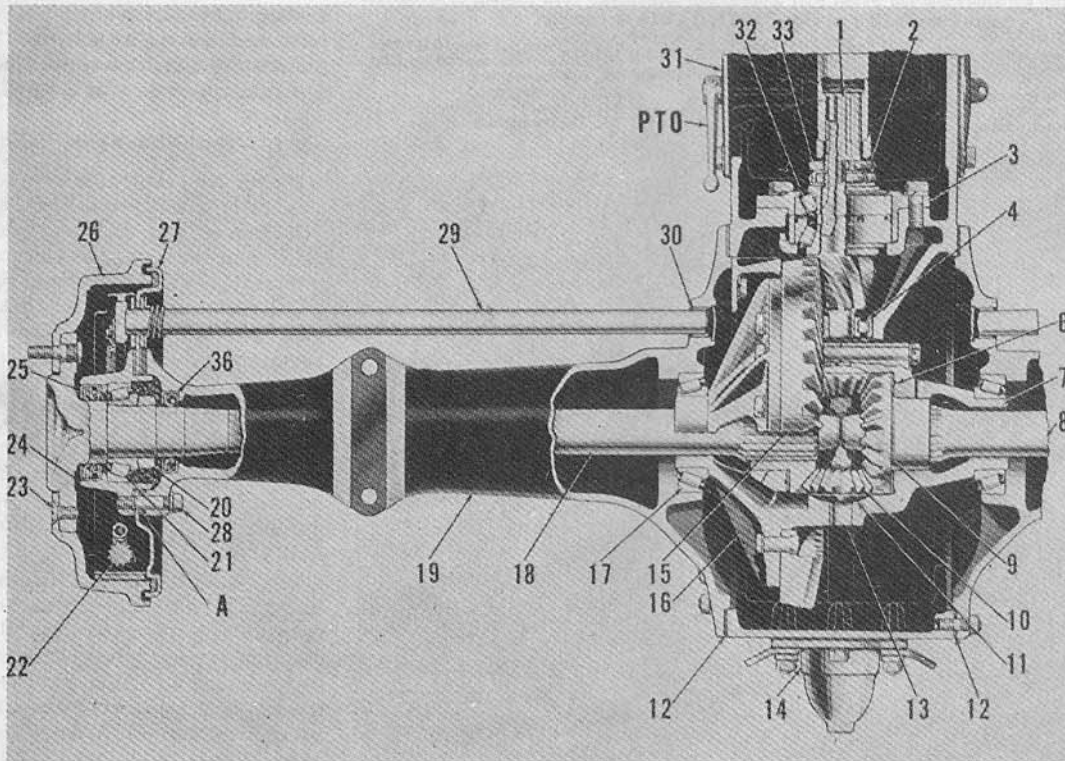


Fig. F41—Model TO30 main drive bevel pinion and ring gear, differential unit, wheel axle shafts and housings assemblies. Bevel pinion (1) and ring gear (15) are available only as matched pairs. Note the use of two oil seals (25 & 36) on the TO30 axle shaft. For service, special heat treated bolts and nuts are used for attaching the ring gear to the differential case.

- | | | | | |
|--|-----------------------------------|-------------------------------------|--------------------------------|-------------------------------------|
| A. Shims | 6. Thrust washer | 14. PTO shaft outer bearing carrier | 20. Axle shaft collar | 27. Brake back plate |
| 1. Main drive bevel pinion & shaft | 7. Differential case (right half) | 15. Main drive bevel ring gear | 21. Wheel axle shaft bearing | 29. Brake shaft |
| 2. Pinion bearing adjusting nut washer | 8. Wheel axle shaft | 16. Differential case (left half) | 22. Brake adjusting screw | 30. Bushing |
| 3. Main drive bevel pinion bearing carrier | 9. Differential side gear | 17. Differential carrier bearing | 23. Brake drum retaining screw | 31. Rear axle center housing |
| 4. Main drive bevel pinion pilot bearing | 10. Differential pinion | 18. Wheel axle shaft | 24. Wheel axle shaft retainer | 32. Main drive bevel pinion bearing |
| | 11. Pinion thrust washer | 19. Wheel axle shaft housing | 25. Oil seal | 33. Pinion bearing adjusting nut |
| | 12. Gasket (0.009-0.012 thick) | | 26. Brake drum | 36. Oil seal |
| | 13. Differential spider | | | |

Reinstall the bevel ring gear and differential unit, using only one manufacturer's standard thickness (0.009-0.012 new) axle shaft housing to rear axle center housing gasket (12—Fig. F41) so as to obtain the correct preload of the differential carrier bearings (17).

Ring gear backlash and preload of differential carrier bearings are controlled by the machining tolerances and using one gasket (12) per side.

SHAFTS AND HOUSINGS

Two types of axle shafts have been used, the butt end type and button end type. The TE20 model is equipped with the button end type axle, whereas the TO20 and TO30 have the butt end type axle, as in Figs. F37 & F41. When renewing an axle, the same type should be reinstalled as was removed. The TE20, TO20, and TO30 axle shafts and/or sleeve units are not interchangeable. However, many of the smaller components (shims, bearings, and outer oil seals) are interchangeable. The TO30 rear axle construction differs from the TE20 and TO30 in that two oil seals, one on each side of the outer bearing, are used. Refer to Figs. F37, F41, F43 and F44.

94. BEARING ADJUSTMENT. To check the bearing adjustment on either type of axle shaft, proceed as follows: Support tractor and remove tire and wheel assemblies. Rotate either axle shaft and observe whether opposite shaft rotates in the same or opposite direction. If both axle shafts revolve in the same direction, the bearings are adjusted too tightly.

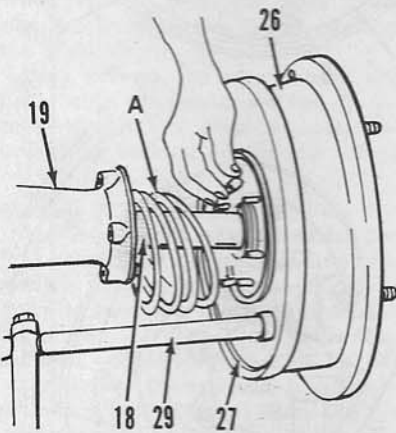


Fig. F42—Wheel axle shaft and brake assembly. Shims (A) control axle shaft end play.

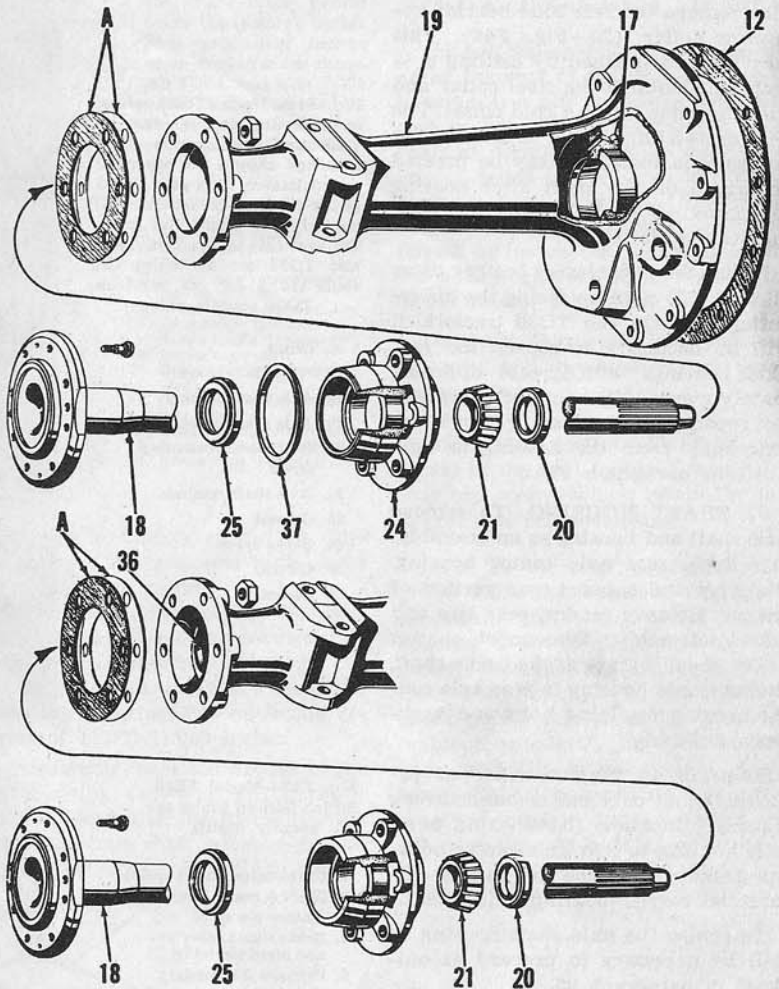


Fig. F43—Wheel axle shaft housing and related parts. Top view—TO20 unit. Oil seal (25) is used on TE20 and TO20 models only. TE20 is similar. Bottom view—TO30 unit. Oil seals (25 & 36) are used on TO30 models only.

- | | | |
|--------------------------------------|------------------------|--------------------------------|
| A. Shims and gasket | 18. Axle shaft | 24. Axle shaft retainer |
| 12. Gasket (.009-.012 thick) | 19. Axle shaft housing | 25. Outer oil seal (TE & TO) |
| 17. Differential carrier bearing cup | 20. Axle shaft collar | 36. Inner oil seal (TO30 only) |
| | 21. Axle shaft bearing | 37. Retainer oil shield |

To adjust bearings on either type of shaft, remove shims (A), shown in Fig. F42 or F44, from between one brake back plate (27) and one axle housing (19), until both shafts rotate in the same direction when one shaft is rotated. Then add shims (A) until the axle shafts rotate in opposite directions. This procedure will provide a recommended 0.002-0.008 clearance between inner ends of the axle shafts. Zero clearance may cause the inner ends of the axle shafts to weld together. Excessive clearance will result in damaged axle shaft oil seals. To add shims, it will be necessary to remove the axle shaft as outlined in paragraph 95.

95. AXLE SHAFTS. To remove an axle shaft, proceed as follows: Jack-up and support both rear axle housings.

Remove wheel and tire unit. Remove brake drum retaining screws, and six nuts (28) which attach the bearing retainer (24) and back plate (27) to axle housing. Withdraw axle shaft and bearing retainer as a unit from the housing.

96. BEARING AND OIL SEAL. On the TO30, to renew the inner oil seal (36) first remove the axle shaft from the housing as outlined in paragraph 95. With shaft removed, use a suitable puller or pry out the oil seal from outer end of axle housing. Install new seal with the lip facing the differential unit. To renew either the axle shaft, bearing cone and cup and/or outer oil seal (only an outer seal is used on the TE20 and TO20 tractors), it will be necessary to remove the rear axle shaft from the axle housing, and

then remove the rear axle bearing retaining collar (20—Fig. F44). This may be accomplished by drilling a 1/4 inch hole through the steel collar and splitting same, using a cold chisel. The bearing retaining collar is a shrink fit on the axle shaft and may be pressed or driven on the shaft after heating to approximately 250 deg. F. so as to facilitate installation.

Install the new treated leather outer oil seal (25) with lip facing the differential unit. On the TO30 tractors, it will be necessary to repack the rear axle bearings with grease approximately every 1000 hours of operation. To repack the bearing, remove the axle shaft from the housing as outlined in paragraph 95.

97. SHAFT HOUSING. To remove axle shaft and housing as an assembly, first drain rear axle center housing. Block up and support rear portion of tractor. Remove fender, rear tire and wheel assembly. Disconnect master brake pedal linkage at the brake shaft. Remove axle housing to rear axle center housing retaining bolts and withdraw assembly.

Reinstall in reverse order of removal, using only one manufacturer's standard thickness (0.009 - 0.012 new) axle housing to rear axle center housing gasket to provide the correct differential carrier bearing adjustment.

To renew the axle shaft housing, it will be necessary to proceed as outlined in paragraph 95.

BRAKES

TE20 tractor models are equipped with 14 inch internal expanding type Girling brakes, located on the outer end of the axle shaft housing. The brake drums are bolted to the outer end of each axle shaft. The TO20, and TO30 tractor models are equipped with 11 inch internal expanding Bendix brakes. Early production TO20 models had linings which were attached to the brake shoes with rivets. On later TO20, and all TO30 models the lining is bonded to the shoes without rivets. A kit comprising the shoes with the bonded type lining is being supplied for servicing all TO models.

Model TE20

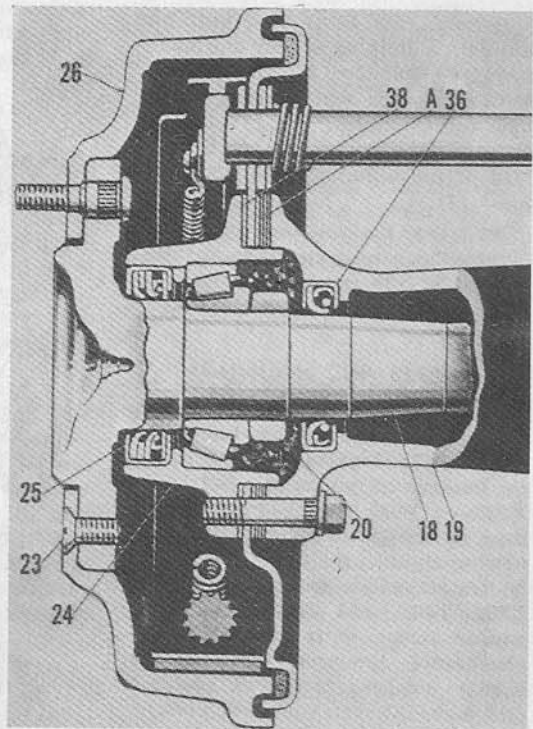
100. ADJUSTMENT. Jack up and block rear portion of tractor. Loosen the nut on centralizer bolt (10—Fig. F46) located on the brake back plate. Turn crown wheel (12) until a medium to heavy drag is obtained when

rotating the brake drum. Tighten the centralizer nut. Back off the crown wheel until the drums are free to rotate without any drag. Equalize the brakes by backing off the crown wheel on the tight brake.

Models TO20-TO30

101. ADJUSTMENT. Jack up and block rear portion of tractor. Remove brake adjusting port plate from inner face of brake back plate. Using a

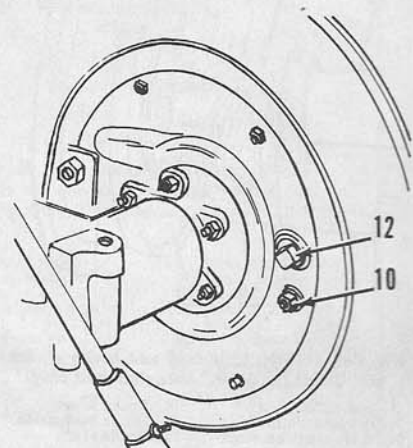
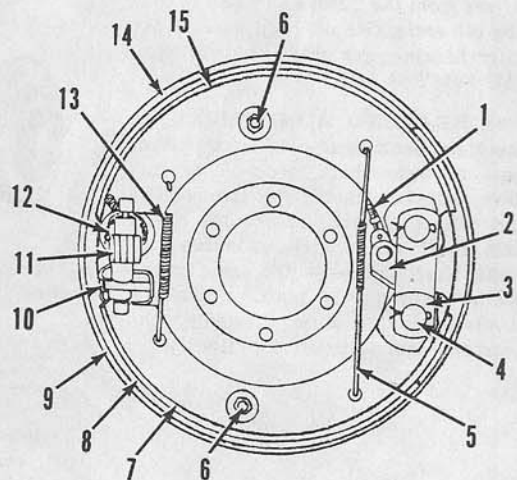
rotating the brake drum. Tighten the centralizer nut. Back off the crown wheel until the drums are free to rotate without any drag. Equalize the brakes by backing off the crown wheel on the tight brake.



- A. Shims
- 18. Wheel axle shaft
- 19. Axle shaft housing
- 20. Axle shaft collar
- 23. Brake drum retaining screw
- 24. Axle shaft retainer
- 25. Oil seal
- 26. Brake drum
- 36. Oil seal
- 38. Gasket

Fig. F45—Model TE20, British Girling brake assembly (right).

- 1. Crank lever return spring
- 2. Shaft & crank lever
- 3. Anchor pin strut
- 4. Brake shoe anchor pin and plate assembly
- 5. Primary & secondary shoe spring
- 6. Back plate steady post
- 7. Brake shoe (primary)
- 8. Brake lining (primary)
- 9. Brake back plate
- 10. Centralizer bolt
- 11. Adjuster pinion
- 12. Crown wheel
- 13. Adjuster screw spring
- 14. Brake lining (secondary)
- 15. Brake shoe (secondary)



BELT PULLEY UNIT

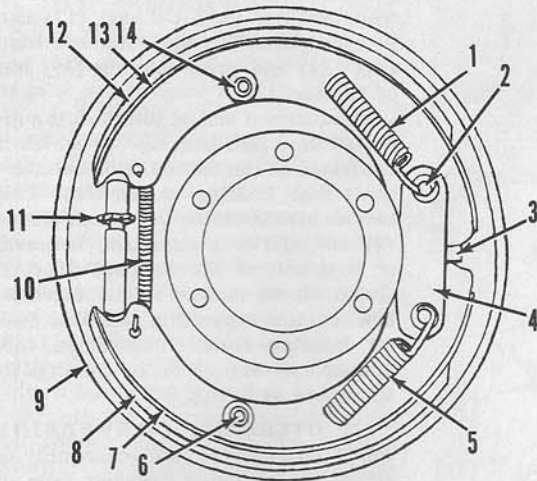
The belt pulley unit, Fig. F49, mounted at the rear of the rear axle center housing, is a self contained drive unit and is driven by the power take-off shaft at a ratio of 1.87 to one. At an engine speed of 2000 rpm, the pulley shaft speed is 1358 rpm. Belt pulley rotation in either direction can be obtained by mounting the unit so that the pulley is either to the right or left of the tractor center line.

The TE20, TO20, and TO30 belt pulley unit and components are interchangeable.

105A. R&R AND OVERHAUL. Removal of the unit requires removal of four cap screws which retain the unit to rear axle center housing.

105B. To overhaul, proceed as follows: With unit removed from tractor, drain the lubricant and remove housing cover (13—Fig. F49) and gasket. Remove the cotter key and castellated nut (6) from the inner end of the pulley shaft. Nut (6) cannot be removed completely, but must be loosened gradually as pulley shaft (1) is removed. After removing the pulley shaft (1), remove drive shaft and gear (11) out through housing cover opening.

Fig. F47—TO20 Bendix brake assembly (right). First production linings were riveted to the shoes. All TO30, and later TO20 brake linings as well as the linings supplied for service are of the bonded type.



1. Brake shoe return spring (secondary-black)
2. Brake shoe anchor pin
3. Brake shaft cam
4. Anchor pin brace
5. Brake shoe return spring (primary-blue)
6. Brake shoe retaining pin
7. Brake shoe (primary)
8. Brake lining (primary)
9. Brake back plate
10. Brake shoe return spring (red)
11. Brake adjusting screw star wheel
12. Brake lining (secondary)
13. Brake shoe (secondary)
14. Brake shoe retaining pin

end of the secondary shoe (13). The red spring (10) connects both shoes at the adjustment end.

An oversize (.030) brake shoe and lining kit is available as a service item under the part number TO2100A. The kit is intended for use where the brake drums are resurfaced to an inside diameter of 11.060-11.065 inches.

A renewable, presized bronze brake shaft bushing (30—Fig. F37 or F41) which is located in the flange portion of the rear axle shaft housing, can be removed by using a suitable puller.

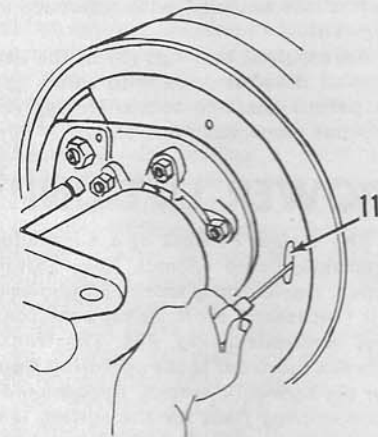


Fig. F48—TO20, and TO30, showing location and method of adjusting brakes with brake shoe adjusting screw star wheel (11). View shows right brake back plate.

screw driver, turn the star wheel (11—Fig. F47 or F48), counter-clockwise when viewed from the back plate side, until the brake lining contacts the brake drum.

Back off on the star wheel adjuster until the drums are free to rotate without any drag. Equalize the brakes by backing off the star wheel on the tight brake.

Models TE20-TO20-TO30

102. R&R AND OVERHAUL. The brake drum can be removed after removing the rear wheel and the brake drum to rear axle shaft flange retaining screws (23—Fig. F44). Brake shoe removal is self-evident after an examination of the assembly and reference to Fig. F45 or F47. Note the arrangement of the brake shoe return springs on the TO Bendix brake. Install the blue spring (5—Fig. F47) to the cam end of the primary shoe (7) and the black spring (1) to the cam

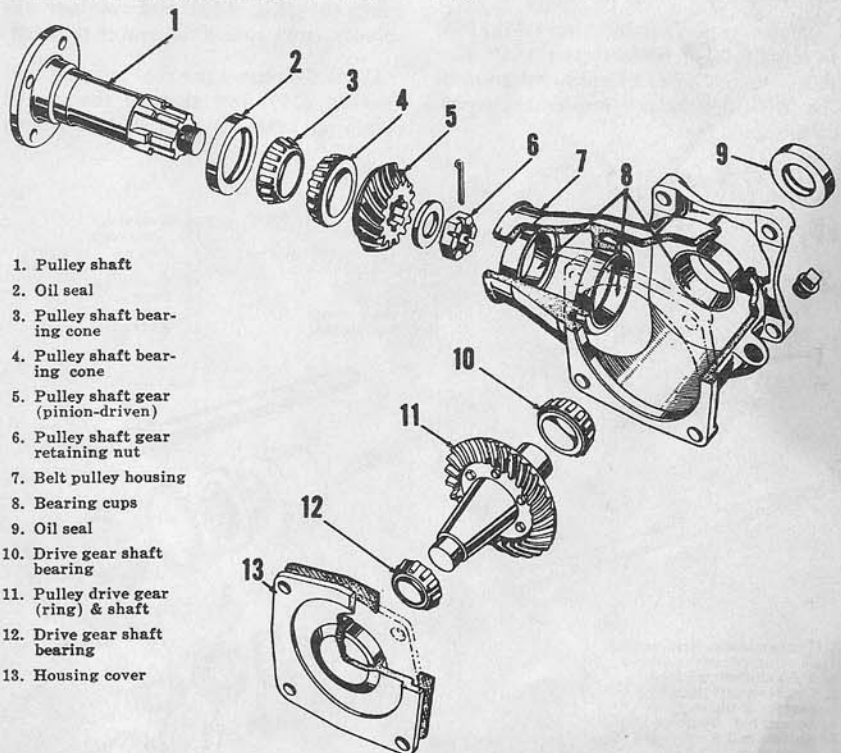


Fig. F49—Belt pulley unit is mounted on the rear face of the rear axle center housing and receives its drive from the pto shaft.

Neither the pulley shaft gear (5) nor drive shaft gear (11) is furnished separately, but only as a matched set. Install the drive shaft oil seal (9) and pulley shaft oil seal (2) with the lip facing inward.

The mesh and backlash of the two bevel gears (5) and (11) are fixed and non-adjustable. After installing nut (6), tighten same to adjust pulley shaft bearings (3) and (4) to a perceptible preload. If only the pulley shaft is in the belt pulley case, the correct preload is when 12 to 20 inch pounds is required to rotate the shaft in its bearings. Adjust the drive shaft bearings to a slight preload, by varying the number of gaskets interposed between housing cover (13) and belt pulley housing (7). Gaskets are available in the .012, .016, and .020 thickness. The correct preload is when 20-30 inch pounds, checked at the pulley, is required to rotate the belt pulley unit.

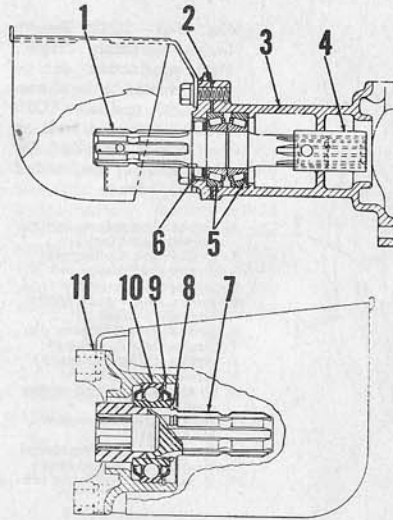


Fig. F51—Adaptors provided by Ferguson convert the pto output shaft splines to the larger ASAE standard 1 3/8 size. Top view: Extension drawbar type conversion. Bottom view: Swinging drawbar type conversion.

- | | |
|---------------------------|-----------------------|
| 1. Extension shaft | 6. Felt seal |
| 2. Shims | 7. Extension shaft |
| 3. Extension housing | 8. Snap ring |
| 4. Extension shaft sleeve | 9. Snap ring |
| 5. Bearings | 10. Bearing |
| | 11. Extension housing |

110. OVERHAUL PTO UNIT. The pto shaft, rear ball bearing and oil seal can be renewed after removing the bearing retainer (13—Fig. F50 or 14—Figs. F37 & F41) and withdrawing shaft (21—Fig. F50) and retainer assembly from rear axle center housing.

110A. To renew the rear support ball bearing (19) first remove the sleeve retaining snap ring (15) and sleeve

(16); then, bump or press the pto shaft from retainer (13). Oil seal (17) can be renewed at this time. Remove snap ring (20) and press bearing (19) out of retainer.

The forward end of the shaft is supported on a ball bearing (7) which is contained in the transmission countershaft rear bearing carrier (3). This carrier also contains the clutch sleeve (9) and shifter mechanism. Removal or overhaul of the forward bearing, clutch sleeve and/or shifter mechanism requires separating rear axle center housing from transmission case (paragraph 81) to make these parts accessible as in Fig. F36.

111. OVERHAUL CONVERSION UNIT. Disassembly and reassembly of either the swinging drawbar type or extension drawbar type pto conversion unit, is self-evident after an examination of the unit and with reference to Fig. F51.

Adjust shaft bearings (5) in the extension drawbar type with shims (2) to permit shaft to rotate freely, yet without perceptible end play.

POWER TAKE-OFF

The power take-off unit and shaft is contained in the rear axle center housing and receives its drive from the transmission countershaft. The crankshaft to pto shaft ratio is 2.75 to one. At an engine speed of 2000 rpm, the pto shaft rotates at 727 rpm.

A conversion kit (adaptor), Fig. F51, is available to convert the shaft size to 1 3/8 inches so as to permit the use of the ASAE standard implement drive coupling.

POWER LIFT UNIT

The system consists of a 4 cylinder hydraulic pump (Scotch Yoke Piston type), single acting work cylinder and lift (rockshaft) shaft, linkage and control mechanism, Fig. F54. The transmission lubricant is the operating fluid for the hydraulic system. Recommended operating fluid for the system is a straight mineral oil, SAE 80 in winter and SAE 90 in summer.

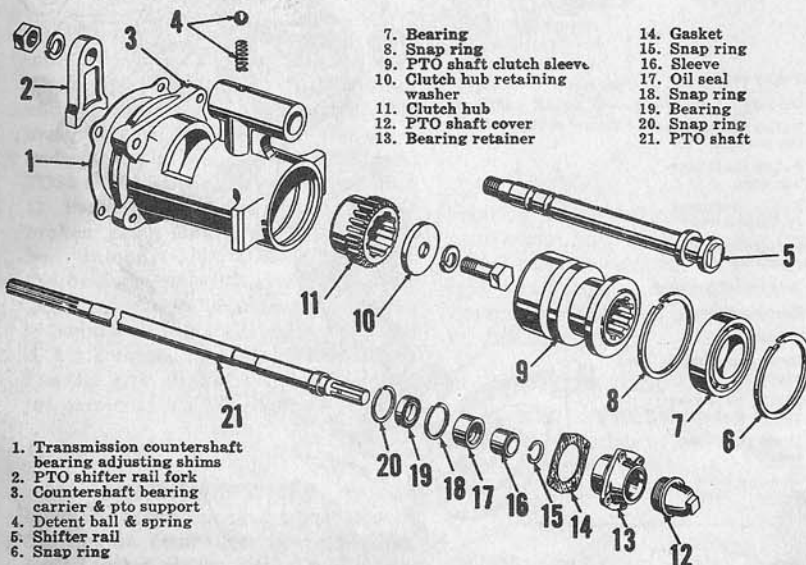
INTERCHANGEABILITY

119. LIFT COVER ASSEMBLY. The TE20, TO20, and TO30 hydraulic lift cover and lift shaft assembly, Figs. F64 and F65, is not interchangeable. However, many of the individual components which make up the assembly are interchangeable.

119A. PUMP. The TE20 after serial 83270 and TO20 hydraulic pump unit is interchangeable. On the TE20 tractors prior to serial 83271 the difference is in the relief valve, Fig. F60, which is set to relieve at 1500-1900 psi, whereas all other models including the TO30 are equipped with a relief valve which is set to relieve at 1900-2300 psi.

Under no condition should the 2100 psi relief valve be used in the 1700 psi system, as this system is not designed for the additional pressure.

Many of the components, excluding the relief valve, which make up the TO30 pump unit can be used in servicing the TE20 and TO20 pumps.



1. Transmission countershaft bearing adjusting shims
2. PTO shifter rail fork
3. Countershaft bearing carrier & pto support
4. Detent ball & spring
5. Shifter rail
6. Snap ring

7. Bearing
8. Snap ring
9. PTO shaft clutch sleeve
10. Clutch hub retaining washer
11. Clutch hub
12. PTO shaft cover
13. Bearing retainer
14. Gasket
15. Snap ring
16. Sleeve
17. Oil seal
18. Snap ring
19. Bearing
20. Snap ring
21. PTO shaft

Fig. F50—Models TE and TO PTO drive and external output shaft assembly. Overhaul of PTO shaft shifter mechanism requires detaching rear axle center housing from transmission.

ADJUSTMENTS

The following points should be checked and adjusted before doing any trouble shooting and/or repair work on the system.

120. MASTER CONTROL SPRING.

Attach a soil engaging implement (2 bottom plow or cultivator) to the tractor, and raise the implement to the transport position. (In transport position, the hand control lever will be in the topmost position on the quadrant.) Master control spring (4—Fig. F54) adjustment is correct when the spring can be rotated freely by hand with a minimum of end play.

Adjust the spring by removing the pin connecting the lift rocker (2) and plunger (3) and rotating the plunger in or out.

121. QUADRANT.

First adjust the master control spring as outlined in paragraph 120. Quadrant adjustment is correct when the implement in a raised position (control lever in topmost position on quadrant) will start to lower when the control lever is moved downward and reaches a point 2½ inches plus or minus ½ inch from its topmost position, refer to Fig. F53.

If the implement starts to lower before or after the specified control point of 2½ inches, loosen the four quadrant assembly attaching cap screws, and move the quadrant assembly forward or rearward until the correct adjustment is obtained.

122. CONTROL LEVER.

The fingertip control lever is held in position by a friction disc which after considerable usage may become worn. If hand control lever will not remain in any set position, remove the friction disc and tighten castellated nut on hand control lever until 4-5 pounds pull is required to move the lever.

123. LIFT ARMS.

With the drawbar linkage disconnected from both lift arms (rockshaft), adjust the lift arm

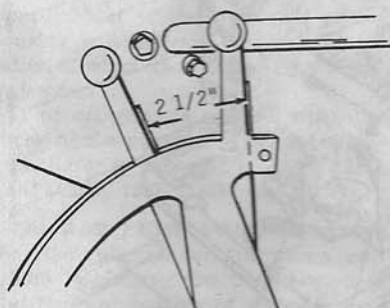
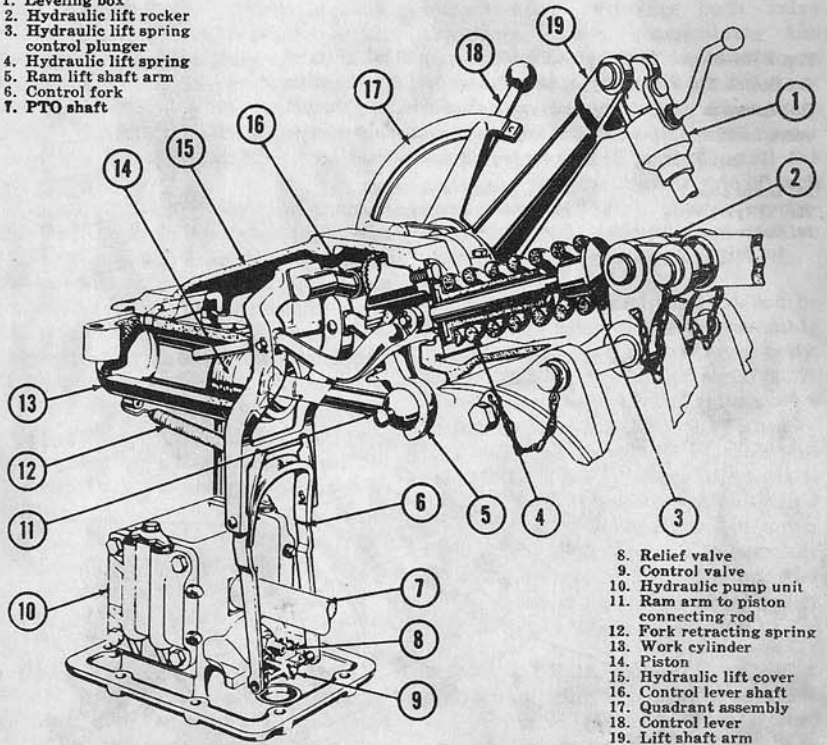


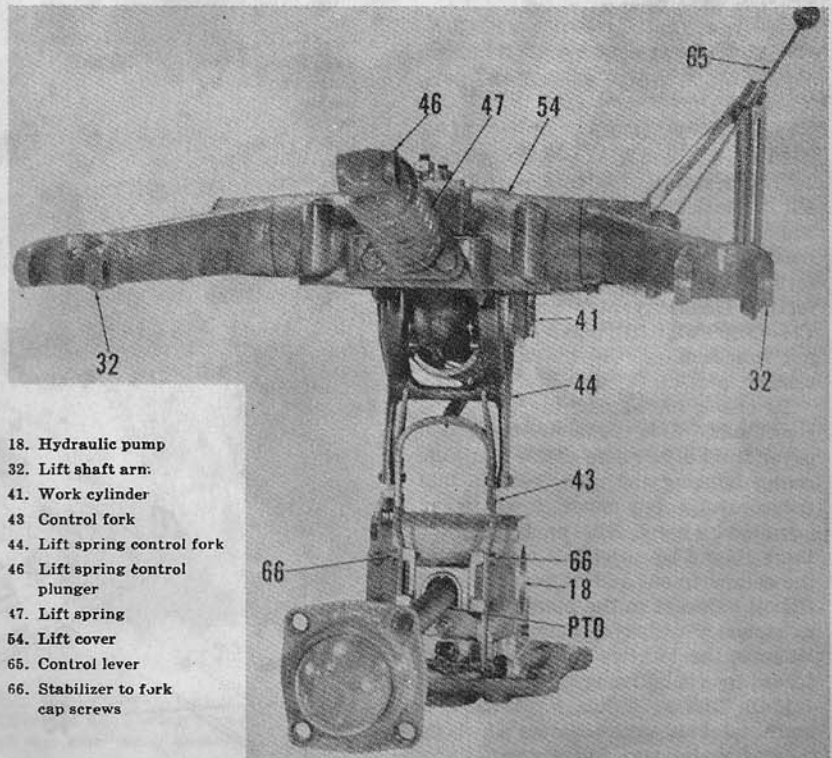
Fig. F53 — Quadrant adjustment is correct when the implement in a raised position will start to lower when the control lever is moved downward and reaches a point 2½ inches from its topmost position.

1. Leveling box
2. Hydraulic lift rocker
3. Hydraulic lift spring control plunger
4. Hydraulic lift spring
5. Ram lift shaft arm
6. Control fork
7. PTO shaft



8. Relief valve
9. Control valve
10. Hydraulic pump unit
11. Ram arm to piston connecting rod
12. Fork retracting spring
13. Work cylinder
14. Piston
15. Hydraulic lift cover
16. Control lever shaft
17. Quadrant assembly
18. Control lever
19. Lift shaft arm

Fig. F54—Models TE20 and TO20 hydraulic power lift assembly as contained in the rear axle center housing. TO30 is similar.

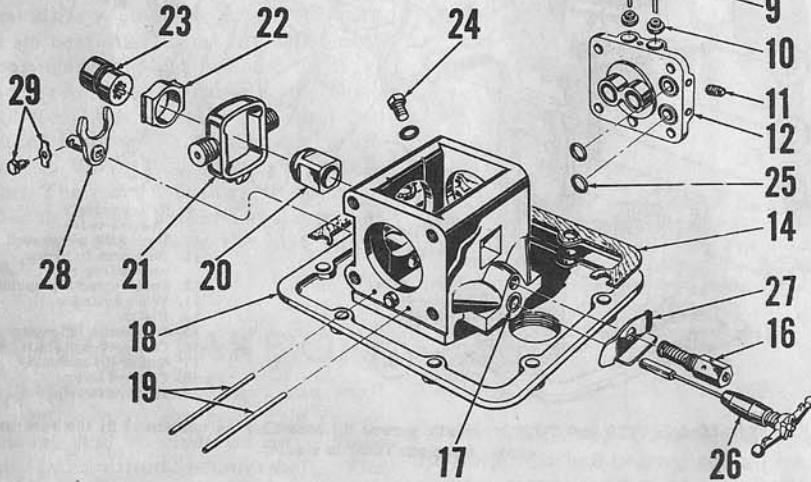


18. Hydraulic pump
32. Lift shaft arm:
41. Work cylinder
43. Control fork
44. Lift spring control fork
46. Lift spring control plunger
47. Lift spring
54. Lift cover
65. Control lever
66. Stabilizer for fork cap screws

Fig. F57—Model TO30 hydraulic power lift assembly as contained in the rear axle center housing. Hydraulic pump is driven by the pto shaft.

Fig. F58—Model TO30 hydraulic lift pump unit which is of the Scotch Yoke Piston type. Note the use of "O" ring seals (25) between pump body and valve chambers, also control valve oscillator drive fork (28) to prevent control valve sticking. Refer to Fig. F59 for legend to callouts.

- | | |
|--------------------------------------|------------------------------------|
| 24. Drain plug | 27. Relief valve shield |
| 25. "O" ring seals | 28. Oscillator drive fork |
| 26. Control valve & oscillator drive | 29. Drive fork retaining set screw |



retaining cap screws until the lift arms when held in a horizontal position will just fall of their own weight.

TROUBLE SHOOTING

For pump testing procedure, refer to paragraph 125.

124A. IMPLEMENT WILL NOT LIFT. If with pump drive engaged and engine running, the implement will not lift, look for (a) control valve (9—Fig. F54) stuck in neutral or outlet position, or unhooked from vertical fork, (b) cracked cylinder, (c) defective (leaking) high pressure tube (74—Fig. F61), (d) pump check valve not functioning, (e) relief valve not seating, and/or (f) defective pump.

To check for any of the preceding conditions, first remove inspection cover from either side of the rear axle center housing and make certain that the control valve moves freely when actuated by hand. With pump running, there should be no visible oil spray in the compartment and no turbulence of the oil adjacent to the pump unit. The existence of either condition indicates leakage, the location of which can be traced by visual inspection.

124B. ERRATIC LIFTING. One or more inlet or outlet valves stuck in valve chambers on side of pump. Refer to paragraph 128A also, check adjustment of lift arms. paragraph 123.

- | | |
|--------------------------------|-----------------------------|
| 1. Clamp to valve chamber bolt | 12. Valve chamber (2 used) |
| 2. Clamp | 13. Valve chamber gasket |
| 3. Valve chamber plug | 14. Pump housing gasket |
| 4. Outlet valve spring washer | 15. Control valve |
| 5. Outlet valve spring | 16. Relief valve |
| 6. Outlet valve (4 used) | 17. Control valve bushing |
| 7. Inlet valve spring | 18. Pump housing |
| 8. Inlet valve (4 used) | 19. Piston guide |
| 9. Valve guide | 20. Pump bushing (1 used) |
| 10. Valve guide socket | 21. Pump piston (2 used) |
| 11. Pipe plug | 22. Pump cam block (2 used) |
| | 23. Pump cam (1 used) |
| | 24. Drain plug |

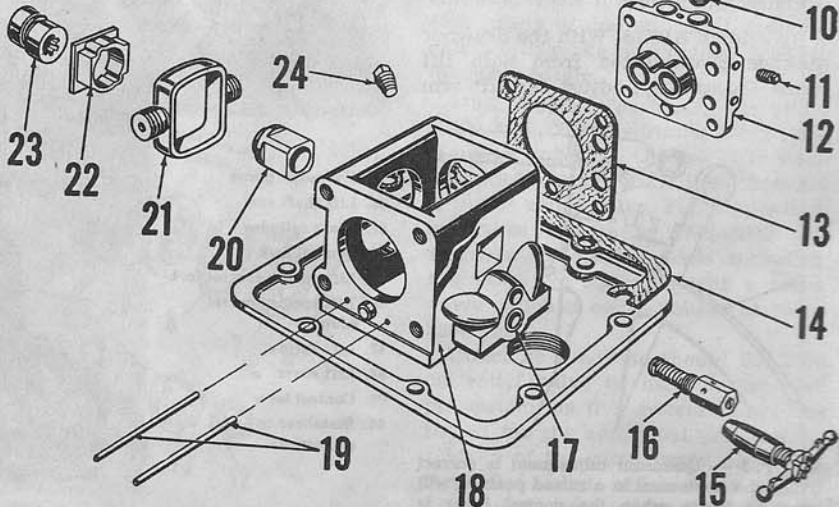


Fig. F59—Models TE20 and TO20 hydraulic pump unit which does not have the control valve oscillator or "O" ring seals used on TO30 unit. Refer to Fig. F58 for TO30 pump unit.

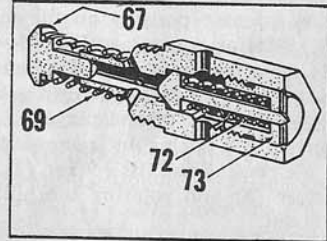
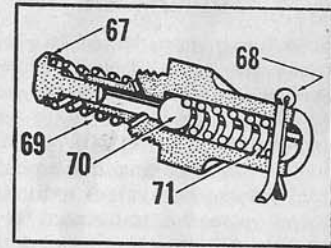


Fig. F60—Hydraulic lift pump relief valve construction. Top view: Model TE20 prior serial 83271 relief valve (set to relieve at 1500-1900 psi). Bottom view: Models TE20 after serial 83270, TO20 and TO30 relief valve (set to relieve at 1900-2300 psi.)

- | | |
|------------------------|-------------------------|
| 67. Check valve | 71. Relief valve spring |
| 69. Check valve spring | 72. Relief valve spring |
| 70. Relief ball valve | 73. Spring retainer |

124C. ERRATIC DEPTH CONTROL. Erratic depth control where the tillage implement alternates between too deep and too shallow can be caused by the master control spring not being properly adjusted, paragraph 120, and/or binding linkage.

124D. IMPLEMENT CANNOT BE LOWERED TO FULL WORKING DEPTH. Check adjustment of quadrant as outlined in paragraph 121.

PUMP UNIT & OIL TUBE

125. TEST PUMP. To check pump operating pressure when pump is installed, proceed as follows: Connect a pressure gauge of sufficient capacity (2000 psi on the TE20 prior to serial 83271, or 2500 psi on TE20 after serial 83270, TO20, and TO30) to the external cylinder pressure connection (P—Fig. F65) which is located on the forward side of the lift cover. With lift arms secured in full lowered position or weighted with a soil engaging implement (2-bottom plow plus a 300 lb. weight) and pump in operation, pull the control lever to the top position on the quadrant. The relief valve should open at 1500-1900 psi for the TE20 prior 83271, and 1900-2300 psi for all other models.

If the pump does not deliver the expected pressure of 1500-1900 for TE20 prior 83271 models, or 1900-2300 for all other models, check for a faulty relief valve. To check for a faulty relief valve, remove either inspection cover from sides of rear axle center housing. With the pump running, there should be no visible oil turbulence in the vicinity of the relief valve as such would indicate that the relief valve is not seating.

If the relief is considered to be in operating condition by the preceding check, and the expected pressure is not obtained, the pump, cylinder, and/or high pressure oil tube is at fault. A visible oil spray in the pump compartment of the rear axle center housing will indicate leakage, the location of which can be traced by visual inspection.

If no oil spray is evident, a further check of the pump unit will be necessary. Refer to paragraphs, 128A, 128B, 128C, 128D, 128E, 128F, and 128G.

126. R&R PUMP UNIT. To remove the hydraulic power lift pump unit which is mounted on the lower face and forward portion of the rear axle center housing, first drain the rear axle center housing. Remove power take-off shaft as outlined in paragraph 110. Remove inspection port cover, and pto shift lever cover from right and left

sides of rear axle center housing. Working through the inspection or pto shift cover opening, remove the hand control fork to stabilizer retaining cap screws (66—Fig. F57) on the TO30 models. TE20 and TO20 models do not have the fork to stabilizer retaining cap screws.

On all models, by working through the inspection cover opening spread hand control fork (43) so as to release lower ends of same from the pump control valve. (A small piece of wood will facilitate spreading the fork.) Remove cap screws retaining pump unit to lower face of rear axle center housing and remove the pump.

127. OVERHAUL PUMP UNIT. Procedure for bench disassembly of the "Scotch Yoke Piston" type pump is as follows:

128A. INLET & OUTLET VALVES (6 & 8—Figs. F58 and F59) can be removed after removing cap screw (1), clamp (2) and valve chamber plugs (3).

128B. VALVE CHAMBERS (12) which contain the inlet and outlet valves can be removed after removing the four retaining cap screws from each chamber. TE20 and TO20 pumps use a paper gasket between the valve chamber and mating surface of the pump, whereas the TO30 valve chambers use neoprene "O" rings as seals.

128C. PUMP PISTONS (21—Figs. F58 and F59), **CAM BLOCKS** (22), **AND BUSHING** (20) can be re-

moved after removing both valve chambers. When reassembling the pump unit, install the two cam blocks (22) on cam (23) so that their flanged faces contact each other. The pump pistons are located slightly off center on their respective yokes. Install the pistons so that the narrow side of each yoke faces each other. Scored or corroded pistons or cylinders (valve chambers) (12) should be renewed.

128D. RELIEF VALVE (16) can be removed by unscrewing the assembly from the rear face of the pump body. Model TE20 tractors prior serial 83271 are equipped with a relief valve shown in top view of Fig. F60, which is factory adjusted to relieve at 1500-1900 psi. Model TE20 tractors after serial 83270, and all TO tractors are equipped with the relief valve shown in lower view of Fig. F60, which is factory adjusted to relieve at 1900-2300 psi. The relief valve is non-adjustable and is serviced only as an assembly.

128E. CHECK VALVE (67—Fig. F60) comprising a poppet type valve and spring is located on the forward end of the relief valve. The check valve and spring are available for service. To remove the check valve, unscrew the relief valve assembly from the rear face of pump body.

128F. CONTROL VALVE (26—Fig. F58) or (15—Fig. F59) can be removed by withdrawing same from bore in pump housing. On the TE20, and TO20 tractors, the control valve can be removed without removing the pump unit by removing the inspection and pto shift lever covers from sides of rear axle center housing. Working through the cover openings, disengage the lower ends of the hand control fork from the valve, and withdraw the valve assembly. To remove the TO30 control valve, it will be necessary to remove the pump unit, because of the oscillating unit which is built on the end of the valve. When installing the control valve, install same so that the slots in front end of valve are in a vertical position.

The presized control valve bushing (17) can be renewed after removing the pump unit and control valve.

128G. PUMP TO CYLINDER OIL TUBE (74—Fig. F61) which carries the oil under pump pressure to the tractor mounted cylinder and to the external hydraulic cylinder oil gallery can be renewed as follows: First, separate the rear axle center housing from the transmission case as outlined in paragraph 81. Remove the pump

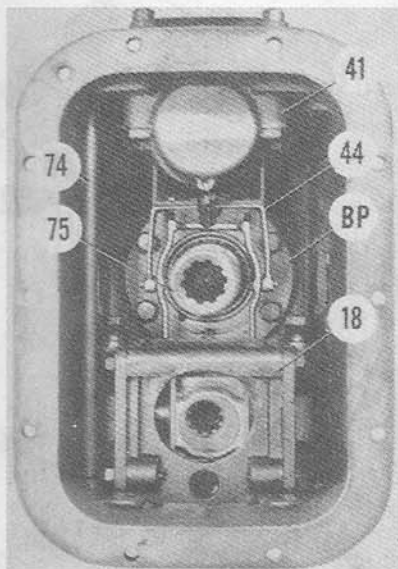


Fig. F61—Hydraulic power lift installation on TE20 and TO20 when viewed from front face of rear axle center housing. TO30 is similar.

18. Hydraulic pump
41. Work cylinder
74. Hydraulic pump to
cylinder tube

75. Main drive bevel
pinion to trans-
mission main shaft
coupling.

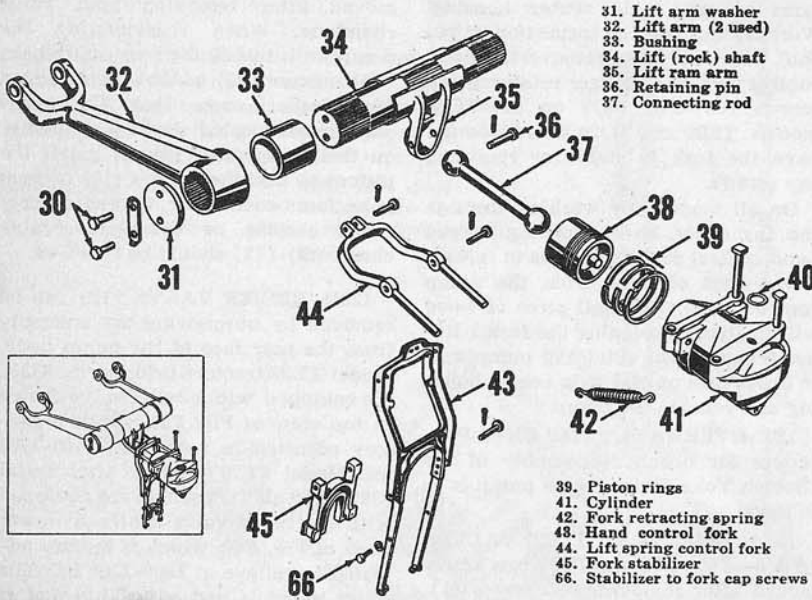


Fig. F64—Hydraulic lift shaft and related parts. TO30 tractors use "O" ring seals (40) between the cylinder and lift cover, whereas the TE20 and TO20 use a paper gasket at this point.

unit as outlined in paragraph 126. Remove the hydraulic lift cover assembly which includes the lift (rock) shaft, cylinder, and controls, as outlined in paragraph 129.

Working through the forward end of the rear axle center housing, squeeze (depress) the tube at the center of its total length. Bump the tube upward until the lower end of same is free of the housing. Bend the tube slightly and pull same downward and out of the rear axle center housing.

Install the new tube, entering it from the top of the rear axle center housing and bumping it into position until the upper end is flush with the hydraulic lift cover gasket surface. Flare the ends of the tube with a 45 degree cone point flaring tool.

LIFT COVER, WORK CYLINDER, CONTROLS & LIFT (ROCK) SHAFT

129. R&R LIFT COVER & RELATED PARTS UNIT. To remove the hydraulic lift cover which is mounted on the top rear portion of the rear axle center housing, proceed as follows: Remove tractor seat and disconnect drawbar linkage from lift (rock) shaft arms. Remove inspection port cover, and pto shift lever cover from right and left sides of rear axle center housing. Working through the inspection or pto shift cover opening, remove the hand control fork to stabilizer retaining cap screws (66—Fig. F57) on the TO30 models. TE20 and TO20 models do not have the fork to stabilizer retaining cap screws.

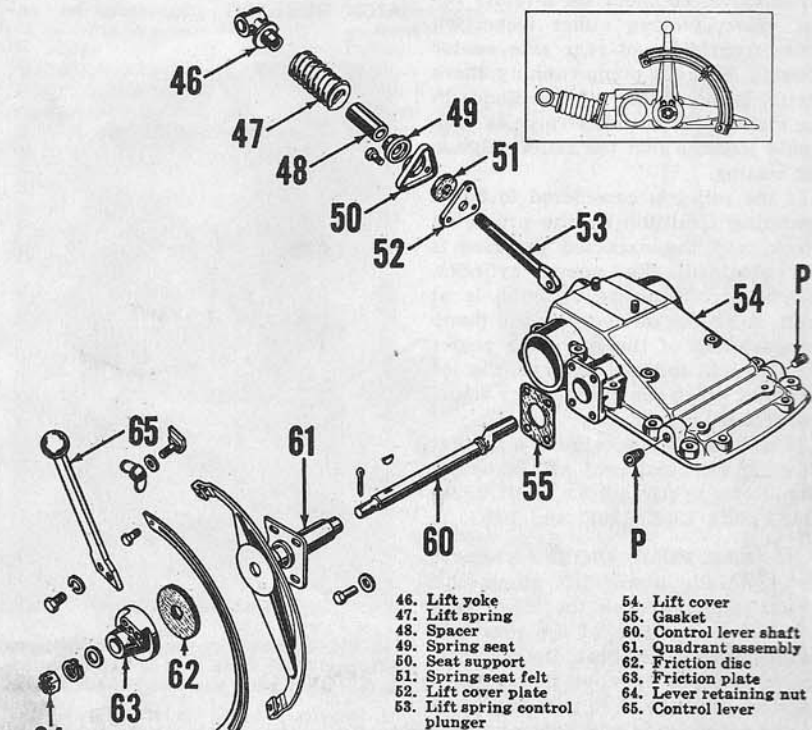


Fig. F65—Hydraulic lift cover and related parts.

rear axle center housing. Lift the entire lift cover assembly from the rear axle center housing.

130. OVERHAUL LIFT COVER & RELATED PARTS. Procedure for disassembly of the lift cover is as follows:

130A. CYLINDER (41—Fig. F64) assembly can be removed for renewing the piston rings, piston, cylinder, and/or, gasket on TE20 and TO20 or "O" ring seal on TO30 after removing the lift cover assembly and removing four bolts retaining the cylinder to the lift cover.

130B. LIFT (ROCK) SHAFT (34—Fig. F64) can be removed for renewing the lift shaft bushings (33) after removing the lift cover assembly, and removing both lift arms (32), pin (36) which connects the cylinder connecting rod (37) to the lift ram arm (35); then, bump lift shaft out of lift cover. Lift shaft bushings supplied for service are presized.

When reassembling the lift arms (32) to the lift shaft, tighten the lift arm retaining cap screws to a point where the arms, when held in a horizontal position, will just fall of their own weight.

130C. CONTROLS (QUADRANT & LEVER SHAFT) can be removed after removing the lift cover. Removal is self-evident after an examination. Adjust quadrant and control lever as outlined in paragraphs 121 and 122.



FERGUSON

SHOP MANUAL

Models ■ TE20 ■ TO20 ■ TO30

For a complete listing of Massey-Ferguson models available, see the following:

Models TE20, TO20, TO30	FE-2
Models TO35, TO35 Diesel, F40, MH50, MHF202, MF35, MF35 Diesel, MF50, MF202, MF204	MF-14
Models MF135, MF150, MF165	MF-27
Model MF285	MF-36
Models MF670, MF690, MF698	MF-41
Models MF230, MF235, MF240, MF245, MF250	MF-42
Models MF255, MF265, MF270, MF275, MF290	MF-43
Models MF3505, MF3525, MF3545	MF-44
Models MF362, MF365, MF375, MF383, MF390, MF390T, MF398	MF-45
Models MF340, MF350, MF355, MF360, MF399	MF-46
Models MF1010 (Standard & Hydro), MF1020 (Standard & Hydro)	MF-47

In addition to the books listed, we offer the following MASSEY-FERGUSON SHOP SERVICE COLLECTIONS. These comprehensive books contain individual Intertec I&T Shop Manuals with easy-to-follow service and repair information for the following Massey-Ferguson tractors:

Model MF65	
Models MF85, MF88, MF Super 90, MF Super 90WR	
Models MF1080, MF1085	
Models MF1100, MF1130	
Model MF1150	
Models MF1105, MF1135, MF1155	MF-201
Models MF175, MF180	
Models MF205, MF210, MF220	
Models MF2675, MF2705	
Models MF2745, MF2775, MF2805	MF-202

FE-2



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