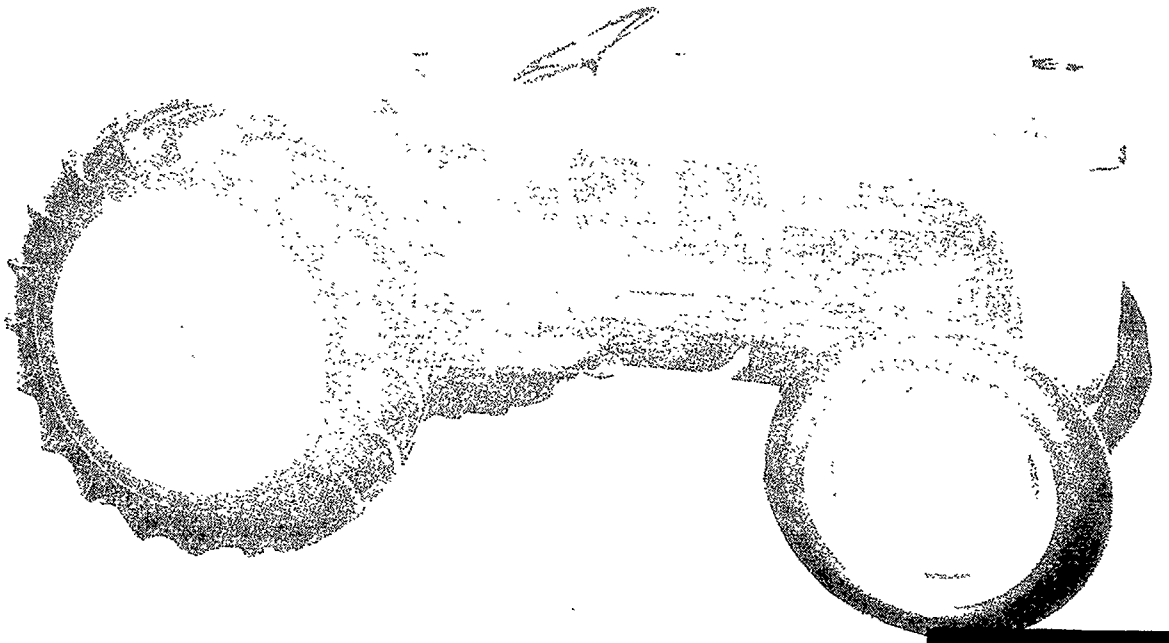
FORD

Operator's Manual

FORD
NEW HOLLAND

Tractors
9N, 2N and 8N



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NOTE: This operator's manual has been compiled from several out-of-print Ford Motor Company publications. Although the primary subject of this manual is the 8N tractor, most of the information which follows is also useful for 9N and 2N tractors.

OPERATOR'S MANUAL

FORD TRACTOR

MODEL 8N

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Dearborn, Michigan

3729-52-C

FOREWORD

The Ford Motor Company has exercised every care in the designing, selection of materials, and the building of this tractor, and you may expect it to operate economically thousands of hours. Maintenance of the tractor in good working order depends on the skill of the driver in its operation, and the prompt application of corrective measures as soon as the need for adjustments and services is apparent.

Part ONE of this book contains information and instructions that will be of assistance in the operation of the tractor.

Part TWO of this book contains lubrication charts and recommendations for periodic preventive maintenance service. This Part also contains various trouble shooting procedures that will prove of assistance when professional aid is not available (see table of contents on next page).

Part THREE of this book gives instructions for replacements and adjustments that may be performed by the owner.

FORD MOTOR COMPANY
Service Department

TABLE OF CONTENTS

	Pages
Foreword	2
Part ONE	
Operating Instructions	
CHAPTER I—DESCRIPTION AND SPECIFICATIONS	6–13
Section 111 Description	6
112 Specifications	9
CHAPTER II—CONTROLS AND OPERATION	14–34
Section 121 Operator's Controls	14
122 Instruments and Gauges	18
123 Tread Width Adjustment	20
124 Starting Engine	22
125 Operation	22
126 Power Take-off	24
127 Belt Pulley	26
128 Hitch Adjustments	28
129 Safety	32
CHAPTER III—STORAGE	35–36
Section 131 Preparing Tractor for Storage	35
132 Removing Tractor from Storage	36
Part TWO	
Maintenance and Trouble Shooting	
CHAPTER I—LUBRICATION AND ENGINE TUNE-UP	37–41
Section 211 Lubrication	37
212 Engine Tune-up	37
CHAPTER II—TROUBLE SHOOTING	42–59
Section 221 Engine	42
222 Cooling System	48
223 Fuel System	49
224 Governor	53
225 Generating System	53
226 Starting System	54
227 Ignition Trouble Shooting	56
228 Hydraulic Control	57

Part THREE
Adjustments and Replacements

		Pages
CHAPTER I—Wheels, Tires, and Brakes		60–64
Section 311	Wheels and Tires	60
312	Front Hub and Bearing Replacement	62
313	Brakes	63
CHAPTER II—Steering Assembly and Front Axle		65–69
Section 321	Steering Assembly Replacement	65
322	Spindle Replacement	67
323	Front Axle Replacement	68
324	Front Axle Support Replacement	68
CHAPTER III—Engine and Clutch		70–79
Section 331	Engine Replacement	70
332	Cylinder Head and Valves	72
333	Connecting Rod and Piston Replacement	76
334	Oil Pan and Oil Pump Replacement	78
335	Clutch Replacement and Adjustment	78
CHAPTER IV—Fuel and Exhaust Systems		80–86
Section 341	Manifold Replacement	80
342	Air Cleaner Replacement and Service	80
343	Fuel Tank Replacement and Cleaning	81
344	Carburetor Replacement and Adjustment	82
345	Governor and Linkage Replacement	85
346	Muffler Assembly Replacement	86
CHAPTER V—Cooling System		87–89
Section 351	Radiator Replacement	87
352	Water Pump Replacement	87
353	Fan and Shroud Replacement	87
354	Fan Belt Replacement and Adjustment	88
355	Thermostat Replacement	88
356	Cooling System Protection	88
CHAPTER VI—Electrical System		90–98
Section 361	Generator and Brush Replacement	90
362	Battery and Rack Replacement	91
363	Starting Motor Replacement	91
364	Distributor and Breaker Contacts Replacement	93
365	Ammeter and Ignition Switch Replacement	97
366	Spark Plug Wiring Replacement	97

		Pages
CHAPTER VII—POWER TRAIN		99–101
Section 371	Drive Pinion, Differential, and Rear Axle Assembly Replacement	99
372	Power Take-off Replacement	100
373	Transmission Replacement	100
CHAPTER VIII—HYDRAULIC CONTROL		102–115
Section 381	Hydraulic Control Operation	102
382	Hydraulic Unit Replacement	106
383	Hydraulic Pump Replacement	107
384	Hydraulic Control Adjustments	108

Part FOUR

Plowing Instructions

Section 401	Mounting Plow on Tractor	117
402	Adjusting Width of Cut	118
403	Coulter and Jointer Adjustments	120
404	Rolling Landside	120
405	Plow Bottoms	120
406	Plow Shares	124
407	Plow Lubrication	125
408	Plowing Procedures	126

Part ONE
OPERATING INSTRUCTIONS

Chapter
I
DESCRIPTION and SPECIFICATIONS

Section

Description 111

Specifications 112

111. DESCRIPTION.

The Ford two-bottom plow tractor (fig. 1) is of the four-wheel type construction. A wide range of wheel spacings are provided. The short wheel base and low over-all height (fig. 2) give it greater flexibility and maneuverability. Implements are easily attached to the tractor by means of the 3-pin mounting.

The Ford tractor is powered by a 4-cylinder, gasoline engine. Model 8N Ford tractors are equipped with a four-forward-speed, constant-mesh transmission. The heavy duty differential divides the power at the semi-floating rear axle.

Internal expansion self-energizing mechanical brakes are provided on the rear wheels. They may be used for steering or manually synchronized as service brakes.

Model 8N Ford tractors are equipped with an improved hydraulic control containing an automatic draft control and a position control (fig. 6). The position control lever and the hydraulic touch control lever are conveniently located. The operator adjusts the implement from the tractor seat by the hydraulic controls and leveling crank. If an obstruction changes the implement setting, the automatic control will reposition the tool when the obstruction is removed or passed. No external hydraulic connections or hoses are used on the link-mounted implements. Implements equipped with one way hydraulic cylinders may be easily connected to the hydraulic control.

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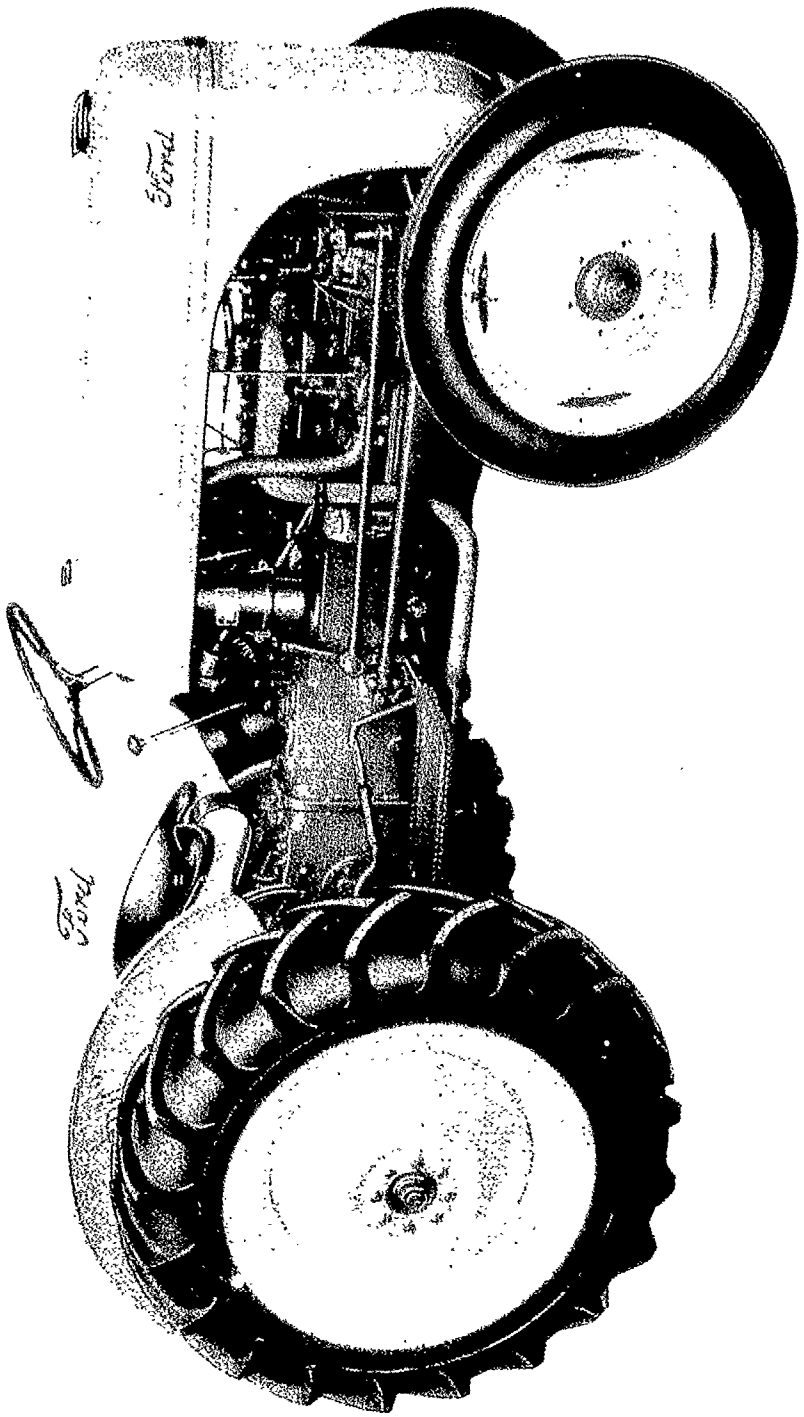


Fig. 1—Ford Tractor, Model 8N, Side View

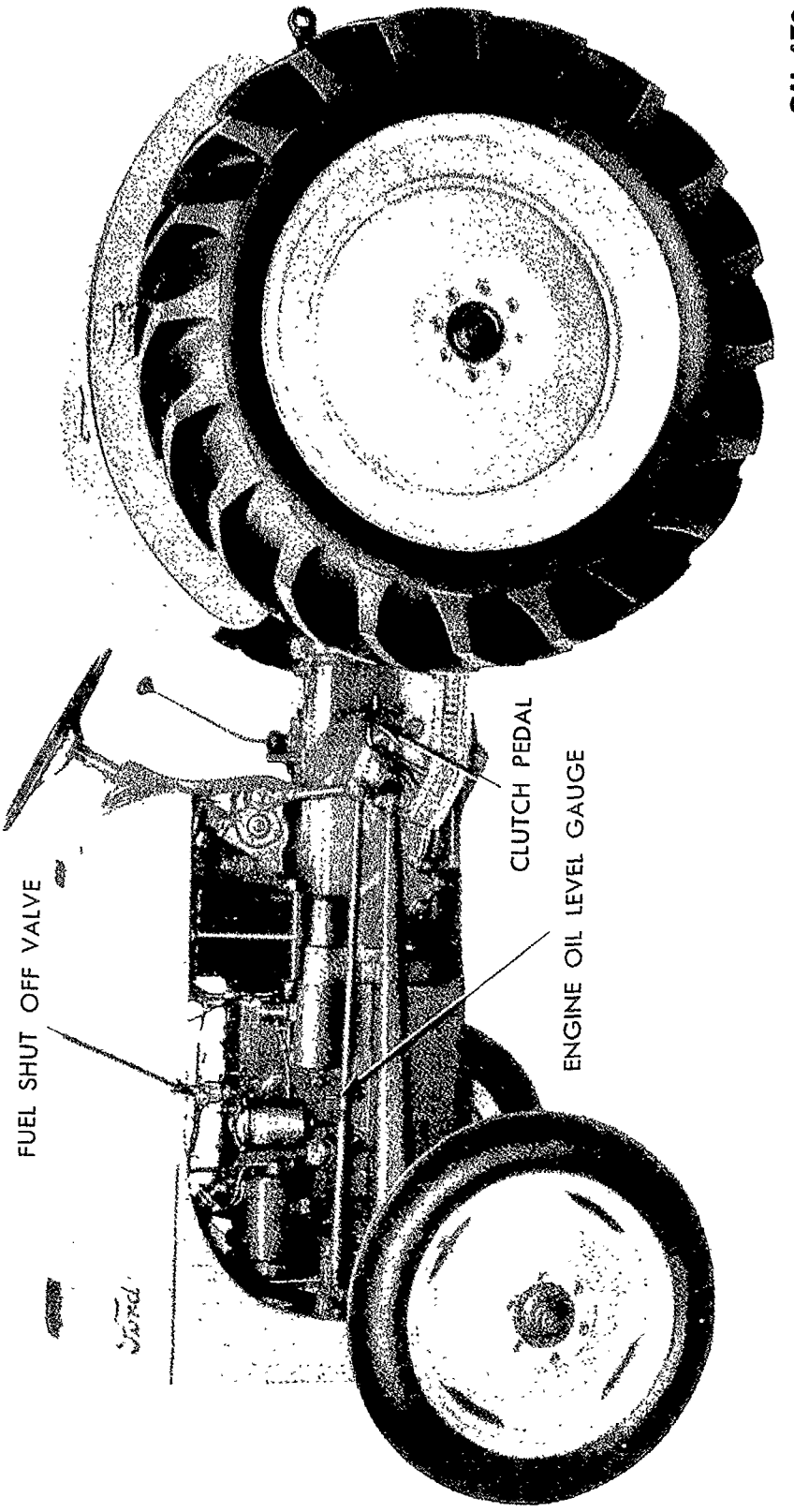


Fig. 2—Ford Tractor, Model 8N, Side View

§ 111.

The tractor serial number is located on the left side of the engine block.

The tractor is provided with a hinged seat and step plates so that the operator can either sit or stand while operating the tractor.

112. SPECIFICATIONS.

The specifications for the Ford tractor, Model 8N, are as follows:

a. General.

Type ..... 4-wheel, general purpose
Wheelbase ..... 70 in. at 48 in. tread width
Over-all length, front to drawbar ..... 115 in.
Over-all height ..... 54½ in.
Over-all width, normal tread ..... 64¾ in.
Tire size:
  Front—standard ..... 4—19 4-ply
  Rear—standard ..... 10—28 4-ply
Front tread ..... 48 to 76 inches in 4-inch steps
Rear tread ..... 48 to 76 inches in 4-inch steps
Ground clearance:
  Front axle ..... 21 in.
  Rear axle ..... 21 in.
  Center ..... 13 in.
Turning circle radius (with use of brakes):
  Made by outer front wheel ..... 8 ft.
  Made by centerline of tractor at rear axle ..... 3½ ft.
Shipping weight (including gasoline, oil, water, tires filled with air, operator not included) ..... 2,410 lbs.
Drawbar height ..... 8½ to 34¼ in., 18 in. standard setting

Gear Ratio	Final Gear Reduction	Speeds in M.P.H.		
		1500 R.P.M.	1750 R.P.M.	2000 R.P.M.
1 Low (first)	73.33 to 1	2.77	3.23	3.69
2 Plowing (second)	57.04 to 1	3.56	4.16	4.75
3 Cultivating (third)	41.45 to 1	4.90	5.72	6.54
4 High (fourth)	19.86 to 1	10.23	11.93	13.64
5 Reverse	44.64 to 1	4.55	5.31	6.07

NOTE: ***1500 R.P.M. is recommended for power take-off tools. 1750 R.P.M. is recommended when power take-off tools are not used.***

b. Capacities—U.S. Measure.

Fuel tank ..... 9 gals. standard
1 gal. reserve
10 gals. total

Engine oil pan (less filter absorption) ..... 5 qts.
Transmission, hydraulic lift, and differential ..... 5 gals.
Cooling system ..... 12 qts.
Oil bath air cleaner ..... 1 pint—Fill to indicated level
Belt pulley ..... 5/8 pint
Tire pressure:
10—28 4-ply ..... 12 lbs.
4—19 4-ply ..... 26 lbs.

c. Engine.

Type ..... 4-cylinder "L" head
Maximum Drawbar H.P. 2nd Gear 23.16
Rated Drawbar H.P. 2nd Gear (75% max.) 17.37
Maximum belt horsepower at 2000 R.P.M. 27.32
Rated belt horsepower (85% of max.) 23.22
Rated speeds ..... 1500, 1750, and 2000 R.P.M.
Idle speed ..... 400 R.P.M.
Cylinder bore ..... 3.188 in.
Stroke ..... 3.75 in.
Piston displacement ..... 119.7 cu. in.
Torque ..... 92 lbs. ft. at 1500 R.P.M.
Compression ratio 6.50:1
Sleeves ..... Dry type
Piston ..... Aluminum
Rings:
Compression 2
Oil 1
Piston pin ..... Full floating
Rod bearings ..... Replaceable shell-type
Main bearings ..... Replaceable shell-type
Crankshaft ..... Cast steel, static and dynamic balanced
Compression pressure at cranking speed (sea level)—90 lbs. minimum

d. Ignition System.

Type ..... Battery
Distributor:
Firing order 1-2-4-3
Drive ..... Spiral gear off camshaft
Automatic spark advance ..... Centrifugal governor
Initial timing (degrees of crankshaft) ..... 4° before T.D.C.
Maximum advance (degrees of crankshaft) ..... 18°
Distributor breaker cam ..... 4 lobe
Breaker contacts ..... 1 set
Breaker contact spacing ..... .024-.026

Spark plugs:

Type	Marked H-10
Size	14 mm
Gap	0.025 to 0.028 in.

e. Carburetor.

Type	Single up-draft
Idle fuel adjustment	1 turn
Main fuel jet	1 turn
Idle speed	1 turn

f. Governor.

Type	Variable speed, mechanically operated, centrifugal type
Governed speed range	800 to 2200 R.P.M.
Maximum governed speed adjustment	By set screw

g. Cooling System.

Radiator cap (pressure type):

Pressure valve opens at	3¼ to 4¼ lbs. per sq. in.
Vacuum valve opens at	½ to 1 lb. per sq. in.
Capacity	12 quarts

Water pump:

Type	Centrifugal
Drive	V-belt

Fan:

Type	4-blade pull.
Drive	V-belt

Thermostat:

Location	Cylinder head outlet hose
Starts to open	160-165° F.
Fully open	190-200° F.

h. Electrical System.

Generator:

Type	2-brush
Drive	V-belt

Rating:

1650 Engine R.P.M. (Hot)	20 Amps
Maximum output	20 Amps
Capacity	140 watts

Generator regulator:
- Cutout closing voltage ..... 6.0 to 6.6 volts
- Voltage limiter ..... 7.1 to 7.5 volts
- Cutout opening voltage .....5 to 1.5 volts less than the closing voltage or 6 amperes maximum reverse current at 6.0 volts minimum.

Battery
- Type 6-volt
- Number of plates (per cell) 13
- Capacity in ampere hours 80
- Terminal grounded ..... +

Starting motor:
- Type 6-volt
- Drive ..... Automatic engagement

i. Transmission.

Type ..... Constant mesh
Number of speeds forward 4

j. Clutch.

Type ..... Single plate
Release bearing (pre-lubricated) ..... Ball bearing
Pedal free travel ..... 3/4 in.

k. Rear axle.

Type ..... Semi-floating
Ratio ..... 6.66 to 1

l. Brakes.

Type ..... Internal expanding
Control ..... Individual, mechanical
Adjustment at each wheel ..... 1 screw
Brake pedal free play ..... 3/4 in.
Thickness of lining ..... 0.187 in.
Width of lining ..... 2.000 in.
Length of lining ..... 12.910 in.
Total brake lining area (two wheels) ..... 103.3 sq. in.

m. Steering Gear.

Type ..... Automotive ball nut
Ratio, turns of steering wheel for total travel of pitman arms, at 48 in. wheel tread 2.25
Steering wheel diameter ..... 18 in.

n. Hydraulic Control.

Type ..... Internal
Maximum pressure ..... 1500-1700 lbs. per sq. in.

Pump:

Type	Scotch Yoke piston
Drive	Direct power take-off shaft
Capacity:	
2000 engine R.P.M.	2.85 gals. per min.
1500 engine R.P.M.	2.15 gals. per min.
Control	Manual and automatic
Oil supply	Transmission and differential

o. Power Take-off Adapter.

Spline	1⅜
Speed (1500 engine R.P.M.)	545 R.P.M.

p. Belt Pulley.

Pulley speed (2000 engine R.P.M.)	1358 R.P.M.
Belt speed (2000 engine R.P.M.)	3199 ft. per min.
Pulley size (standard)	9 in.

q. Tractor Performance.*

Maximum Drawbar H.P. 2nd Gear	23.16
Rated Drawbar H.P. 2nd Gear (75% max.)	17.37
Maximum belt horsepower at 2000 R.P.M.	27.32
Rated belt horsepower (85% of max.)	23.22

*These results obtained from Nebraska Tractor Test No. 443.

Chapter II

CONTROLS and OPERATION

	Section
Operator's Controls	121
Instruments and Gauges	122
Tread Width Adjustment	123
Starting Engine	124
Operation	125
Power Take-off	126
Belt Pulley	127
Hitch Adjustments	128
Safety	129

121. OPERATOR'S CONTROLS.

Operator's controls are illustrated in figs. 3 through 7.

a. Brakes. Two-shoe, self-energizing mechanical brakes are provided at each rear wheel. They may be operated individually by foot pedals located on the right side of the transmission. Both brakes may be applied by depressing the two pedals with the right foot. Only a slight pressure on the brake pedals is required because of the self-energizing action which automatically increases the engagement pressure at the brake shoes. The brakes may be set by engaging the brake pawl at end of brake control shaft (figs. 3 and 4). The

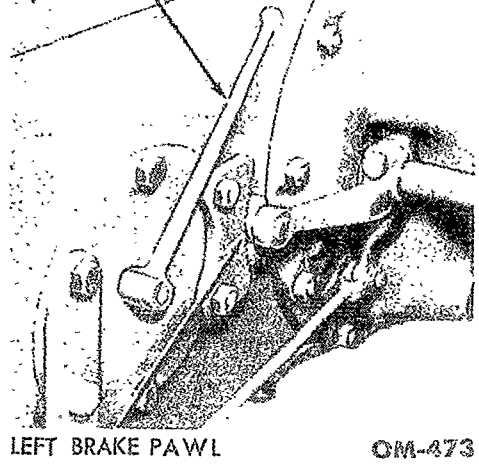


Fig. 3—Power Take-off Lever

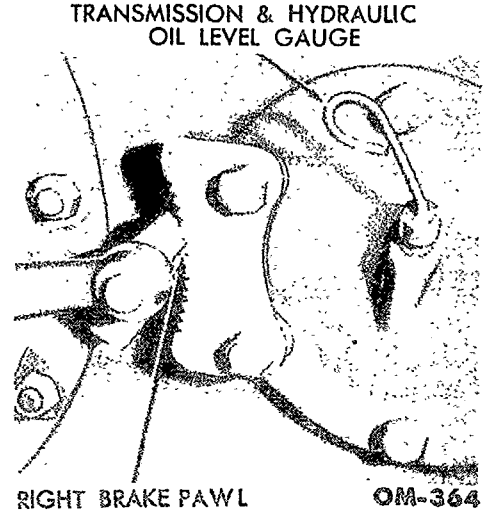


Fig. 4—Brake Pawl

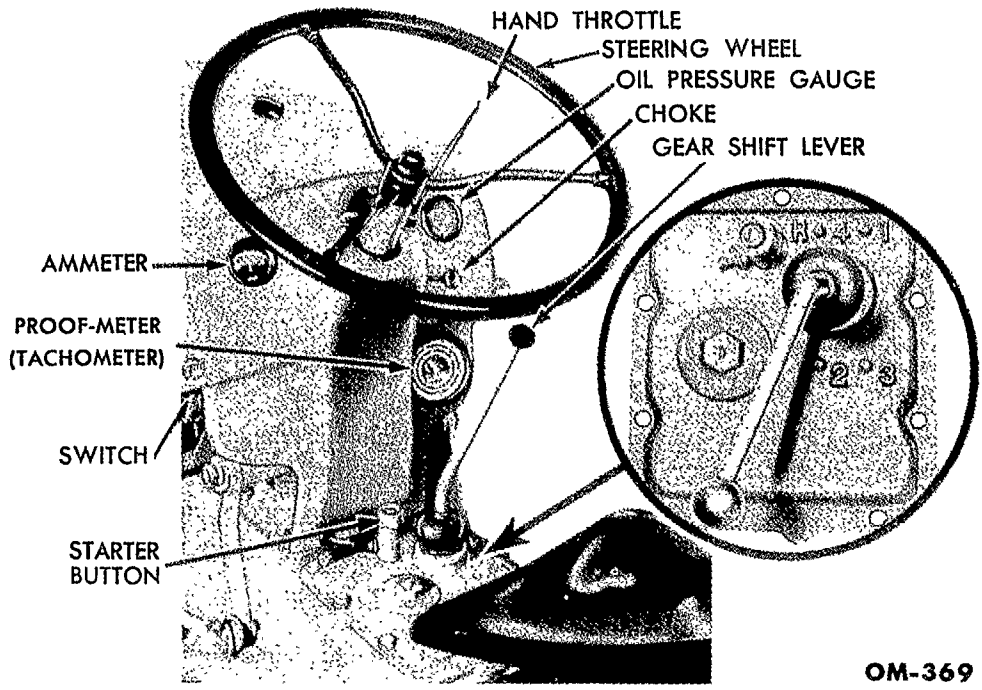


Fig. 5—Operator's Controls

brakes may be used individually to assist in making short turns, and both brakes should be applied to bring the tractor to a stop.

b. Throttle Control. The hand-throttle control is located on the right side of the steering column. The throttle controls the engine speed through a flyball mechanical governor.

c. Clutch Pedal. The clutch pedal is located on the left of the transmission housing. The clutch pedal is depressed to release the transmission from the engine. Avoid operating the tractor with the foot resting on the clutch pedal as this results in premature clutch wear.

d. Gearshift Lever. The gearshift lever is on top of the transmission housing and forward of the seat. Fig. 5 shows the position of the lever for the five gear ratios. The gearshift position is marked on the transmission cover plate for all gears.

e. Power Take-off Lever. The power take-off lever (fig. 3) is part of the inspection plate assembly on the left side of the center housing. In the forward position the power take-off is disengaged. Depress the clutch pedal when engaging or disengaging the power take-off shaft while the engine is running.

f. Hydraulic Control. Constant implement draft and position control are the two types of automatic control incorporated in the Ford tractor hydraulic control.

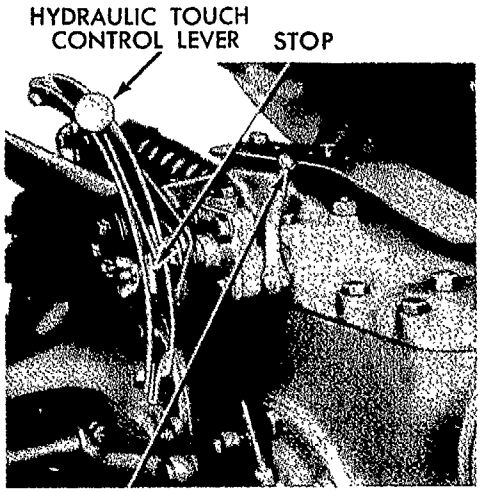


Fig. 6—Hydraulic Control Levers

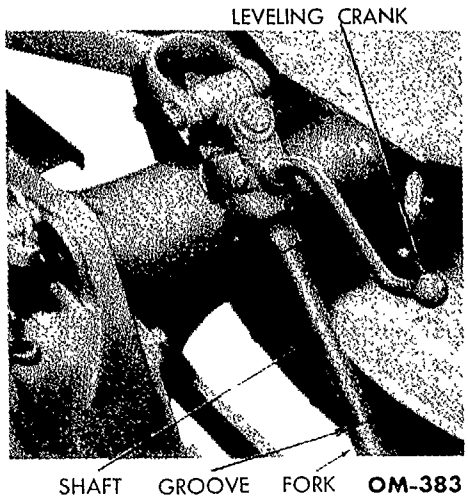


Fig. 7—Leveling Crank

The position control lever is the small lever located on the right side of the hydraulic control cover under the seat. The hydraulic control operates under position control when this lever is in the vertical position, and under constant draft control when it is in the horizontal position.

The hydraulic touch control lever is the large lever located directly behind the position control lever. The hydraulic touch control lever is the master control lever of the hydraulic control, and positioning it governs both the constant implement draft and the position control (fig. 6).

When raising the hydraulic touch control lever, the drawbar or implement will raise. The power take-off shaft must be engaged to operate the hydraulic control. The hydraulic lift mechanism must not be used when the drawbar stays are installed on the tractor. The drawbar stays (fig. 12) are the two steel braces installed between the drawbar and the top link yoke.

Constant draft is the control commonly used with tillage tools. The implement will operate at a predetermined depth as long as the soil is uniform. The constant draft control will automatically reposition the implement as needed when crossing ridges and ditches.

The improved rocker has two additional holes for the top link attachment for occasions when the draft of the implement is so light that little or no reaction is registered through the main control spring. In such cases it will be possible to raise the top link into one of the additional positions provided to increase its leverage over the main control spring.

A general rule that may be followed regarding the position of the link in the rocker is that the top hole is for light draft, middle hole for medium draft and bottom hole for heavy draft. If an implement with heavy draft is used with the link in the top hole it upsets the balance of the hydraulic control, which can be corrected by putting the link in the bottom hole.

The position control is used when implement adjustment is controlled by the position of the lower links. The use of this control also maintains a constant tillage tool depth when operating on level ground regardless of uniformity of soil texture.

Some hydraulically controlled, pull type, disk harrows, scoops, and grain drills are examples of tools with which the position control may be used.

g. Drawbar Stays. Drawbar stays (fig. 12) are used to support the drawbar when employing many pull type implements. When the drawbar stays are being used, the lower links (fig. 12) should not be raised with the hydraulic control as such action may damage the drawbar stays.

The safety chain, attached to the right drawbar stay, should be installed to lock the hydraulic touch control lever at the bottom of the quadrant.

If the power take-off is not being used, it should be disengaged by means of the power take-off lever, when using the drawbar stays.

h. Leveling Crank. Turning the leveling crank, located to the right of the operator and in back of the tractor seat, raises or lowers the right lower link. This action will level the 3-link mounted implements to give the desired performance. The two lower links are level when the groove on the shaft is just visible above the fork (fig. 7).

i. Fuel Shut-off Valve. The fuel shut-off valve is located on the left side and below the gasoline tank (fig. 2). The valve is turned to the right to shut off the fuel. Opening the shut-off valve two turns will allow the main fuel supply to be fed to the carburetor. One gallon of fuel, called the reserve supply, cannot be used with the valve in this position. By opening the shut-off valve wide open, the reserve fuel can be used. The operator may drive the tractor on this reserve fuel to the source of refill.

j. Choke Rod Button. The choke button is located on the right-hand side of the instrument panel (fig. 5).

k. Starter Button. The starter button is located to the left of the gearshift lever (fig. 5). It is equipped with a safety latch which will allow the starter button to complete the starting motor circuit only when the gearshift lever is in the neutral position.

l. Ignition Switch. The ignition switch is located on the lower left-hand corner of the instrument panel (fig. 5). The ignition switch is ON when the key is in the vertical position.

122. INSTRUMENTS AND GAUGES.

Instruments and gauges are provided so that an operator can easily check the performance of the tractor during operation.

a. Ammeter. The induction type ammeter, located on the left-hand side of the instrument panel, indicates the amount of current flowing into or from the battery. The current flow is controlled by the generator regulator, and will vary with the electrical load and condition of the battery. When the battery is fully charged the ammeter will indicate a low charging rate.

b. Engine Oil Pressure Gauge. The oil pressure gauge, located on the right side of the instrument panel, indicates the oil pressure at the engine bearings. The gauge should read approximately 27 pounds per square inch at 1500 R.P.M., or half throttle, when the engine is at operating temperature. The oil pressure will be higher than normal when the engine is cold. The oil pressure will decrease as the engine speed is decreased. Failure of the gauge to indicate pressure is usually caused by a low oil level in the crankcase. If the pressure is low, the oil level should be checked immediately.

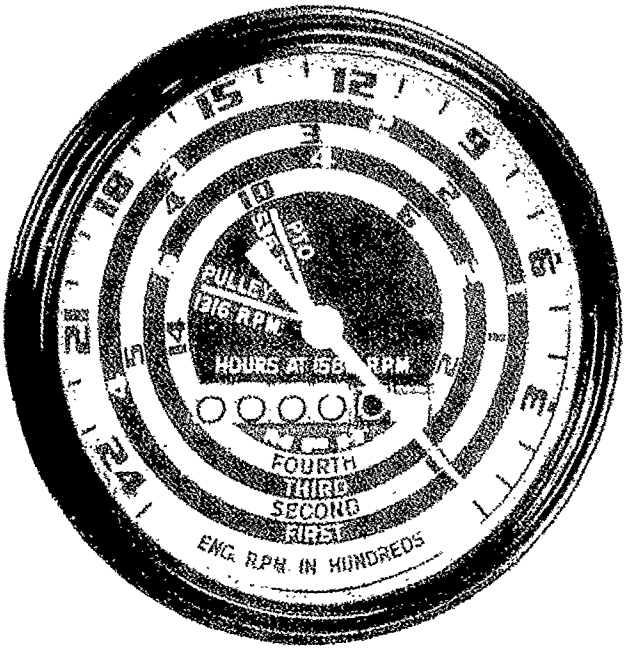


Fig. 8—Illustration of Proof-Meter

c. Proof-Meter (Tachometer). The proof-meter (tachometer) indicates engine revolutions per minute, tractor ground speed in the various forward gears, power take-off speed, pulley speed and operating hours. Engine revolutions per minute and miles per hour tractor speed are both indicated by the long pointer on face of dial. Ring at perimeter of proof-meter represents engine revolutions per minute in hundreds. The remaining four rings represent tractor ground speed based on gear ratio selected. For example, when tractor is operating in first speed, tractor miles per hour is indicated by the figure the long pointer points to in the ring labeled first. Second, third and fourth speed are read in their respective order as labeled on face of dial.

The hourmeter registers hours of engine operation. The checkered wheel indicates a lapsed engine time in increments of 1/100 hour for each black or white checker. The next hourmeter wheel registers 1/10 hour. The next four figure wheels register accumulated hours. One hour on hourmeter represents one clock hour of tractor operation at 1580 engine revolutions per minute. Engine speed below 1580 revolutions per minute, however, will accumulate hourmeter hours slower than clock hours. Engine speed in excess of 1580 revolutions per minute registers faster than clock hours. Total hourmeter incorporates seven figure wheels and is designed so that as each wheel finishes a complete revolution it turns the next figure wheel 1/10 of a revolution.

Proof-meter provides an accurate means of determining when the tractor should be lubricated in hours of operation. Refer to Lubrication Chart (fig. 22).

(1) *MAINTENANCE.* When installing a new proof-meter cable, disconnect casing nut from proof-meter and remove cable by pulling it out of casing. If cable is broken, lower section of cable can be pulled out after disconnecting casing nut at engine governor. Replace cable if it is kinked, broken or distorted. A casing radius of not less than five inches must be maintained at bends.

(2) *LUBRICATION.* Proof-Meter is lubricated at the factory prior to assembly. Whenever it becomes necessary to replace cable due to cable breakage, replacement cable must be lubricated.

Spread a thin layer of graphite grease over lower two-thirds of cable. When cable is reinstalled, lubricant will spread over its entire length. Over lubrication may result in failure of proof-meter.

d. Oil Level Gauges. The bayonet gauge for the engine oil level is located on the left-hand side of the engine block. (fig. 2). The transmission and hydraulic oil level gauge is located on the right-hand side of the center housing (fig. 4). Both oil level gauges have calibrations showing the full and minimum oil levels.

e. Radiator Cap. The radiator cap is of the pressure type. It must have an air-tight fit for the engine to have efficient cooling. When removing the cap, turn it slowly to the first notch. After the vapor pressure has escaped, the cap can be safely removed.

123. TREAD WIDTH ADJUSTMENT.

A large selection of wheel spacing is provided to satisfy the requirements of field crops.

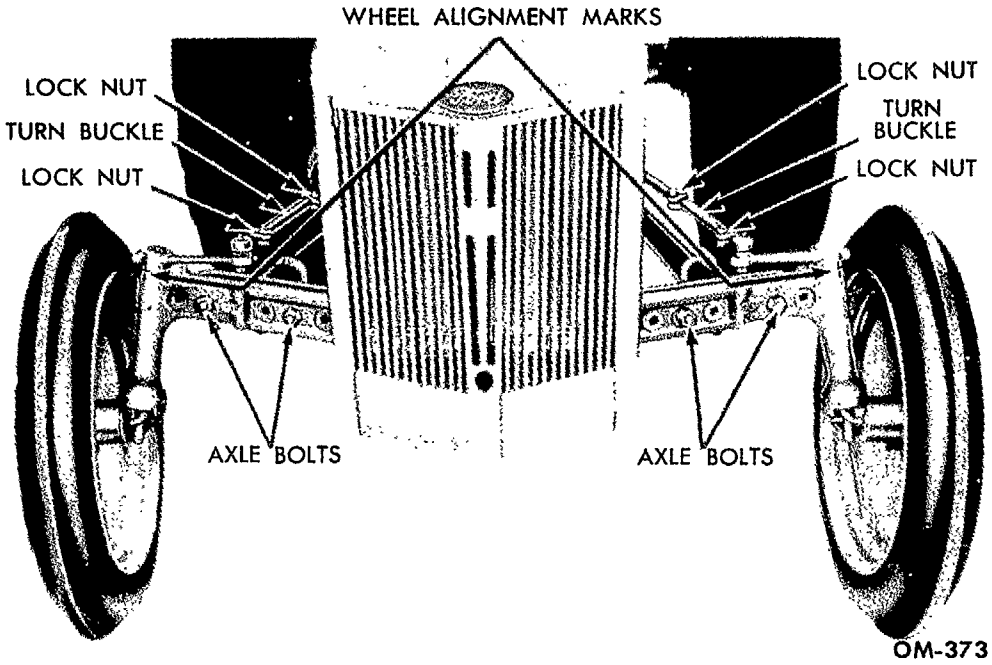


Fig. 9—Front Wheel Tread Adjustment

a. Rear Wheels. The rear wheels are adjustable from 48 to 76 inches tread in 4-inch spacings. Tread width settings are made by changing the position of the steel disks and the rims. The tread is widened by installing wheel disks in convex or concave position and/or by installing rims in any of the four positions as shown in fig. 11. To make the change from 52 inch tread to 72 inch tread, it is only necessary to change the wheels from one side of the tractor to the other. Other wheel changes are similar and are shown in fig. 11.

NOTE: ***In making tread adjustments, the arrow on the side wall must always point in the direction of the rotation of the wheel during forward travel, thus assuring proper cleaning of the tire tread.***

b. Front Wheels. The front wheels are adjustable from 48 to 76 inches in 4-inch spacings. The 48 to 72-inch spacings are obtained

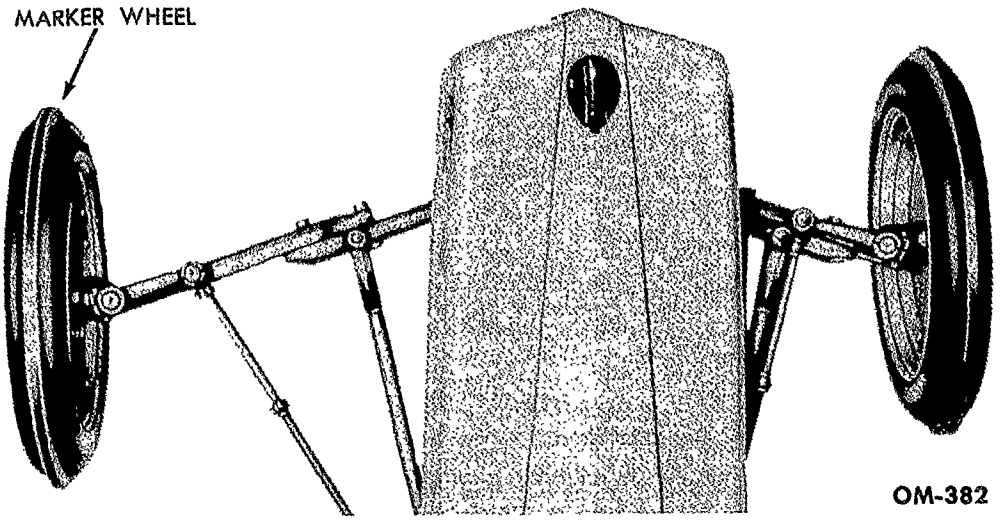


Fig. 10—Front Wheel Adjustment For Use as Marker

by jacking up the front end of the tractor and removing the four bolts holding the three sections of the front axle (fig. 9). Move the front wheels to the desired tread width, and replace the four bolts. Always have at least one open hole between the bolts. The 76-inch wheel spacing is obtained by reversing the front wheels and setting the axle for the 68-inch tread. It is possible to obtain front wheel

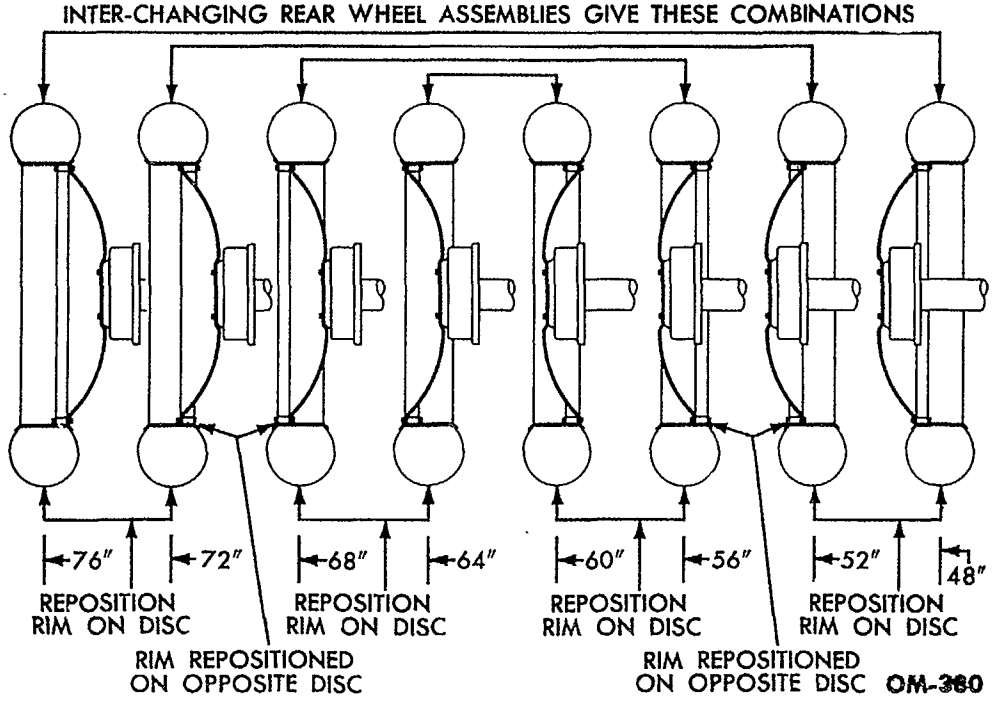


Fig. 11—Rear Wheel Tread Adjustment

tread spacings wider than the 76-inch setting, however, these are not recommended.

The drag link must be adjusted when changing the wheel tread. With the steering wheel in the center position, loosen the lock nuts on the drag links and turn the turnbuckle with the plow wrench until the steering arm slot is aligned with wheel alignment marks top outside edge of spindle housing. Tighten the lock nuts on the turnbuckle. Adjust the other drag link by the same procedure. This will assure obtaining the desired amount of toe-in of the front wheels. If desired, one front wheel may be set out for use as a marking or guide wheel (fig. 10).

124. STARTING ENGINE.

Before attempting to start the engine, make sure that the function of each control and instrument is thoroughly understood. The gearshift lever must be in neutral (fig. 5) before the starter button can be depressed.

To start the engine, turn the ignition switch on, and partially open the throttle. Hold the clutch pedal down, and press the starter button. If the engine does not start promptly, pull the choke button out for several engine revolutions. Use the choke as needed until the engine runs smoothly. During cold weather it may be desirable to let the engine run at approximately ⅓ throttle for 5 minutes to warm up.

NOTE: ***If the engine is hot and does not start promptly, pull the hand throttle down while the engine is being cranked. Do not use the choke. If the engine fails to start, refer to section 221.***

125. OPERATION.

Successful and economical operation of the tractor depends largely upon the skill of the operator. This section gives the essential operating principles.

a. Setting the Tractor in Motion. Before attempting to set the tractor in motion, make sure that the brakes are released. After the engine is running smoothly, fully depress the clutch pedal (fig. 2), and move the gearshift lever to the desired gear. Slowly release the clutch pedal as you increase the engine speed. Increase the engine speed until the tractor is traveling at the desired speed. The tractor should be started in the same gear in which it is to be operated.

NOTE: ***Do not shift gears while tractor is in motion as the transmission may be damaged.***

b. Steering Tractor. The steering wheel turns the front wheels which will steer the tractor. The brakes, used independently, may be

used to assist in making short turns and when pulling heavy loads, with one wheel tending to spin.

c. Choice of Gear Ratios. By intelligent selection of the working gear for a particular field operation, the operator can save fuel and engine wear. Tractors operating in a low gear with a light load and high engine speed are wasting fuel. An engine operating at a high speed and a light load is running with a high manifold vacuum and a low compression pressure which cause inefficient combustion. "Lugging" is a term applied to a condition of excessive engine load for a selected gear and throttle setting. Lugging of an engine increases the wear. The Ford tractor has four forward speeds (fig. 5) to provide for different operating conditions.

	Speed at 1500 R.P.M.
1st for heavy work	2.77 M.P.H.
2nd for plowing	3.56 M.P.H.
3rd for cultivating	4.90 M.P.H.
4th for light work	10.23 M.P.H.

d. Use of Gauges. The operator should be familiar with the ammeter, oil pressure gauge and proof-meter and read them frequently while operating the tractor. When these readings appear abnormal, the engine should be stopped and the cause determined.

e. Stopping the Tractor. Depress the clutch pedal, and at the same time reduce the engine speed. Apply the brakes as needed. The

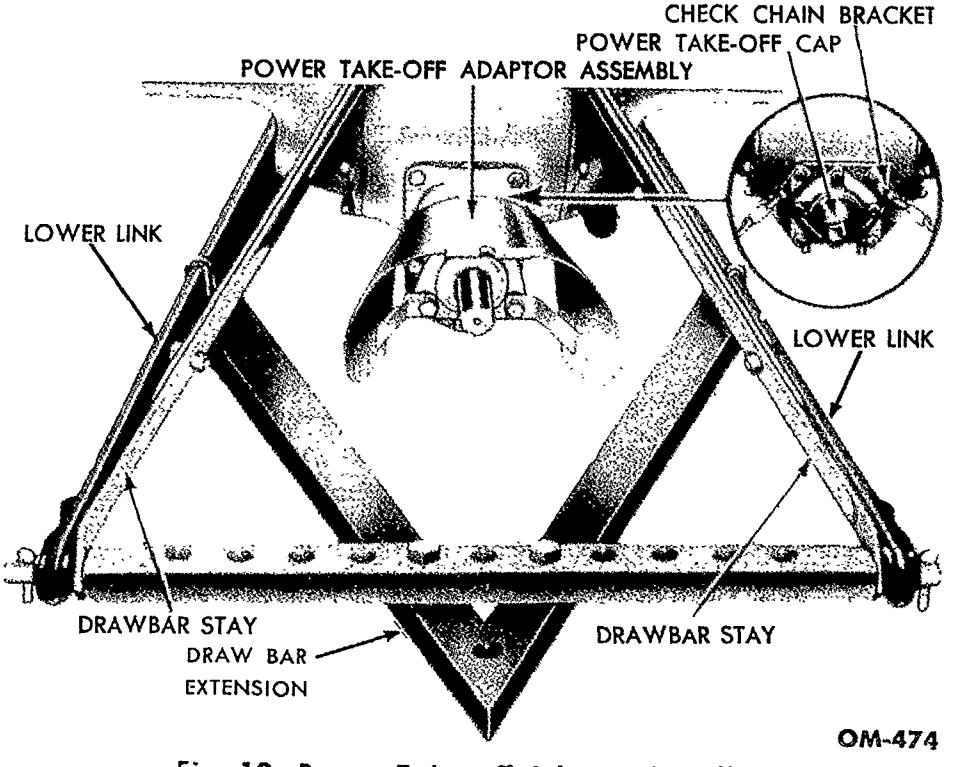


Fig. 12—Power Take-off Adapter Installed

gearshift lever should be shifted to neutral and the brakes set.

f. Hydraulic Control and Leveling Crank. The operator may adjust the hydraulic controls and leveling crank (figs. 6 and 7) while the tractor is in motion to obtain the desired implement performance (sec. 121). Position the hydraulic touch control lever stop so the lever can be immediately positioned when lowering the implement. Temporary changes of the lever position may be made beyond the stop.

To prevent possible damage to the hydraulic control mechanism, all implements should be transported with the hydraulic control linkage in the uppermost position.

g. Belt Pulley Operation. The belt pulley should be installed as outlined in section 127. The tractor must be positioned so the drive and driven pulley shafts are parallel and a line connecting the two pulleys is perpendicular to the pulley shafts. The belt tension is adjusted by slowly driving the tractor away from the driven pulley. When the desired tension is obtained, set the wheel brakes and place blocks behind both rear tires. While adjusting the belt tension it may be necessary to slip the clutch. Never slip the clutch more than absolutely necessary. To start the pulley rotating, depress the clutch pedal (fig. 2), engage the power take-off shaft (fig. 3), and slowly release the clutch pedal as the engine speed is gradually increased. Large changes in throttle setting should be made slowly except in emergencies. Short belts must be kept tight to reduce slippage. Belt dressing should only be used as a last resort to reduce slippage. While using the belt, the tractor should be grounded by means of a chain or other conductor of electricity to prevent the building up of a static charge. Installing a shield over exhaust line will protect belt from heat, thus assuring longer belt life.

126. POWER TAKE-OFF.

The power take-off is used to transfer engine power direct to mounted and drawn implements, and to the belt pulley. Release load on P.T.O. by disengaging before shifting gears.

a. Power Take-off Adaptor. The power take-off adaptor has a 1⅜-inch spline shaft and meets the American Society of Agricultural Engineer's specifications for a standard tractor hitch. Any implement built to these standards may be hitched to the Ford tractor without the purchase of additional accessories. The power take-off safety shield is built to A.S.A.E. standards and is attached to the implement power shaft shield.

NOTE: *Always use this shield. It is designed to protect the* **operator.**

To install the power take-off adaptor, first remove the power take-

off cap (fig. 12). Remove the four cap screws which hold the check chain brackets to the center housing. Insert the power take-off adaptor over the spline of the power take-off shaft with the grease fitting on the bottom, and fasten it to the center housing with the four cap screws (fig. 12). Drawbar stays should always be used when using the power take-off adaptor. Adjust the drawbar stays to give a drawbar height of 12 inches. Install the drawbar extension. To remove the power take-off adaptor, follow reverse procedure for installation. NOTE: ***Check chain must be attached with the short section of the bracket on top (fig. 12). If the brackets are not installed correctly, it is impossible to raise the lower links to the top of their travel, thus resulting in excessive pressure in the hydraulic pump.***

b. Power Take-off Speeds. The Ford tractor engine has a triple speed rating of 1500, 1750 and 2000 R.P.M. A.S.A.E. standards call for a power take-off speed ot 526 to 546 R.P.M. The 1500 R.P.M. engine rating meets the A.S.A.E. power take-off speed standard. Implement manufacturers design their tools for this power take-off speed. NOTE: *The 2000 R.P.M. engine rating is for belt work only. The 1750 R.P.M. rating is for general field use without power take-off tools.*

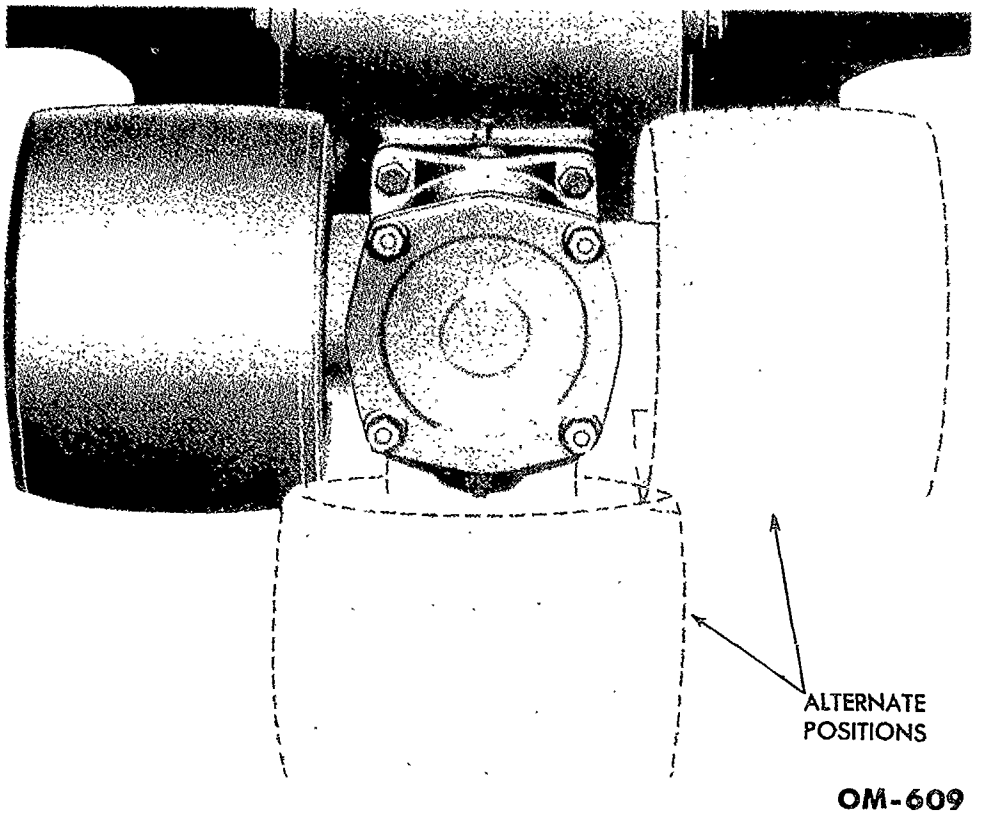


Fig. 13—Belt Pulley

127. BELT PULLEY.

American Society of Agricultural Engineers have standardized the belt speed on farm tractors. Using the standard 9-inch pulley (fig. 13), this belt speed is obtained at the 2000 R.P.M. engine rating. A belt-driven implement designed to these standards will be run at the correct speed without changing any pulleys. Some implements do not meet this standard and others have had the driven pulley changed. For these reasons, it is advisable to determine the revolutions per minute by reading the proof-meter.

The following formulas may be used in calculating belt pulley sizes and pulley speeds:

(a) The diameter of the driven pulley equals the R.P.M. of the drive pulley multiplied by the diameter of the drive pulley divided by the R.P.M. of the driven pulley.

(b) The diameter of the drive pulley equals the R.P.M. of the driven pulley multiplied by the diameter of the driven pulley divided by the R.P.M. of the drive pulley.

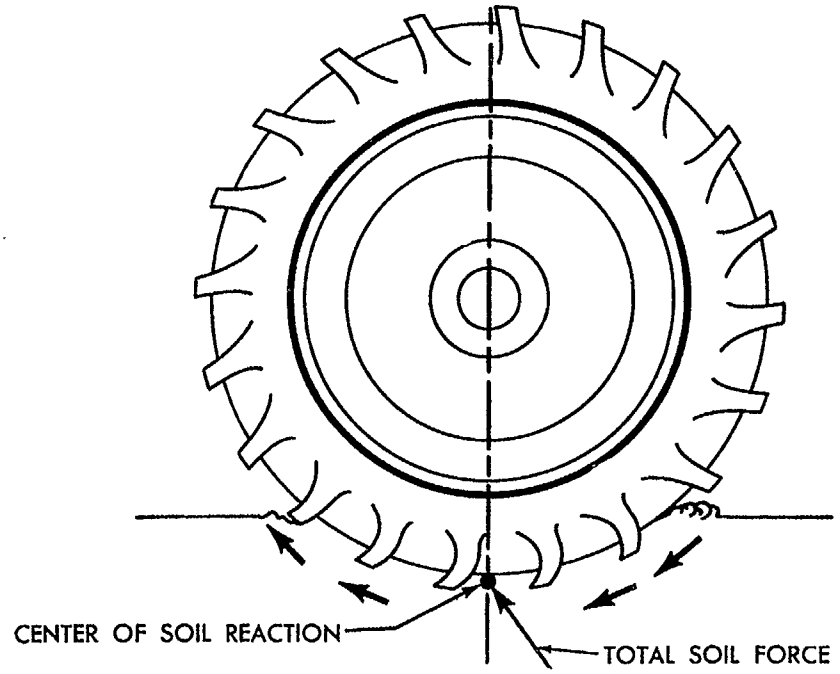


Fig. 14—Center of Soil Reaction

(c) The R.P.M. of the driven pulley equals the R.P.M. of the drive pulley multiplied by the diameter of the drive pulley divided by the diameter of the driven pulley.

(d) The R.P.M. of the drive pulley equals the R.P.M. of the driven pulley multiplied by the diameter of the driven pulley divided by the diameter of the drive pulley.

(e) The belt speed in feet per minute equals the R.P.M. of the

pulley multiplied by the circumference of the pulley in feet.

(f) The R.P.M. of the pulley equals the belt speed in feet per minute divided by the circumference of the pulley in feet.

NOTE: ***The circumference in feet may be obtained by multiplying the pulley diameter in feet by 3.1416.***

a. Belt Pulley Installation and Pulley Positions. The belt pulley may be installed in three positions.

The two horizontal positions are the most commonly used (fig. 13). The direction of the pulley rotation is reversed by changing the position of the pulley from one side to the other. Choice of the horizontal position will allow the operator to use a straight or crossed belt. It will also allow the tractor to be shifted to the right or left if it is desirable.

The vertical position (fig. 13) is used where the driven pulley is vertical.

NOTE: ***Do not install the pulley in the vertical position above the power take-off shaft.***

To install the belt pulley assembly, remove the power take-off cover (fig. 12). Remove the four cap screws which hold the two lower link check chains. Engage the spline of the pulley assembly on the power take-off shaft. Rotate the pulley assembly to the desired position and secure it with the four cap screws. To remove the pulley assembly, reverse the mounting procedure.

NOTE: ***Check chains must be attached with the short section of the bracket on top. If they are not installed correctly, it will be impossible to raise the lower links to the top of their travel, thus resulting in excessive pressure in the hydraulic pump.***

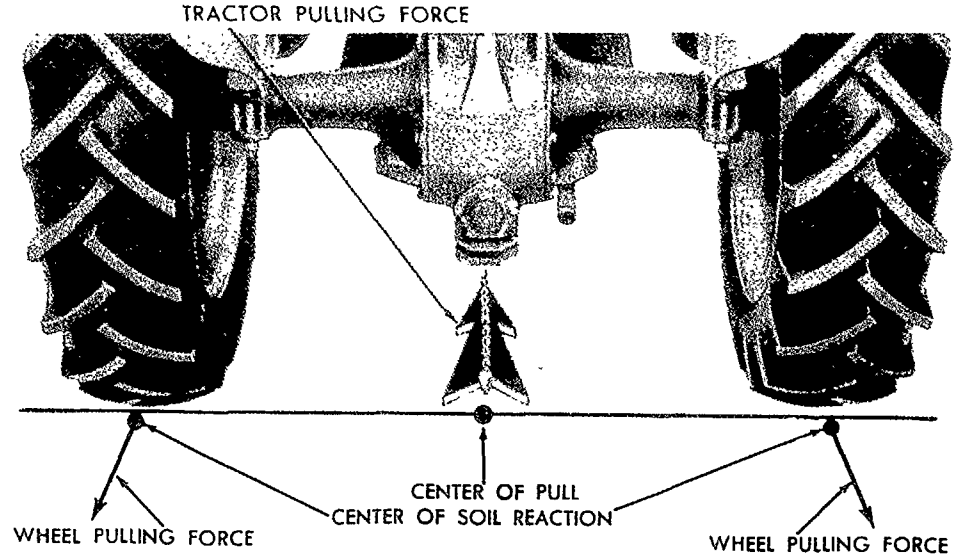


Fig. 15—Center of Pull

128. HITCH ADJUSTMENTS.

Pulling forces on a tractor drive wheel equipped with rubber tires may be considered concentrated at a point near the ground level and directly below the center of the rear axle. This point is called the center of soil reaction. Fig. 14 illustrates the direction of the soil forces, total soil force, and the location of the center of soil reaction.

Half-way between the center of soil reaction of each wheel is the balance point of the tractor pulling forces. This is called the center of pull (fig. 15). Hitch adjustments must be considered from the center of pull. On the Ford tractor the center of pull is near the

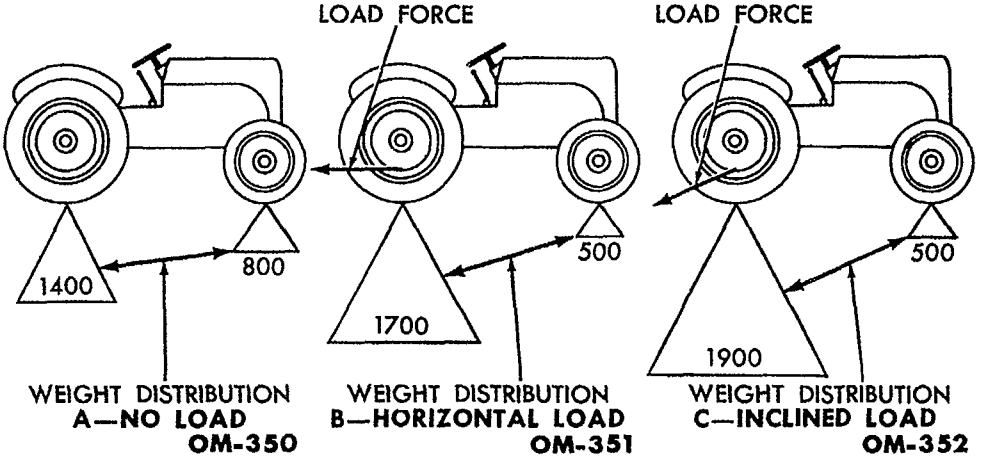


Fig. 16—Vertical Hitch Adjustments

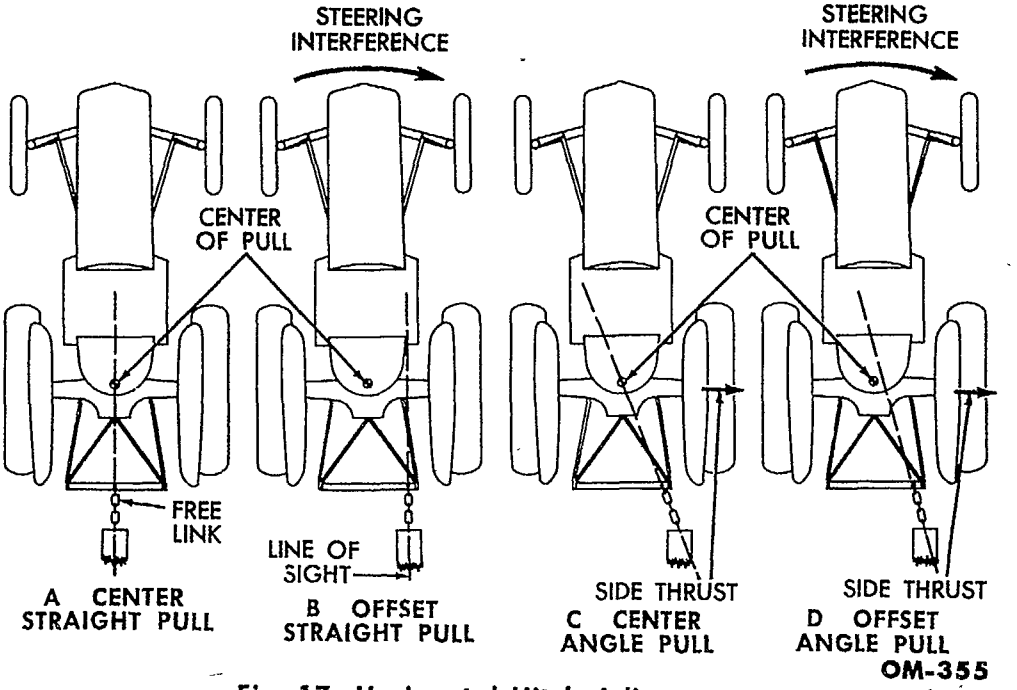


Fig. 17—Horizontal Hitch Adjustments

ground level, and directly below the rear axle midway between the rear wheels.

a. Vertical Hitch Adjustment. The load hitch point is above the center of pull when using a drawbar. This hitch position reduces front wheel weight and increases rear wheel weight. Additional traction is obtained from this weight transfer. This additional traction results in less rear wheel slip and therefore effects a saving in fuel. Compare fig. 16 A, B, and C.

If the center of load is below hitch point, additional traction is secured. Fig. 16C illustrates how additional traction is obtained.

As a general rule, the higher the hitch point the more weight is transferred from the front wheels to the rear wheels.

CAUTION: ***A tractor drawbar should be adjusted to have sufficient front end weight for steering and safety (sec. 129). Pull only from the drawbar. Pulling from the top link or the rear axle is definitely dangerous.***

The Ford tractor drawbar height may be adjusted with the hydraulic touch control lever (fig. 6) when not using drawbar stays.

b. Horizontal Hitch Adjustment. The field method of determining the correct horizontal drawbar hitch is by inserting a short chain or clevis as a free link between the implement and tractor hitch point (fig. 17). When under load, the free link will take a line connecting

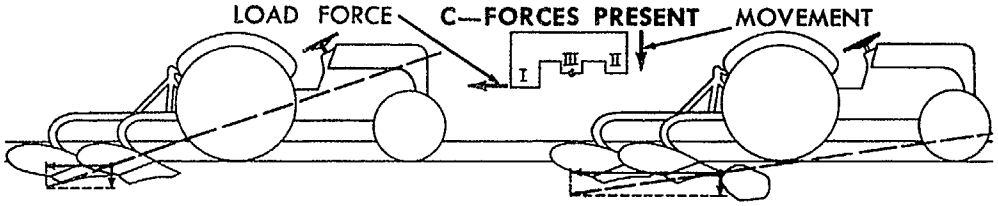


Fig. 18—Safety Design Features

the hitch point and the center of load (fig. 17). The center of load is the balance point of the load forces. By sighting down the free link (clevis or chain), it is possible to determine the position of this line with reference to the center of pull. Study fig. 17 A, B, C, and D to determine the type of hitch and operating characteristics.

If different hitch characteristics are desired, move the hitch point to the right or left as needed.

The best hitch for a particular operation may be any one of the four types. In many farm implements the hitch is necessarily a compromise. The side thrust on the drive wheels is not serious, since the Ford tractor is designed to carry this thrust.

On hillside work the offset straight pull or offset angle pull may be

used to hold the tractor on the slope. In this case it may be easier to steer the tractor.

The center straight pull is the most common hitch. The center angle pull, offset straight pull, and offset angle pull are sometimes referred to as side draft.

Intelligent hitch adjustment gives improved tractor performance and ease of operation.

c. Mounted Implement Hitch. Mounted and drawn implements have the same hitch principles. Implements engineered by Dearborn Motors, Inc. are designed for the Ford tractor and hitch adjustments are engineered in the design. For details of individual mounted implement adjustments, refer to the implement instruction book.

Fig. 18 shows the load force line when plowing under ordinary conditions. When an obstruction is hit, the horizontal load force is greatly increased and the center of load is lowered. Compare horizontal load forces in fig. 18A and B. The load force line is lowered and is much flatter when the obstruction is hit. This tends to increase the front end weight. Fig. 18C illustrates some of the forces present when the plow hits an obstruction. When a pull is exerted on point I, there is a tendency to force point II down since point III is the pivot point. Points I, II and III represent the following:

I—Load force
II—Front wheels
III—Rear wheels

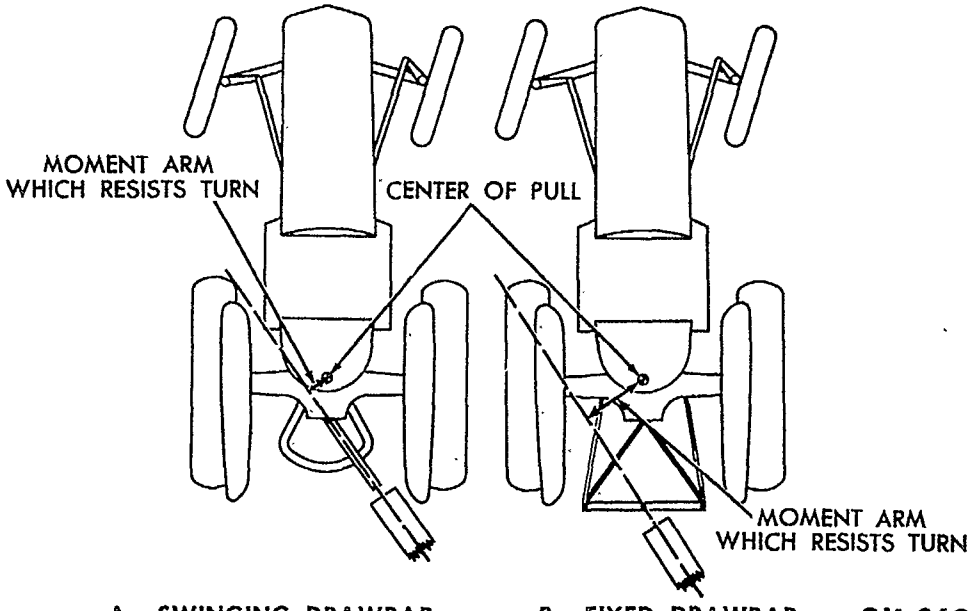


Fig. 19—Turning With a Drawbar Load

Mounted plow hitch principles and adjustments are outlined in Part FOUR.

d. Swinging Drawbar. A swinging drawbar may be used on many drawbar loads. It is easier to turn the tractor when the swinging drawbar is used. This may be accomplished by reducing the moment arm (leverage) of the load force which is resisting the turning effort, as shown in fig. 19.

e. Wheel Weight. In many farming operations it is desirable to add weight to the tractor to increase traction. Liquid in tires is the most popular method of adding weight as the weight is in the tire where it is the most beneficial. Calcium chloride solution has the advantage of a low freezing point and of weighing more per gallon than water. In a few cases, liquid is added to the front tires as a counterbalance for a heavy implement that is to be transported on the three links. Fluid in tires has the advantage of placing weight

SIZE OF TIRE	MAXIMUM CALCIUM CHLORIDE SOLUTION		
	Calcium Chloride, Lbs.	Gals. Water	Weight of Solution
10—28 4-ply	116	23	310 lbs.
6.00—16 4-ply	30	6	80 "
6.00—16 6-ply	30	6	80 "
4—19 4-ply	15	3	40 "
5.50—16 4-ply	25	5	65 "

Fig. 20—Maximum Recommended Tire Fluid Capacities

where it is needed and not interfering with tractor use. However, unneeded weight added to the tractor will result in a waste of fuel and added load on the engine, therefore weight should be added only if necessary. Fig. 20 shows maximum recommended tire liquid capacities. This table is based on the tires being 90% full with 5 pounds of calcium chloride per gallon of water. The addition of this amount of calcium chloride will prevent freezing. Multiplying the table figures by 0.8 will give the data for valve level filling. To fill tires 90% full requires special equipment.

Tractors often require added weight to reduce tire slippage. The added weight, together with the weight of the mounted implement and tractor, should not exceed the table of recommended weight to be carried by the tires. Fig. 21 lists the maximum recommended weight that can be carried without overloading the tires.

Weighing the front or rear end of the tractor is a good method of measuring tire loads. A tractor equipped with 4.00 x 19—4-ply front tires carrying 26 pounds per square inch air pressure should not weigh more than 1,100 pounds or 550 pounds per front wheel.

f. Tire Slippage. When a tractor pulls a load, there is measurable tire slip. Excessive slippage causes additional tire wear and fuel consumption. For example, if 10 rear wheel revolutions should have given 120 feet of travel but slippage reduced this to 90 feet, there is a slip of 25 per cent.

Measure slip by first counting rear wheel revolutions required to travel 100 feet at no load. Drive tractor under load the same number of wheel revolutions. Difference in distance traveled in feet in two runs is per cent of slip. Slip in excess of 12% causes excessive tire wear. Reduce excessive slip by adding weight to tractor or reducing drawbar load.

Economical operation is achieved by using the least amount of weight necessary to keep slippage at a minimum.

MAXIMUM RECOMMENDED POUNDS LOAD PER WHEEL ON LIGHT-DUTY WHEELS MARKED "L" IS 795 LBS.		
TIRE SIZE	Inflation Pressure	Maximum Lbs. Tire Load Per Wheel
Rear Wheels:		
10—28 4-ply	12	1575
10—28 4-ply	14 Max.	1720
Front Wheels:		
4—19 4-ply	20	470
4—19 4-ply	24	525
4—19 4-ply	26	550
4—19 4-ply	28 Max.	575
6.00—16 4-ply	20	750
6.00—16 4-ply	24	835
6.00—16 4-ply	26	875
6.00—16 4-ply	28 Max.	915
6.00—16 6-ply	20	750
6.00—16 6-ply	24	835
6.00—16 6-ply	26	875
6.00—16 6-ply	28	915
6.00—16 6-ply	32	990
6.00—16 6-ply	36 Max.	1065
6.00—16 8-ply	56	1370
6.00—16 8-ply	60 Max.	1430
5.50—16 4-ply	28 Max.	795

Fig. 21—Maximum Recommended Tire Loads

129. SAFETY.

The Ford tractor embodies all the safety features consistent with good performance. This section describes these safety features, and gives many helpful hints on accident prevention.

a. Four-wheel Construction. Field crops determine the necessary row clearance and wheel spacing. Additional tractor stability is obtained by building a tractor as low as possible and with four-wheel construction. A low four-wheel tractor can be turned quickly with additional safety. The safe turning speed on level ground may not be safe on a slope. A negative bank of 20 degrees will reduce the safe turning speed about 25 per cent.

b. Hitch Construction. Drawbar linkage is designed as a built-in safety feature. If the front end should start to raise under load, the drawbar is rapidly lowered which greatly reduces the effectiveness of the force tending to overturn the tractor.

c. Safe Starting. It is necessary for the transmission to be shifted to neutral before the starting motor can be operated through the starter button. This prevents starting the engine when the tractor is in gear and greatly reduces the possibility of a serious accident.

d. Power Take-off Shield. The shield on the power take-off adapter meets the standards of the American Society of Agricultural Engineers. Power shaft shields on implements will fit this shield. Always use the power shaft shield. It is provided for your protection.

e. Dangerous Conditions. The following dangerous conditions should be carefully noted. By following the simple precautions given here, accidents can be avoided.

(1) *REAR WHEELS FROZEN TO THE GROUND.* If the rear tractor wheels are frozen solidly to the ground, it is possible for the tractor to rotate around the rear axle. Under these conditions the tractor should be backed up to free the wheels as the front wheels of the tractor will not raise in reverse gear. If backing the tractor is impossible, the ice under the wheels should be first removed mechanically or by salt before driving the tractor forward.

(2) *VERY HIGH HITCH.* The tractor hitch is the part of the tractor designed for pulling. Pulling from the top link, or from the axle housing, can cause the front end of tractor to raise under ordinary loads. *Always hitch to the drawbar.*

f. Avoiding Accidents.

(1) Good judgment is the best accident preventive.

(2) Reduce speed on turns.

(3) If the front end tends to raise, use reverse gear. Do not operate the tractor forward under these conditions.

(4) When pulling, use the drawbar.

(5) Use good judgment when pulling loaded wagons in high gear.

(6) Your tractor has many built-in safety features not found on most tractors as standard equipment.

The electric starter is much safer than the outmoded method of cranking the engine by hand. Design of starting button is such that the engine cannot be started unless the shifting lever is in neutral position. An ignition lock is also provided so that unauthorized persons, such as small children, cannot start the tractor without your permission.

Chapter III

STORAGE

Section

Preparing Tractor for Storage 131

Removing Tractor from Storage 132

131. PREPARING TRACTOR FOR STORAGE.

Tractors which are used only seasonably should be protected while in storage. The following operations are suggested:

(1) Block clutch in released position to keep clutch disk from siezing to pressure plate. Drain and refill transmission with clean oil.

(2) Drain and refill engine crankcase with engine preservative oil M-4834-A or equivalent to prevent internal corrosion. (Army Specification 2-126 Grade 1 Type.)

Run engine until completely out of gasoline, then restart and run on unleaded, undyed gasoline for at least ten minutes. While engine is running, inject the foregoing grade of oil into the carburetor air intake for about two minutes. Open throttle for a burst of speed, shut off ignition while continuing to inject engine preservative oil M-4834-A into carburetor air intake.

M-4834-A Engine Preservative Oil—SAE 10 (2-121) (AXS-934)
Sinclair Refining Co.—Rustolene No. 10
Socony-Vacuum—Mobile Rustproofer 934 Gr.1.

(3) Install new oil filter element and service oil breather cap.

(4) Remove the air cleaner and wash element in the body of the filter.

(5) Install the air cleaner and refill with clean oil.

(6) Repack front wheel bearings.

(7) Apply pressure gun grease to all fittings.

(8) Drive the tractor to ensure that all parts are coated with clean oil.

(9) Place the tractor in a dry shed.

(10) Remove the spark plugs and pour 3 ounces of engine pre-

servative oil M-4834-A into each cylinder. Turn engine several revolutions with starter, replace the plugs. This will coat the combustion chamber with an oil film.

(11) If tractor is weighted with water in the tires, they should be drained to prevent possible damage from freezing.

(12) Drain the fuel tank and leave the cap off to allow air circulation.

(13) Seal all openings in engine and accessories with Non-Hygroscopic Adhesive Tape or M-6471 equivalent. Make sure all surfaces are dry. Spray all taped openings, all engine accessories including ignition wiring, and all exterior surfaces of engine with Insulation Compound meeting United States Army Specification 382 for varnish, Army AXS858, or M-4858-B equivalent.

(14) Remove the battery and place in storage.

(15) Place blocking under the tractor axles to remove the weight from the tires.

(16) Drain cooling system to prevent possible damage from freezing by opening drain cock at bottom of radiator and on left side of engine block. The recommended procedure is to add the required amount of anti-freeze for lowest temperature prevailing in your area.

132. REMOVING TRACTOR FROM STORAGE.

Tractors which have been placed in storage should be completely serviced before use. The following operations are recommended.

(1) Inflate the tires to recommended pressure, and remove the blocking under the tractor axles.

(2) Fill cooling system.

(3) Fill fuel tank.

(4) Check oil level in crankcase, rear end and transmission, and air cleaner. Change if dirty.

(5) Install fully charged battery.

(6) Tighten cap screws and nuts on tractor.

(7) Start the engine and let it idle a few minutes. Be sure the engine is receiving lubrication and that each control is functioning correctly.

(8) Drive the tractor without a load to be sure it is operating satisfactorily.

(9) Lubricate all fittings.

Part TWO

MAINTENANCE AND TROUBLE SHOOTING

Chapter

I

LUBRICATION and ENGINE TUNE-UP

Section
Lubrication 211
Engine Tune-up 212

211. LUBRICATION.

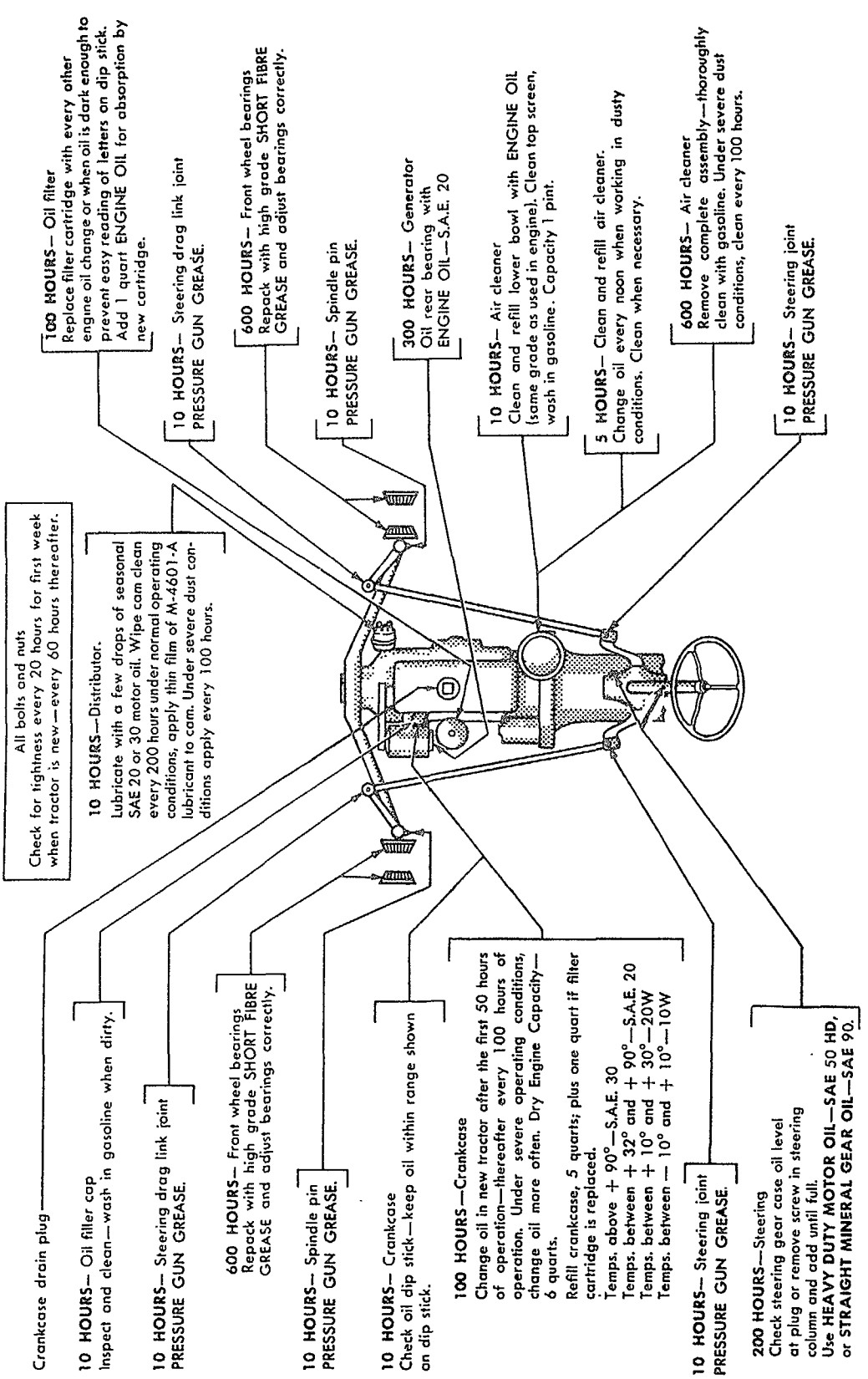
Clean lubricants prevent self destruction in all mechanical devices. Study and follow lubrication recommendations so that your tractor will operate with a film of oil or grease in all bearings. Metal-to-metal bearing contact without a protecting film of lubricant soon ruins high velocity bearing surfaces.

Transmission oils are produced to meet many different requirements. No one oil is satisfactory for all uses. Compounds sometimes are added to oils which form a gum deposit. Such deposits on the hydraulic system control valves may cause operational failure. It is, therefore, important to follow the recommendations as shown in the lubrication chart.

The lubrication chart (fig. 22) shows the points to be lubricated on the Ford tractor. For convenience in reading, points to be lubricated at the various frequencies are indented different amounts. The suggested frequency of application and specifications of the lubricants are given for average operating conditions. Extremes of temperature and dust must be considered when following the suggested lubricating schedules. Extremely low temperatures may increase the transmission oil viscosity to a point where the hydraulic control cannot operate properly. When the tractor is running in thick dust, the air cleaner and breather cap should be serviced more frequently.

212. ENGINE TUNE-UP.

If the tractor is to be used the year around, a semi-annual tune-up of the engine should be performed. If the tractor is to be stored during the winter months, the engine should be tuned when the tractor is removed from storage.


All bolts and nuts
Check for tightness every 20 hours for first week when tractor is new—every 60 hours thereafter.
10 HOURS—Distributor.
Lubricate with a few drops of seasonal SAE 20 or 30 motor oil. Wipe cam clean every 200 hours under normal operating conditions, apply thin film of M-4601-A lubricant to cam. Under severe dust conditions apply every 100 hours.
100 HOURS— Oil filter
Replace filter cartridge with every other engine oil change or when oil is dark enough to prevent easy reading of letters on dip stick. Add 1 quart ENGINE OIL for absorption by new cartridge.
10 HOURS— Steering drag link joint PRESSURE GUN GREASE.
600 HOURS— Front wheel bearings
Repack with high grade SHORT FIBRE GREASE and adjust bearings correctly.
10 HOURS— Spindle pin PRESSURE GUN GREASE.
300 HOURS— Generator
Oil rear bearing with ENGINE OIL—S.A.E. 20
10 HOURS— Air cleaner
Clean and refill lower bowl with ENGINE OIL (same grade as used in engine). Clean top screen, wash in gasoline. Capacity 1 pint.
5 HOURS— Clean and refill air cleaner.
Change oil every noon when working in dusty conditions. Clean when necessary.
600 HOURS— Air cleaner
Remove complete assembly—thoroughly clean with gasoline. Under severe dust conditions, clean every 100 hours.
10 HOURS— Steering joint PRESSURE GUN GREASE.
Crankcase drain plug
10 HOURS— Oil filler cap
Inspect and clean—wash in gasoline when dirty.
10 HOURS— Steering drag link joint PRESSURE GUN GREASE.
600 HOURS— Front wheel bearings
Repack with high grade SHORT FIBRE GREASE and adjust bearings correctly.
10 HOURS— Spindle pin PRESSURE GUN GREASE.
10 HOURS— Crankcase
Check oil dip stick—keep oil within range shown on dip stick.
100 HOURS—Crankcase
Change oil in new tractor after the first 50 hours of operation—thereafter every 100 hours of operation. Under severe operating conditions, change oil more often. Dry Engine Capacity—6 quarts.
Refill crankcase, 5 quarts; plus one quart if filter cartridge is replaced.
Temps. above + 90°—S.A.E. 30
Temps. between + 32° and + 90°—S.A.E. 20
Temps. between + 10° and + 30°—20W
Temps. between — 10° and + 10°—10W
10 HOURS— Steering joint PRESSURE GUN GREASE.
200 HOURS—Steering
Check steering gear case oil level at plug or remove screw in steering column and add until full.
Use HEAVY DUTY MOTOR OIL—SAE 50 HD, or STRAIGHT MINERAL GEAR OIL—SAE 90.

§ 212.

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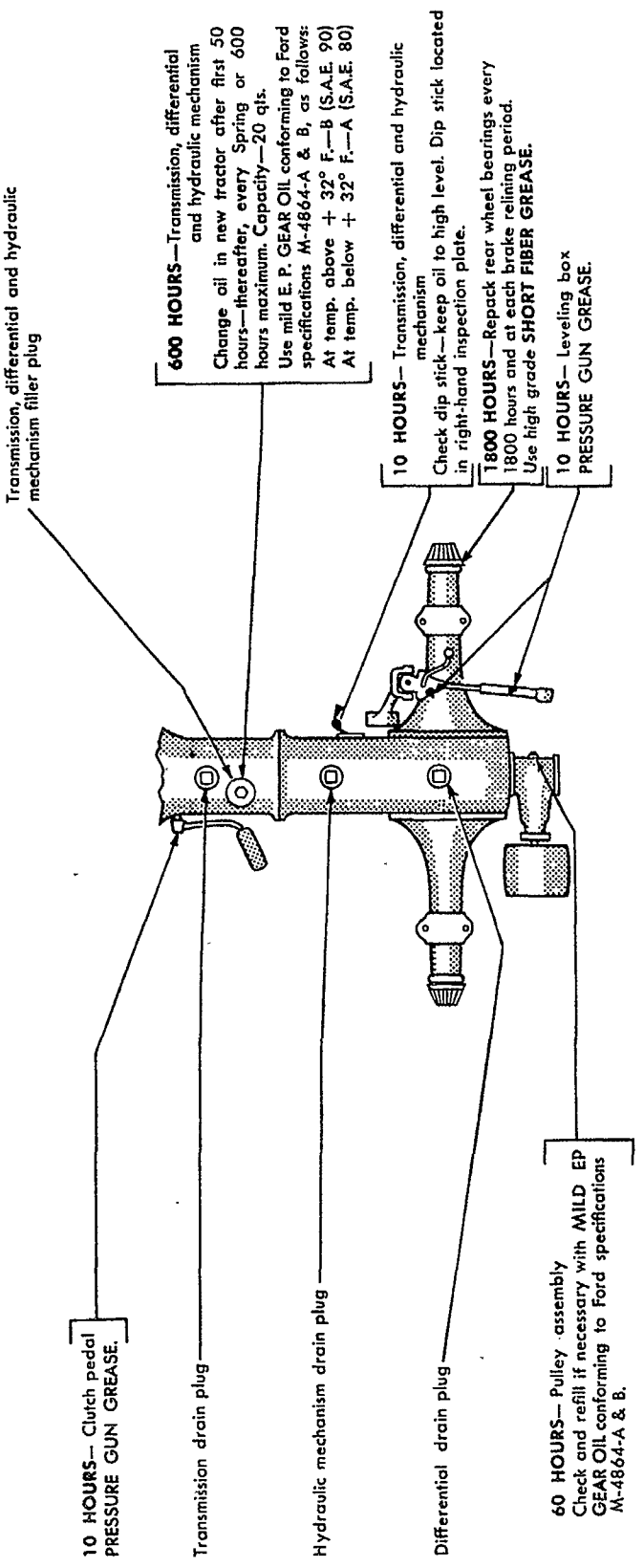

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Fig. 22—Lubrication Chart

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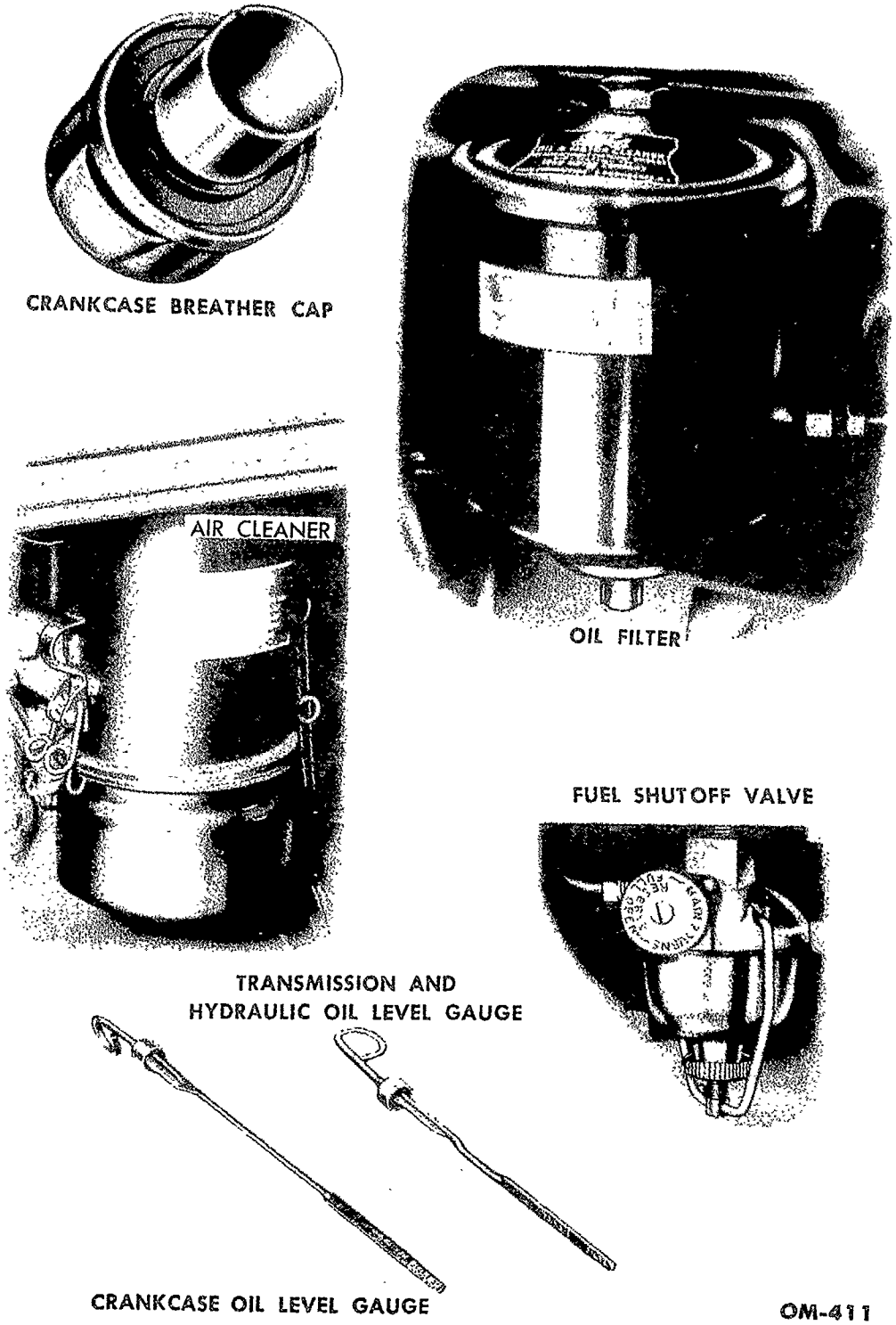

Fig. 23—Frequent Check of These Items Helps to Prevent Trouble

Tune-up consists of a general conditioning procedure as outlined in the following paragraphs.

a. Spark Plugs. Remove the spark plugs, and have them cleaned with a sand blast cleaner. Set the gaps at 0.025 inch. Replace any plugs that have broken or chipped porcelain, or badly burned electrodes.

b. Compression. Test the compression of each cylinder with a compression gauge. Cylinders with the compression below 90 pounds per square inch have leaking valves or piston rings. Above 140 pounds per square inch compression indicates an excessive accumulation of carbon. If either condition exists, repair is indicated.

c. Cylinder Head. Tighten all cylinder head cap screws to approximately 70 pounds-feet, starting from a centrally located nut, and working toward the outer row.

d. Wire Connections. Tighten the wire connections at the ignition switch, generator, generator regulator, coil, starting motor relay, and the starting motor. Clean and tighten the battery terminal connections. Make certain that wires are pushed into distributor cap until they bottom.

e. Distributor. Check the breaker contacts and replace them if required. Replace the distributor cap if it is cracked or shows evidence of carbonized tracks or otherwise damaged.

f. Test Spark. Test the length of the spark from each spark plug wire. The spark should jump a 3/16 to 1/4-inch gap. If it will not, make the necessary repairs.

g. Generator Regulator. Test the action of the generator and generator regulator as outlined in section 225.

h. Carburetor. Disassemble the carburetor and clean all passages. Reassemble and check for any binding of choke or throttle controls.

i. Fuel Shut-off Valve. Remove the shut-off valve and clean the screens and sediment bowl. Remove the fuel inlet elbow from the carburetor and clean the screen.

j. Adjust Carburetor. Adjust the carburetor idle speed to approximately 450 R.P.M.

k. Air Cleaner. Remove lower element of air cleaner filter assembly and wash in gasoline. Fill the cup to the indicated level with clean oil of the same viscosity used in the engine crankcase.

Chapter II

TROUBLE SHOOTING

	Section
Engine	221
Cooling System	222
Fuel System	223
Governor	224
Generating System	225
Starting System	226
Ignition Trouble Shooting	227
Hydraulic Control	228

221. ENGINE.

Troubles that are experienced are the result of normal wear, deterioration, or neglect.

The diagnosis of troubles start with symptoms that are apparent and the procedure under one symptom will uncover additional symptoms consecutively until the underlying cause of the trouble and its remedy is apparent.

a. Engine Does Not Develop Full Power. Apparent loss of power may be due to excessive power absorption by the tractor. It may also be due to low power development.

(1) *PRELIMINARY INSTRUCTIONS.* Check for improper governor operation, dragging brakes, improperly loaded tires, restricted exhaust, improper lubrication, restricted fuel line or clogged air cleaner.

If the governor is not operating efficiently, the engine will be slow in picking up load and will not reach full rated speed. For adjustment of the governor, see section 345.

Brake drag will be evidenced by the brake drum heating up, even though the brakes have not been applied. To correct this condition, see section 313.

Overloaded tires require excessive power to move the tractor. For correct load limits, see sections 128 and 311.

Make sure that the exhaust pipe has not been bent or plugged with mud.

If the engine has not been properly lubricated, efficiency is reduced and total ruin may result. Follow the instructions on the lubrication chart, section 211.

(2) *WARM UP ENGINE.* Allow the engine to idle until normal operating temperature is reached, and follow whichever of the following conditions that apply:

(a) IF THE VALVES ARE QUIET. If the valves are quiet, proceed with subparagraph (3) below.

(b) IF THE VALVES ARE NOISY. If, with the engine at normal operating temperature, the valves are noisy, either the valve action is sluggish or the spacing is too wide. Wide spacing usually has very little effect on the performance, and since the spacing rarely increases in service, it usually can be assumed that the valve action is sluggish. If the valve action is sluggish with the engine idling, or if there is any evidence of sludge in the oil, or if there is any indication of oil pumping, or excessive carbon, disconnect the air cleaner and slowly pour ¼ pint of light, gum solvent oil into the carburetor throat. The engine speed will slow down as the oil is added. Do not pour the oil in so fast that the engine will stall. This oil will usually free up the valve action, temporarily at least, and should reduce the valve noise.

Add gum solvent to the engine oil (replace the engine oil after 10 hours' operation with new oil).

(3) *CHECK FOR CYLINDERS MISFIRING AT IDLE SPEED.* With the engine running, momentarily short out in turn each spark plug. If the shorting of one or several plugs has no effect on the running of the engine, those particular cylinders are misfiring. Follow the procedure in subpar. (6) below. If this does not correct the misfiring, follow the procedure in subpar. (5) below. If the misfire is now correct or if none of the cylinders were misfiring, proceed with "Test Tractor on Hard Pull" (subpar. (4) below).

(4) *TEST TRACTOR ON HARD PULL.*

NOTE: ***If, during the test, the engine fails to reach or maintain normal operating temperatures, the thermostat may not be operating.***

Accelerate the engine rapidly from idle to half throttle in high gear with the brakes partially applied. Follow whichever of the following conditions that apply:

(a) IF CLUTCH SLIPS UNDER LOAD. If the clutch slips under load, adjust pedal free play or replace the clutch, whichever is required.

(b) IF ENGINE BACKFIRES. If the engine backfires through the carburetor when accelerated rapidly, it indicates the fuel mixture is too lean. Follow the procedure for this symptom under section 223. (Valves holding open or shorted ignition also are possible causes, however, the test under subpar. (3) will have determined if the valves or the ignition are at fault.)

(c) IF ENGINE DOES NOT PING (SPARK KNOCK). If a slight ping cannot be obtained, time the ignition and check the spark advance.

(d) IF ENGINE PINGS EXCESSIVELY. If the engine pings excessively, adjust the timing. If this does not correct the pinging, follow the procedure outlined in subpar. (6) below.

(e) IF ENGINE PULLS EVENLY. If the engine pulls evenly and there is no indication of late spark or excessive carbon, check the fuel system for a lean mixture.

(f) IF ENGINE PULLS UNEVENLY. If the engine pulls unevenly, proceed with subpar. (5) below.

(5) *TEST SPARK AT SPARK PLUG WIRES.* Run the engine at idle speed. Remove the wire from No. 1 spark plug, hold the wire terminal 3/16 to 1/4 inch from the cylinder head, and observe if the spark jumps the gap regularly without missing. Make this test at each spark plug wire. Follow whichever of the following conditions that apply:

(a) SATISFACTORY SPARK FROM ALL WIRES. If a satisfactory spark from all wires is obtained, proceed with subpar. (6) below.

(b) UNSATISFACTORY SPARK. If an unsatisfactory spark is obtained on any cylinder, refer to section 227 for correction of the fault.

(6) *CLEAN AND SPACE OR REPLACE SPARK PLUGS AND TEST COMPRESSION.* Clean and space spark plugs .025-.028-inch air gap or replace if necessary. Before reinstalling the plugs, test the compression of each cylinder. Compression pressure should be checked with all spark plugs removed and the carburetor throttle full open. Compression pressure should be 90 pounds minimum at starter cranking speed. Follow whichever of the following conditions that apply:

(a) NORMAL COMPRESSION. If the compression is normal, time the ignition.

(b) ABOVE NORMAL COMPRESSION. If the compression of any cylinder is above 140 pounds per square inch, remove the carbon from

the combustion chamber, and while the head is removed, make sure that the valve stems are not gummy.

(c) BELOW NORMAL COMPRESSION. If the compression of any cylinder is below 90 pounds per square inch, remove the cylinder heads and make necessary repairs to the valves, cylinders, or pistons. Compression will be slightly low on new tractors until they are broken in.

(7) *REPEAT TEST ON HARD PULL.* Repeat the test of the engine on hard pull (subpar. (4) above). If the engine now pulls unevenly or still lacks power, the fuel mixture is probably lean. Follow the procedure in section 223.

(8) *TIME IGNITION.* If the above procedure has not corrected the trouble and if this operation has not already been performed, time the ignition.

b. Engine Cranks But Will Not Start. If the engine fails to start when cranked, the fault lies in the ignition or the fuel system. The following procedures will assist in locating the defects.

(1) *PRELIMINARY INSTRUCTIONS.* Make certain the ignition switch is ON and that there is fuel in the fuel tank, and follow the procedure given below for whichever of the conditions that apply:

(a) IF ENGINE IS WET. If the engine is wet, wipe all moisture from the distributor cap, coil, spark plugs, and spark plug wires.

(b) IF ENGINE IS HOT. If the engine is hot, open the throttle and crank the engine. This clears away vapor lock which may be present.

(c) IF ENGINE IS FLOODED. If the engine is flooded (due to repeated attempts to start while the carburetor was choked), release the choke and open the hand throttle. Crank the engine several revolutions to exhaust the surplus fuel.

(d) IF ENGINE IS EXTREMELY COLD. If the engine is extremely cold, make sure that the choke is working, and pull the choke button out to the stop. Hold the clutch pedal down. With the ignition switch ON, press the starter button.

(e) IF ENGINE CRANKS SLOWLY. If the engine cranks slowly, make sure the battery is not partially discharged and that the viscosity of the engine oil is correct for the prevailing temperature. If the cranking speed is still slow, follow the procedure under Starting System, section 226.

(f) IF ENGINE STILL FAILS TO START. If the engine still fails to start after the above procedures have been followed, proceed with the procedures below in the order given until the trouble has been corrected.

(2) *DETERMINE IF FUEL IS BEING DELIVERED TO CARBURETOR.* Remove a drain plug from the carburetor float chamber. If gasoline runs from the drain, it indicates fuel is being delivered to the carburetor.

If no gasoline is observed at the drain on the carburetor, fuel is not reaching the carburetor. Follow the procedure given in section 223, Fuel System.

(3) *DETERMINE IF CURRENT IS BEING DELIVERED TO SPARK PLUGS.* Turn the ignition switch ON. Remove the wire from any spark plug and hold the wire terminal $\frac{3}{16}$ to $\frac{1}{4}$ inch from the cylinder head while the engine is being cranked. If a spark does not jump this gap, the ignition is at fault. Follow the procedure under section 227.

c. Engine Backfires But Will Not Start. This symptom indicates that the spark plugs are not firing in their proper order, either due to the ignition high tension system being shorted, the spark plug wires being transposed, or the camshaft out of time. Perform the following operations in the order given.

Wipe all dust and moisture from the exterior of the distributor, coil, spark plugs, and spark plug wires, and again attempt to start the engine. If the engine still fails to start, make sure each spark plug wire is attached to the correct spark plug. Make sure that the spark plug wires are installed at the correct terminals of the distributor cap, and that the interior of the distributor cap is not wet. Replace the distributor cap if there is evidence of damage. If the above procedure has not corrected the trouble, the camshaft probably is out of time, remove the engine front cover plate, and correct the camshaft timing by aligning the marks on the camshaft and crankshaft gears.

d. Engine Runs Unevenly and Backfires Through Carburetor. If the engine is cold, the carburetor may need further choking until the engine is warmed up.

Check to determine if the spark plug wires are attached to the spark plugs and the distributor cap in their proper firing order. Replace the distributor cap if it is cracked or shorted. If the ignition is found not to be at fault, check the fuel system as outlined in section 223.

e. **Engine Starts But Fails to Keep Running.** If the engine starts and stops after a short period of running and cannot again be started, fuel is not reaching the carburetor in sufficient quantity, follow the procedure under section 223.

In rare cases the ignition coil or condenser will allow the engine to start but will fail to deliver a spark when hot. Turn the ignition switch ON. Remove the wire from any spark plug and hold the wire terminal 3/16 to 1/4 inch from the cylinder head while the engine is being cranked. If the spark does not jump the gap, remove the distributor and have it tested.

f. Engine Misfires at High Speed. Misfire at high speed may be caused by an incorrect fuel and air mixture, by improper spark plug gap, by faulty distributor, coil, or breaker contact setting, or by sticking valves.

(1) *INCORRECT FUEL AND AIR MIXTURE.* See section 223 for correction procedure.

(2) *IMPROPER SPARK PLUG GAP.* Remove the spark plug and clean with sand blast. Set the gap at 0.025-.028 inch.

(3) *FAULTY DISTRIBUTOR AND COIL.* See section 227 for correction procedure.

(4) *STICKING VALVES.* Run the engine at idle speed at normal operating temperature, and observe if any of the valves are noticeably noisy. Abnormally noisy valves indicate sluggish valve action. Make the necessary corrections to the valves.

g. Engine Misfires on Fast Acceleration or Hard Pull. Run the engine at idle speed. Remove the wire from No. 1 spark plug, hold it 3/16 to 1/4 inch from the cylinder head. Observe if the spark jumps regularly without missing. Make this test at each spark plug wire. If an unsatisfactory spark or no spark is obtained at any of the wires follow the procedure given for whichever symptom applies (sec. 227).

Clean and space spark plugs or replace damaged or faulty plugs.

NOTE: ***It may be advisable to check the engine compression while the spark plugs are removed to again avoid removing the spark plugs later.***

Remove and clean the carburetor thoroughly. Reset the float level if required.

Test the compression of each cylinder, and make corrections as required. Run the engine at idle speed and observe if any of the valves

are noticeably noisy. Abnormally noisy valves indicate sluggish valve action. Make the necessary correction to the valves.

222. COOLING SYSTEM.

The cooling system may be at fault when the engine overheats or fails to reach operating temperature.

a. Preliminary Instructions. The various factors that control the cooling of the engine are so designed as to provide a liberal margin of safety, and, in most cases, the reestablishment of these factors back to normal will reestablish adequate cooling.

(1) *SHROUDS.* On tractors, the fan shroud assures the air being drawn through the radiator, and, if the shroud has been removed, it should be installed before any tests are made.

(2) *PROPER DRIVING.* Tractor operation requires operation through whatever transmission gear ratio is required to keep the engine from lugging. By using the higher ratios the engine and consequently the fan speed is increased, thus providing adequate cooling.

(3) *ANTI-FREEZE.* Heavy duty operation requires the use of Ethylene Glycol anti-freeze rather than alcohol. This raises the boiling point of the coolant from 160°F. to 212°F. and eliminates overheating attributable to loss of coolant due to evaporation of the alcohol.

b. Engine Overheats. The following suggested procedures will usually correct engine overheating.

(1) *CORRECT EXTERNAL LEAKAGE.* Fill the cooling system and idle the engine. Inspect for leakage at all hose and hose connections, and tighten connections or replace hose as required. Inspect the radiator cap for tightness and the condition of the gasket. If leakage is observed at the cylinder head gaskets, replace the gaskets (including remove carbon). Inspect the radiator for leakage, and repair or replace if required. Rust spots or wet spots on the radiator core are an indication of radiator leakage, even though there is no dripping.

(2) *ADJUST FAN BELT.* Adjust or replace the fan belt if required.

(3) *CLEAN RADIATOR CORE.* If the air flow through the radiator is restricted (insects, leaves, grease, dirt, etc.), clean the fins and the air passages. If the above procedure has not corrected the trouble, proceed as follows.

(4) *LEAN CARBURETOR MIXTURE.* Adjust the fuel system as outlined in section 344.

(5) *TIME IGNITION.* Time the ignition as instructed in section 227.

(6) *CHECK RADIATOR HOSE.* Remove the radiator hose, and replace any hose that has become soft or collapsed.

(7) *CHECK THERMOSTAT.* Remove the thermostat and submerge it in hot water. It should start to open at 160°F. to 165°F., and be fully opened at 190°F. to 200°F. Replace thermostat if it is faulty.

(8) *FLUSH COOLING SYSTEM.* Use a good cooling system cleaner according to directions on the container.

(9) *CHECK FOR INTERNAL LEAKAGE.* Drain the oil from the engine oil pan, and observe if there is water in the oil. If an abnormal amount of water is found in the oil, remove the spark plugs, and observe if water is present at the plug holes. If water is evident from either of these inspections, remove the cylinder head, inspect for faulty gasket or head, and examine for cracks in the cylinder block usually found in the vicinity of the valve ports. Replace the cylinder head gasket or make the necessary corrections in case of a cracked block.

(10) *ADDITIONAL POSSIBLE CAUSES.* If the engine continues to overheat, remove the cylinder head, and inspect the water openings in the cylinder head and cylinder block for excessive lime deposits. If excessive lime deposits are present, the cylinder block and heads must be replaced as flushing will not remove lime deposits.

NOTE: ***Excessive deposits of lime are the result of using hard water, having a high mineral content, in the cooling system.***

Soft or rain water should be used in the cooling system.

c. Engine Fails to Reach Normal Operating Temperature. Remove the thermostat, and test it to make sure that it is closing at 160°F.

223. FUEL SYSTEM.

Troubles encountered in the fuel system will be: excessive fuel consumption, fuel not reaching the carburetor, carburetor flooding, and fuel mixture too lean or too rich.

a. Excessive Fuel Consumption. So many factors can result in excessive fuel consumption that it is usually advisable to recommend an engine tune-up (sec. 212) and a complete lubrication of the tractor as outlined in section 211. If this does not correct the trouble, proceed as follows, omitting consideration of such factors as are known to be right.

(1) *PRELIMINARY INSPECTIONS.* Make sure the brakes are not dragging and that the tires are inflated to the specified pressure.

Make sure that the exhaust tail pipe has not been bent or plugged with mud so as to cause restriction of the exhaust.

Excessive added weight or tire slippage will increase fuel consumption. Correct weight and slippage may be determined as outlined in section 128.

Make sure the spark plugs are spaced correctly. Remove the wire from No. 1 spark plug and hold the wire $\frac{3}{16}$ to $\frac{1}{4}$ inch from the cylinder head. Observe if the spark jumps the gap regularly without missing. Make this test at each of the spark plug wires. If an unsatisfactory spark is delivered from any of the wires, follow the procedure which applies under section 227.

(2) *PROCEDURE.* If the fuel consumption is believed to be higher than normal, accelerate the engine in high gear with the brakes partially applied. If a ping is not heard, it indicates the ignition timing is late. Ignition timing must be adjusted as outlined in section 364.

NOTE: ***If the above procedure has not corrected the higher than normal fuel consumption, proceed as follows, omitting those operations that have already been performed.***

Service the air cleaner as outlined in section 342. With the air cleaner removed, make sure the choke valve opens fully each time the choke button is released. Make whatever adjustments are required.

Clean the spark plugs and adjust the gaps to 0.025 inch. Replace any faulty plugs.

Test the compression of each cylinder, and make the necessary repairs to the valves, rings, and pistons.

Remove, disassemble, and adjust the carburetor as outlined in section 344.

(3) *ADDITIONAL POSSIBLE CAUSES.* The above procedure will correct excessive fuel consumption in nearly every case, how-

ever, several other unlikely conditions are possible, and, if the trouble still is not corrected, one of the following may be the cause:

(a) BRAKES DRAGGING WHEN HOT. Feel the brake drums after the tractor has been in operation. If they are hot, adjust as outlined in section 313.

(b) EXCESSIVE EXHAUST BACK PRESSURE. Disconnect the muffler from the exhaust manifold, and compare fuel consumption. If the fuel consumption is noticeably less, replace the muffler.

(c) CAMSHAFT OUT OF TIME. The camshaft may be out of time if either gear has been replaced or major repairs have just been made. If the main bearings have been replaced, the crankshaft may have dropped low enough to get the gear out of time. The timing marks are shown in fig. 24. Remove the engine front cover plate to inspect.

(d) TOO LITTLE VALVE CLEARANCE. Too little valve clearance results in valves not completely closing when hot. Remove the valve chamber covers to inspect.

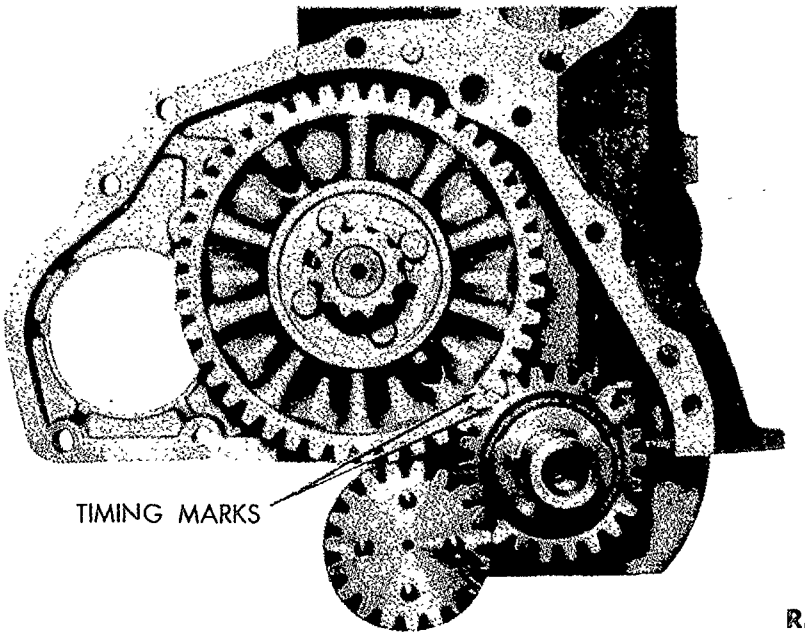

Fig. 24—Timing Marks

NOTE: ***Intake valve clearance should be from 0.010 to 0.012 inch and the exhaust valve clearance should be 0.014 to 0.016 inch. Uneven valve clearance will make an engine noisy.***

(e) TOO MUCH VALVE CLEARANCE. Too much valve clearance results in valves opening late and closing early. Remove the valve chamber covers to inspect.

(f) VALVES STICKING. It is possible for the valve action to be sluggish during operation and not show up as noisy during idle. Repair as needed.

(g) ENGINE TIGHTNESS. Wrong size parts may have been installed. This is particularly true if piston rings have been installed without sufficient gap.

b. Fuel Not Reaching Carburetor. Make sure that the fuel shut-off valve is open and that there is a sufficient supply of fuel in the tank.

(1) *CHECK FUEL LINE.* Disconnect the fuel line from the carburetor. If the fuel continues to drain from the line, the vents are open and the fuel line is not plugged. If necessary, repair as outlined in section 343.

(2) *CHECK FOR WATER IN FUEL TANK.* Remove the fuel shut-off valve assembly, and drain any accumulation of water or sediment from the tank. In freezing weather, water in the fuel tank will freeze and may prevent fuel from entering the fuel line. Allow the tank to reach room temperature before draining.

c. Carburetor Floods. In addition to the engine running unevenly, a strong odor of gasoline usually is present when the carburetor is flooding. If the carburetor is flooding due merely to overchoking, open the throttle wide and crank the engine to exhaust the rich gases in order to start the engine. Foreign material under the float needle may cause a carburetor to flood.

(1) *CHECK CARBURETOR CHOKE ACTION.* Remove the air line connection, and operate the choke rod. Observe the carburetor choke plate to see that it opens freely. If the choke action is faulty, make necessary corrections.

(2) *REMOVE AND DISASSEMBLE CARBURETOR.* Remove and disassemble the carburetor. Clean all parts, examine the float for leaking and the condition of the float needle valve and seat. Make repairs as required and set the float level. Reinstall the carburetor on the engine (sec. 344).

d. Fuel Mixture too Lean or too Rich. Check fuel lines as outlined in par. **b** above. Clean and adjust the carburetor as outlined in section 344.

There may be leaks in the intake manifold system. If so, replace the gaskets.

224. GOVERNOR.

The governor opens and closes the carburetor butterfly automatically to maintain a set engine speed with changing load. Faulty governor operation may result in a sluggish engine which will not come up to speed. External adjustments are responsible for most governor faults.

a. Hand Throttle Inoperative on First Section of Quadrant. The hand throttle being inoperative on the first section of the quadrant is caused by end play in the governor spring. The governor spring should be adjusted as outlined in section 345.

b. Engine Idle Speed too High. Preload on the governor spring may increase the idle speed. The spring and linkage should be adjusted as outlined in section 345.

c. Engine Will Not Run at Top Speed. The throttle linkage and spring are not allowing the governor to bring the engine up to speed. They should be adjusted as outlined in section 345.

d. Engine Hunts or Sluggish. Hunting and sluggish operation can be caused by foreign material and binding in the governor and governor linkage. The carburetor throttle shaft must work freely. The carburetor-to-governor rod must be straight and the ball joints must work freely. If the throttle shaft and rod are free, the governor should be removed. The governor should be cleaned, repaired, and adjusted as required (sec. 345).

e. Repeated Governor Shaft Breakage. Repeated governor shaft breakage is usually the result of worn timing gears. To correct the shaft breakage, it is usually necessary to replace both the camshaft and crankshaft gears.

225. GENERATING SYSTEM.

The condition of the battery reflects the condition of the generating system.

WARNING: ***Do not allow flames or sparks to be brought near the vent opening of the battery since hydrogen gas, produced in the battery, might explode. The liquid in the battery is a solution of sulphuric acid which, if accidentally spilled on the skin or spattered in the eye should, as a first-aid measure, be flushed away promptly with quantities of clear water only. Seek medical aid if discomfort continues. If acid is spilled on the clothes, wet***

it thoroughly with a weak solution of ammonia or with sodium bicarbonate or baking soda dissolved in water.

a. Battery Gassing and Using Excessive Water. Gassing and using an excessive amount of water is an indication of overcharging. Charging is controlled by the voltage regulator. If it is set too high, it can be adjusted. If it is inoperative, it must be replaced.

b. Battery Low in Charge. If the battery fails to keep charged, it may be possible that the current used is greater than the capacity of the generator due to:

Excessive use of lights.

Accidental discharge of the battery due to a short circuit.

Excessive current used in starting as would be true with a tight engine, heavy oil, need of adjustment of the spark plugs, distributor contacts, etc.

(1) *RECHARGE OR REPLACE BATTERY.* Recharge the battery if its specific gravity is below 1.225. Replace the battery if a high discharge test, after charge, indicates it is worn out or under capacity.

(2) *GENERATOR OUTPUT LOW.* Connect a jumper wire between the armature and field terminals on the generator. Discharge battery slightly by operating starter with ignition off for approximately 30 seconds. Start engine and observe ammeter. Remove the jumper wire and follow the procedure given that applies.

(a) If the charging rate increases, the generator is satisfactory and the regulated voltage should be checked and reset within the limits shown on page 12 if found low.

(b) If the charging rate shows no change, replace or repair the generator.

(c) If neither of the above adjustments corrects the trouble, search for poor connections causing high resistance.

226. STARTING SYSTEM.

A discharged battery and the use of heavy oil in sub-zero weather are the two most common causes of starting trouble.

a. Discharged Battery. If the battery tests lower than 1.225 with a hydrometer reading corrected to 80°F., have the battery recharged and an after-charge test made. Replace the battery if reading is unsatisfactory.

b. Sub-zero Cranking. For starting in sub-zero temperatures, oil dilution is recommended as follows:

(1) *DILUTE ENGINE OIL.* Where temperatures from 10°F. below zero to 65°F. below zero prevail, dilute the engine oil by adding one pint of kerosene. This kerosene should be added while the engine is still warm. Stop the engine and add oil of S.A.E. 10 or 10W viscosity up to the FULL mark. Then add the pint of kerosene. This will bring the level of the oil higher than normal. This level should be marked on the gauge for future reference.

(2) *DILUTION INCREASES OIL CONSUMPTION.* The presence of a large percentage of light dilutent will increase oil consumption, and for that reason the oil level should be checked frequently.

(3) *REDILUTION OF ENGINE OIL.* This can be accomplished by adding oil of S.A.E. 10 or 10W viscosity to the FULL mark, then add kerosene to the dilution mark on the gauge described in subpar. (1) above. Start the engine and allow it to run for two minutes to assure mixing of the oil and kerosene.

c. Engine Cranks Slowly with Clutch Released. Make certain that the viscosity of the engine oil is correct for the prevailing temperature. If recent major repairs have been made, the engine may be tight.

(1) *TEST STARTER RELAY AND STARTING MOTOR.* Test the state of charge and the condition of the battery. If the battery is satisfactory, remove the cable from one side of the starter relay, and contact the loose end of the cable against the terminal on the other side of the relay.

If cranking speed is now normal, replace the starter relay.

If cranking speed is still low, repair or replace the starting motor.

d. Starting Motor Spins But Does Not Crank Engine. If the starting motor spins and does not engage with the flywheel gear,

remove the starting motor, and clean the starter drive. Replace worn or damaged parts as required.

CAUTION: ***Do not oil the starting motor, clean the starter drive in kerosene.***

227. IGNITION TROUBLE SHOOTING.

In the procedures outlined in this section, it is assumed that the engine can be cranked with the starting motor. If this is not the case, refer to trouble shooting on the starting system (sec. 226 above).

a. No Spark at Any of the Spark Plug Wires. Turn the ignition switch on. Hold the end of a spark plug wire 1/16 inch from the cylinder head while the engine is being cranked. Repeat this test for the remaining cylinders. If the spark fails to jump the gap, disconnect the primary wire from the top of the coil. Turn the ignition switch on and observe if a spark occurs when the coil lead is grounded. If a spark occurs, the distributor and coil assembly are at fault. The distributor and coil assembly should be removed and repaired.

If no spark occurred when the coil lead was grounded, the trouble is located between battery terminal on the starter relay and the primary lead on the coil. To locate the trouble between the coil terminal and the starter relay, the two terminals on the terminal block should be grounded in the following order. If a spark does not occur when the upper terminal is grounded, the trouble is in the connection between the terminal and the starting motor relay. Turn the ignition switch on and ground the lower terminal. If no spark occurs when the lower terminal is grounded, the ignition switch or its leads are faulty. If a spark occurs, the connection is faulty between the terminal just grounded and the primary connection on the coil.

b. Satisfactory Spark from Some But Not All Spark Plug Wires. Hold the one spark plug wire 3/16 inch to 1/4 inch from the cylinder head while the engine is running about 500 R.P.M. If a spark fails to regularly jump this gap, it is considered weak. Since a satisfactory spark is obtained from some spark plug wires, it is evident that the coil, condenser, breaker contacts, and distributor rotor are satisfactory, since they affect the output of all spark plug wires. Make sure that the spark plug wire terminals are clean and firmly seated in the socket. Spark plug wires should be soldered to the terminals. Replace spark plug wires which have damaged insulation. If this does not correct the trouble, remove the distributor cap, and inspect for cracks and carbon runs to ground.

c. Intermittent Spark at All Spark Plug Wires. When an intermittent spark is received by all cylinders, the trouble is probably in the primary circuit. Check and tighten the following terminals: battery, starter relay, two terminals on the terminal block, and the primary lead to the coil. Replace and/or respace the distributor contacts if required. The distributor assembly should be thoroughly cleaned. Make sure that the breaker arm is not binding. Install a new condenser and check the system. If the trouble has not been corrected, install a new coil and check the ignition. In a few cases foreign material around the distributor cap and rotor will cause an intermittent spark.

228. HYDRAULIC CONTROL.

Oils which depart from the specifications outlined in section 211 may cause failure in the hydraulic control. Dirty oil may cause the machined surfaces in the pump and ram cylinder to be scored. Oils that form a heavy gum deposit may prevent the valves from moving freely. Oil conforming to the specifications shown in fig. 22 and is clean can be relied upon to give good results.

a. Preliminary Procedure. Depress the clutch pedal and engage the power take-off. If the links do not raise, proceed as follows:

Check oil level and if it is low, fill to the required level, and raise the hydraulic control lever to top of quadrant.

Remove the inspection plate on the right side of the center housing. Move the hydraulic touch control lever, and feel to determine if both control valves are moving freely (fig. 63). If not, remove the hydraulic pump as outlined in section 383. Wash the control valves and control valve bushing in gasoline. After the control valves operate freely, replace the pump as outlined in section 383.

b. Control Will Not Raise Full Load. If a pressure gauge which will register pressures of 2500 pounds per square inch accurately is available, follow subpar. (1). If no gauge is available, follow subpar. (2).

(1) Remove the inspection plate on the right side of the center housing. Attach the pressure gauge to the hydraulic pump at exterior connector. Secure the lower links in a lowered position. Start the engine, engage the power take-off, and raise the hydraulic touch control lever to the top of the quadrant. If the pressure is between 1500 and 1700 pounds per square inch, the control is developing its full lifting force. If the pressure is below 1500 pounds per square inch,

inspect the control for leakage. Feel the end of the safety valve to determine if it is relieving the pressure (fig. 60) which it should not do at pressures less than 1500 pounds per square inch. Replace the safety valve assembly if necessary. Leaks in the hydraulic control may be located by oil sprays and excessive oil turbulance.

(2) Mount an implement on the tractor which can be lifted only by a hydraulic control that is operating correctly. Remove the inspection plate on the right side of the center housing. Start the engine, engage the power take-off, and raise the hydraulic touch control lever to the top of the quadrant. Feel the end of the safety valve to determine if it is relieving the pressure before it should (fig. 60). Replace the safety valve assembly if necessary. Leaks in the hydraulic control may be located by oil sprays and excessive oil turbulance.

c. Control Will Lift Only at High Engine Speeds. The trouble is usually due to a leak in the hydraulic control. Follow the procedure outlined in par. **b** above.

d. Control Will Not Lower. If the links will not lower, either the exhaust control valve is frozen in the closed position, or the exhaust lines have become clogged with dirt. Remove the inspection plates, and inspect the mechanical linkage for binding or damaged parts. Apply hand pressure to the long control arm for evidence of valve sticking. If the inspection does not reveal the difficulty, remove the hydraulic pump as outlined in section 383. Remove the hydraulic unit as outlined in section 382. Have the pump and hydraulic unit adjusted and checked, and the pump thoroughly flushed.

e. Control Raises and Lowers in the Transport Position. There should be no noticeable fluctuation in the height of the link mounted implement when carried in the transport position, unless the hydraulic controls are moved.

If such fluctuation occurs, the following procedure will assist in locating the trouble.

Attach a link mounted implement and place the position control lever for constant draft control (forward). Be sure the power take-off is engaged. Remove the two inspection plates from the center housing. With the engine running at idle speed, raise the hydraulic touch control lever to the top of the quadrant. If the implement is not steady in the transport position, inspect the control for internal leakage as indicated by excessive oil spray or dripping. Leaking gaskets, leaking safety valves, and scored ram cylinders are examples of possible causes. There is a remote possibility that the difficulty is in the pump. In this case, a trained service man should be consulted.

f. Position Control Inoperative. If the constant draft control is operating correctly, the hydraulic pump is satisfactory. Remove the hydraulic unit as outlined in section 382. Check for damaged linkage. Check the adjustments of the unit as outlined in section 384.

g. Bobbing. Bobbing is a rhythmic raising and lowering of an implement when using the constant draft control. Bobbing can be the result of improper implement adjustment or a hydraulic control which is in need of repair and adjustment or both. The following steps should be taken to correct bobbing:

(1) If there is end play at the control spring, the implement may bob. Check the control spring adjustment as outlined in section 384.

(2) Resharpened plow shares which have the point dubbed down should be replaced with a set of new shares. In a few cases, extending the top link will eliminate bobbing. As the plow share wears, it may be necessary to again shorten the top link.

(3) If the above steps have not corrected the trouble, adjust the hydraulic unit as outlined in section 384.

h. Hydraulic Controls Not Synchronized. To test for the control synchronization, the engine should be operated at idle speed. Engage the power take-off and lower the hydraulic touch control lever to the bottom of the quadrant. Place the position control lever for constant draft control (forward) and measure the drawbar height. Place the position control lever for position control (vertical). Raise the hydraulic touch control lever to the top of the quadrant. After the links have raised to the top of their travel, place the hydraulic touch control lever at the bottom of the quadrant. Be sure the quadrant stop, shown in fig. 6, does not prevent the hydraulic touch control lever from being placed at the bottom of the quadrant. Measure the drawbar height.

If the two drawbar height measurements vary by more than three inches, the hydraulic control should be adjusted as outlined in section 384.

Part THREE
ADJUSTMENTS AND REPLACEMENTS

Chapter
I
WHEELS, TIRES, and BRAKES

Section

Wheels and Tires 311

Front Hub and Bearing Replacement 312

Brakes 313

311. WHEELS AND TIRES.

Before a tire is removed, drain the calcium chloride solution, if any, from the tire into a barrel. This solution can be reused when the tire is replaced.

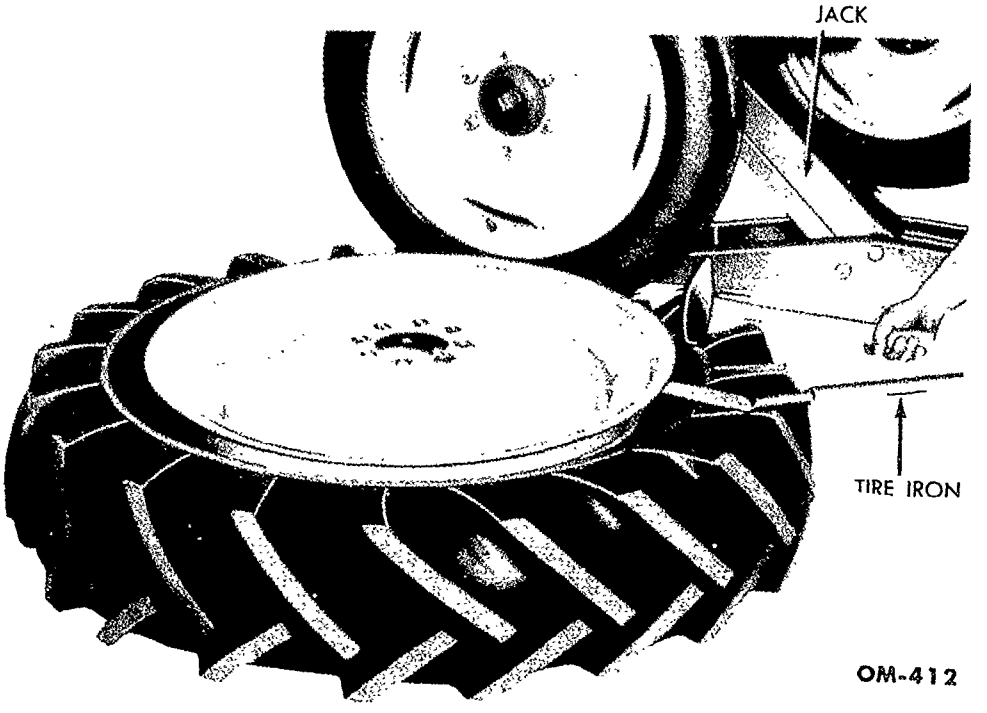

Fig. 25—Loosen Bead From Rim Edge

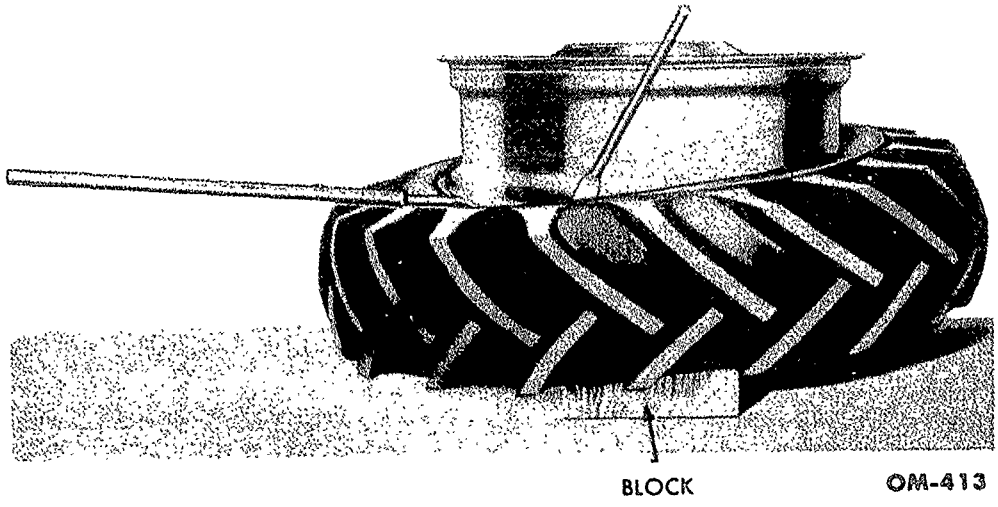

Fig. 26—Wheel in Position to Pry Rim Out of Tire

a. Remove Tire. Remove the wheel from the hub. Deflate the tube completely. Press valve through valve hole in the rim. Loosen both beads from the rim edges, using a tire iron and heavy mallet. In case of rear tires sticking to the rim, it may be necessary to jack up the front end of the tractor, slide the rear wheel under a front wheel, and let the tractor down on the tire as shown in fig. 25. Stand on the tire, with feet about 15 inches apart, opposite the valve, and force the bead off the bead seat into the drop center of the rim.

CAUTION: ***Care should be taken that the soft rubber tip on the inner edge of the tire bead is not damaged by the tire iron, as such damage will have a tendency to chafe the inner tube.***

Insert two tire irons about 8 inches apart between the bead and the rim flange, near the valve. Pry a short length of bead over the flange. Leave one tire iron in position, and follow around the rim with the other iron to remove the remainder of the bead. Remove the inner tube.

Turn the rear wheel over and block up the disk until the tire is clear of the floor (fig. 26). Pry the tire off the rim, starting with a small section and following around the wheel.

b. Install Tire. Place the wheel and rim in a flat position. Inflate the inner tube until it is barely rounded out. Install the tube in the tire.

NOTE: ***It is advisable to coat the inside and outside of the tire beads with soft soap and water solution. This will assist in moving the bead over the edge of the rim and will also protect the inner edge of the bead.***

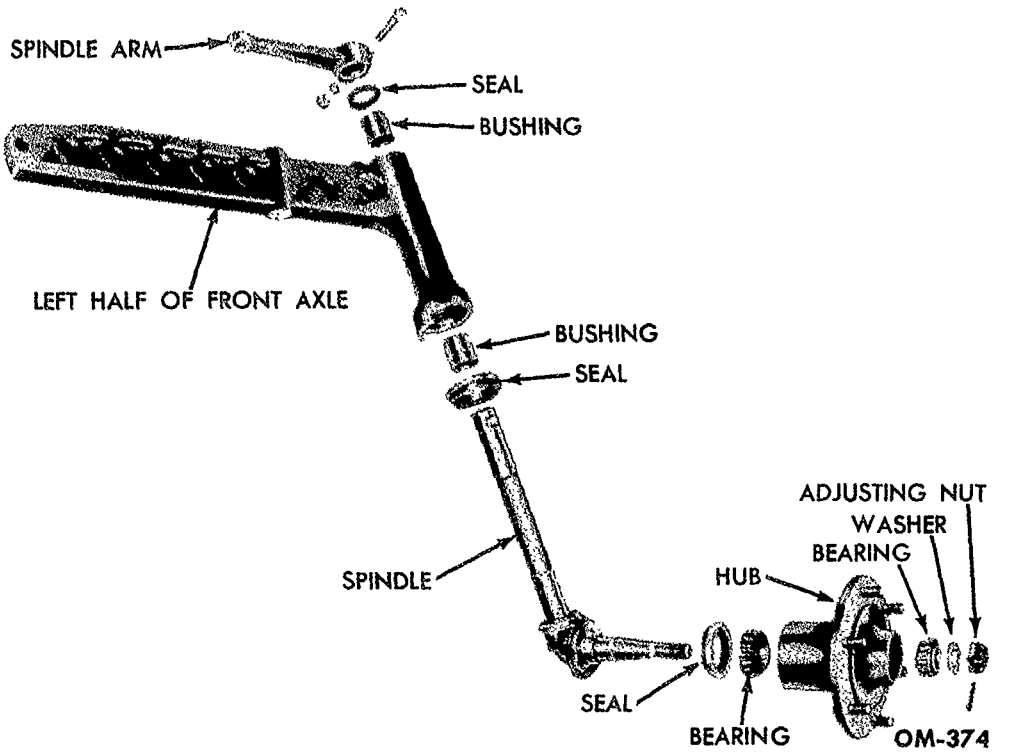

Fig. 27—Front Hub and Spindle Assembly

Place the tire on the rim, and guide the valve through the valve hole. Push the bottom bead down into the drop center of the rim at the valve. Force the bead over the flange, using the tire irons.

To apply the top bead, insert a tire iron between the top bead and flange at a point on the wheel *opposite the valve*. With the other tire iron, pry on the top bead, working all the way around the rim. Inflate the tire slowly until the tire seats evenly all the way around. "Centering" may be done by pounding the casing all the way around while it is being inflated.

c. Loading Tires. It is possible to increase the weight of the tractor as much as 620 pounds by the use of a solution of calcium chloride and water in the tires, see fig. 20.

312. FRONT HUB AND BEARING REPLACEMENT.

The front hub and bearing should be removed at the beginning of the spring season for cleaning and relubricating. The hub and bearing are illustrated in fig. 27.

a. Removal. Raise the front of the tractor until the wheel is clear of the ground. Remove the hub cap, cotter pin, wheel bearing adjust-

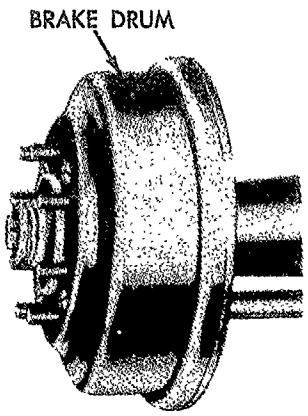

Fig. 28—Wheel Removed to Expose Brake Assembly

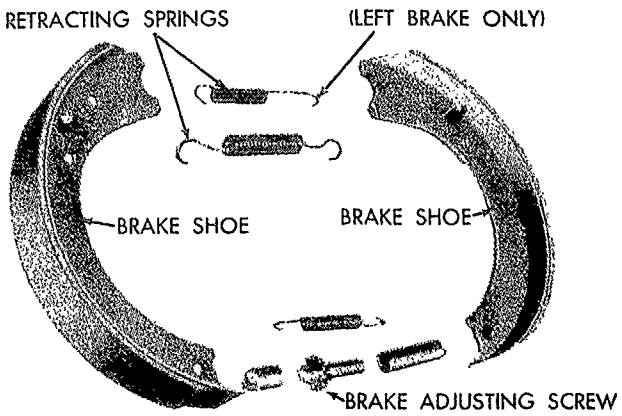

Fig. 29—Brake Shoe Assembly, Disassembled

ing nut, and washer. Pull the wheel outward until the outer roller bearing is near the end of the spindle. Push the wheel back on, and remove the outer bearing. Pull the wheel assembly off the spindle. Drive the inner bearing and grease retainer out of the wheel.

b. Installation. To install the wheel bearing, pack the inner wheel bearing with wheel bearing grease, and place it in the hub. Drive the retainer into the hub.

NOTE: ***Use a new retainer if the old one is worn or damaged.***

Place the wheel on the spindle. Pack the outer wheel bearing with wheel bearing grease, place the bearing on the spindle, and install the washer. Install the bearing adjusting nut, draw it up tightly, then back it off approximately ⅛ turn. There should be no visual looseness, yet the wheel should rotate freely. Install the cotter pin and hub cap. Lower the front of the tractor.

313. BRAKES.

When the brakes can no longer be adjusted to satisfactorily stop the tractor or assist in turning, the brake linings and shoes should be replaced.

a. Removal. Jack up the rear end of the tractor, and remove the rear wheels. Remove the four screws from the brake drum, and slide the drum off the shaft (fig. 28).

On the left brake, remove the two retracting springs. On the right brake, remove the one retracting spring. Remove the brake shoes (fig. 29). If one brake shoe is replaced, it is advisable to also replace

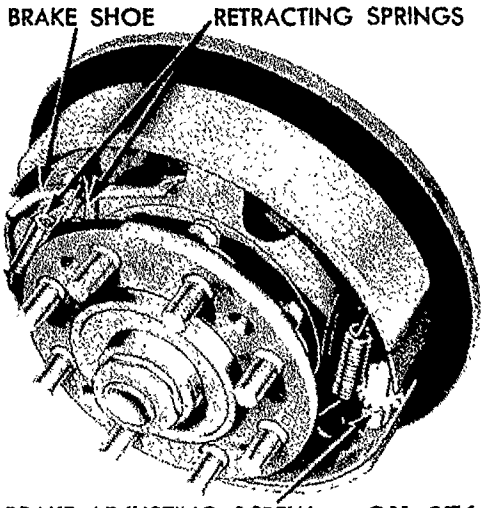

Fig. 30—Brake Assembly with Brake Drum Removed

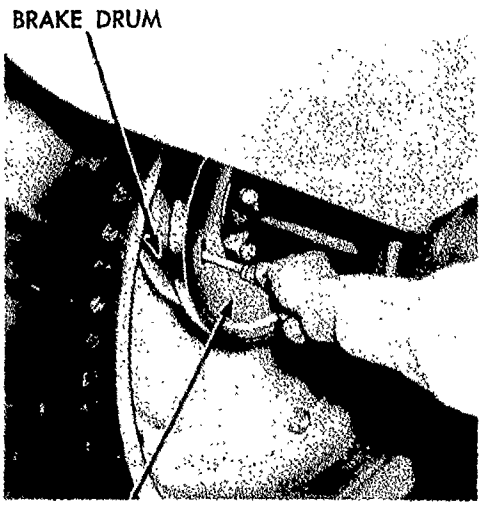

Fig. 31—Adjusting Brakes

the other three shoes to assure equalized braking action. Inspect the brake backing plate felt, and replace it if needed. Inspect anchor pin. If worn, replace brake support plate.

b. Installation. Place the shoes in the brake support plate, and attach the retracting spring (fig. 30). The left brake has two retracting springs, and the right brake uses one retracting spring.

Adjust the brakes so they are completely retracted, and install the brake drum. Mount the rear wheel.

c. Adjustment. Jack the tractor up until both rear wheels are free of the ground. Remove the brake adjustment cover, and turn the adjustment (fig. 31) until the brake drags with the pedal in the released position. Back off the adjustment until the wheel turns with a very slight brake drag. Shorten or lengthen the left brake tie rod, by using the clevis, until both brake pedals are in line with both brakes engaged. During the first hour of operation, after the brakes have been adjusted, feel of the drums occasionally to be sure that they are remaining cool. If the drums are hot, readjust as outlined above.

Chapter II

STEERING ASSEMBLY and FRONT AXLE

Section
Steering Assembly Replacement 321
Spindle Replacement 322
Front Axle Replacement 323
Front Axle Support Replacement 324

The steering system includes the steering gear, steering wheel, and steering drag links between the pitman arms and the front axle spindle arms. The steering gear is of the recirculating ball bearing worm and nut type. Anti-friction steering is achieved by steel balls which serve as rolling contacts between the worm and nut.

Rotation of the steering tube shaft moves the ball nut along the worm. The right steering sector engages the rack on the ball nut, and is thereby rotated through an arc by the movement of the ball nut. The left sector engages the right sector and rotates the same number of degrees in the opposite direction. The pitman arms transfer the motion of the sector to the spindle arms through the drag links.

321. STEERING ASSEMBLY REPLACEMENT.

The steering assembly may require removal from the tractor for service to the assembly itself, or to gain easy access to the transmission.

a. Removal. Remove the steering wheel with a puller.

To remove the hood, shut off the fuel at the fuel shut-off valve, and disconnect the fuel line to the carburetor. Remove the four cap screws that secure the hood to the instrument panel. Remove the cap screws that secure the hood to the front axle support. Remove the intake air screen, connection, radiator grille and unfasten wiring harness from hood. Lift off the hood.

Remove the air cleaner, tool box, battery, battery box, and choke rod.

Disconnect the throttle rod at its rear end, the governor compensating spring at the housing end, the starter wire at the switch end, and the oil line at the oil gauge.

Detach wiring from the regulator. Remove the two bolts that secure the steering gear to the instrument panel. Lift the instrument panel assembly off the steering shaft.

Remove the four bolts at the base of the steering gear, and lift out the assembly.

b. Installation. Place the steering gear in position, securing with four bolts at the base.

Install the instrument panel, securing with two bolts.

Connect the oil line, the starter wire, the governor compensating spring, and the throttle rod.

Install the choke rod, battery box, battery, tool box, and air cleaner.

Place the hood in position and install the air intake screen and connection. Install grille and cap screws that secure the hood to the front axle support. Install the four cap screws at the instrument panel. Connect the fuel line at the carburetor and turn on the fuel at the fuel shut-off valve and fasten wiring harness to hood.

Install the steering wheel.

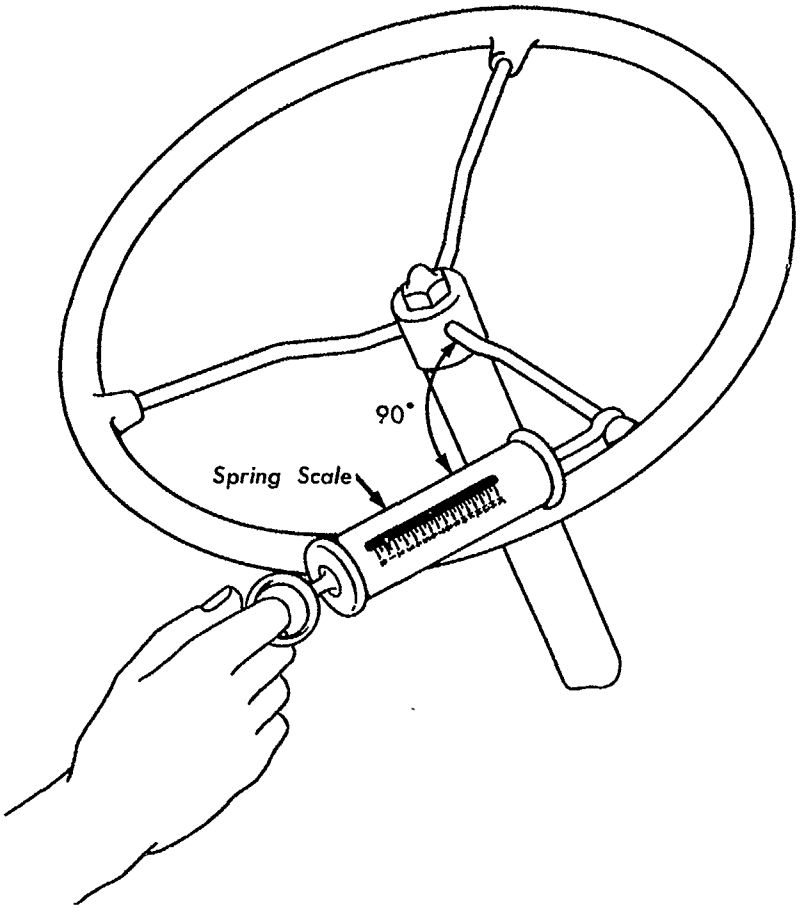

Fig. 32—Checking Steering Adjustment

c. Adjustments. When the wheels are in the straight ahead position, all backlash should be removed, but if the wheels are turned to the extreme right or left, a slight backlash will be present, due to the gear tooth design. This characteristic permits a backlash adjustment for wear between the worm nut teeth and the sector gears in the much-used center position without causing binding or tightness in less-used portions of the sector gears and worm nut.

Steering gear adjustments may be checked before removing the unit from the tractor or disassembling the unit. Adjusting the steering gear on the tractor in many cases will eliminate excessive backlash caused by improper adjustment between the sectors and the ball nut.

To determine the cause of excessive backlash, first check the adjustment of the steering tube bearings. Disconnect the drag links from the pitman arms. Turn the steering wheel to the right or left to the end of its travel, then back about ½ turn. Measure the force required to rotate it by use of a spring scale attached to the rim (fig. 32). If a force from ½ to 1½ pounds will maintain the wheel in motion during the next ½ turn toward the center position, the tube shaft bearings do not require adjustment. If the tube shaft bearings require adjustment, take the tractor to your dealer.

To adjust the right steering sector clearance, loosen the sector adjusting screw lock nut, and adjust the sector adjusting screw (fig. 33) for minimum backlash that will not cause hard steering. Tighten the lock nut. Two or three pounds force should be required to maintain the steering wheel in motion through the straight-ahead position.

Repeat the same procedure for adjusting the backlash on the left-hand sector. A force of 2½ to 6 pounds should be required to maintain the steering gear in motion through the straight-ahead position after both right and left sectors have been adjusted.

322. SPINDLE REPLACEMENT.

Support the front end of the tractor, and remove the wheel hub as outlined in section 312. Disconnect the drag link from the steering arm (fig. 34). Remove the steering arm bolt, and remove the steering

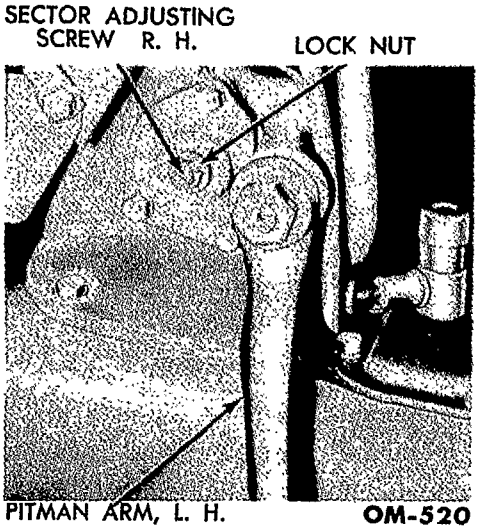

Fig. 33—Steering Sector Clearing Adjustment

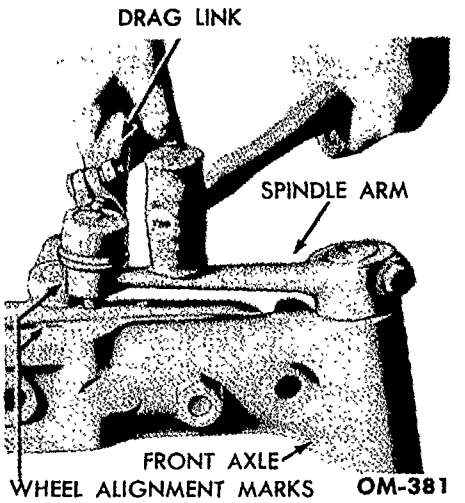

Fig. 34—Drag Link Removal

arm. Remove the key at the upper end of the spindle. Remove the spindle. Drive out the spindle bushings.

Install new bushings, seals, and spindles as required. Press the spindle bushings in place. Assemble as shown in fig. 27. Install the front wheel hub as outlined in section 312. Install the drag link.

323. FRONT AXLE REPLACEMENT.

Remove the two cap screws that secure the radiator to the front axle support. Support the tractor under the engine assembly. Remove the cap screw that secures the king pin in position. Raise the radiator a sufficient distance to clear the king pin. Remove the king pin as shown in fig. 35.

Remove the radius rod from the front axle assembly. Remove the tread width adjusting bolts.

Install the center section of the front axle in the front axle support as shown in fig. 36.

Attach the radius rods to the front axle. Adjust the front wheels to the desired width. Install the radiator.

324. FRONT AXLE SUPPORT REPLACEMENT.

a. Removal. Remove the king pin as outlined in section 323 above. Place a block on top of the engine to support the gasoline tank. Remove the two cap screws that secure the hood to the front axle support and remove the support.

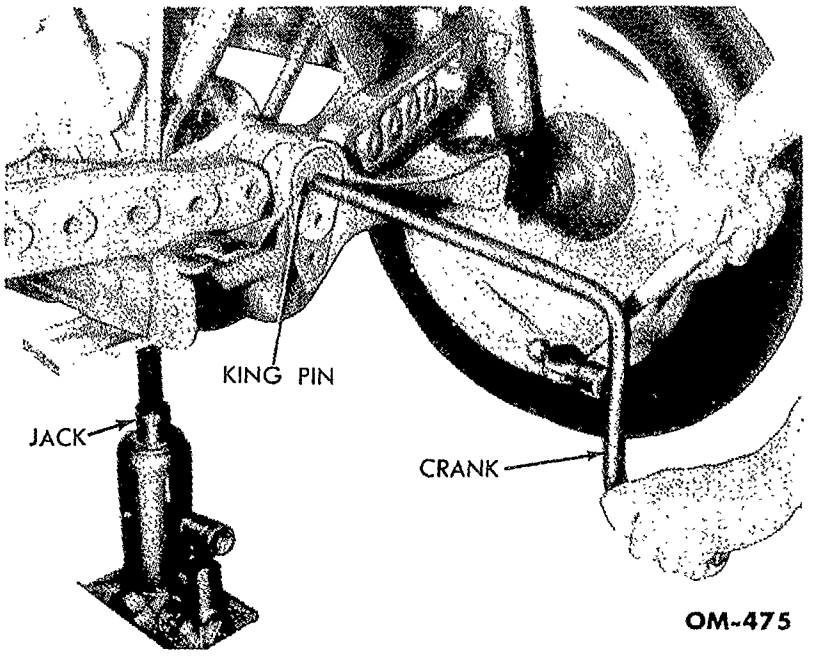

Fig. 35—King Pin Removal

b. Installation. Secure the front axle support to the engine. Secure the hood to the front axle support with two cap screws. Install the king pin (fig. 36). Secure the radiator to the front axle support. Remove all supporting blocks.

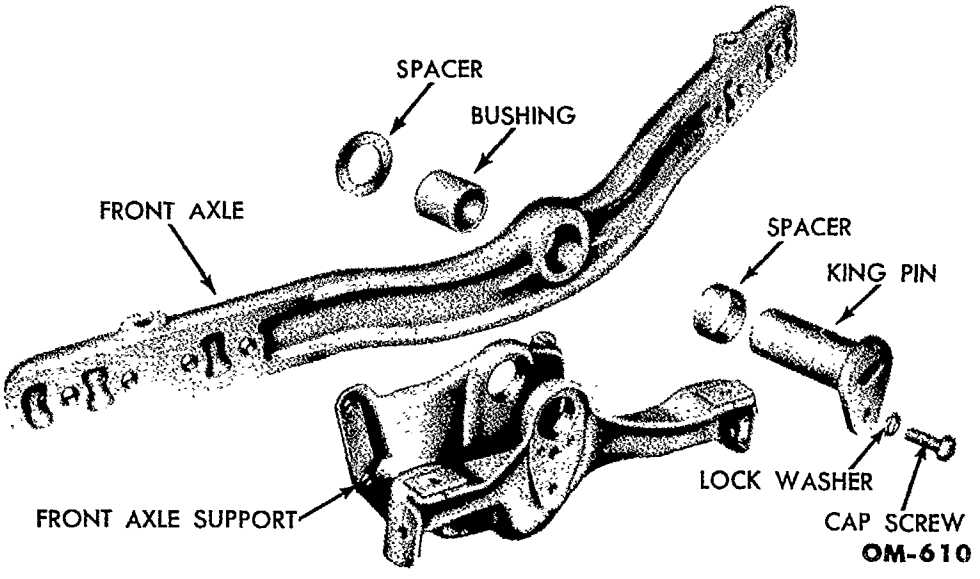

Fig. 36—Front Axle Support Assembly, Disassembled

Chapter III

ENGINE and CLUTCH

	Section
Engine Replacement	331
Cylinder Head and Valves	332
Connecting Rod and Piston Replacement	333
Oil Pan and Oil Pump Replacement	334
Clutch Replacement and Adjustment	335

331. ENGINE REPLACEMENT.

The first step in removing the engine is the removal of the hood.

a. Remove Hood. Shut off the fuel, and disconnect the fuel line to the carburetor. Remove the four cap screws which secure the hood to the instrument panel. Remove the cap screws which secure the hood to the front axle support. Remove the intake air screen and connection from the hood. Remove the hood as shown in fig. 37.

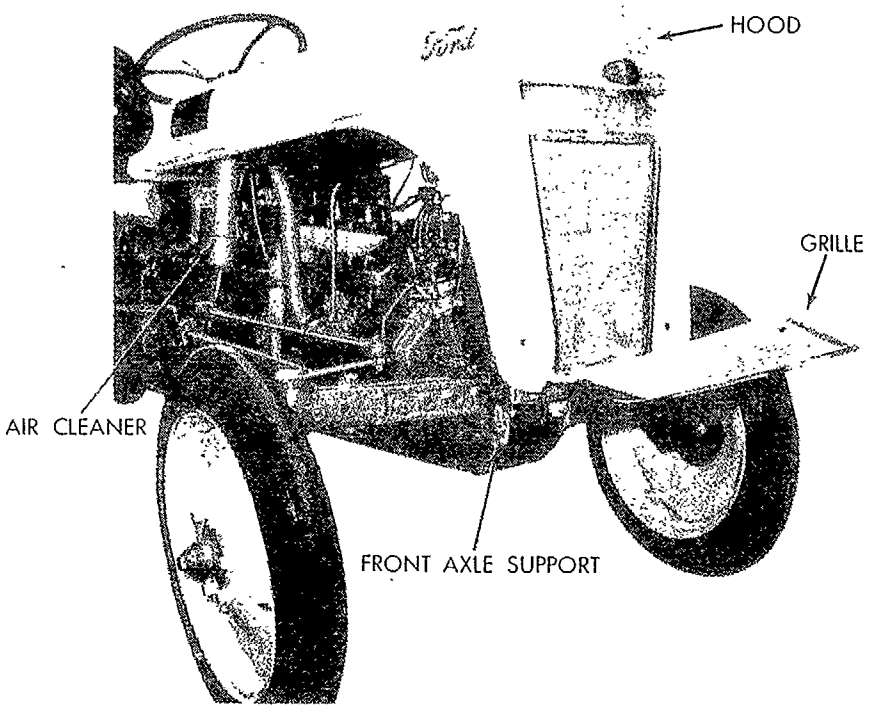

Fig. 37—Hood Removal

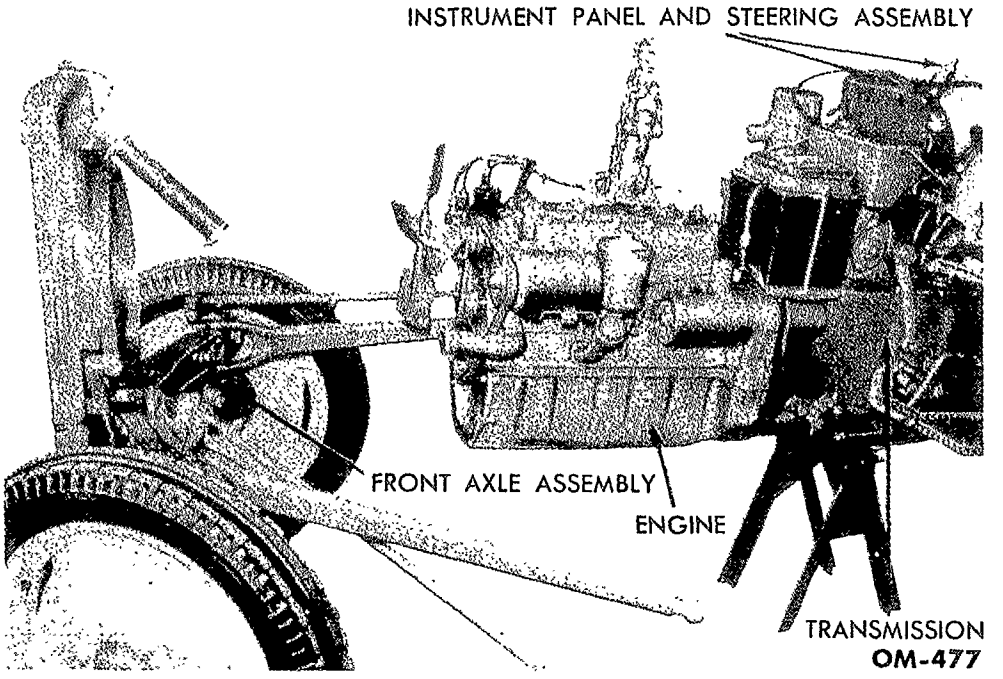

Fig. 38—Installing Engine

b. Remove Engine. Support the tractor under the transmission housing. Drain the radiator and the engine block. Drain the crank case. Remove the radiator hose. Disconnect radius rods from transmission case (fig. 38), and drag links from Pitman arms. Remove the six bolts that secure the front axle support to the engine assembly. Disconnect and label the generator, starter and coil electrical leads. The electrical connections may then be hung on the dash assembly. Remove the choke and governor control rods. Remove the air line from the air cleaner to the carburetor. Remove the oil pressure gauge line. Disconnect the proof-meter cable at governor and muffler from the exhaust manifold. Support the engine (fig. 38), and remove the cap screws which fasten the engine to the transmission. Slide the engine assembly ahead to disengage the clutch shaft. Remove the engine.

c. Install Engine. Engage the clutch shaft spline, and slide the engine in place. Secure the transmission to the engine assembly. The throttle spring is installed under one of the cap screws that secure the transmission to the engine block as shown in fig. 53. Connect the coil, generator, starter, and distributor leads. Attach the front axle support to the engine. Connect the drag links and radius rods. Connect the choke and governor linkages. Install the oil pressure gauge line. Connect the muffler to the exhaust manifold. Install the air line from the air cleaner to the carburetor. Install the radiator and hoses. Fill the radiator and crank case.

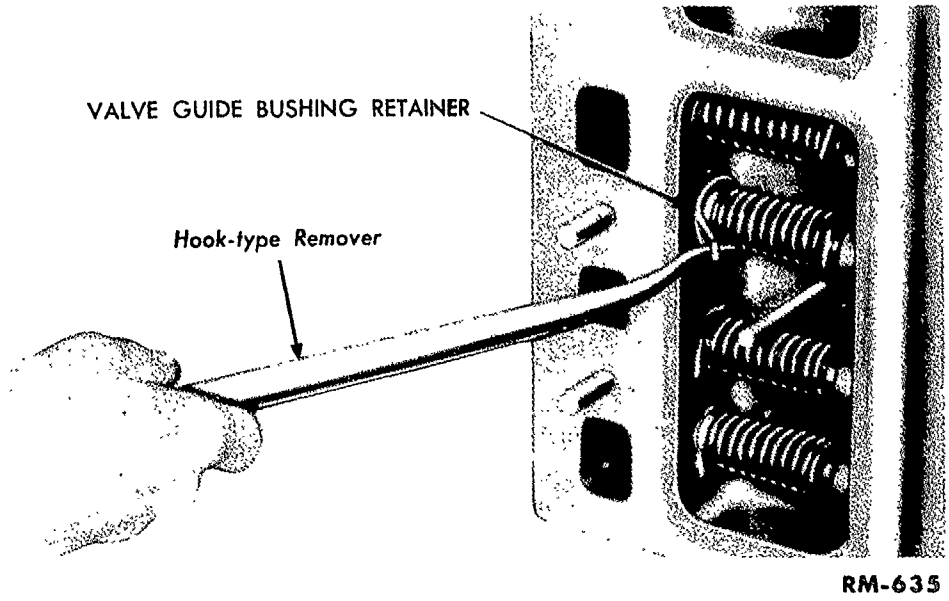

Fig. 39—Removing Valve Guide Bushing Retainer

d. Install Hood. Place the pad on top of the radiator if it has been removed. Place the hood assembly in position on the tractor. Install, but do not tighten, the four screws which secure the hood to the instrument panel. Install the cap screws which secure the hood to the front axle support. Install radiator grille before cap screws are tightened. Install the intake air connection. Tighten the screws which secure the instrument panel to the hood. Connect the gasoline line to the carburetor. Fasten wiring harness to clip on hood.

332. CYLINDER HEAD AND VALVES.

To remove the cylinder head and valves, it is necessary to remove the hood as outlined in section 331.

a. Remove Cylinder Head. Drain the radiator and engine block. Remove the spark plugs. Remove the two cap screws that mount the oil filter. Remove the two cap screws that fasten coil to cylinder head. Remove the cylinder head cap screws. Remove the cylinder head.

b. Remove Valve. Disconnect the choke and throttle rod from the carburetor. Remove the air line from the air cleaner to the carburetor. Disconnect the muffler from the exhaust manifold. Remove the carburetor and manifold as an assembly. Remove the valve covers. Crank the engine until the valve to be removed is closed. Remove the retainer with a hook-type remover (fig. 39). Remove the valve assembly.

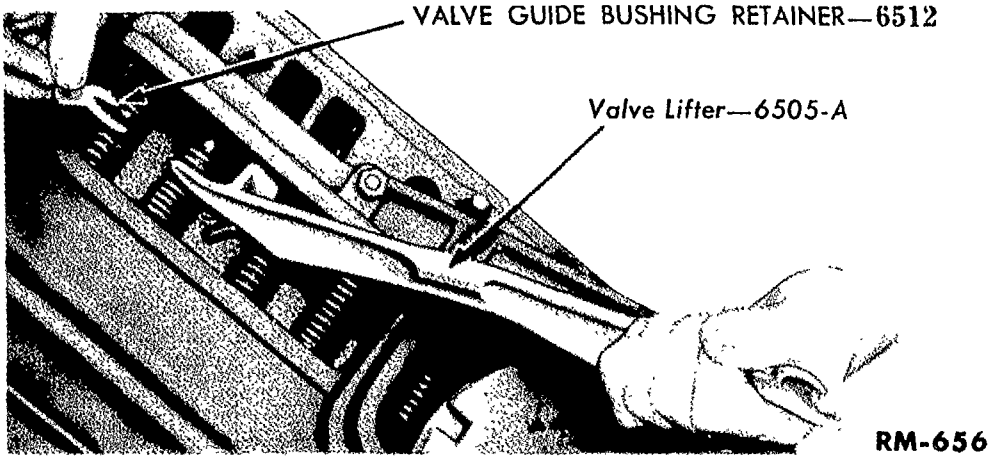

Fig. 40—Installing Valve Guide Bushing Retainer

c. Install Valve. Crank the engine until the push rod is at the bottom of its travel. Place the valve assembly in the engine. Compress the valve spring and insert the retainer as shown in fig. 40.

d. Install Cylinder Head. Make sure there is no foreign material either in the cylinders or on the surface of the cylinder head or block. Position a new head gasket on the cylinder block. Install the cylinder head on the cylinder block. Install and tighten the cylinder head cap screws from 65 to 70 foot pounds. When tightening cap screws, start from a centrally located cap screw, and tighten alternately each way. Install the spark plugs, using 24 to 28 pounds-feet torque. Mount the oil filter on the engine. Install the hood as outlined in section 331. Secure coil to cylinder head with two cap screws.

Checking Free Valve Clearance

(a) Turn engine crankshaft until exhaust valve is in full open position.

(b) Position an indicator on valve head. Set indicator at zero, then move valve vertically with fingers while observing indicator reading. This reading is actual clearance between valve cap seat and end of valve stem. Clearances must be .0002—.004 inch.

(c) If clearance is in excess of .004 inch, remove cap No. 8EQ-6550-B and slightly reduce length of cap by lapping open end of cap on fine emery cloth placed on flat surface (plate glass).

(d) If clearance is less than .0002 inch between end of stem and cap seat, check keys, part No. 8EQ-6518, for wear. If worn, replace; if no wear is apparent, grind off end of stem until specified clearance is obtained.

IMPORTANT: ***When overhauling an engine or refacing valves, clearance between cap No. 8EQ-6550-B and valve stem end must be checked in accordance with foregoing instructions.***

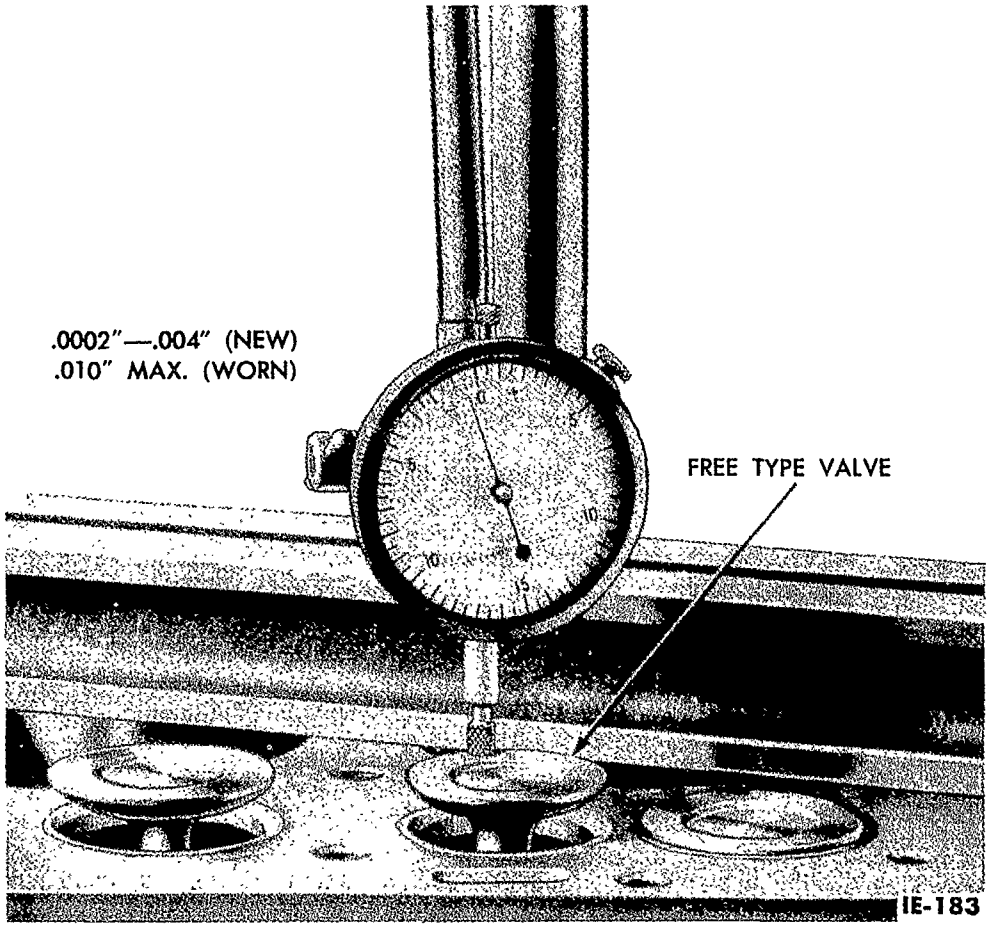

Fig. 41—Checking Clearance Between End of Valve Stem and Cap with an Indicator (Free Type Valve)

NOTE: ***If indicator is not available, clearance may be checked by rotating valve when in full open position. Valve must be free to rotate without noticeable vertical movement.***

Tappet Adjustment.

(a) Correct tappet clearance is of utmost importance if normal valve life is expected. Valves that do not seat will soon burn through at edges. Excessive tappet clearance may result in valve breakage due to valve pounding on its seat.

(b) To adjust tappets, rotate crankshaft to obtain compression stroke (both valves closed).

(c) Insert protruding lip of tappet holding wrench into rear hole of tappet being adjusted.

(d) Place other end over the head of adjacent tappet, Fig. 42.

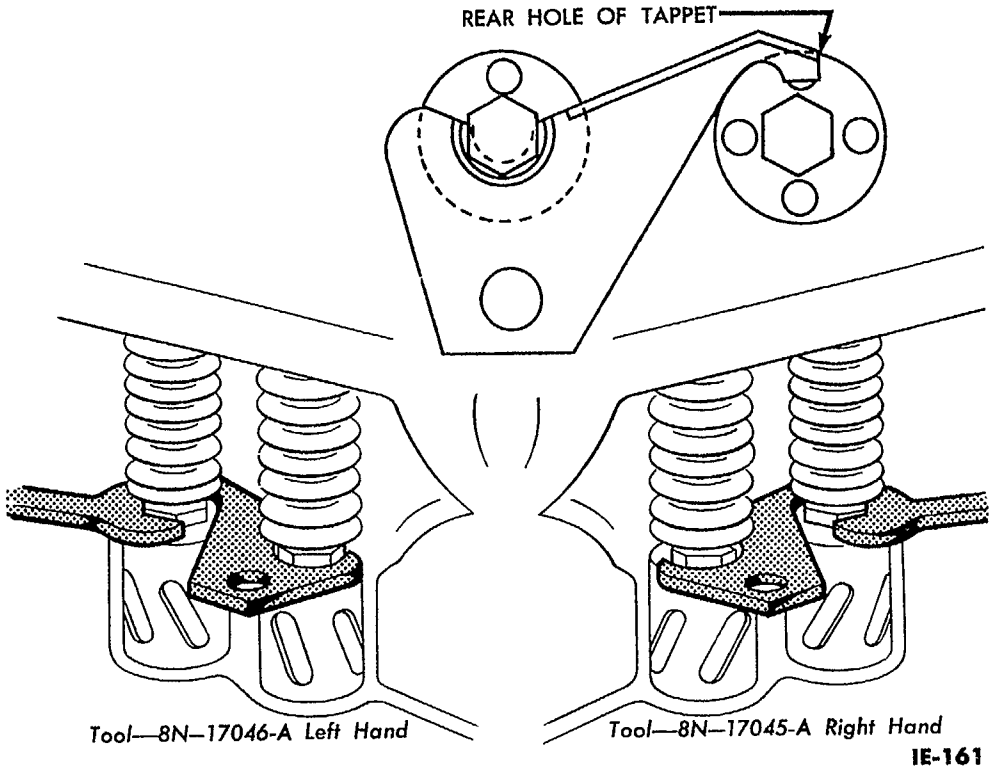

Fig. 42—Tappet Holding Tools

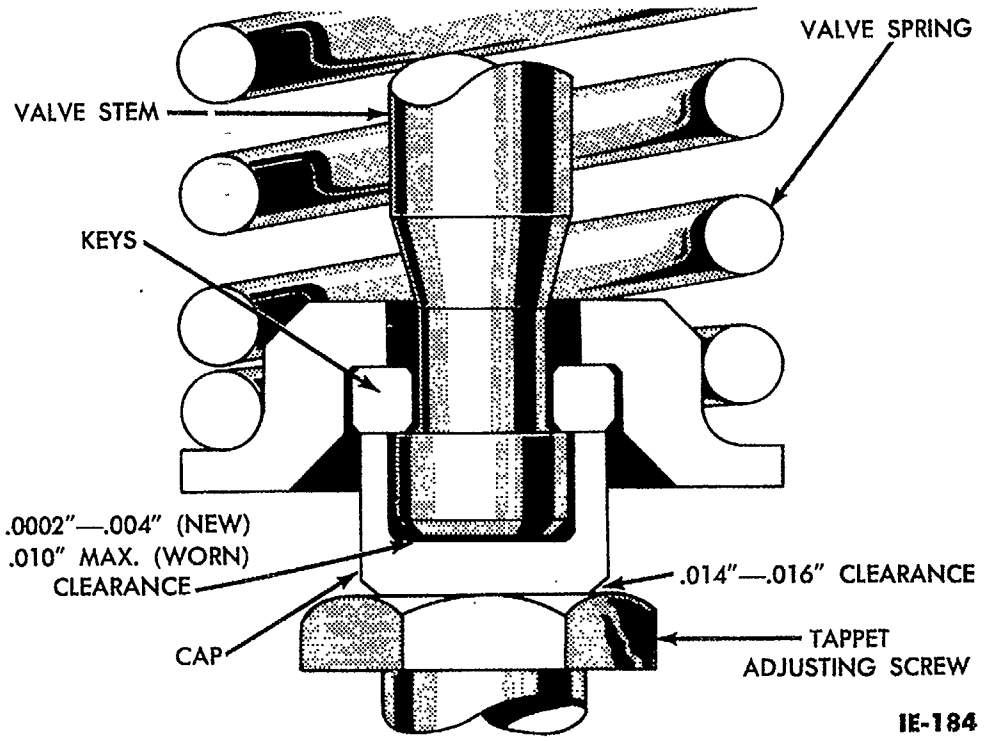

Fig. 43—Sectional View Showing Clearances of 8N Engine Free Type Exhaust Valve

(e) Grind the open end of your tappet wrench so that it does not extend past the head of adjusting nut.

(f) Check clearance between tappet adjusting screw head and cap. Gauge cap and tappet adjusting screw to clearances shown in Figures 42 and 43.

NOTE: ***These are cold engine clearances.***

(g) To increase clearance, hold tappet with tappet holding wrench 8N-17045-A right hand, 8N-17046-A left hand (both tools are necessary), and turn tappet adjusting screw counterclockwise to decrease clearance, clockwise to increase clearance.

333. CONNECTING ROD AND PISTON REPLACEMENT.

a. Remove Connecting Rod and Piston Assembly. Remove the cylinder head as outlined in section 332. Remove the oil pan as outlined in section 334. If desired, the front axle may be removed to obtain easy access to the engine. Remove the connecting rod nuts. Remove the bearing cap and lower half of the insert bearing. Push the rod and piston assembly up with a hammer handle, and remove the upper half of the insert bearing. Remove the piston and connecting rod from the top of the cylinder block.

b. Fitting Pistons. To check the clearance of a piston in a cylinder bore, use a thickness gauge ½ inch wide and long enough to cover the entire length of the piston. Attach the gauge to a tension scale. Place the gauge on the side of the piston bore (fig. 45). Invert piston, then push in cylinder until piston is flush with cylinder head. Make certain thickness gauge is 90 degrees (right angle) from the piston pin hole. Withdraw gauge and observe reading on the piston pull scale. The thickness of the gauge to be used and the pounds pull for various combinations of pistons and cylinder bores are shown in fig. 46.

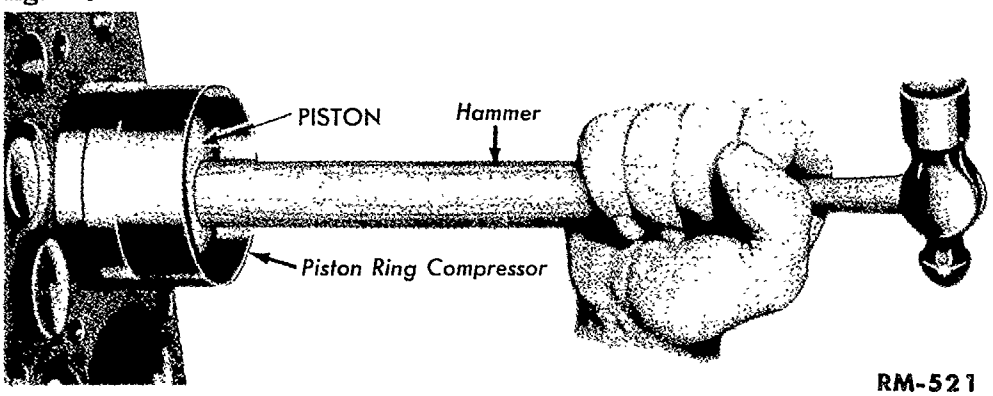

Fig. 44—Installing Connecting Rod and Piston Assembly

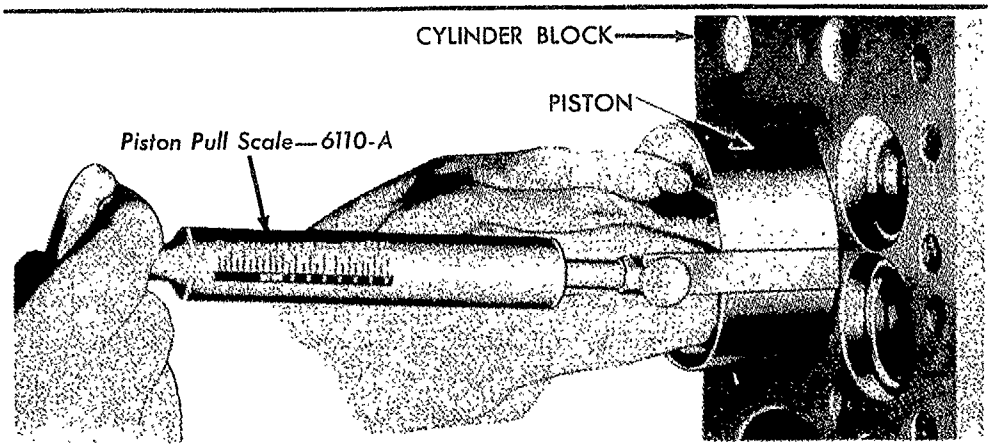

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Fig. 45—Fitting Piston to Cylinder Bore

c. Install Connecting Rod and Piston Assembly. Place number one connecting rod and piston assembly in number one cylinder with the notch in top of piston facing toward front of the engine. Oil squirt hole in connecting rod can face either way. Install a piston ring compressor on piston rings, and tap piston down into the cylinder with the handle end of a hammer. Fig. 44.

Cylinder Bore and Piston Combination	Gauge Thickness	Pull Pounds
New Aluminum Pistons—New Sleeve	.002	5-10
New Steel Sleeve—Worn Alum. Piston	.003	5-10
Worn Sleeve—New Alum. Piston	.003	5-10
Worn Sleeve—Worn Alum. Piston	.004	5-10

Fig. 46—Dimensions for Fitting Piston in Cylinder Bore

Before installing connecting rod assemblies carefully examine the connecting rod bearings for evidence of fatigue failure. Fatigue failure can be recognized by the breaking away of the bearing overlay material.

Place one-half of the connecting rod insert bearing in the connecting rod and the other half in the connecting rod bearing cap. Coat the connecting rod insert bearing with a light film of oil. Carefully position the connecting rod on the crankpin, and install the bearing cap on the connecting rod, making sure the number on the bearing cap is toward the same side as the number on the connecting rod. Be sure bearings are not jarred out of place. Install, but do not tighten, the nuts.

Repeat the above procedure when installing the other connecting rod and piston assemblies. Tighten all connecting rod nuts 35 to 40 pounds feet and install pal nuts then tighten 4 to 5 lbs. feet.

CAUTION: ***Pal lock nuts should be discarded after they have***

been used once.

Install the oil pan as outlined in section 334. The front axle should be installed if it was removed.

334. OIL PAN AND OIL PUMP REPLACEMENT.

The oil pump can be removed only after the oil pan has been removed.

a. Remove Oil Pan. Drain the engine crankcase. Support the tractor under the transmission housing. Remove the pin from the forward end of both radius rods. Remove the bolts holding the front axle support to the oil pan. Remove the cap screws which secure the transmission housing to the oil pan. Remove the pan-to-engine-block cap screws and lower the pan out of the tractor.

b. Remove Oil Pump. Remove the front main bearing cap nuts. Pull the oil pump assembly off the studs.

c. Install Oil Pump. Install the main insert bearings and the main bearing cap and pump assembly. The correct torque on the main bearing place bolts is 90 to 100 pounds-feet. Be sure the nuts are evenly tightened.

d. Install Oil Pan. Raise the pan in position, check to see that the gaskets are in place, then install the cap screws. All the cap screws and bolts should be installed before starting to tighten any of them. Tighten pan to engine block cap screws from 15 to 18 pounds-feet. Install the pins in the radius rods.

335. CLUTCH REPLACEMENT AND ADJUSTMENT.

Before removing the clutch, the hood must be removed as outlined in section 331.

a. Remove Clutch. Disconnect the radius rods from transmission housing. Disconnect the drag links from the pitman arms. Support the tractor under the transmission and engine. Disconnect and label the generator, starter and coil electrical leads. The electrical connections may then be hung on the dash assembly. Remove the choke and governor control rods. Remove the air line from the air cleaner to the carburetor. Remove the oil pressure gauge line. Disconnect the muffler from the exhaust manifold. Remove the cap screws which secure the engine to the transmission. Roll the rear end assembly away from the engine. Remove the cap screws that secure the clutch assembly to the flywheel.

b. Install Clutch. Install the clutch assembly on the flywheel. Roll the rear end assembly up to the engine assembly. Engage the clutch shaft spline and roll the assembly into place. Secure the transmission to the engine assembly. Install the throttle spring. Connect the electrical leads. Connect the choke and governor linkages.

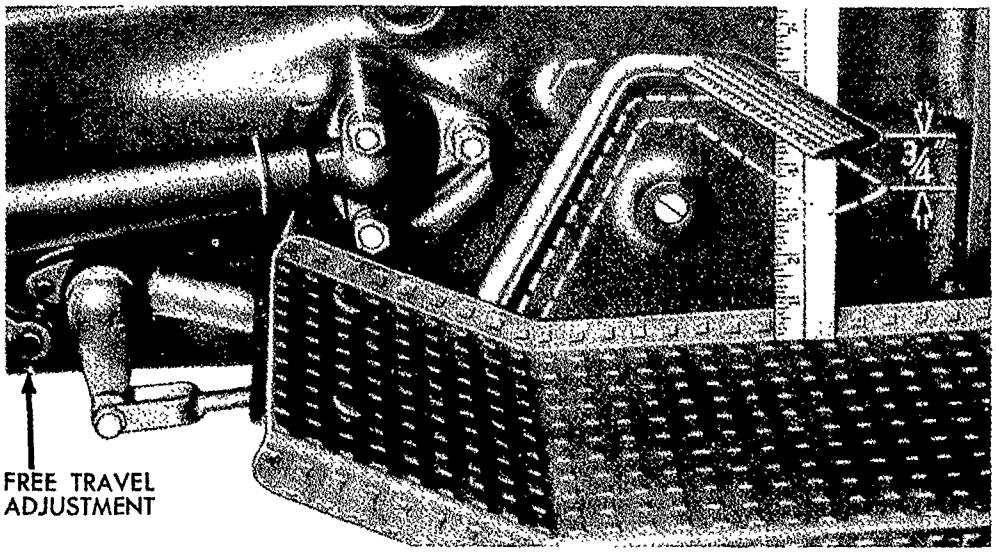

Fig. 47—Clutch Pedal Free Travel Adjustment

Install the oil pressure gauge line. Connect the muffler to the exhaust manifold. Install the air line from the air cleaner to the carburetor. Install the hood as outlined in section 331.

c. Remove Clutch Linkage. Disconnect the engine from the transmission as outlined above. Drive the pin out of the fork and clutch release shaft. Remove the release shaft. Remove the clutch pedal by disconnecting the brake tie rod and removing the left wheel brake pedal. Remove the brake shaft and clutch pedal.

d. Install Clutch Linkage. Install the clutch release shaft and fork. Rivet the fork to the shaft. Place the clutch pedal on the brake shaft, and insert it into the transmission housing. Mount the left brake pedal. Connect the brake tie rod. Install the transmission on the engine as outlined in section 331.

e. Adjust Clutch Pedal Free Travel. The clutch pedal should be adjusted to have ¾ inch free travel. The adjustment screw is located on the clutch pedal. Fig. 45 shows the method of adjusting and measuring the clutch pedal free travel.

Chapter IV

FUEL and EXHAUST SYSTEMS

Section
Manifold Replacement 341
Air Cleaner Replacement and Service 342
Fuel Tank Replacement and Cleaning 343
Carburetor Replacement and Adjustment 344
Governor and Linkage Replacement 345
Muffler Assembly Replacement 346

341. MANIFOLD REPLACEMENT.

Remove the clamp that attaches the manifold to the exhaust pipe. Remove the carburetor as outlined in section 344. Remove the manifold.

Make sure there is no foreign material either on the manifold or block surfaces. Position new gaskets on the block. Install the manifold on the block tightening nuts from 40 to 50 pounds-feet. Install the clamp that attaches the muffler to the exhaust manifold. Mount the carburetor as outlined in section 344.

342. AIR CLEANER REPLACEMENT AND SERVICE.

The air cleaner is essential for long engine life, and the cleaner should receive frequent service. Poor air cleaner service results in inefficient cleaning and allows foreign material to collect in the cleaner which restricts the air flow. Restricted air flow through the cleaner will increase fuel consumption because it gives the same results as running with the choke partly closed.

a. Remove Air Cleaner. Remove the air line from the air cleaner to the carburetor. Remove the four screws which secure the intake air connection to the hood. Remove the cap screws which secure the cleaner to the battery rack, and lift off the cleaner. The disassembled air cleaner is shown in fig. 48.

b. Install Air Cleaner. Mount the air cleaner in position, and secure it with cap screws to the battery rack. Mount the intake air connection to the hood, securing it with four screws. Install the air line from the air cleaner to the carburetor. Clean the air cleaner cup. Fill the cup with clean oil to the indicated level, and install the cup.

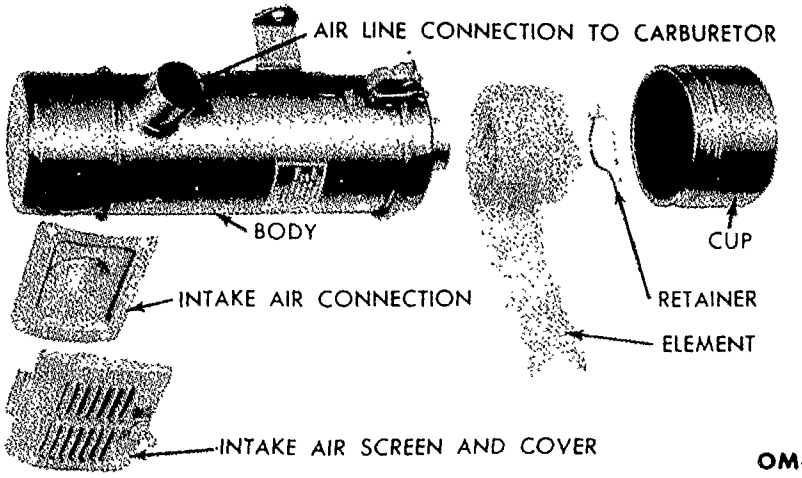

Fig. 48—Air Cleaner, Disassembled

c. Service. Daily cleaning of the air cleaner cup is usually sufficient under most field operations. Under very dirty conditions, it may be necessary to service the cleaner several times each day. Routine cleaner service consists of cleaning the cup and the lower end of the cleaner body. Fill the cup to the indicated level with clean oil of the same weight used in the engine crankcase. When operating in sub-zero temperature, it is desirable to thin the cleaner oil with a little kerosene. Clean the intake air cleaner as required. The engine breather cap (fig. 23) should be washed when giving the air cleaner routine cleaning.

The routine service of the cleaner will allow dust deposits to accumulate in the body of the cleaner. Semi-annually, the cleaner should be removed from the tractor and thoroughly cleaned.

With a screw driver, pry the element retainer from the cleaner body. Remove the lower section of the element and wash it thoroughly in gasoline. Place the lower section of the element in the cleaner body, and install the element retainer. If the heavy deposits cannot be removed, the cleaner body should be replaced.

343. FUEL TANK REPLACEMENT AND CLEANING.

The use of clean fuel prevents fuel system failures. Always refill the gasoline tank at the end of the day's operation. This removes the moisture laden air from the tank, and thereby reduces the condensation of water.

a. Removal. Disconnect the fuel line, and drain the gasoline with the shut-off valve opened to the reserve position. Remove the hood as outlined in section 331. Remove the tank from the hood assembly.

b. Cleaning. It is advisable to remove the fuel shut-off valve, by unscrewing the assembly, when cleaning the gasoline tank. Clean

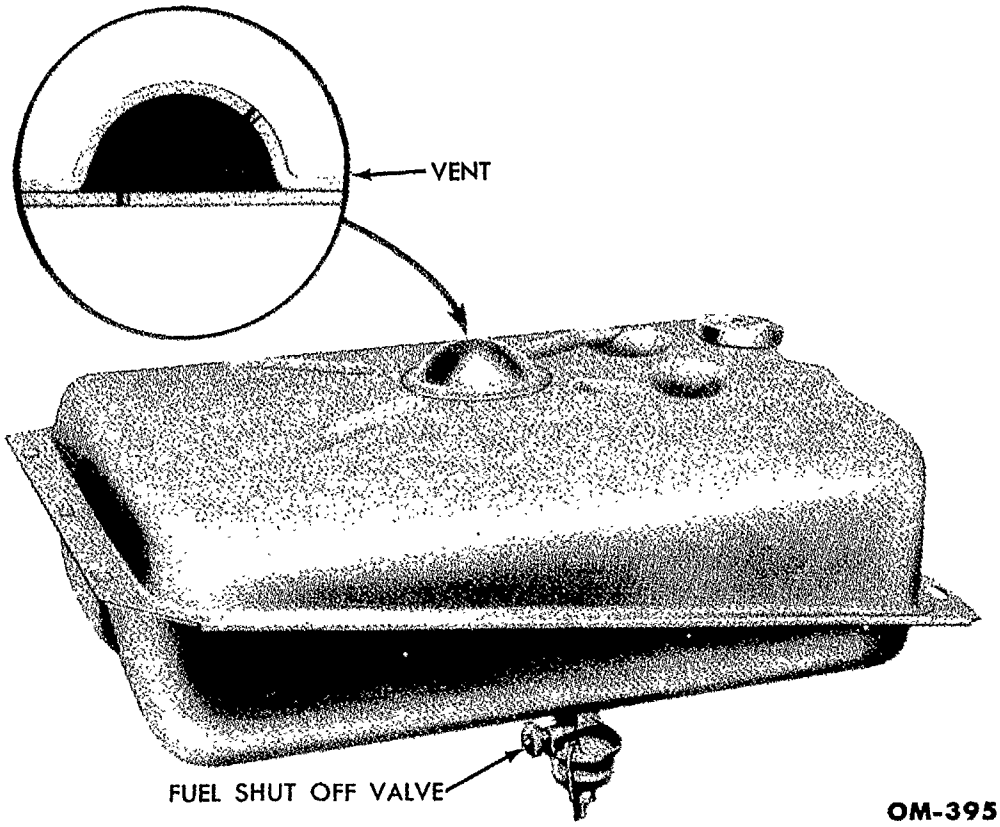

Fig. 49—Fuel Tank

the sediment bowl, screws, and valve passages as required. Clean the fuel line to remove any foreign material.

c. Installation. Screw the fuel shut-off valve into position in the gasoline tank. Mount the tank in the hood assembly. Install the hood as outlined in section 331.

344. CARBURETOR REPLACEMENT AND ADJUSTMENT.

A correctly adjusted, clean carburetor is necessary for efficient tractor operation.

a. Removal. Disconnect the choke and governor control rods. Disconnect the air line from the air cleaner. Remove the carburetor from the manifold.

b. Cleaning. Remove the main adjustment needle (fig. 52). Remove the four screws that secure the carburetor body to the carburetor throttle body (fig. 50). Thoroughly clean all passages in the carburetor. Be sure that the drain screen washer remains within the main air intake drain.

c. Float Adjustment. Bend the float lever until the float is positioned as shown in fig. 51.

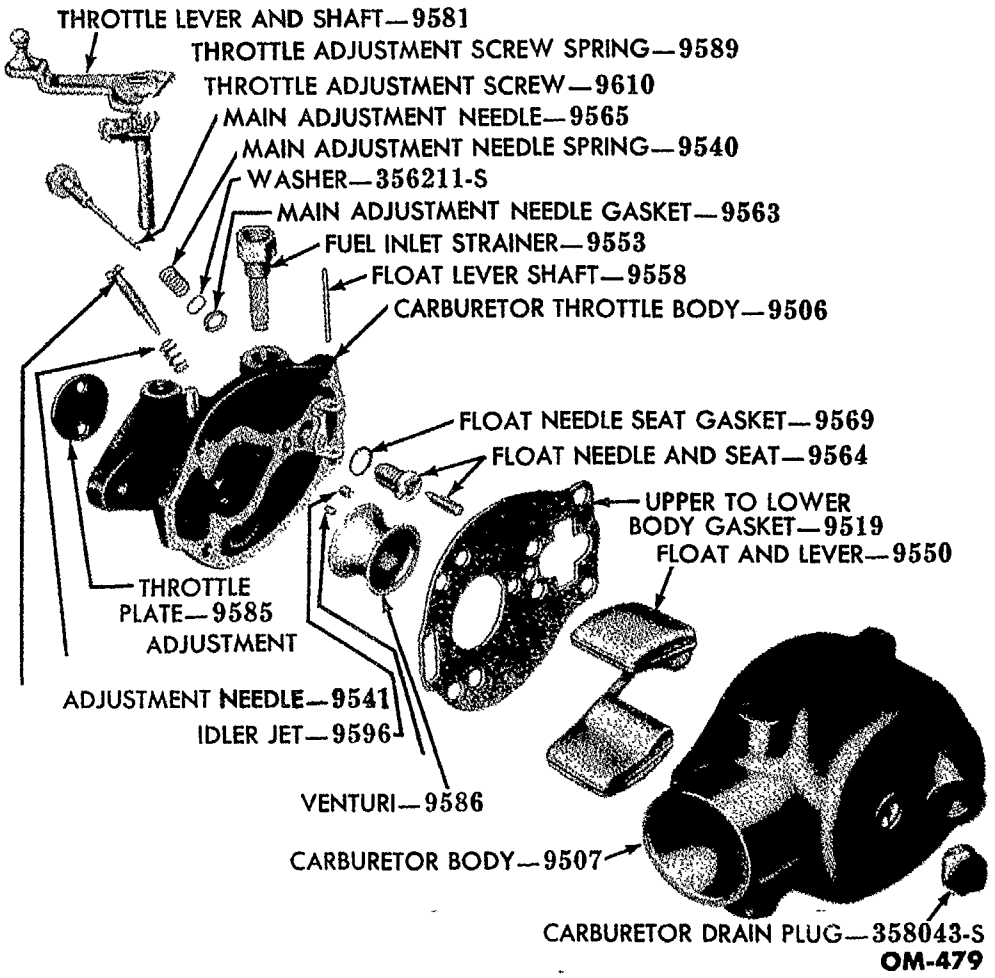

Fig. 50—Carburetor, Disassembled

d. Installation. Mount the carburetor on the manifold, securing with two studs. Connect the air line to the carburetor. Connect the choke and governor rods.

e. Carburetor Adjustment. The carburetor adjustments are: main adjustment needle, throttle adjustment screw, and idle adjustment needle.

The main adjustment needle should be opened 1 turn from the closed position. A field method of checking this adjustment is to open the throttle quickly with the engine under partial load. The engine should respond immediately to the increased throttle setting. If the engine "coughs," or hesitates, open the main adjustment needle about $\frac{1}{8}$ turn more and repeat the check.

When the hand throttle is in the idle speed position, the engine should be running about 400 R.P.M. The engine speed may be determined by the proof-meter. The throttle adjustment screw is located on the left side of the carburetor, as shown in fig. 52. The

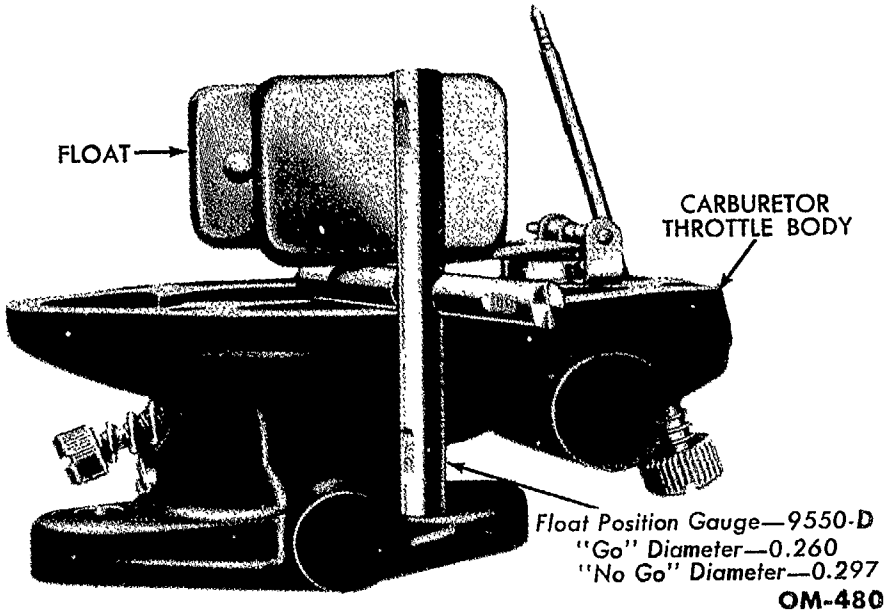

Fig. 51—Correct Position for Float Level

idle speed adjustment should be made with the engine at operating temperature.

The idle adjustment needle assists in making the engine run smoothly at idle speed. The engine should be at operating temperature when making the adjustment. The idle adjustment needle should be opened approximately 1 turn. Continue adjustment until the engine idles smoothly.

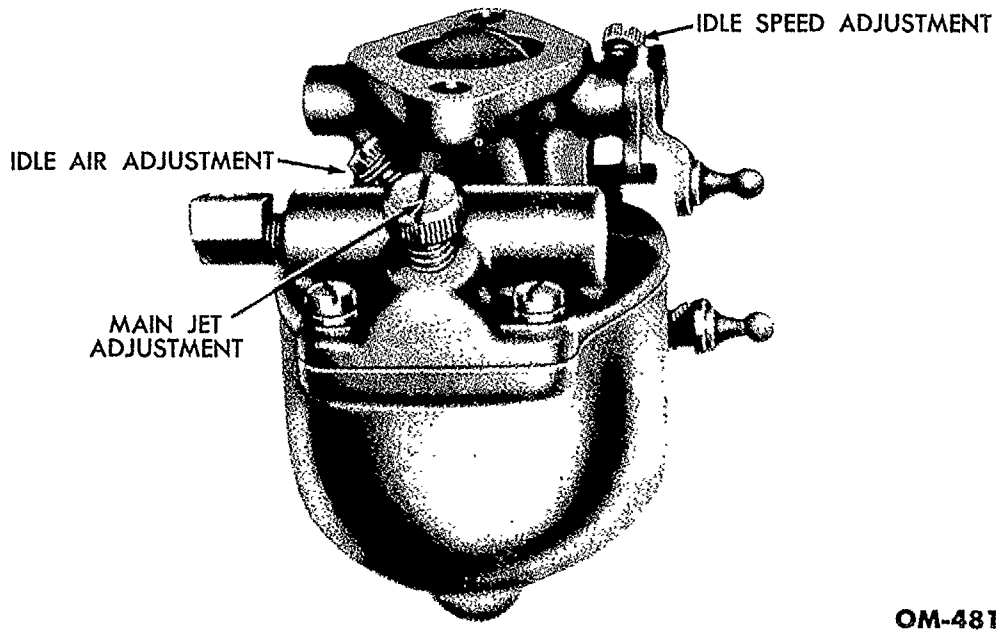

Fig. 52—Carburetor, Assembled

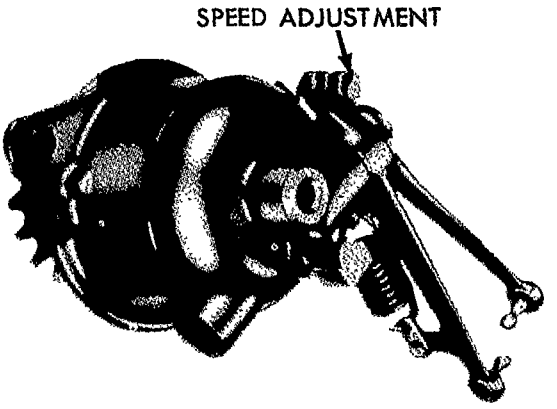

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Fig. 53—Governor Adjustment



OM-368

Fig. 54—Hand Throttle Spring Tension Adjustment

345. GOVERNOR AND LINKAGE REPLACEMENT.

The governor changes throttle setting as required, to maintain a given engine speed under varying engine loads.

a. Remove Governor. Disconnect the two rods from the governor arms. Disconnect the oil line. Remove the governor from the engine assembly.

b. Install Governor. Mount the governor on the engine, and connect the two rods and the oil line.

c. Governor Linkage Adjustment. The governor spring should be a snug fit and should have no end play or preload. The spring may be adjusted by bending the loop on the spring with a pair of pliers.

The hand throttle is held in closed position by the spring tension. The spring tension may be adjusted by raising the stationary spring seat. This adjustment is located on the right side of the steering gear as shown in fig. 54.

The correct engine governed speed (no load) with the hand throttle full open is 2200 R.P.M. which can be determined by observing the proof-meter ring marked engine R.P.M. in hundreds.

(1) *ENGINE SPEED OVER 2200 R.P.M.* Manipulate the maximum speed adjustment to give a top speed of 2200 R.P.M. as shown in fig. 53. Lengthen the governor rod so that when the governor arm strikes the maximum speed adjustment, the throttle lever is in the last notch on the quadrant. Turn governor screw clockwise to reduce R.P.M.; counterclockwise to increase.

(2) *ENGINE SPEED UNDER 2200 R.P.M.* Shorten the governor rod to secure an engine speed of 2200 R.P.M. when the throttle lever is in the maximum speed position (fig. 55). It may be necessary to back off the maximum speed adjustment to adjust the governor rod (fig. 53). Adjust the maximum speed adjustment after the governor rod has been adjusted.

346. MUFFLER ASSEMBLY REPLACEMENT.

Remove the clamp holding the exhaust pipe to the manifold. Remove the nut on the tail pipe support.

Install the tail pipe support. Clamp the exhaust pipe to the manifold.

GOVERNOR LINKAGE ADJUSTMENT

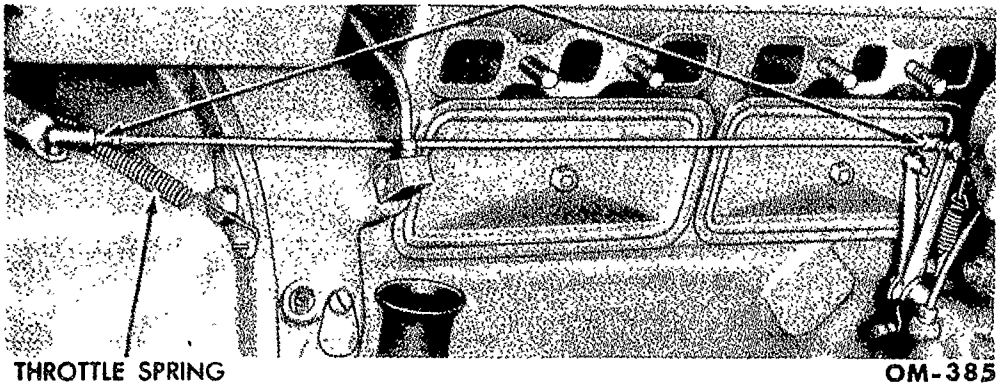


Fig. 55—Governor Linkage Adjustment

Chapter V

COOLING SYSTEM

Section
Radiator Replacement 351
Water Pump Replacement 352
Fan and Shroud Replacement 353
Fan Belt Replacement and Adjustment 354
Thermostat Replacement 355
Cooling System Protection 356

351. RADIATOR REPLACEMENT.

Remove the hood as outlined in section 331. Drain the cooling system. Remove the radiator hose connections. Remove the radiator

Install the radiator and hose connections. Replace the hood as outlined in section 331.

352. WATER PUMP REPLACEMENT.

Drain the cooling system. Loosen the fan belt tension. Remove the water pump hose connection. Remove the four cap screws that secure the fan to the pulley. Remove the three cap screws that mount the water pump assembly on the engine. Remove the water pump assembly. Remove the fan.

Position the fan in the shroud. Mount the water pump on the engine. Secure the fan to the pulley with the four cap screws. Set the fan belt tension as outlined in section 353. Install the hose connection, and refill the cooling system.

353. FAN AND SHROUD REPLACEMENT.

Remove the radiator as outlined in section 351. Remove the shroud from the radiator. Remove the fan from the water pump assembly.

Install the fan on the water pump assembly. Install the shroud on the radiator. Install the radiator as outlined in section 351.

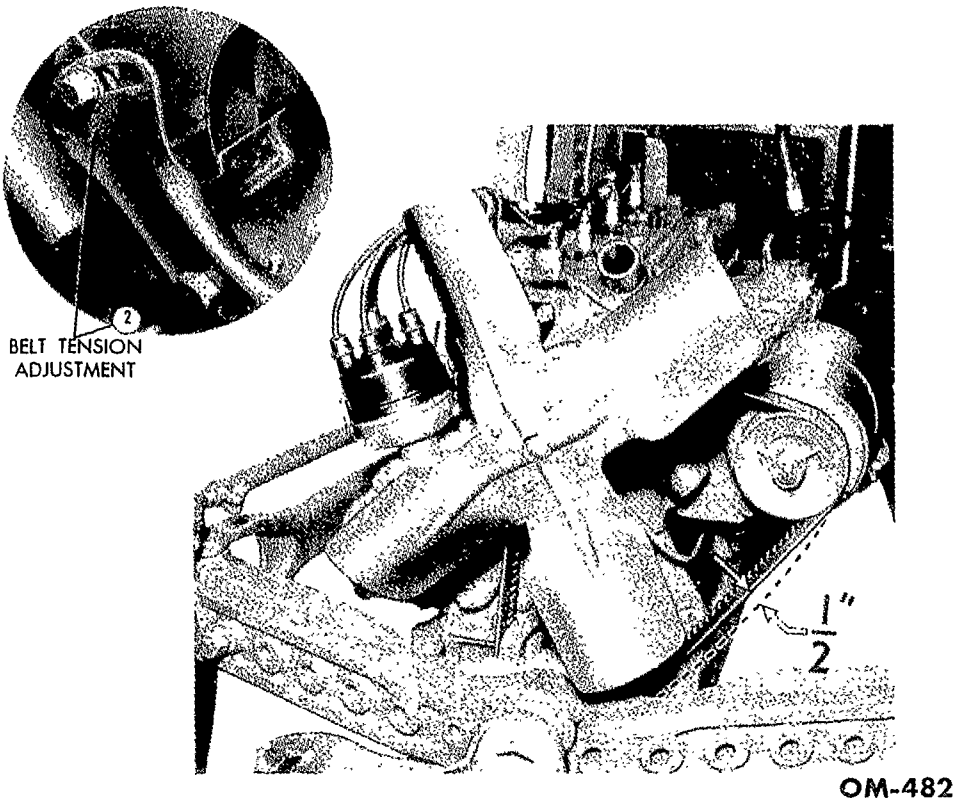


Fig. 56—Fan Belt Adjustment

354. FAN BELT REPLACEMENT AND ADJUSTMENT.

The fan belt may be removed and installed without removing any assemblies. Fan belt tension may be adjusted by changing the position of the generator. This adjustment is shown in fig. 56. This figure also shows the correct tension adjustment on the fan belt.

355. THERMOSTAT REPLACEMENT.

Remove the upper radiator hose connection. Press the thermostat out of the hose.

Before installing a thermostat, try its operation in hot water. It should start to open at 160° F. to 165° F. and be fully open at 190° F. to 200° F. The replacement thermostat may be pressed into the hose. Be sure to install the thermostat in the correct position with the bi-metal spiral on the bottom. Install the hose on the engine.

356. COOLING SYSTEM PROTECTION.

It is necessary to protect the tractor cooling system when the air temperature is below 32° F. The radiator may be filled with alcohol

or ethylene glycol anti-freeze. The following chart gives the amount of anti-freeze required to protect the Ford tractor cooling system at various temperatures. The system has a capacity of 12 quarts.

NOTE: ***Do not use a calcium chloride solution as an anti-freeze. It will corrode the cooling system.***

ANTI-FREEZE CHART

Temperature	Ethylene Glycol
20°F.	4¼ pts.
10°F.	7 pts.
0°F.	8½ pts.
—10°F.	11¼ pts.
—20°F.	12½ pts.
—30°F.	16¾ pts.

All new Tractors are delivered with a rust preventative added to the water which gives it a slightly milky color. In the winter time, the anti-freeze furnished has a rust preventative incorporated in it.

If it becomes necessary to drain the cooling system a good rust preventative should be added to the refill water. If drained during the winter, a rust preventative should be added if it is not incorporated in the anti-freeze being used.

BRITISH IMPERIAL ANTI-FREEZE CHART

Temperature	Ethylene Glycol
20°F.	3¾ pts.
10°F.	6 pts.
0°F.	7¼ pts.
—10°F.	9½ pts.
—20°F.	10½ pts.
—30°F.	14 pts.

Chapter VI

ELECTRICAL SYSTEM

	Section
Generator and Brush Replacement	361
Battery and Rack Replacement	362
Starting Motor Replacement	363
Distributor and Breaker Contacts Replacement	364
Ammeter and Ignition Switch Replacement	365
Conduit Replacement	366

361. GENERATOR AND BRUSH REPLACEMENT.

To replace the generator brushes, remove the end plate and remove the screws that fasten brushes to the end plate.

CAUTION: ***Do not lose the end plate locating dowel (fig. 57).***

Inspect the generator commutator and if rough, it should be turned down and the mica undercut. Dirty commutators should be cleaned with carbon tetrachloride.

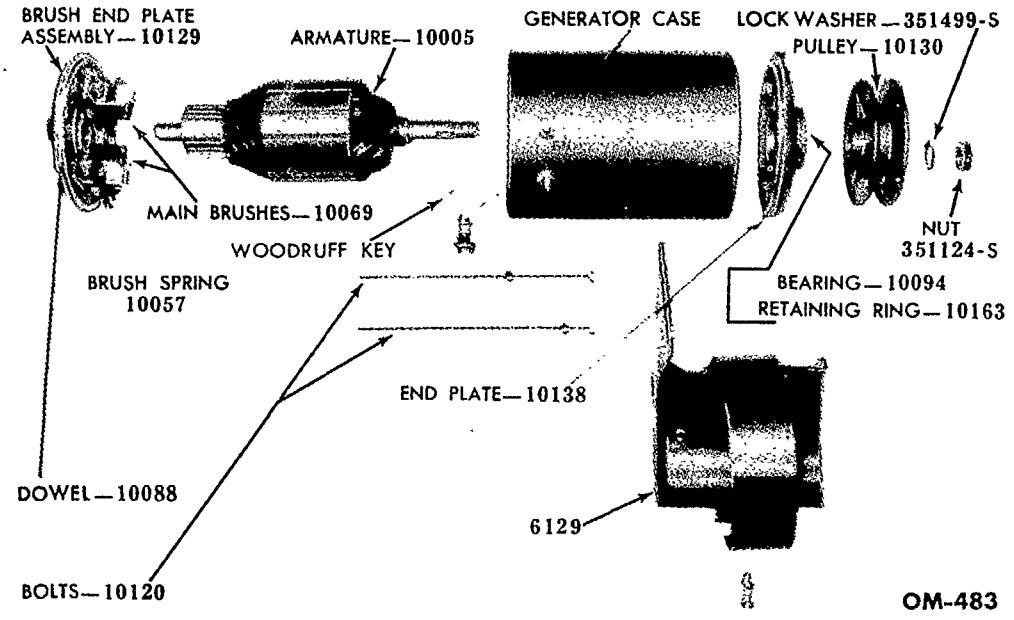


Fig. 57—Generator Assembly

Replace the brushes on the end plate assembly. Install the end plate assembly with the locating dowel in the recess on the bottom side of the case. Install the two through bolts.

To remove the generator, disconnect and tag the generator electrical leads. Remove the bolt from the fan belt tension adjustment. Remove the generator from the engine.

Mount the generator on the engine assembly (fig. 56). Place the belt on the generator pulley, and install the bolt in the belt tension adjustment. Adjust the belt tension as shown in fig. 56. Connect the generator electrical leads.

362. BATTERY AND RACK REPLACEMENT.

Remove the two wing nuts from the battery cover. Remove the battery cover. Disconnect the battery leads. Remove the battery.

Remove the air cleaner as outlined in section 342. Loosen the clamps around the electrical harness on the right end of the battery rack. Remove the tool box. Remove the four cap screws which secure the rack. Remove the battery rack.

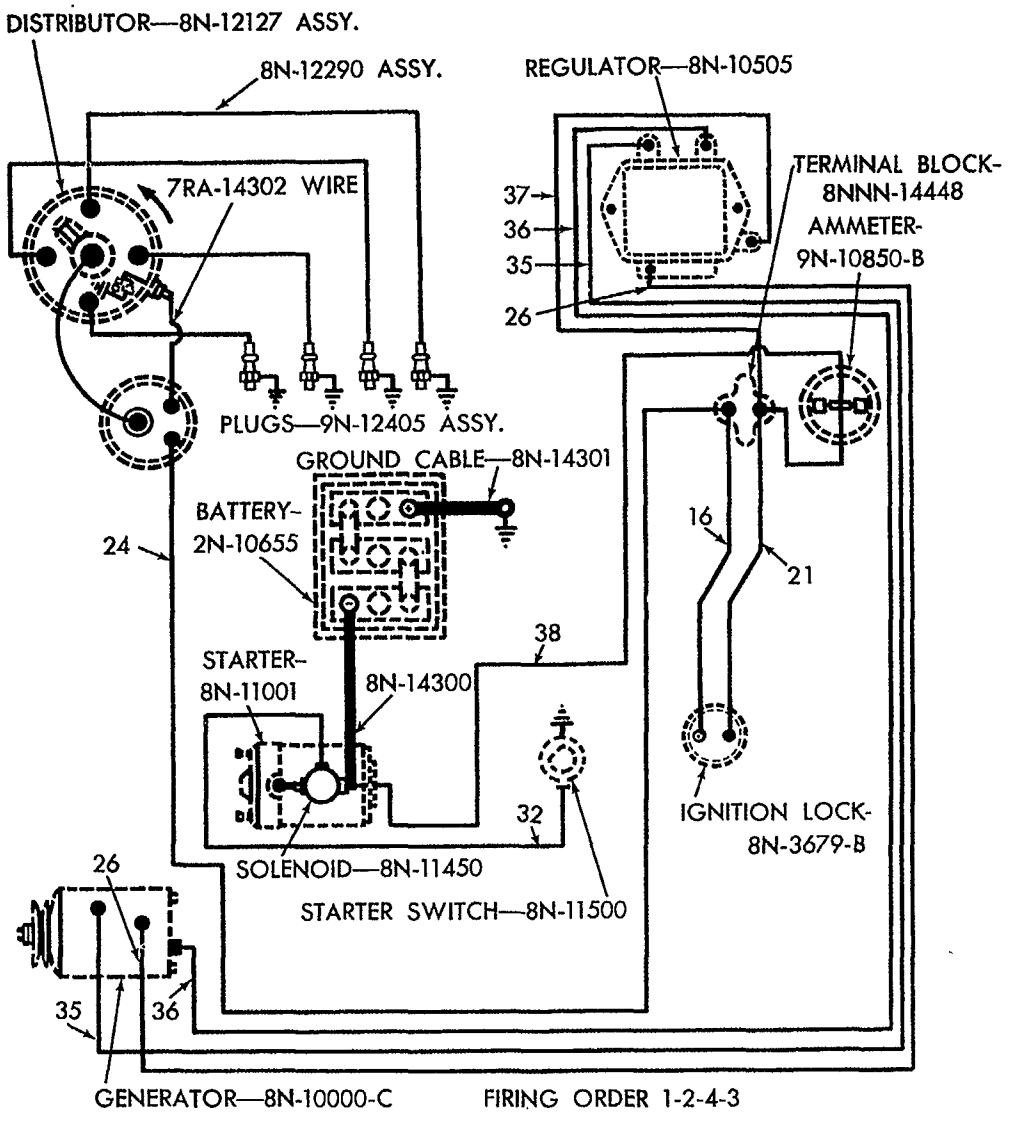
To install the rack, place it in position and secure with the cap screws. The ground strap fits under the upper left cap screw. Install the tool box. Clamp the electrical harness in position on the right end of the battery rack. Mount the air cleaner as outlined in section 342.

To install the battery, slide it into the rack. Connect the ground strap to the positive terminal of the battery (largest terminal). Connect the battery cable to the negative battery terminal. Secure the battery cover in position with the wing nuts.

363. STARTING MOTOR REPLACEMENT.

Disconnect the battery lead. Remove the top nut from the starting motor electrical terminal. Remove the two screws that attach the starter relay to the starting motor. Lay the electrical leads to one side. Remove the two cap screws from the end of the starting motor. Remove the starting motor.

To install the starting motor, place it in position on the engine, securing it with two cap screws. Mount the starter relay on the starting motor. Connect the electrical strap to the starting motor terminal. Connect the battery lead.



KEY

CIRCUITS	WIRE NO.	COLOR
WIRING JUNCTION BLOCK TO IGNITION LOCK	16	*Red—Green Tr.*
WIRING JUNCTION BLOCK TO IGNITION LOCK	21	*Yellow*
COIL TO WIRING JUNCTION BLOCK	24	*Red*
GENERATOR GROUND TO REGULATOR	26	*Black—Red Tr.*
STARTER SOLENOID TO STARTING SWITCH	32	*Red—Blue Tr.*
GENERATOR FIELD TO REGULATOR	35	*Black—White Tr.*
GENERATOR ARMATURE TO REGULATOR	36	*Yellow—Black Tr.*
REGULATOR TO WIRING JUNCTION BLOCK	37	*Yellow*
STARTER SOLENOID TO WIRING JUNCTION BLOCK	38	*Yellow*

Fig. 58—Schematic Wiring Diagram

§ 363.

364. DISTRIBUTOR AND BREAKER CONTACTS REPLACEMENT.

The distributor used on the Ford 8N engine provides automatic spark advance which is controlled by centrifugal weights mounted in the distributor base. It is mounted on front of engine and driven by a replaceable gear on forward end of camshaft. One of the distributor's functions is to interrupt the current flow through the primary winding of the ignition coil, thus causing the coil to produce voltage high enough to jump the gap at the spark plugs at the desired instant during the compression stroke. It also distributes this current through the distributor rotor and spark plug wires to the spark plugs in proper firing order. As engine speed increases, spark must occur earlier at the spark plugs. This is necessary to allow the fuel air mixture sufficient time to ignite. The centrifugal weights incorporated in the distributor design advance the breaker cam to give a predetermined variation in spark advance for different engine speeds. An accurate measurement of spark timing at any given engine R.P.M. can only be accurately determined on the engine by the use of a timing light.

The distributor assembly must, at all times, deliver a correctly timed and strong spark to each cylinder.

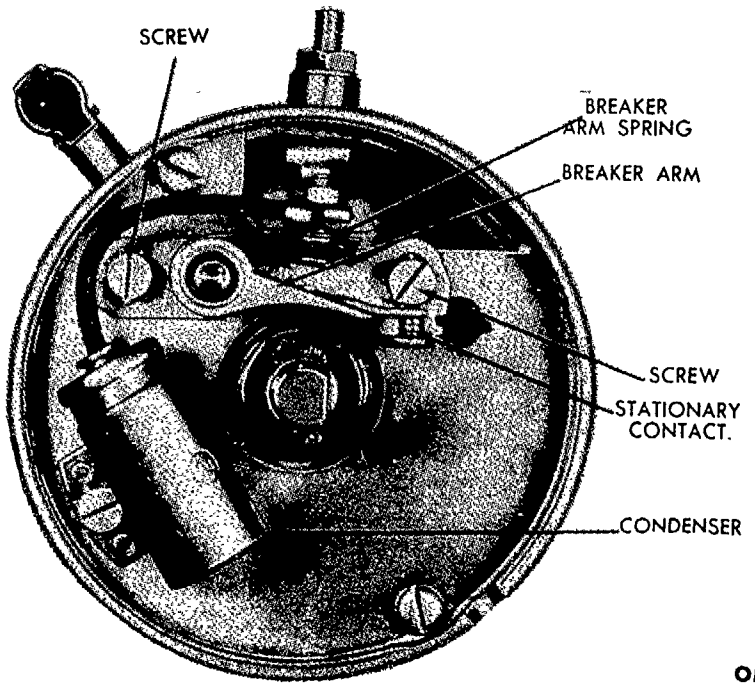


Fig. 59—Breaker Contacts

a. Remove Distributor. Disconnect the electrical lead from coil. Release the distributor cap clips and lift off cap. Remove distributor mounting cap screw, then remove the distributor.

b. Breaker Contacts Replacement and Adjustment. Remove

breaker contact spring screw and washer (fig. 57). Remove the two screws and lock washers that secure the breaker contacts to the plate assembly, and lift out the breaker contacts.

c. Installing and Adjusting Ignition Points.

(1) Ignition timing should be checked each time ignition points are adjusted or replaced. When contact points are closed they must be parallel. If points need aligning, a special wrench No. 12150-A can be obtained from your local dealer, which is made especially for this purpose.

(2) Install ignition points in normal operating position and secure lightly with adjusting lock screws.

(3) Install condenser and primary circuit leads on distributor point terminal.

(4) Check ignition point contact parallelism and adjust, if necessary, using distributor adjusting wrench No. 12150-A.

(5) Breaker arm tension should be checked with replacing new points and when trouble is experienced. Breaker arm tension is 17 to 20 ounces measured from inner edge of point contact surface and at right angle to same. Breaker points that bounce or are out of alignment throw the whole ignition system out of balance.

(6) Adjust ignition points in following manner:

(a) Rotate cam until rubbing block of breaker arm is at high point of cam.

(b) Make sure screws are loose enough to allow adjustment.

(c) Insert adjusting blade of distributor adjusting wrench No. 12150-A in adjustment openings and turn in proper direction to obtain air gap of .024″ to .026″.

CAUTION: ***If feeler gauge is used to check air gap, extreme care should be exercised to remove oil film from gauge before inserting between point contacts.***

(d) Tighten screws and recheck air gap.

(e) Distributor and rotor should be installed (if distributor is on engine) and engine started.

d. Trouble Shooting. If excessive point pitting exists, check all connections for tightness, test condenser on a condenser tester, check condenser lead for frayed strands and ignition points to make sure they are Ford replacement type.

Never use emery cloth to dress contact points. Use a file made especially for this purpose.

Contacts must be set properly. Points set too closely burn and pit

rapidly. Points with too wide a gap cause weak spark at high engine R.P.M.

Do not use a feeler gauge on used points since roughness of points makes it impossible to set gap correctly. Use a dial indicator or point wire gauge instead of thickness gauge to set points.

Oxidized points may be caused by high resistance or loose connections in condenser circuit or oil on contact surfaces. Replace distributor cap and rotor if they show evidence of carbonized paths.

e. Lubrication. Clean and lubricate cam with a light film of Ford M-4601-A lubricant in accordance with instructions in fig. 22. Do not over lubricate because oil reaching contact points causes rapid burning of points.

f. Installing Distributor.

(1) Be sure shifting lever is in neutral position and ignition switch is off. Remove #1 spark plug, then find the compression stroke by holding thumb over hole as engine is cranked by pressing starting button.

(2) Follow instructions in Operation 7 under Setting Basic Engine Timing.

(3) Hold distributor in hand so that condenser is closest to person.

(4) Turn rotor until it is directly in line with primary circuit terminal post.

(5) Install distributor in hole so the distributor primary terminal points toward rear of tractor. As gear teeth mesh, rotor will turn until it is just past the distributor terminal housing clamp closest to engine. This is correct rotor position to fire #1 cylinder.

(6) Follow Operations 8, 9, 10 and 11 under Setting Basic Ignition Timing.

g. Setting Basic Ignition Timing.

(1) Be sure gear shifting lever is in neutral position and ignition switch is off before attempting to check ignition timing.

(2) Remove distributor cap.

(3) Remove spark plug from #1 cylinder.

(4) Hold thumb over spark plug hole as engine is cranked by pressing starting button on transmission cover.

(5) Observe distributor rotor closely while it revolves, then mark its exact location on distributor body the moment compression blows (pops) by thumb.

(6) Press starting button again until rotor is almost in alignment

with rotor location mark placed on distributor housing and compression is felt at #1 spark plug hole. Stop with the rotor in this position.

(7) Remove timing hole cover on flywheel housing. Observe location of 4° before top dead center on flywheel in relation to timing pointer on housing. If 4° before top dead center marking does not align with pointer, insert screwdriver in hole until it contacts the flywheel starting gear teeth. Turn flywheel by applying leverage on screwdriver until 4° before top dead center marking on flywheel does align with pointer.

(8) When the 4° before top dead center marking on flywheel aligns with pointer, #1 piston is 4° ahead of the top dead center position and is on the compression stroke ready to fire. In this position the ignition contact points should just begin to separate and the rotor must point to #1 spark plug wire. This is the basic ignition timing setting for idle speeds (350 R.P.M.) only.

(9) If ignition points must be moved to obtain their separation point, loosen clamp screw on distributor body and turn the distributor manually.

(10) To advance ignition timing, turn distributor body clockwise. To retard ignition timing, turn distributor body counterclockwise.

(11) In the event distributor body must be turned more than 10 or 12 degrees, lift the distributor vertically until gears do not mesh, then turn distributor rotor so that it points to #1 spark plug wire location. Position and reinstall distributor in operating position and tighten clamp screw securely.

IMPORTANT: ***Correct basic engine timing does not indicate that engine spark timing is correct throughout the various R.P.M. range. After engine speed reaches 500 R.P.M., spark advance is controlled by the centrifugal advance mechanism built in the distributor. The use of an accurate timing light directed on flywheel degrees is necessary to determine whether the centrifugal advance range (above 500 R.P.M.) is correct.***

h. Setting Ignition Timing with Timing Light.

(1) Clip secondary lead of light to #1 spark plug—leave spark plug wire on plug.

(2) Connect primary positive lead (RED) of light to ground.

(3) Connect primary negative lead (BLACK) to "Battery" terminal of ignition coil.

(4) Start engine and run at idle speed 350-400 R.P.M.

(5) Direct timing light onto flywheel through opening in bellhousing and note timing marks as light flashes.

(6) Timing should be 4° before top dead center at idle speed (350 R.P.M.).

(a) To advance timing, turn distributor body clockwise.

(b) To retard timing, turn distributor body counterclockwise.

(7) When timing is at 4° before top dead center, tighten distributor body clamp screw securely, then recheck timing again with timing light. Unhook timing light.

Engine R.P.M.	0 to 400	1200	2000
Corresponding Spark Advance (Crankshaft Degrees)	4°	9° to 11°	16° to 18°

Fig. 60—Spark Advance for 8N-12127 Tractor Distributor

365. AMMETER AND IGNITION SWITCH REPLACEMENT.

Disconnect the leads at the battery. To remove the ammeter, disconnect the electrical lead and pull it out of the ammeter clamp. Tag the lead for identification. Remove the two nuts on the ammeter clamp. Remove the ammeter.

Install the ammeter in the instrumental panel, and secure it with the clamp. Thread the wire through the ammeter clamp, and connect it to the terminal.

To remove the ignition switch, disconnect and tag the two wires at the terminals which lead to the switch. Remove the ignition switch clip. Remove the switch.

Install the switch in the instrument panel, and secure it with the clip. Connect the two wires to the terminals. Connect the battery cable.

366. SPARK PLUG WIRING REPLACEMENT.

a. Remove Wiring. Remove the nut that holds the bracket to the cylinder head. Disconnect the wires from the spark plugs, and the secondary wire from the coil. Unsnap the two clips that hold the distributor cap to the distributor, and remove the cap, wires, and bracket from the engine.

b. Disassembly. Remove the wires from the distributor cap, and pull them out of the bracket.

c. Assembly. Note the numbers on the wire ends. Insert them in their proper positions in the conduit and connect the other end of the wires to the corresponding numbers on the distributor cap.

Make sure all the wires are in their proper terminals and seated firmly in the terminal sockets.

NOTES

Chapter VII

POWER TRAIN

Section

Drive Pinion, Differential, and Rear Axle Assembly Replacement. 371
Power Take-off Replacement 372
Transmission Replacement 373

371. DRIVE PINION, DIFFERENTIAL, AND REAR AXLE ASSEMBLY REPLACEMENT.

Before removing the drive pinion, differential, and rear axle assembly, remove the hydraulic pump as outlined in section 383, and the hydraulic unit as outlined in section 382.

a. Remove Assembly. Remove the cover plate from both sides of the center housing. Remove the nut from the tail pipe support. Remove the pin from the forward end of the brake tie rod. Support the tractor under the transmission housing and under the center housing with separate supports (fig. 61). Remove the bolts that secure the center housing to the transmission housing. Roll the rear end assembly away from the tractor. Support the rear end assembly and remove the wheels. If desired, fenders and lower links may be removed.

b. Install Assembly. Install the rear wheels. Slide the drive shaft on the drive pinion spline. Install the transmission gasket. Engage the main transmission shaft spline with the drive shaft. Bolt the transmission to the center housing. Install the hydraulic pump as outlined in section 383. Install the hydraulic unit as outlined in section 382. Connect the brake tie rod to the brake cross shaft by installing the pin. Install the inspection plates on the sides of the center housing. Be sure the power take-off lever is engaged when installing the left inspection plate. Install the tail pipe support. Install the fenders and lower links if they were removed.

c. Check Rear Axle Shaft End Clearance. Proper rear axle shaft end clearance is obtained by increasing or decreasing the number of rear axle bearing adjusting shims, located between the brake backing plate and the bearing cup retainer.

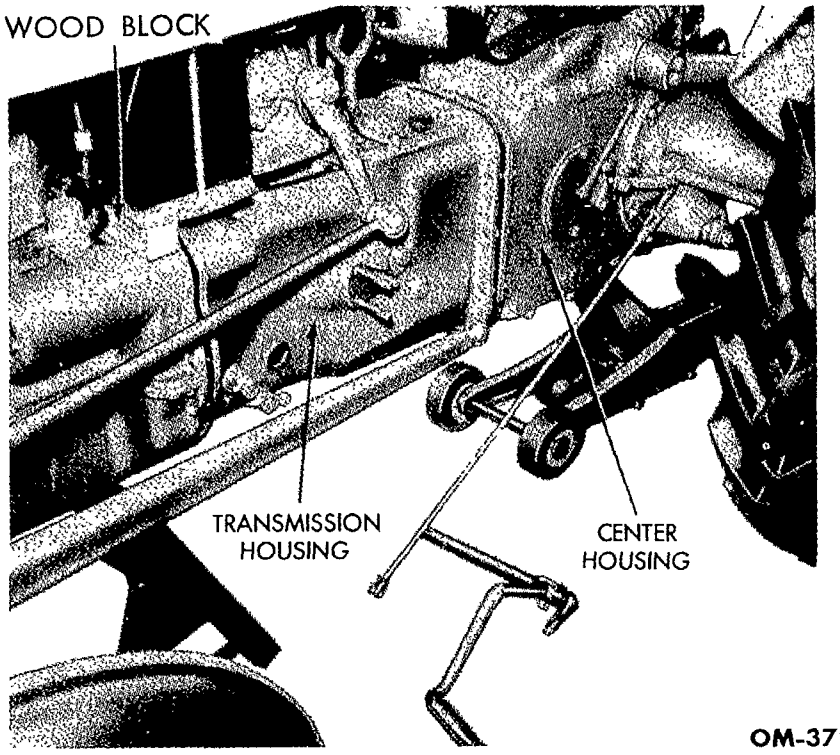


Fig. 61—Aligning Transmission Housing and Center Housing

To check the axle shaft clearance, jack up the tractor so that both rear wheels are clear of the ground. With the tractor out of gear, it should be possible to turn one rear wheel and cause the other rear wheel to rotate in the opposite direction.

If both rear wheels rotate in the same direction, there is insufficient clearance and additional shims should be installed.

Check excessive axle shaft end play by attempting to move a wheel in and out. If any motion is apparent, excessive end play exists, and shims should be removed to correct the condition.

372. POWER TAKE-OFF REPLACEMENT.

Drain the oil from the transmission and center housing. Remove the four cap screws on the power take-off bearing housing. Pull the power take-off assembly out of the rear end of the tractor.

Insert the power take-off in the tractor, and install the cap screws. Refill the transmission with lubricant.

373. TRANSMISSION REPLACEMENT.

Before removing the transmission, remove the steering wheel using a puller.

a. Transmission Removal. Drain lubricant from transmission. Install sawhorse or other suitable support under engine. Place jack under rear axle. Place front wheels in straight ahead position. Place pencil mark on hub of steering wheel and column for reassembly in same location before removing the hand wheel.

Attach lifting fixture to the transmission as shown in fig. 61. Disconnect right and left radius rods from transmission. Disconnect starting button support. Remove steering gear housing retaining cap screws. Elevate the hood sufficiently to install small block of wood between battery frame and housing as shown in fig. 59 by lifting on radius rod ends.

Remove clutch and brake clevis pins. Remove clevis pins at forward end of brake rod. Remove running boards on both sides. Remove clamp bolt from left brake pedal, then withdraw Woodruff key. Drive out shaft, if necessary, with soft punch and hammer. Remove cap screws from both ends of transmission as shown in fig. 61. Move axle housing away far enough to remove transmission.

IMPORTANT: ***It is not necessary to remove the power take-off shaft; however, its removal simplifies assembly of transmission to axle housing.***

b. Transmission Installation. Slide the drive shaft on the drive pinion spline. Install the transmission gasket. Engage the main transmission shaft spline with the drive shaft. Bolt the transmission to the center housing. Engage the clutch shaft in the clutch, and secure the transmission to the engine assembly. Install the left inspection plate on the center housing. Be sure the power take-off lever is engaged. Install the power take-off assembly as outlined in section 372. Connect the brake tie rod. Install the step plates and radius rods. Install the muffler as outlined in section 346. Install the steering gear assembly as outlined in section 321.

Chapter VIII

HYDRAULIC CONTROL

	Section
Hydraulic Control Operation	381
Hydraulic Unit Replacement	382
Hydraulic Pump Replacement	383
Hydraulic Control Adjustments	384

381. HYDRAULIC CONTROL OPERATION.

The hydraulic control is used on the Ford tractor to obtain automatic control of the implements. The constant draft control and position control use many of the same parts.

a. Ram Cylinder. The ram cylinder and piston are used to support the lower links. Fig. 62 shows the ram cylinder. When there is no oil in the ram cylinder, the links are in the lowered position. The links are in the raised position when the ram cylinder is full of oil. Inter-

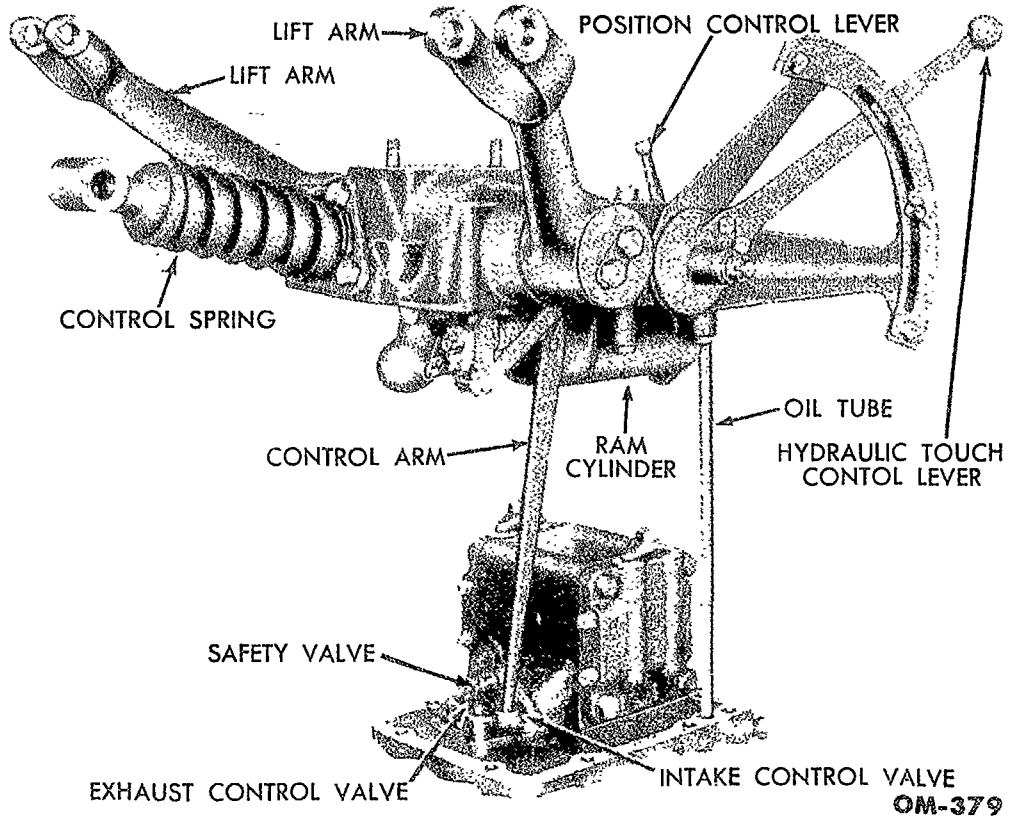


Fig. 62—Hydraulic Control

mediate link positions are obtained by filling the ram cylinder with the required amount of oil. When the control valves are in the neutral position with intake and exhaust ports closed, oil is trapped in the ram cylinder and the links are held in position.

b. Oil Flow to Raise the Links. The intake control valve is positioned in the bushing to open the intake ports. When the pump piston is on the suction stroke, oil flows through the intake ports and through the inlet valve into the pump cylinder (fig. 63). The inlet valve closes and the outlet valve opens when the pump is on the discharge stroke. During the discharge stroke, oil flows through the outlet valve, check valve, and into the ram cylinder. The pump continues to pump oil to the ram cylinder as long as the intake ports are open. When the intake ports are open, the exhaust ports are closed.

c. Oil Flow to Lower the Links. For oil to be discharged from the ram cylinder, the exhaust control valve must be positioned to open the exhaust ports (fig. 63). Oil flows from the ram cylinder out the exhaust ports. When the exhaust ports are opened, the intake ports are closed.

d. Constant Draft Control. The constant draft control is illustrated in fig. 63. For constant draft control, the position control lever is placed in the forward position. The control arm functions on points A, B, D, and E (fig. 63) when using constant draft control. Pivot point A is manually positioned by the hydraulic touch control lever. Pivot point B is positioned by the implement draft. An increase in draft will compress the control spring and move point B to the left.

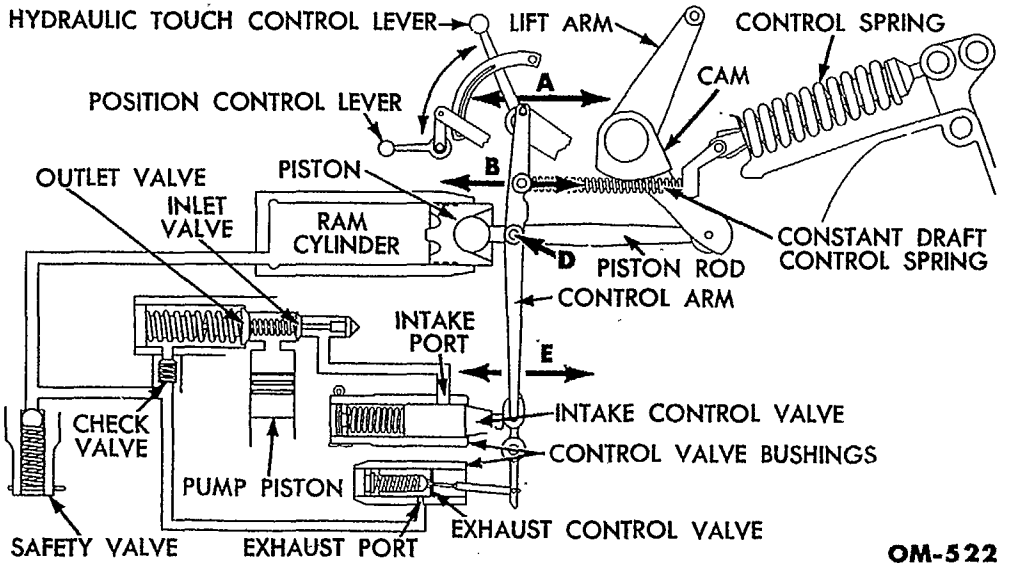


Fig. 63—Constant Draft Control

Point E is mechanically connected to the control valves. Point E can place the control valves in an intake, neutral, or exhaust position. The following subparagraphs list the sequence of events in constant draft control.

(1) *HYDRAULIC TOUCH CONTROL LEVER LOWERED.* When the hydraulic touch control lever is lowered, point A is moved to the left, B is momentarily stationary, and E moves to the right. The movement at E opens the exhaust ports. As oil flows out of the ram cylinder, the implement lowers and enters the soil. When the implement enters the soil, the control spring is compressed. As the control spring compresses, points B and E are moved to the left. The implement will continue to enter the soil until point E has moved into the neutral position to close the exhaust ports.

(2) *HYDRAULIC TOUCH CONTROL LEVER RAISED.* When the hydraulic touch control lever is raised, point A is moved to the right, B is momentarily stationary, and E moves to the left. The movement at E opens the intake ports and oil is pumped to the ram cylinder. As the implement raises, the draft is decreased and the control spring expands. As the control spring expands, points B and E are moved to the right. The implement will continue raising until point E is in the neutral position and the intake ports are closed.

(3) *TRANSPORT POSITION.* When the hydraulic touch control lever is moved to the top of the quadrant, point A is moved to the right, B is momentarily stationary, and E moves to the left. The movement at E opens the intake ports and oil is pumped to the ram cylinder. In transport position, the control spring is fully expanded, but E may not be in the neutral position. The skirt on the piston contacts D and moves points D and E to the right until the control valves are in the neutral position.

(4) *FRONT WHEELS CROSS A RIDGE.* When the tractor front wheels cross a ridge, the implement tends to operate deeper in the soil. The increased depth increases the draft. Increased draft will further compress the control spring and move points B and E to the left. The movement at E opens the intake ports, and oil is pumped into the ram cylinder. As the implement raises, the draft decreases, the control spring expands, and points B and E move to the right until the control valves are in the neutral position. The implement has, in this manner, been automatically repositioned.

(5) *FRONT WHEELS ENTER A DEPRESSION.* When the tractor front wheels enter a depression in the soil surface, there is a tendency to raise the implement out of the soil. When the implement tends to raise, the draft is decreased and the control spring expands.

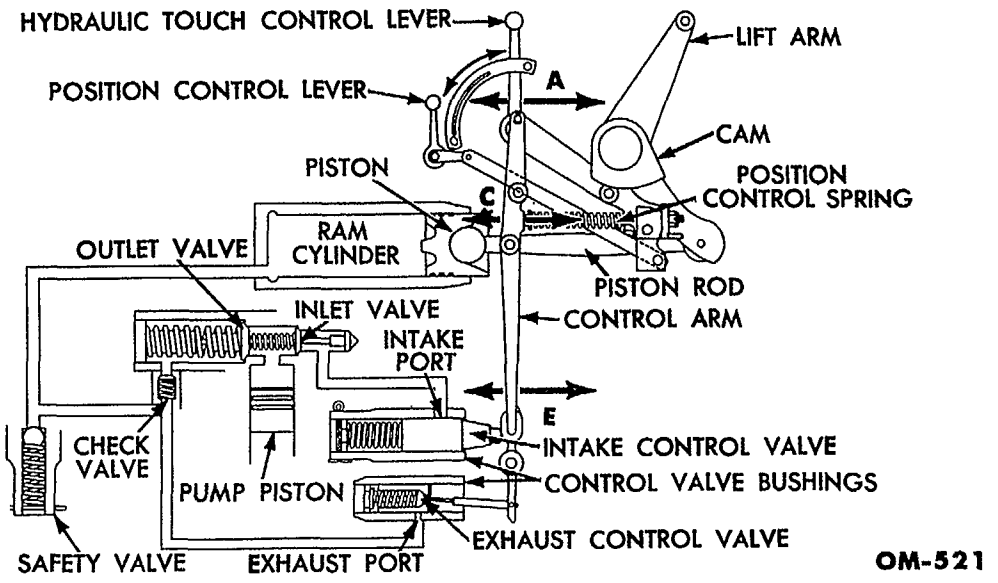


Fig. 64—Position Control

The expanding control spring moves points B and E to the right. The exhaust ports are opened and oil is bled out of the ram cylinder. The implement lowers and the draft is increased. As the draft increases, the control spring is again compressed and points B and E move to the left until the control valves are in the neutral position. The implement has again been automatically repositioned.

(6) *VARIATION IN SOIL TEXTURE.* Variations in soil texture will change slightly the draft on an implement. If the draft tends to increase, the action of the hydraulic control is the same as outlined in subpar. (4). If soil variation tends to decrease the draft, the action of the hydraulic control is similar to subpar. (5). When necessary, the operator may easily make small adjustments with the hydraulic touch control lever.

e. Position Control. The position control is illustrated in fig. 62. For position control operation, the position control lever is placed in the vertical position. When using position control, the control arm functions on points A, C, and E (fig. 64). Pivot point A is manually positioned by the hydraulic touch control lever. Pivot point C is positioned by the cam on the lift arm assembly. A lowering of the lift arms will move point C to the left. Point E can position the control valves in an intake, neutral, or exhaust position. The following subpars. list the sequence of events in position control.

(1) *LOWERING HYDRAULIC TOUCH CONTROL LEVER.* When the hydraulic touch control lever is lowered, point A moves to the left, C is momentarily stationary, and E moves to the right,

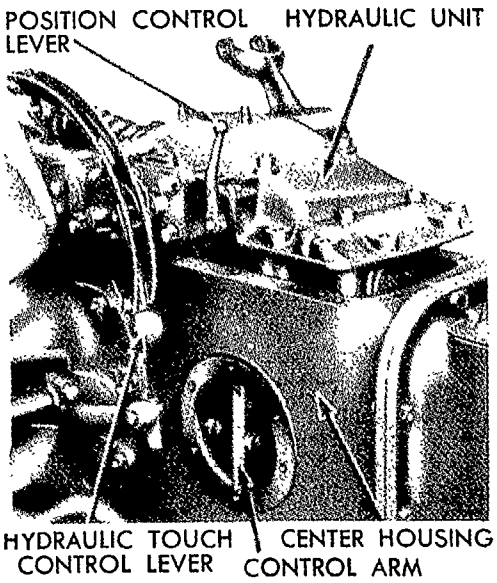


Fig. 65—Hydraulic Unit Replacement

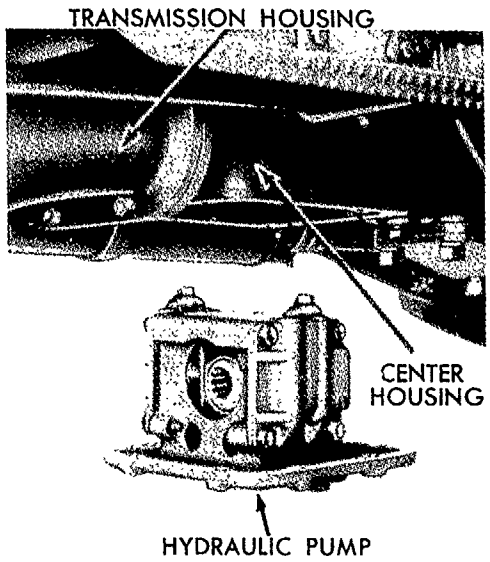


Fig. 66—Hydraulic Pump Replacement

opening the exhaust port. As oil bleeds out of the ram cylinder, the links are lowered. As the links lower, the cam moves points C and E to the left until the control valves are in the neutral position.

(2) *RAISING HYDRAULIC TOUCH CONTROL LEVER.* When the hydraulic touch control lever is raised, point A moves to the right, C is momentarily stationary, and E moves to the left. The intake ports open and oil is pumped into the ram cylinder. As the links are raised, the cam allows points C and E to move to the right until the control valves are in the neutral position.

382. HYDRAULIC UNIT REPLACEMENT.

Remove the tractor seat. Disconnect the lift arms from the lift rods by removing the cotter and clevis pins. Disconnect the control spring from the yoke by removing the cotter pin and yoke. It is not necessary to drain the oil. Remove the cap screws which secure the hydraulic unit to the center housing. The lift arms must be in the lowered position before it is possible to lift the hydraulic unit vertically out of the center housing as shown in fig. 65. Care must be taken not to damage the control arm while removing the hydraulic unit.

To install the unit, remove the inspection plate on the right side of the center housing, and place a gasket on the center housing. The lift arms must be in the lowered position before lowering the hydraulic

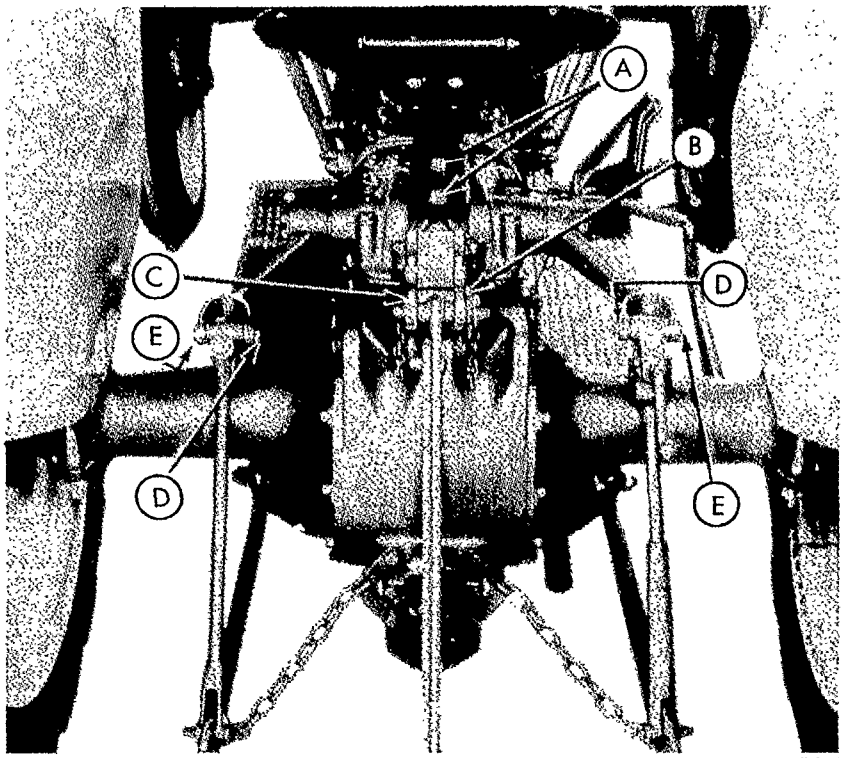


Fig. 67—Control Spring Adjustment

unit into the center housing. As the hydraulic unit is being lowered, carefully fit the control arm into the socket in the control valve arm (fig. 62). Before securing the unit, move the hydraulic touch control lever, and check to determine whether the control valves follow the lever movement without binding. After the hydraulic unit is in position, insert the cap screws, and install the inspection plate. Attach the lift rods to the lift arms. Attach the control spring to the yoke. Install the tractor seat.

383. HYDRAULIC PUMP REPLACEMENT.

Drain the oil from the transmission and hydraulic control. Remove the power take-off shaft as outlined in section 372. Remove the cap screws and lower the hydraulic pump out of the center housing.

To install the hydraulic pump, remove the inspection plate on the right side of the center housing. Insert the pump into the center housing (fig. 66). Make sure the control arm enters the socket on the control valve arm (fig. 62). Install the pump base cap screws, but do not tighten. Install the power take-off shaft as outlined in section 372. Tighten the pump base cap screws before filling the transmission with oil.

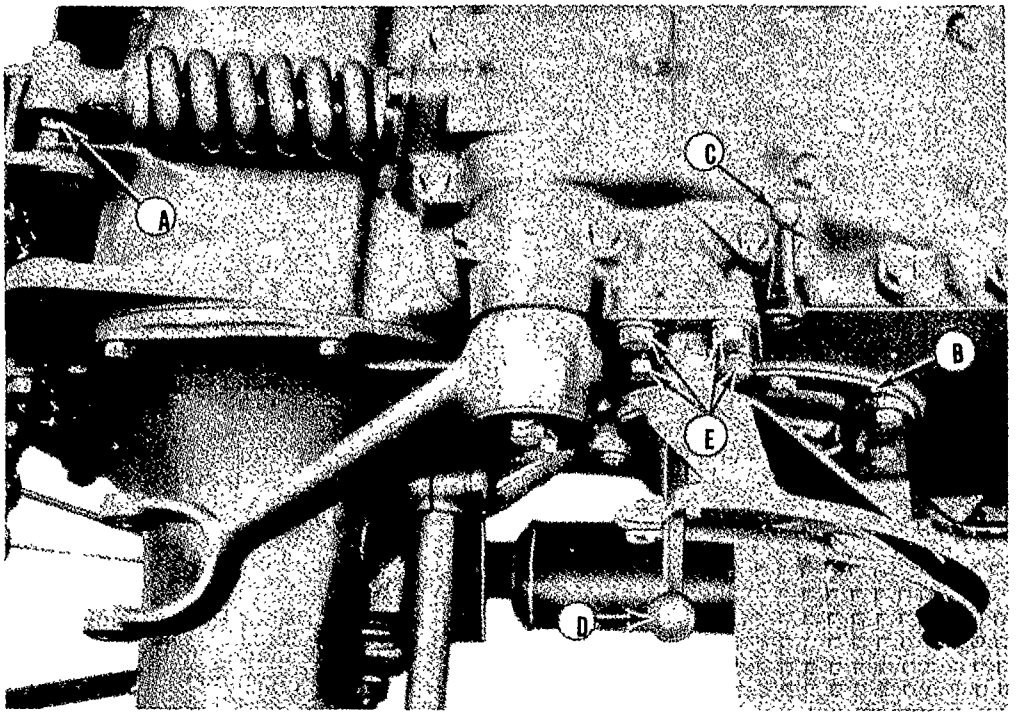


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Fig. 68—Adjusting Main Control Spring

384. HYDRAULIC CONTROL ADJUSTMENTS.

a. Adjusting the Main Control Spring

(1) Remove the cotter pin (B-fig. 67) from the rocker pin.

(2) Pull the rocker pin (C-fig. 67) and free the rocker from the main control spring yoke.

(3) Turn the control spring yoke (A-fig. 68) until there is no end play in the spring. (It should be possible to turn the spring by hand using pressure of the thumb and the first two fingers. See fig. 69.)

b. Adjusting the Friction on Touch Control Lever

(1) Tighten or loosen the nut on the end of the hydraulic lift control lever shaft (A-fig. 70). This nut should be adjusted so that a pull of four to five pounds is required to move the lever.

c. Checking Quadrant Adjustment

(1) Remove the inspection plate (B-fig. 68) from the right side of the center housing, and remove the oil from the case.

(2) Disengage the implement position control lever (C-fig. 68) by pushing forward to the down position.

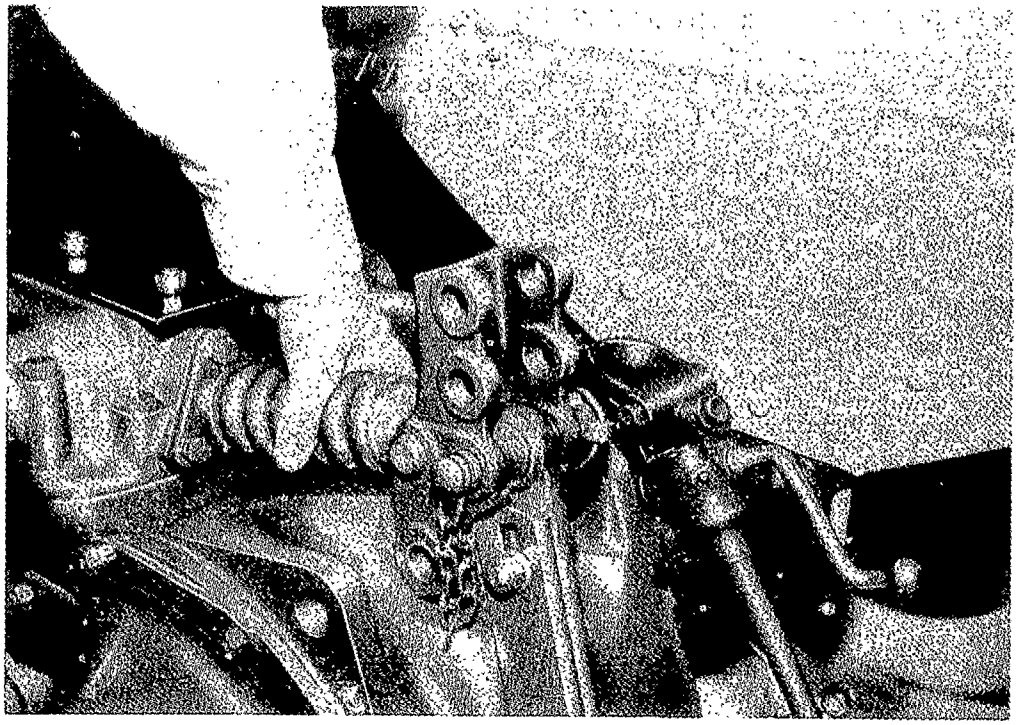

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Fig. 69—Turning Spring to Eliminate End Play

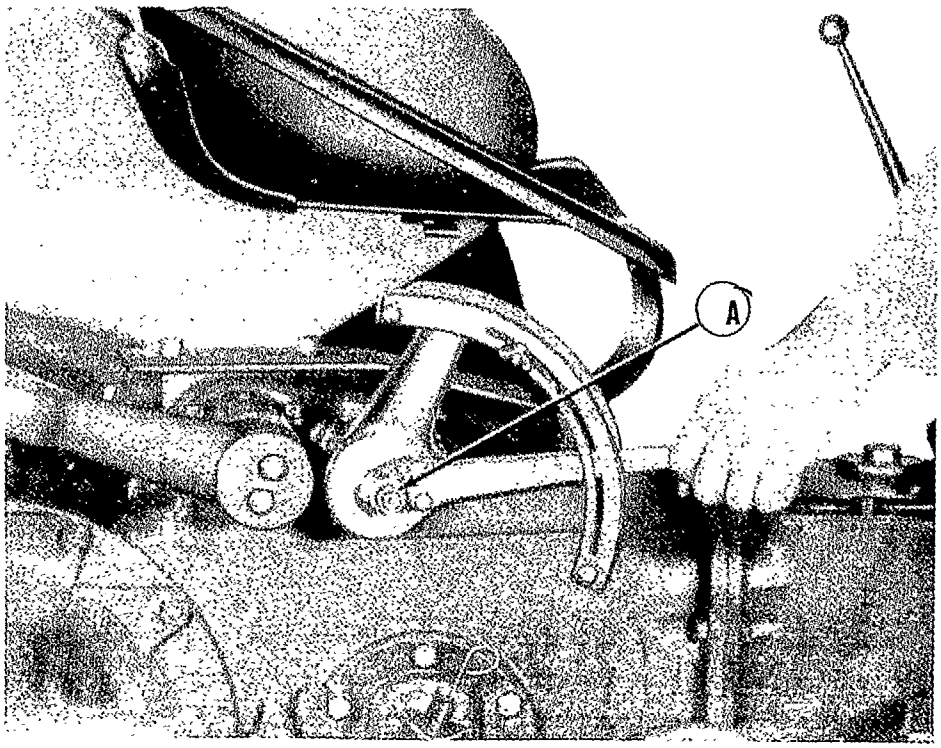

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Fig. 70—Adjusting Friction of Touch Control Lever

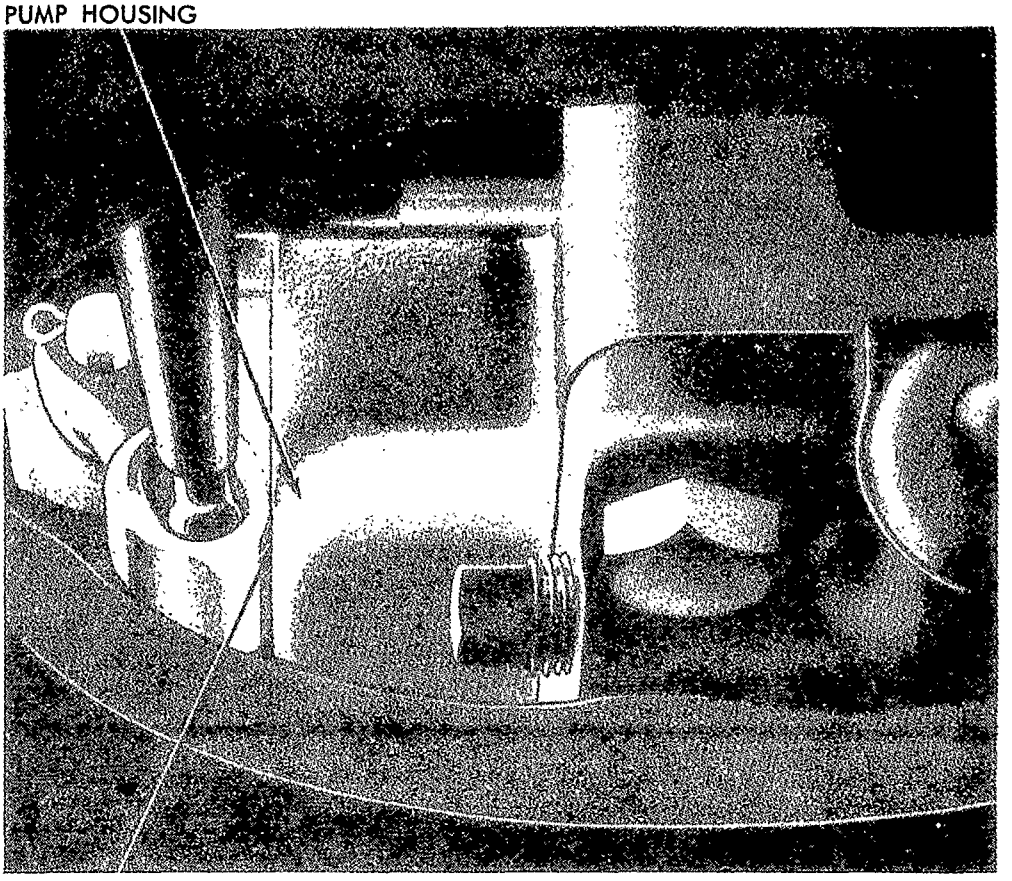


Fig. 71—End of Intake Control Valve Flush with Pump Housing

(3) Take hold of the control arm by inserting the left hand through the inspection plate opening, and with the right hand slowly raise the touch control lever (D-fig. 68) toward the top of the quadrant. Determine by sight and feeling when the end of the intake control valve is flush with the pump housing (fig. 71).

NOTE: ***If the quadrant adjustment is correct, the end of the intake control valve will be flush with the pump housing, as shown in fig. 71, when the touch control lever is in full up position, as shown in D-fig. 68.***

d. Control Valve Adjustment (Condition 1). If the end of the intake control valve is not flush with the pump housing, as shown in fig. 72 make the following adjustment:

(1) Loosen the four cap screws (E-fig. 68) in the quadrant support plate.

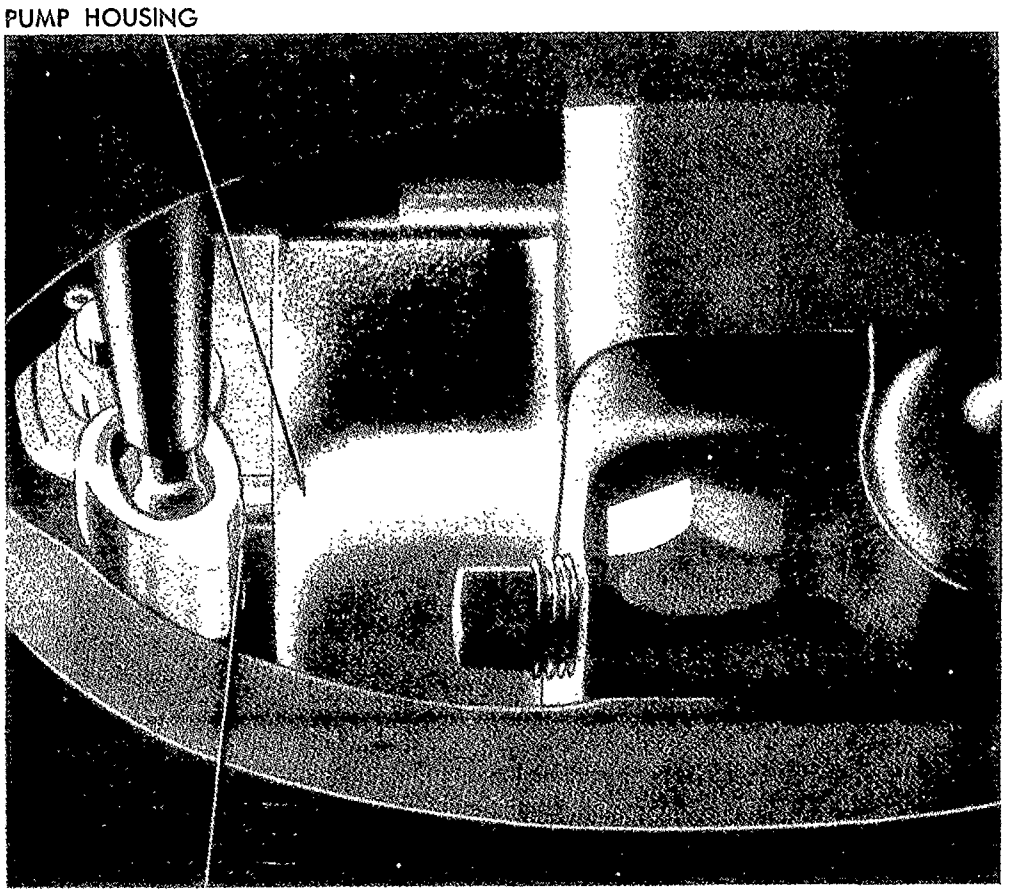


Fig. 72—End of Intake Control Valve Not Flush with Pump Housing

(2) Move the quadrant assembly rearward, until the end of the intake control valve is flush with the pump housing with the touch control lever in the maximum up position (D-fig. 68).

NOTE: ***The top of the quadrant support plate should be parallel with the top of the attaching plate on the lift cover.***

(3) Retighten the cap screws and check to see that the intake valve is fully open when the touch control lever is in the up position (D-fig. 68).

e. Control Valve Adjustment (Condition 2). If the end of the intake valve reaches a position flush with the pump housing before the touch control lever is raised to its maximum up position, adjust by using the following procedure:

(1) Loosen the four cap screws in the quadrant support plate.

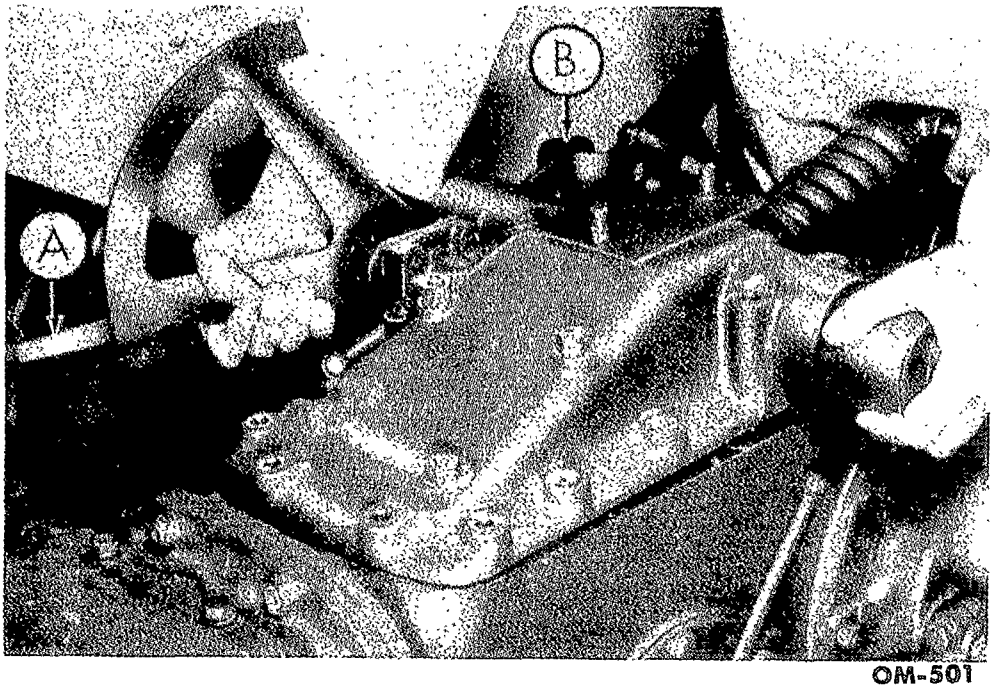


Fig. 73—Removing Lift Cover Assembly

(2) Move the quadrant assembly forward until the end of the intake control valve becomes flush with the pump housing when the touch lever is in the maximum up position (fig. 71).

(3) Tighten the four cap screws.

f. Removing the Lift Cover Assembly. Start the tractor and raise the touch control lever to the maximum up position. When the lift arms have been raised to their highest position by the pump, check to see if the chisel marks are aligned. If not, mark them with a cold chisel.

(1) Remove the cotter pins (D-fig. 67) from both leveling arm knuckle pins.

(2) Remove the knuckle pins (E-fig. 67) disengaging the leveling arms from the lift arms.

(3) Remove the fourteen hex head bolts that secure the lift cover casting to the center housing.

(4) Set the touch control lever in the down position (A-fig. 73).

NOTE: ***Be sure implement position control lever is disengaged.***

(5) Place the lift arms in the down position (B-fig. 73).

(6) Grasp the assembly at the base of the quadrant with the right hand and the left lift arm with the left hand. Lift the rear of the assembly upward with a slight forward motion as shown in fig. 73.

CAUTION: ***Handle carefully to avoid damaging control arm and linkage assembly.***

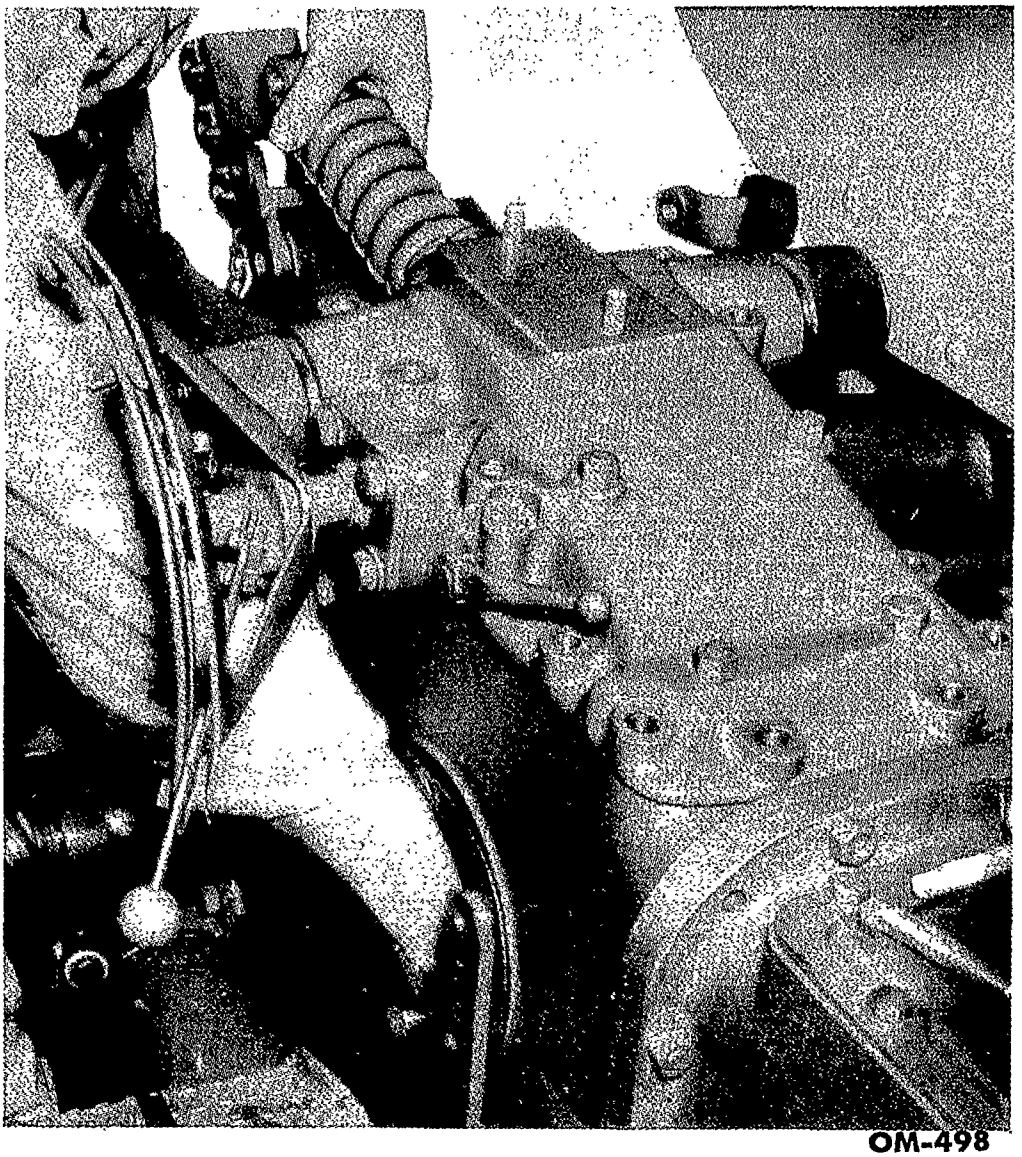


Fig. 74—Installing Hydraulic Lift Cover Assembly

g. Installing the Hydraulic Lift Cover Assembly on the Tractor.

(1) Install new gasket on center housing.

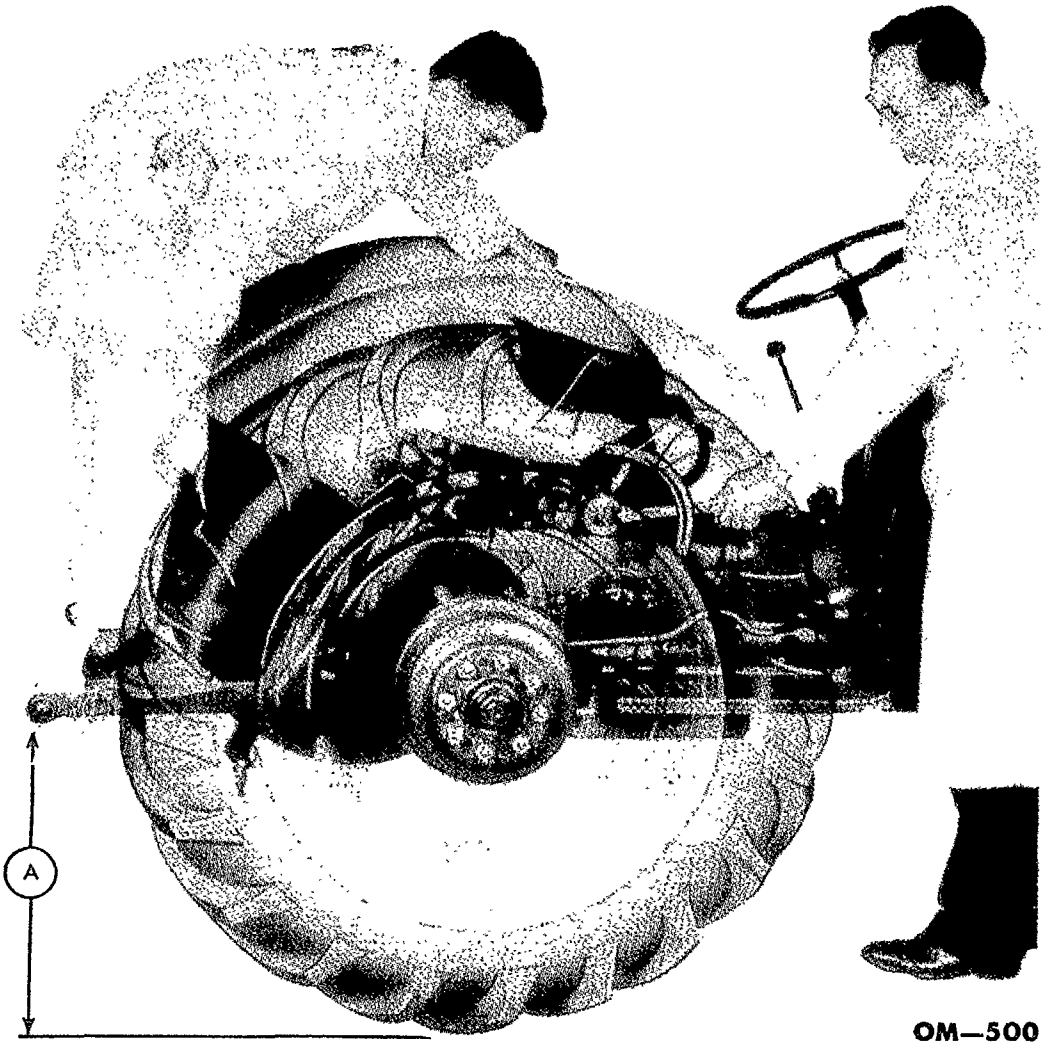


Fig. 75—Final Check of Adjustments

(2) Lower the hydraulic lift cover assembly into position.

NOTE: ***Be sure the touch control lever, the hydraulic lift arms and the implement position control lever are in the down position before lowering the lift cover unit into position.***

(3) Set the lift cover assembly on the center housing, placing the front of the assembly slightly to the rear of the position required to line up the bolt holes.

(4) Insert the right hand in the center housing at the inspection plate opening, as shown in fig. 74, and guide the tip of the control arm into position in the control valve lever.

(5) Bolt the lift cover assembly to the center housing.

(6) Attach the leveling arms to the lift arms.

h. Final Check of Adjustments.

(1) Recheck the main control spring adjustment as shown in fig. 67.

(2) Recheck the quadrant adjustment. Follow the same procedure as in par. c.

(3) Check the implement position control spring adjustment.

(a) Raise and lower the lift arms to ensure complete operating range.

(b) Engage the implement position control lever (up position).

(c) Move the touch control lever to the top of the quadrant, raising the lift arms.

(d) Move the touch control lever to the bottom of the quadrant.

(e) When the lift arms have stopped lowering, measure the height of the rear end of the lower links (A-fig. 75) from the ground.

(f) Disengage the implement position control, and check the amount of drop of the lower links by re-measuring the height of the rear end of the lower links from the ground.

NOTE: ***If the drop exceeds 3 inches, this indicates that the implement position control spring is too long.***

(4) Install the rocker on the main control spring yoke.

(5) Install the inspection plate.

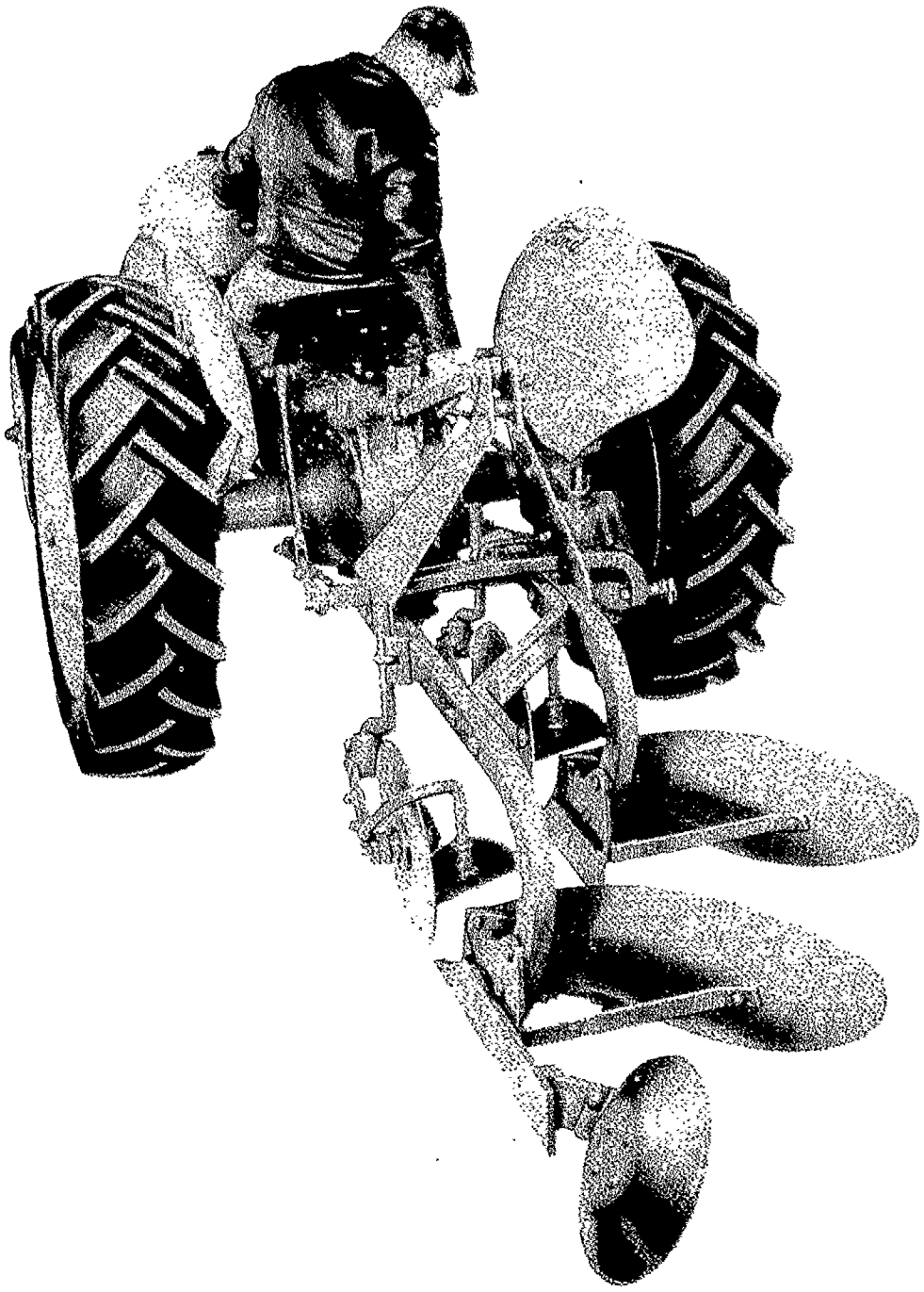


Fig. 76—Dearborn Plow Mounted on Ford Tractor

Part FOUR
PLOWING INSTRUCTIONS

	Section
Mounting Plow on Tractor	401
Adjusting Width of Cut	402
Coulter & Jointer Adjustments	403
Rolling Landside	404
Plow Bottoms	405
Plow Shares	406
Plow Lubrication	407
Plowing Procedures	408

These instructions cover use of Dearborn Moldboard Plows, which are designed for use with the Ford Tractor. Following these instructions will help you use both plow and tractor to best advantage—and to get the maximum in plowing performance, convenience and economy.

401. MOUNTING PLOW ON TRACTOR.

After starting the engine, see that the power take-off, which operates the hydraulic pump, is engaged, then back the tractor squarely up to the plow. Dismount from the tractor and attach the lower left link to the cross-shaft. Align the lower right link with the leveling crank and attach the link to the cross-shaft. Lay the top link near the attachment pin on the tractor center housing. Get on tractor. Ease the tractor forward or backward to align the top link with the yoke. Install the top link pin in the bottom holes of three-hole rocker (fig. 76).

Place the implement position control lever in the constant draft position (forward position). To raise the plow, move the hydraulic touch control lever to the top of the quadrant. When the plow has cleared the ground, it is ready for transport (fig. 76).

Reverse the above procedure to detach the plow.

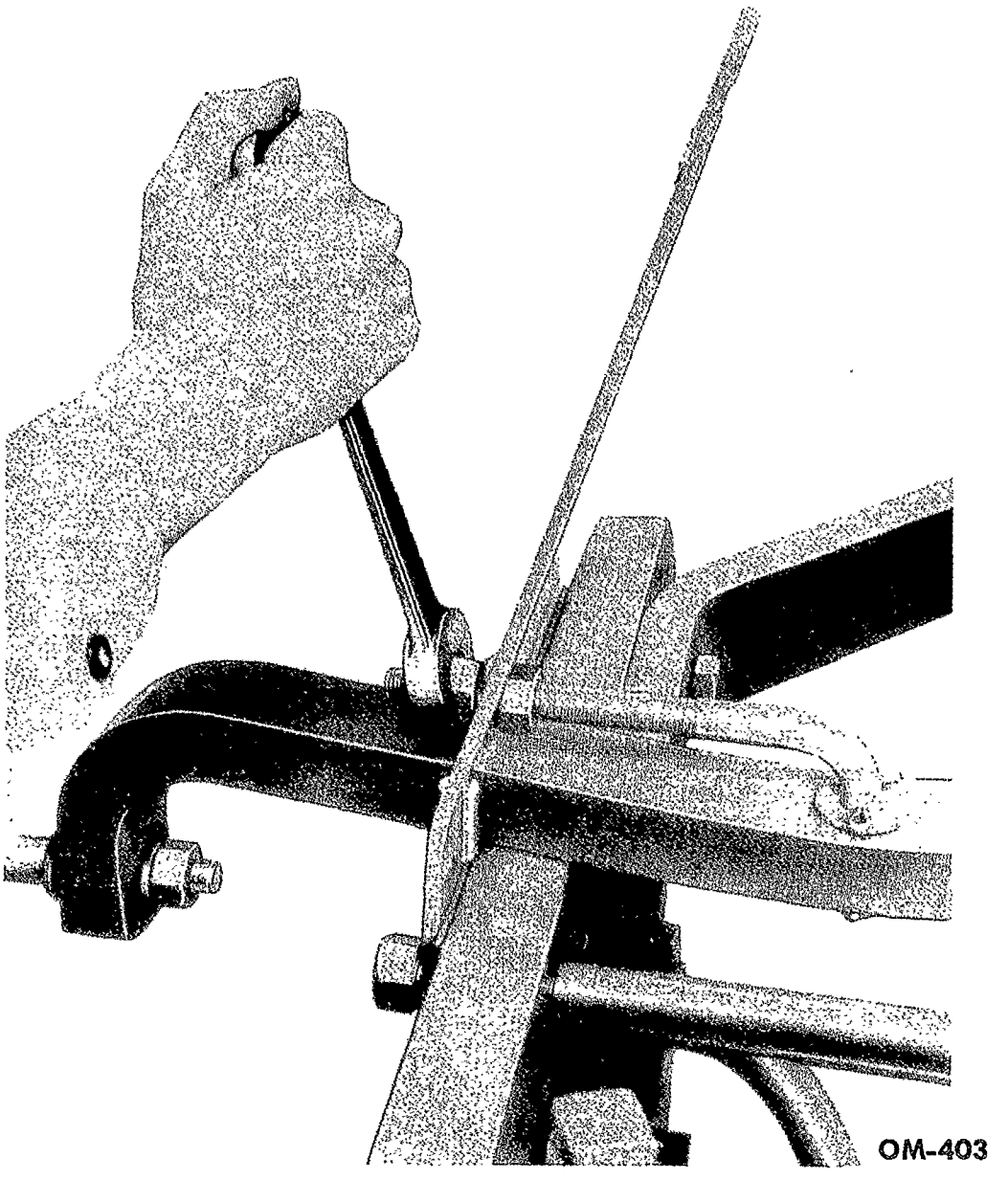


Fig. 77—Adjusting Width of Cut

402. ADJUSTING WIDTH OF CUT.

These instructions apply to the Dearborn Economy Plow. If you have an earlier model Dearborn Moldboard Plow follow the instructions given in the Operating Manual which comes with the plow.

The Dearborn Economy Plow flat cross-shaft, designed to function like an arc, provides a direct method of adjusting the width of cut of the plow. No preliminary positioning of the cross-shaft is necessary since, when assembled, it automatically positions correctly in relation to the plow beams and plow bottoms.

A hardened, 5/8" cadmium-plated, L-shaped, adjusting arm has one end set through a hole at the center of the cross-shaft. The other end fits through the right hand "A" frame member and is threaded for a distance of four inches to provide an adequate range of adjustments for any type or width bottom used. Adjustment is made by means of an inner and outer adjusting nut. To decrease width of cut, loosen outside nut and tighten inside nut. Operation is reversed to increase width of cut (fig. 77). A movement of 1/4" on the adjusting arm results in about 1" change at the point of the share.

The width of the cut of the front bottom should be 14 inches on a two-bottom, 14-inch plow, 12 inches on a two-bottom, 12-inch plow, etc. Width of cut is easily determined by measuring directly from the left-hand side of the moldboard shin of the front bottom to the furrow wall.

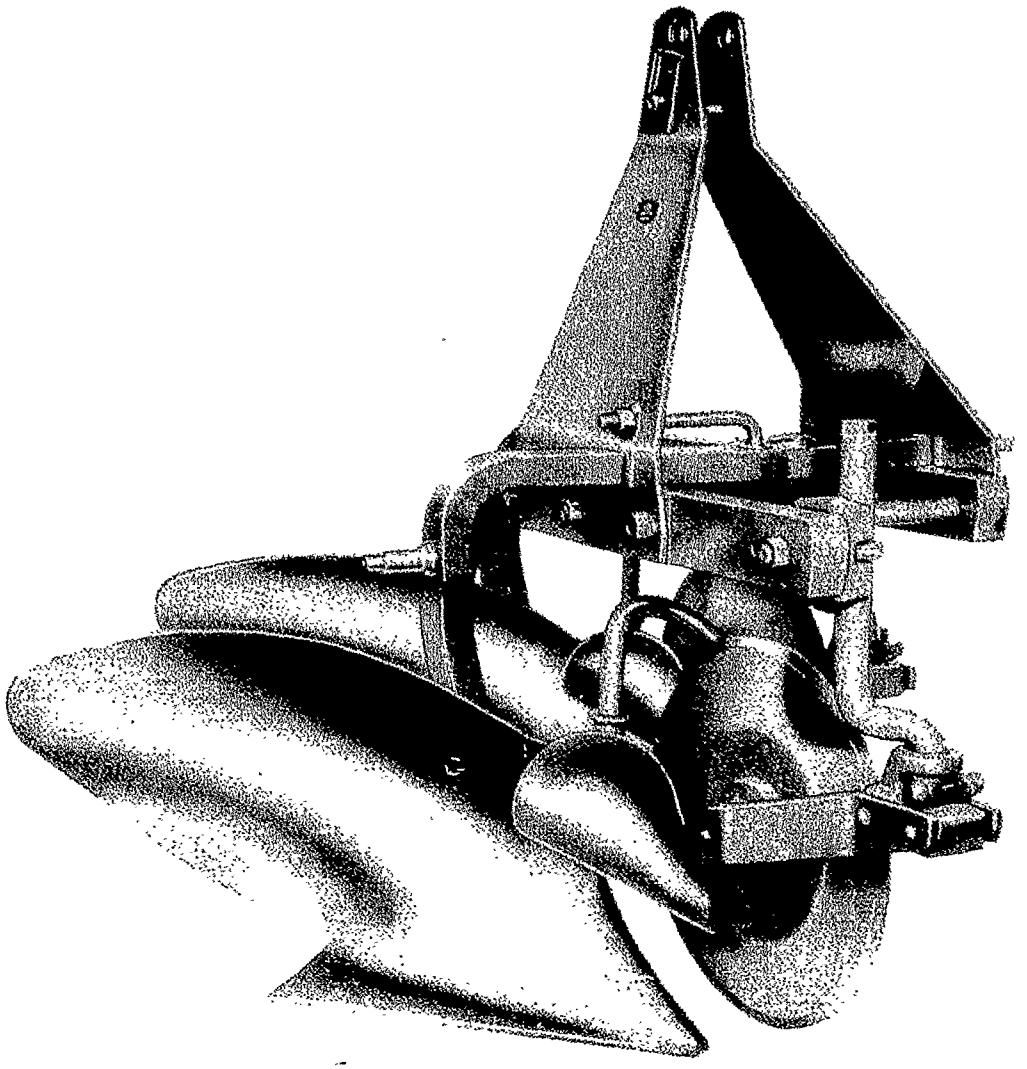


Fig. 78—Coulter and Jointer Attached to Dearborn Economy Plow

403. COULTER AND JOINTER ADJUSTMENTS.

Rolling coulters are used to cut trash, roots, reduce draft, and to leave a uniform furrow wall. The coulters should be set about ½ the plowing depth on average soils. In soils where plow penetration is difficult, it may be necessary to raise the coulters. Coulters should be sharp to lessen draft, leave a uniform furrow wall, and reduce the tendency to ride the plow out of the ground. Vertical adjustment is made by loosening the eye bolt and raising or lowering the coulter shank. You adjust the lateral position of the coulter by slightly loosening the eye bolt and twisting the coulter shank (with plow wrench) to the position desired (fig. 78). Adjust the coulter limit stop collar to get the desired amount of coulter swing. Tighten securely. A rolling coulter should run as near the shin of the moldboard as possible and leave a clean furrow wall. In most cases, this is ½ to ¾ inch to the left of the shin, but under no condition should it run to the right of the shin of the moldboard. In some soils, slightly increasing the coulter width adjustment will aid in scouring. Under all conditions have both coulters on a two-bottom plow set alike.

Jointers are used to turn over a small furrow along the inside edge of the furrow slice. This is an aid in obtaining clean coverage in sod or in a trashy field. Turn the jointer until the point is lightly touching the coulter blade. The top of the jointer should be approximately ½ inch from the coulter blade. Set the jointer downward until it rolls a slice of soil.

The jointer and jointer arm may be removed if desired by simply removing two carriage bolts on the left side of the coulter fork.

404. ROLLING LANDSIDE.

The side thrust of a Dearborn moldboard plow is carried principally by a rolling landside (fig. 76). The rolling landside is not intended to carry any weight. Rolling landsides reduce draft because rolling friction is less than sliding friction.

405. PLOW BOTTOMS.

Dearborn plow bottoms are made of different materials and are different shapes to meet the requirements of different soils and conditions. The table in fig. 79 will serve as an aid in the selection of plow bottoms.

DEARBORN PLOW BOTTOMS

Bottom	Type of Material in Moldboard and Share	Bottom Characteristics	Soils and Conditions for Which Adapted
16″ Economy	**Moldboard.** Carburized steel Replaceable shin. **"Razor Blade" shares.** Special heat treated steel.	Modified general purpose type. Covers, pulverizes and scours well.	Light to moderately light soils where exceptionally good covering and pulverizing is required.
14″ Economy	**Moldboard.** Carburized steel. Replaceable shin. **"Razor Blade" shares.** Special heat treated steel.	Modified general purpose type. Covers, pulverizes and scours well.	For use in the great majority of soils and conditions. An exceptionally good covering, pulverizing and scouring bottom.
14″ Economy Combination	**Moldboard.** Carburized steel. Replaceable shin. **"Razor Blade" shares.** Special heat treated steel.	Modified general purpose type. Gives good pulverization. Scours exceptionally well. Light draft.	For hard to scour soils where trash is not a problem. Adapted to most areas where stubble bottoms are used.

Fig. 79—Plow Bottoms for Various Soil Conditions—Continued on Page 122

DEARBORN PLOW BOTTOMS			
12″ Economy	**Moldboard.** Carburized steel. Replaceable shin. **"Razor Blade" shares.** Special heat treated steel.	Modified general purpose type. Covers and pulverizes well and scours exceptionally well. Light draft.	For use in tough, hard to scour soils where light draft, good covering, pulverizing and scouring is required.
14″ General Purpose	**Moldboard.** Soft center steel. **Shares.** Soft center steel. Carburized steel. Solid steel. Chilled.	General purpose type. Slow turning moldboard. Favorable draft at higher speeds.	For heavy sod conditions such as old bluegrass pastures and tame sod in good rotations.
14″ Stubble	**Moldboard.** Soft center steel. **Shares.** Soft center steel. Carburized steel. Solid steel. Chilled.	Stubble shape. Quick turning moldboard which pulverizes, covers and scours well.	For use in moderately light to light soils where tight stone is a problem.

*Fig. 79—Plow Bottoms for Various Soil Conditions—**Continued on Page 123*

DEARBORN PLOW BOTTOMS

14″ Slat	**Moldboard.** Soft center steel. **Share.** Soft center steel.	Modified stubble shape. Slat moldboard used for good scouring.	For use in extremely sticky, hard to scour soils.
12″ Sod and Clay	**Moldboard.** Soft center steel. **Shares.** Carburized steel. Solid steel. Chilled.	Sod and clay shape, slow turning moldboard, light draft.	For tough, heavy draft soils where a light draft, good turning bottom is required.
12″ General Purpose Chilled	**Moldboard.** Chilled iron with replaceable chilled shin. **Share.** Chilled iron.	Moderately quick turning moldboard resists wear, gives excellent covering and pulverization.	For use in highly abrasive soils where excessive wear is a problem. Excellent covering and pulverizing bottom.
10″ Scotch	**Moldboard.** Soft center steel. **Share.** Cast steel.	Moldboard designed to leave furrow slice on edge.	For use where furrow slice is not to be completely turned.

Fig. 79—Plow Bottoms for Various Soil Conditions

406. PLOW SHARES.

Dearborn plow shares are made of different materials and different shapes to meet the requirements of different soils and soil conditions.

Having sharp plow shares is very important. Over ½ of the power required to pull a plow is used in cutting the furrow slice. Dull shares will greatly increase the load and will cause additional fuel consumption. Dull shares or improperly sharpened shares are the most common causes for poor plow penetration.

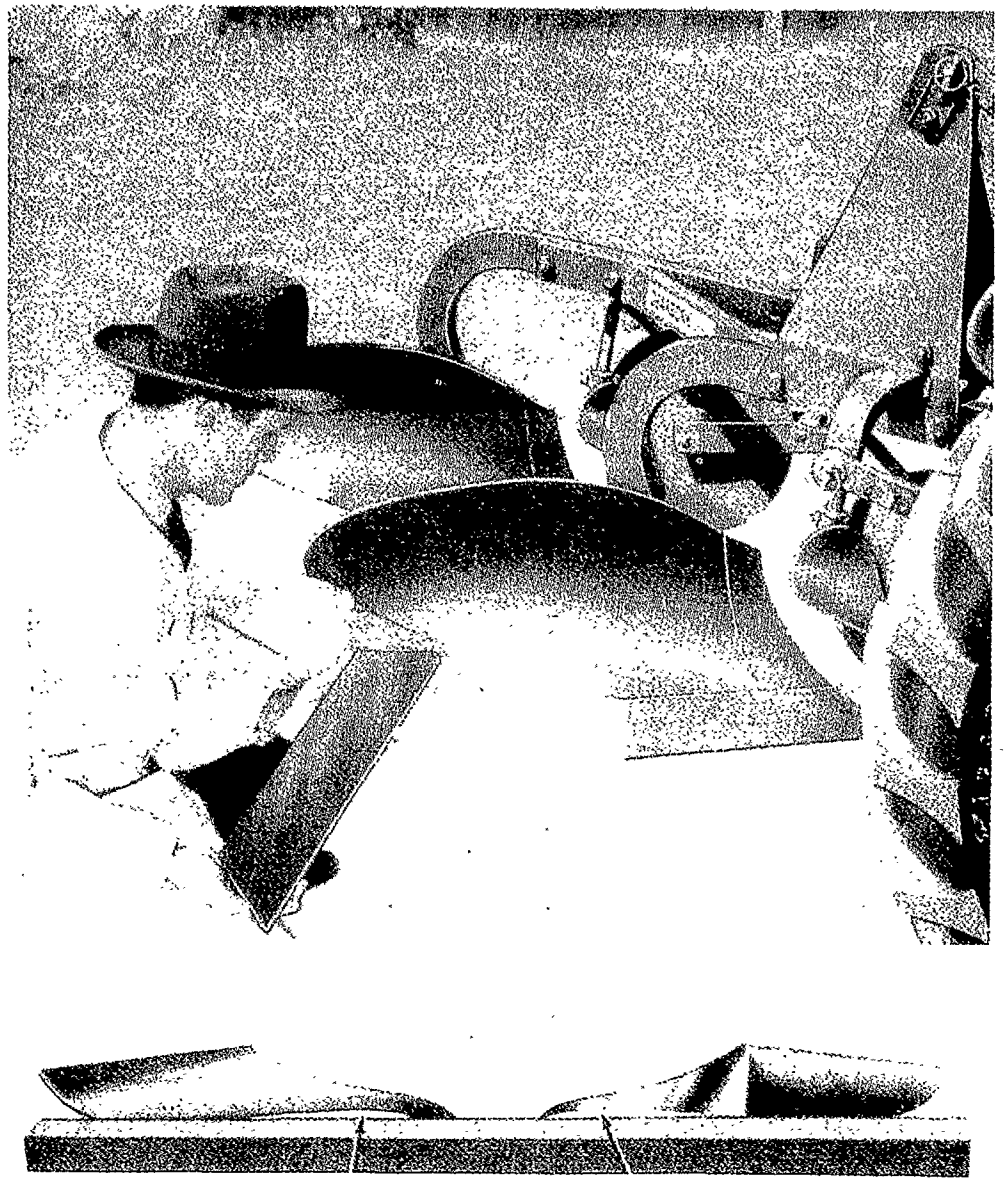


Fig. 80—Plow Shares—Ground Suction and Throat Clearance

Seven different sizes of "Razor Blade" shares to fit the Dearborn Economy Plow Bottoms are made in addition to the conventional shares available for conventional plow bottoms.

The "Razor Blade" share has a particular design that gives the same degree of suction throughout its entire length, and helps retain its sharpness until completely worn out.

In the case of conventional shares—when resharpened, they should be as near the original shape as possible. It is very helpful to have a new share of the same type to compare with the old share while resharpening. The following procedure is suggested for resharpening steel shares:

(1) Use a clean, well-banked forge fire, and heat ⅓ of the share point to a cherry red temperature. With an anvil and blacksmith hammer, draw the point as near the original shape as possible. Do not continue to work the metal after it has lost its heat.

(2) Heat a 2″ or 3″ length of the cutting edge to a cherry red temperature, and draw it to its original shape, otherwise the share may warp. Continue this step until all of the cutting edge has been sharpened.

(3) Heat the point and set the ground suction at approximately 3/16 inch and the throat clearance at approximately 1/8″ (fig. 80).

(4) To harden soft center shares, heat the cutting edge and quench by slowly moving it in and out of the tempering brine, water or oil. Forged steel shares should not be hardened.

Cast iron shares should be sharpened by grinding on the top surface of the cutting edge with an ordinary grinding wheel. Do not grind on the bottom of the cutting edge, as this will result in a sled runner shape tending to force the plow out of the ground.

407. PLOW LUBRICATION.

The Dearborn Moldboard Plow has only three points that require lubrication. Use a grease gun daily on the coulter bearings and rolling landside hub.

Never leave a plow in the ground as soil moisture and acids may pit the polished surface of the moldboards, shares, etc., causing scouring trouble. In many areas, it is advisable to coat the plow bottom with heavy oil when not using the plow for several hours. If the plow is not to be used for several weeks or months, the bottoms should be coated with heavy waterproof grease or a good rust preventive. The plow should be lubricated before being placed in storage.

To remove a plow from storage and prepare for use, lubricate, clean grease from bottoms, and, if necessary, install new shares.

408. PLOWING PROCEDURES.

Good plowing is an art in which most farmers take great pride. Many have developed methods to meet their own needs. The following paragraphs cover some of the common terminology used, together with some accepted plowing methods.

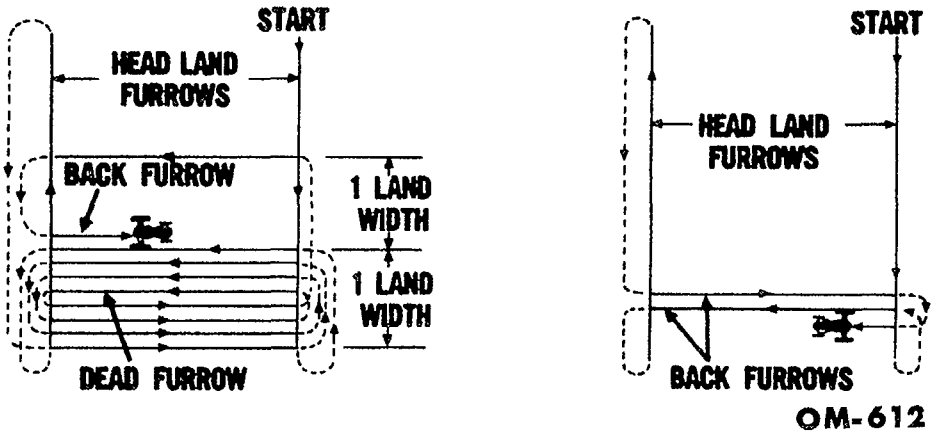


Fig. 81—Two Methods of Opening a Field to be Plowed by Lands

a. Plowing by Lands. Plowing by lands is a method whereby the field is plowed in sections or strips. The following operations are performed when plowing by lands. Fig. 81 shows a procedure for laying out the field.

(1) *HEADLAND FURROWS.* Headland furrows should be marked out when opening up a field. This is a big aid in securing a uniform plowing job. When making headland furrows, the plow should be tilted to the left with the leveling crank. The headland furrow should be turned toward the area to be plowed. Allow adequate room for turning between fence and headland furrows.

(2) *OPENING A LAND.* Tilt the plow to the left in the same manner as when plowing a headland furrow. Lower the plow into the soil and drive across the field. Picking a point at the far end of the field and driving toward it is an easy way to plow a straight furrow. Complete the back furrow and then level the plow at the start of the next round.

(3) *ENTERING FURROW.* When entering a furrow, it is important to have the tractor in a position so that the plow will take

a full cut. The plow should be lowered by moving the tractor's hydraulic touch control lever forward as the rear wheels cross the headland furrow. Drive with the right front wheel of the tractor close to the furrow wall to insure the proper width of cut.

(4) *LEAVING FURROW.* After finishing a furrow, when the rear wheels cross the headland furrow, raise the plow by returning the hydraulic touch control lever to the top of the quadrant. The turn should not be started until the plow is clear.

(5) *FINISHING A LAND.* When the unfinished land is narrower than the tractor tread, level the plow with the leveling crank. The left front wheel should be driven near the furrow wall. This will leave a narrow strip which may be neatly finished on the return trip by steering the right front wheel near the furrow wall. Re-level the plow as needed.

(6) *FINISHING OUT FIELD.* Headlands are plowed after the lands have been plowed. Place the plow in the working position and plow along the headland furrow, turning the soil toward the plowed ground. Repeat this operation until the headlands are plowed.

b. Rectangular Plowing. To leave the dead furrow in the center of the field, an opening furrow is plowed around the field. Continue following this furrow until the area is plowed (fig. 82-A). One big

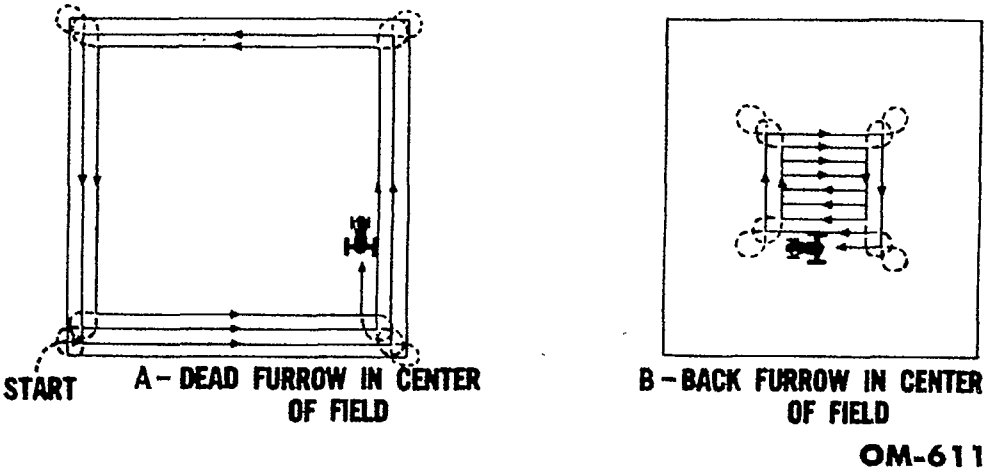


Fig. 82—Rectangular Plowing

disadvantage of this method is that turns must be made on the plowed ground.

To plow from the center of the field, the first step is to make a short back furrow in the center of the field (fig. 82-B). Plow along this back furrow until the area is large enough to plow around the rectangle. Turns in this method are made on unplowed ground.

c. Contour Plowing. Many farmers prefer to plow on the contour for soil conservation reasons. When plowing terraced land, it is possible, during seedbed preparation, to turn the soil in such a manner as to build up the terrace crown (fig. 83). The short coupled, maneuverable Ford Tractor and Dearborn Moldboard Plows are exceptionally well-suited to contour plowing. The Ford Tractor Hydraulic Control eliminates lever tugging when crossing unplowed grassed waterways.

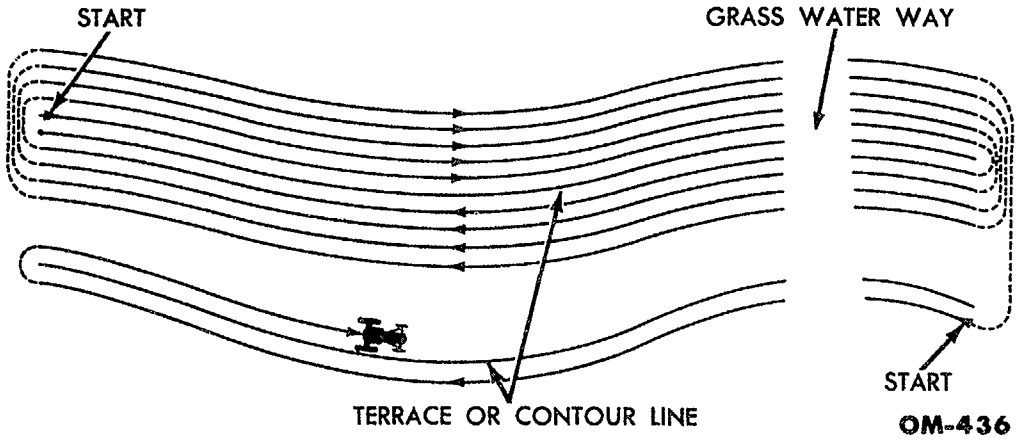


Fig. 83—Contour Plowing

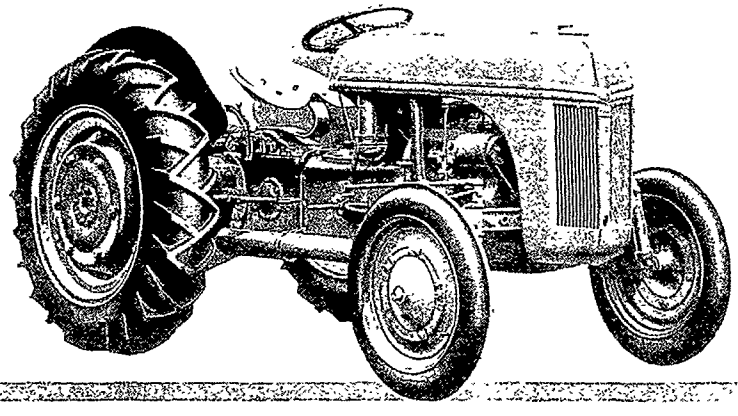
INSTRUCTION BOOK

FORD TRACTOR

FERGUSON SYSTEM

The Ford Tractor Ferguson System is a fine precision built machine designed for efficient performance, economy and ease of operation. Although it is unusually rugged and capable of giving good service, it should not be abused or neglected. The safety features of the tractor are among its many advantages. However, machinery accidents occur far too frequently on the farm solely because of operator carelessness. The operator is warned to minimize the possibility for accidents by observing a few simple precautions:

1. Do not leave tractor without *FIRST* lowering implement *to the ground.*
2. Do not attempt to pull from the top link connection.
3. Use an adequate shield to protect the power take-off universal joints.
4. Drive slowly in difficult going.
5. Do not attempt to turn sharply using one brake when travelling at high speed.
6. Keep a new tractor on light work for fifty hours.
7. Do not carry anything on the implement.
8. Keep all bolts, studs and nuts tight. This precaution is a general practice with all good operators who have found that it prolongs the life of the tractor by keeping all parts in perfect alignment.



MAINTENANCE SECTION

In order that the tractor shall give the long and efficient service of which it is capable, certain attention is necessary. This section of the book gives the necessary instructions for this work. In fact, all guarantees expressed or implied are contingent upon these instructions having been carried out.

LUBRICATION

ENGINE CRANKCASE

Working Hours

Examine the dip stick and keep oil up to the "Full" mark every---- **10**

Change oil in a new engine after the first 30 hours. Thereafter, change the *oil and the oil filter cartridge* whenever the oil begins to show dark on the dip stick, or every---------- **200**

Use S.A.E. 30 for temperatures above 90° F.
S.A.E. 20 for temperatures between 32° and 90° F.
20W for temperatures between 10° and 32° F.
10W for temperatures between —10° and +10° F.

Crankcase Capacity 6 quarts. (U. S. measure)
5 quarts. (Br. Imp'l measure)

TRANSMISSION, HYDRAULIC MECHANISM AND DIFFERENTIAL

WARNING: More harm can be done to a tractor in *one hundred hours* with inferior oil than could be done in *thousands* of hours with the correct oil. Insist on getting the exact oil specification as follows:

Examine transmission dip stick and keep oil up to "Full" mark every- **60**
One filler plug located near the shift lever supplies oil to transmission, hydraulic system and rear axle.

Change oil in a new tractor after the first 200 hours, thereafter every- **600**

For Temperatures Above Freezing:
STRAIGHT MINERAL OIL—S.A.E. 90

For Temperatures Below Freezing:
STRAIGHT MINERAL OIL—S.A.E. 80

Capacity: 5 gallons (U.S. measure)
4.2 gallons (Br. Imp'l measure)

Caution—Drain oil from all three drain plugs.

BELT PULLEY

Examine and refill if necessary every---------- **60**

Fill to high level plug with tractor oil S.A.E. 90.

Working Hours

TIRES AND THEIR CARE

Both *over inflation* and *under inflation* materially shorten tire life. Maintain proper pressure at all times. Check tire pressure every-- 60

Front 26 lbs. Rear 12 lbs.

If water is used for weight in the tires use calcium chloride to prevent freezing as follows: 1⅕ pounds per gallon of water for protection to zero degrees F. and in proportion for other temperatures. Warning: Never use this mixture in engine cooling system.

COOLING SYSTEM

Use clean soft water only. Drain both the radiator and cylinder block in freezing weather or use an antifreeze in accordance with the manufacturer's recommendations. To drain the radiator, loosen the pressure cap to break the vacuum allowing complete drainage. When hot, care should be exercised to allow the steam to escape before the complete removal of the cap. Check radiator every---------- 10

BATTERY AND ELECTRICAL SYSTEM

Examine and refill the battery with distilled water every---------- 30

An air valve prevents over-filling the battery. Do not depress air valve when filling.

Keep terminals greased to prevent corrosion.

Keep connections tight, and battery clean at all times.

If tractor is idle for 30 days or more, maintain charge in battery by removing to a battery service station or running tractor motor occasionally.

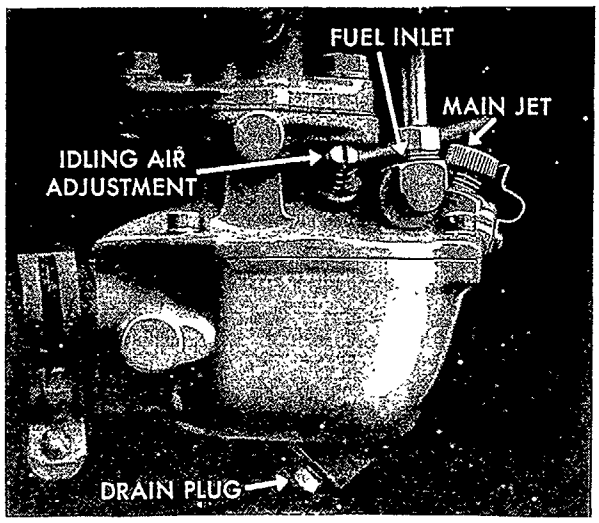
CARBURETOR AND FUEL LINE

Remove drain plug from bottom of carburetor, and drain, every---- 60

To find the approximate correct adjustment of the main jet: Turn the needle gently to the closed position and open one turn. Maximum economy can be obtained by adjusting the carburetor to suit conditions under which the tractor is working. It is not advisable to use too lean a mixture, as it tends to overheat the motor.

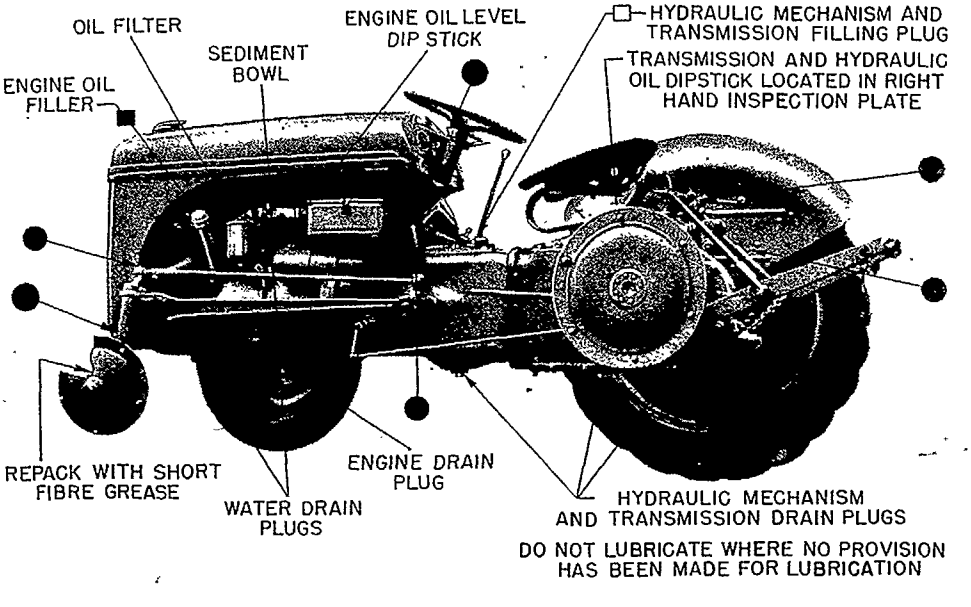
The air adjustment jet should be turned in or out until the motor runs smoothly when idling.

See Fuel System.



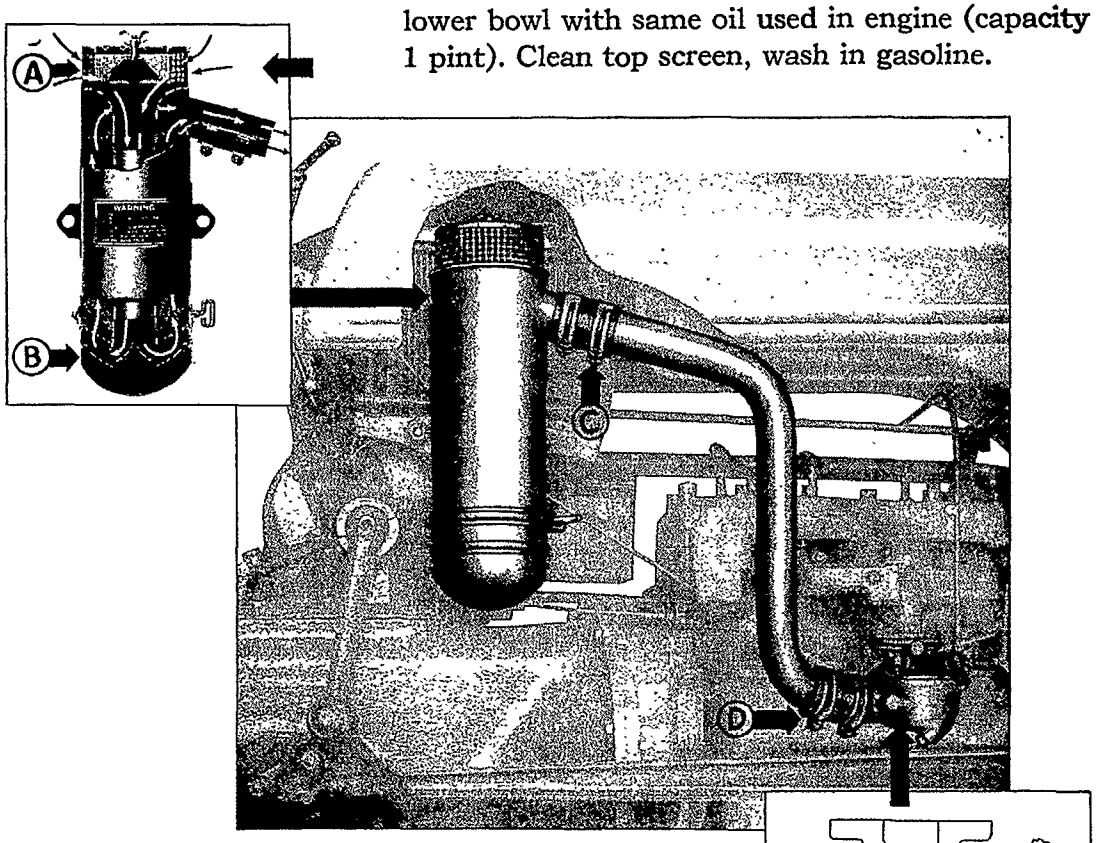
	Working Hours
FRONT WHEEL HUB BEARINGS	
Wash clean with kerosene or gasoline and repack with short fibre grease each working season. Renew dust seal if not in good condition.	
SPINDLES, ball and socket joints on the ends of each drag link in the steering mechanism, leveling crank gear box and leveling crank thread, use grease gun every	10
LINKAGE AND FRONT AXLE PIN	
Caution. Do not lubricate ball and socket joints or the pins of the linkage, or front axle pin.	
STEERING COLUMN	
Two shots from grease gun every	10
Warning! Grease *only as directed.* Too much grease will contaminate the transmission oil and may affect the hydraulic mechanism.	
GENERATOR BEARING (REAR)	
Use a few drops of engine oil every	300
AIR CLEANER	
In normal conditions clean and refill bowl with oil every	10
In dusty conditions every	5
Use engine oil for servicing.	
S.A.E. 30 for summer.	
S.A.E. 20 for winter down to 40° F.	
S.A.E. 10 for 40° F. to 10° F.	
S.A.E. 10 plus kerosene from 10° F. to sub-zero.	
Inspect and clean the screen at the air inlet to the air cleaner every	10

● ***Grease Every Ten Hours***



CLEAN AIR MEANS LONGER MOTOR LIFE

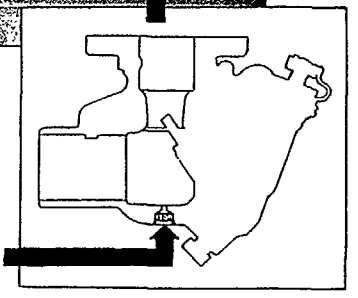
Service the top of the precleaner (A) and the bottom air cleaner bowl (B). Clean daily and refill lower bowl with same oil used in engine (capacity 1 pint). Clean top screen, wash in gasoline.

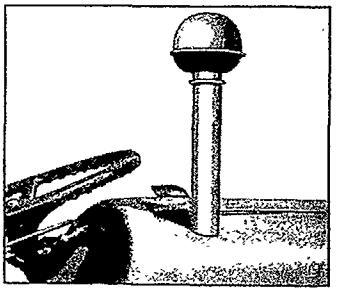


Check the hose connections (C) and (D) and keep them tight.

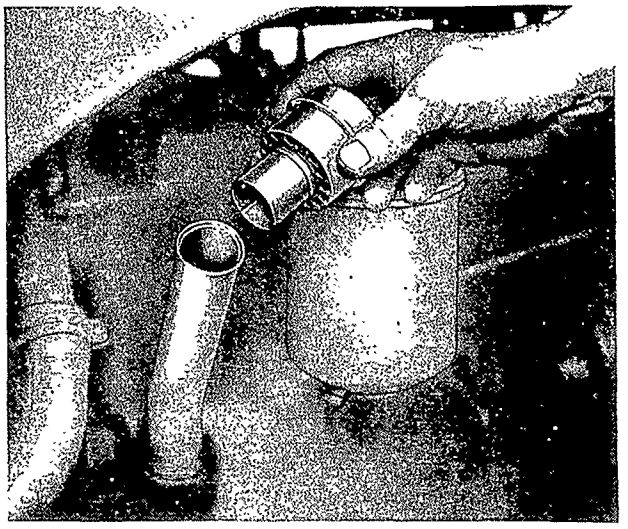
Keep Filter Packing in Drain Opening of Carburetor. This filter allows manifold condensation and excess fuel to escape. DO NOT PICK OR REMOVE. Removing of this felt packing admits abrasive dirt and grit directly to the engine and may damage the engine in a few days.

In extreme dusty conditions an air cleaner extension draws air from above the most heavily dust laden area.





OIL FILLER CAP



Check the oil filler cap daily. Wash clean with gasoline to insure proper breather action, and to remove accumulation of dirt.

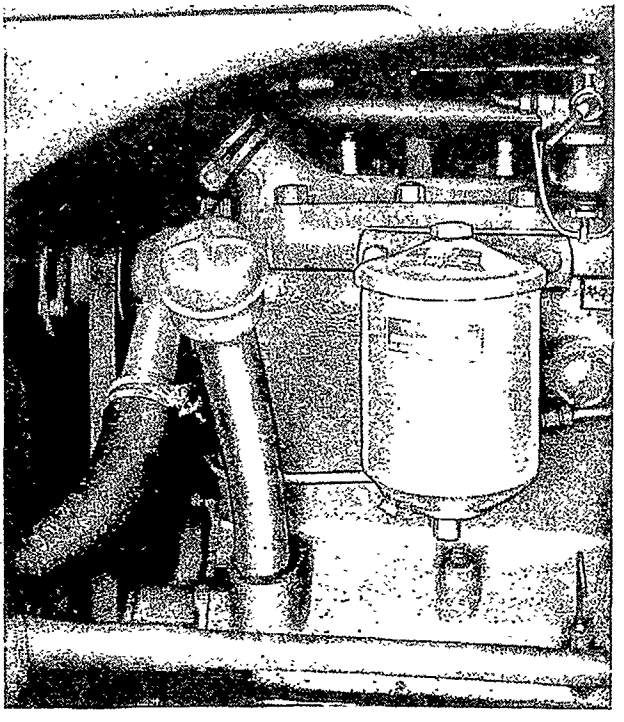
After washing put a few drops of clean oil on the wire mesh, with an oil can.

The filler cap must be kept clean, as it is through this cap that crankcase vapors escape.

Failure to do so will build up pressure in the crankcase. Retaining vapors in crankcase will contribute towards the formation of sludge in the crankcase, corrosion and rust in the engine, governor and distributor.

OIL FILTER

Change the oil and oil filter cartridge whenever the oil begins to show dark on the dipstick. A sludge-choked filter will stop governor lubrication which is obtained direct from the filter. It should be changed at least every two hundred hours, or more often if dust conditions are abnormal. Make sure in replacing the oil filter cartridge that all connections are tight, that new gaskets are used and fit perfectly.

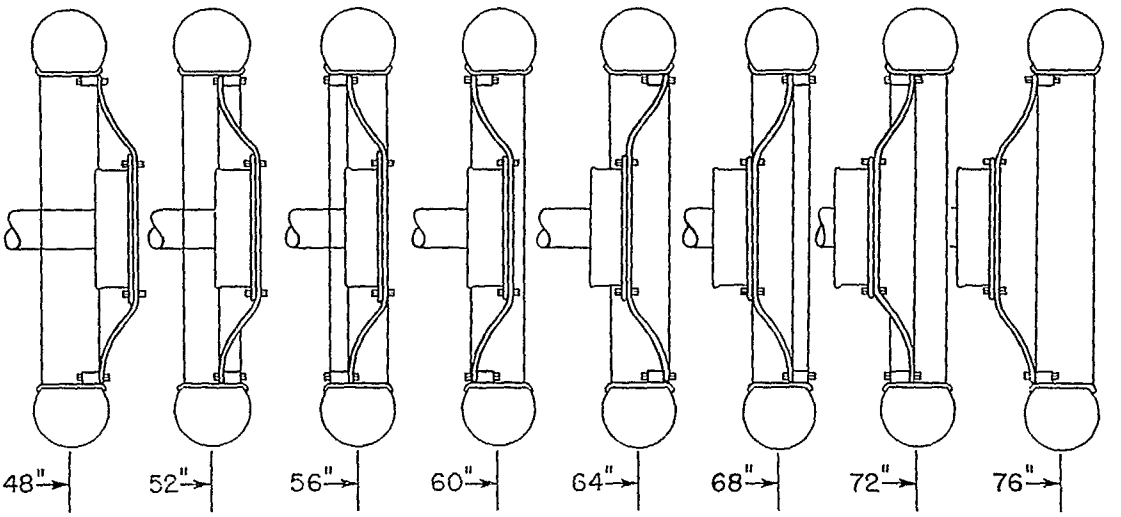


After removing the cartridge from filter take out drain plug on bottom of filter, drawing out as much sludge as possible. To clean filter, replace plug and fill filter about 1/3 full of kerosene or gasoline and clean filter case, remove drain plug and drain.

There are two small holes, one on each side of the stand pipe in filter a little over half way up from the bottom; as long as flushing liquid is kept below these holes, there is no danger of liquid getting into the crankcase.

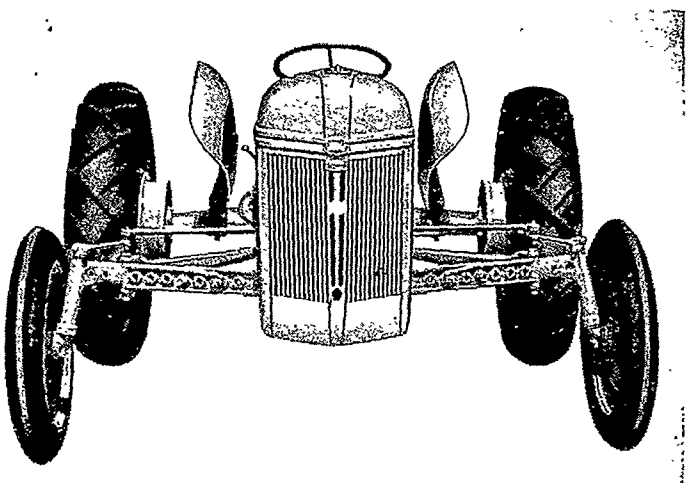
CHANGING THE GAUGE OF THE TRACTOR

The gauge of the rear wheels of the tractor is adjustable by means of assembling the disc and rim in different positions, as shown in drawing below.



Treads of 48, 52, 64, 68 inches are made without changing rear wheels to opposite side of tractor. Treads of 56, 60, 72, 76 inches are made with rear wheels changed to opposite side of tractor, to keep treads running the proper direction. Note: Arrow on sidewall of tire must always point in direction of travel.

The front axle is made in 3 parts and the gauge is adjustable in front from 48″ to 72″ by assembling the three parts of the axle to the proper length. The additional width from 72″ to 76″ is obtained by reversing the front wheels.



Caution: Loosen the bolt through the radius rod yoke first, then spread axle as desired. No change in the steering connection is necessary. Always assemble the axle with one hole between the bolts holding the halves together, never in adjacent holes.

THE LINKAGE

All connections on the linkage must be kept clean and allowed to move freely. Do not lubricate the ball and socket joints or the pins. Lubricate only the leveling lever gear box and leveling lever thread as indicated in the Maintenance Section.

WARNING! Do not pull from the drawbar until the drawbar stays are in place as illustrated. Do not pull from the top link or master control spring rocker clevice under any conditions.

THE ADJUSTABLE DRAWBAR

with stays in place.

SEE CAUTION NOTE BELOW

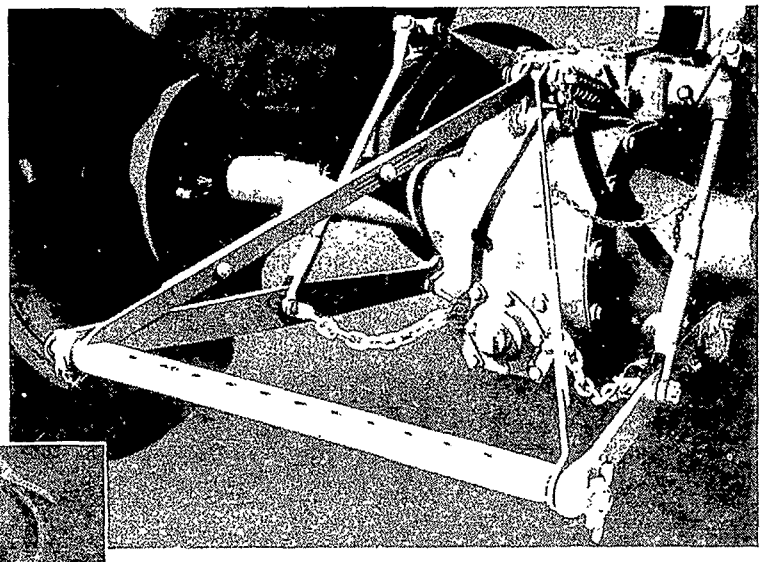
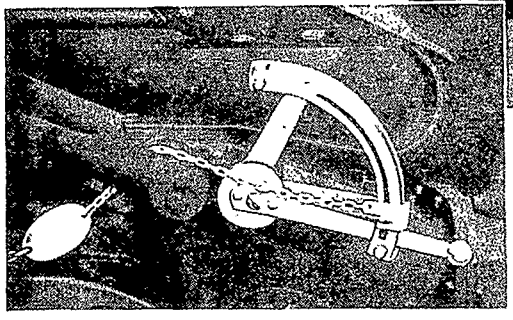


Illustration below shows Safety Wedge on Quadrant.

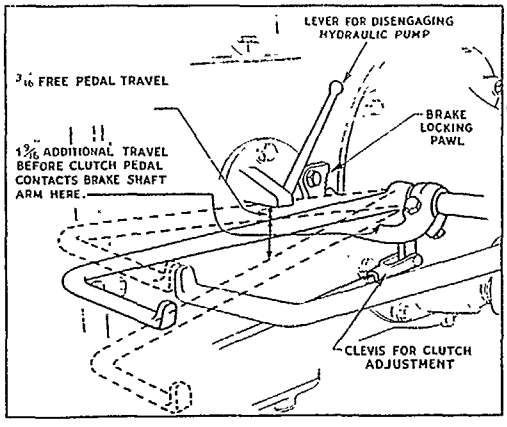


The drawbar is attached as shown. The standard setting is 18″ from the drawbar to the ground but it may be easily adjusted up or down to suit different pull type implements.

Caution: (a) Before installing drawbar stays, *lock* Hydraulic Control Lever in "down" position, as shown. DO NOT unlock or move lever while stays are in place. (b) Disengage Pump Control Lever on left side of transmission.

THE CLUTCH PEDAL

The clutch pedal should be adjusted as shown: 3/16″ of free pedal travel as shown. 1 9/16″ in addition for disengaging the clutch. Bring the brake pick-up arm into contact with the pedal at the proper position as shown.



THE HYDRAULIC MECHANISM

The hydraulic mechanism, which automatically controls the implements, is built into the tractor and operates while submerged in oil. It requires no special attention.

WARNING: *Do not leave tractor without first lowering implement to the ground.*

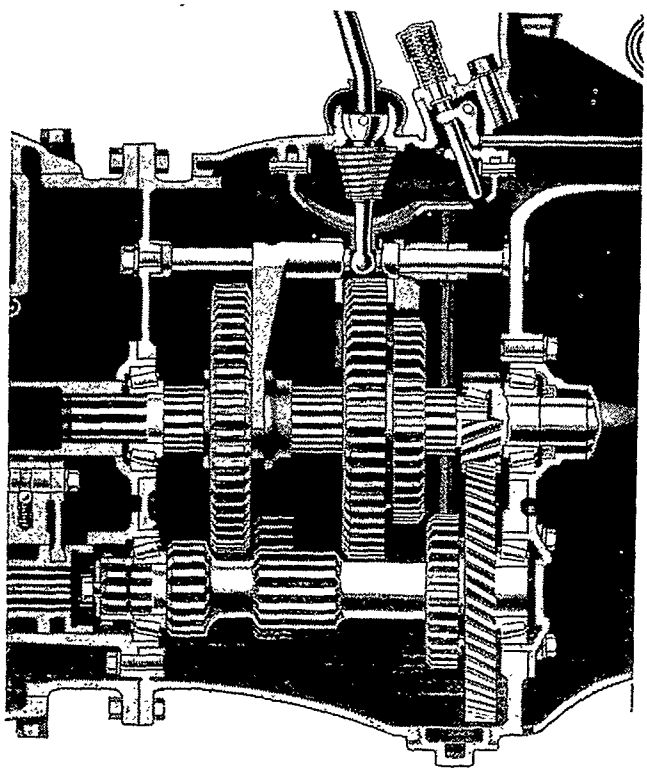
TRANSMISSION

The transmission has three speeds forward and one reverse with ratios and speeds given—

Low	2⅝ M.P.H. at 1500,	Ratio	73.3–1
2nd	3½ M.P.H. at 1500,	Ratio	57.0–1
3rd	8 M.P.H. at 1500,	Ratio	24.6–1
Rev.	2⅞ M.P.H. at 1500,	Ratio	68.4–1

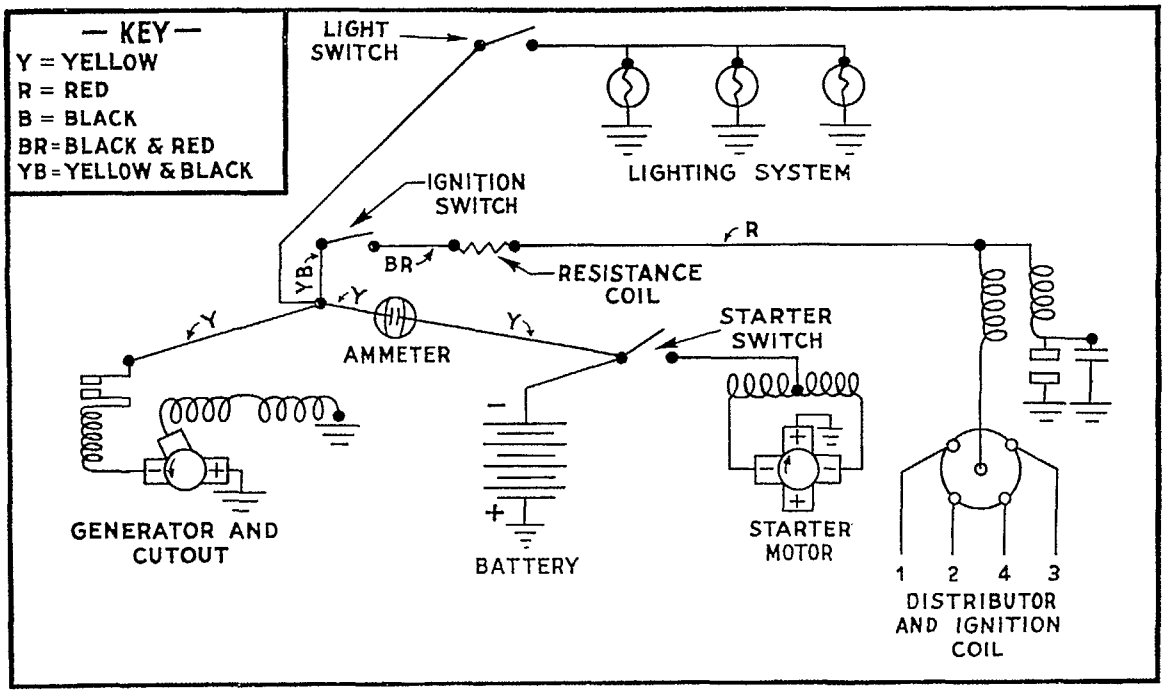


All bearings are tapered roller, anti-friction type except the reverse idler gear. *The pump for the hydraulic mechanism is driven by the power takeoff shaft, and the two as a unit are thrown in and out of gear by the lever on the left side transmission inspection case* —the down and back position of the lever being the engaged position. *The up and forward position is the disengaged position.* The power take-off shaft runs at .36 of the engine speed. 1500 R.P.M. of the motor gives a power take-off speed of 545 R.P.M.



THE ELECTRICAL SYSTEM

The energy for starting, lighting, and ignition is supplied by a 6-volt battery and generator, shown below with connections. The charging rate of the generator is adjustable by 3rd brush rotation—the maximum rate being 16 amps. The correct spark-plug gap is .024″ to .029″. The correct plug is Champion, 14mm, No. H-10. The breaker points in the distributor should be adjusted to .015″ and inspected occasionally.

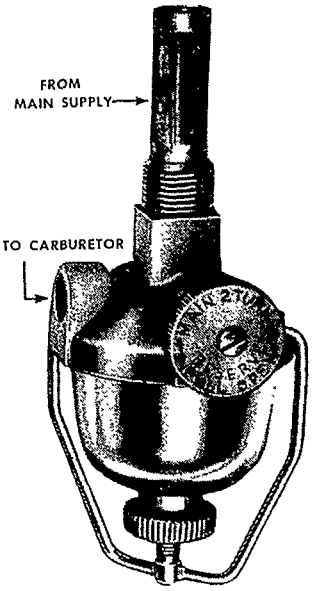


THE FUEL SYSTEM (Gasoline Only)

Fuel is supplied by gravity from a tank under the cowl to the carburetor. Only one tank is provided. By means of a two-way valve, fuel can be drawn from the tank at the bottom or from an opening in a short standpipe. Thus a portion of the fuel (1 U.S. gallon) can be held in reserve for emergencies. The tank holds a total of ten U.S. gallons (8.4 Br. Imp'l gallons).

The carburetor has two adjustments—the idling air adjustment and the main jet. The quantity of fuel passing through the main jet is limited by a fixed jet so that the adjustment functions only through a range sufficiently broad to provide

for operation in different conditions; thus the adjustment cannot be thrown completely off. The approximately correct adjustment for the main jet is open one full turn from the closed position. Further refinements of the adjustments are determined by observing the operation of the motor. The proper fuel for the tractor is gasoline with a minimum octane number of 70.



When it is desirable to disassemble the carburetor, always remove it from the manifold first; remove the main jet adjusting screw, then disassemble in the normal manner. Never attempt to blow out a carburetor by connecting an air line to the fuel inlet—always disassemble and blow out the parts individually.

Do not permit any air leaks to occur between the air cleaner and carburetor.

When tractor is to be idle for 30 days or more, drain the entire fuel system including the gasoline tank. Fuel should be removed through bottom of carburetor, with sediment bulb valve on "reserve." Gasoline, when stored, forms a gum which has a tendency to clog up the small openings in the carburetor. For the same reason, do not use gasoline which has been stored in the tractor for more than 60 days.

Clean sediment bulb when sediment collects.

THE GOVERNOR

The governor is lubricated by clean oil direct from the oil filter. The governor functions through the entire speed range from 400 to 2,000 rpm. All settings can be made from the tractor seat by moving the hand throttle. The connections between the governor and carburetor should be kept free and clean so that it will operate smoothly.

THE COOLING SYSTEM

The cooling system, consisting of a tubular radiator with shroud, pressure cap, fan, pump, and connections, needs no special attention. The centrifugal type water pump has prelubricated bearings and needs no lubrication or other attention. The fan belt should be maintained at the proper tension at all times, the method of adjustment is by the spring mounted on the generator to the front cylinder head bolt; to tighten, turn the bolt in the spring counter-clockwise; to loosen turn clockwise.

The tension of the belt is proper when it can be depressed ½ to ¾ inch by the hand midway between the generator and fan belt pulleys.

The air passages through the radiator should be cleaned of trash when necessary by blowing out with an air hose.

The capacity of the cooling system is 12 quarts (10 Br. Imp'l quarts). A thermostat is provided to facilitate warming up. The use of a good rust inhibitor is recommended where water with corrosive properties is used. To drain radiator, always loosen the radiator cap to break vacuum. *Caution:* When radiator is hot, carefully loosen cap, allowing pressure to escape before complete removal.

MOTOR AND LUBRICATION

The motor is lubricated by pressure feed to the main, connecting rod and camshaft bearings and by splash to other parts. The gear type oil pump housing is cast integral with the front main bearing cap and is driven from the crankshaft gear of the timing gear set. The oil pressure relief and regulating valve lifts at 30 pounds pressure, which will show a gauge pressure from 15 to 30 lbs. on the instrument panel, depending on the temperatures of the oil and speed of the motor.

Refer to the section on specifications for details on the construction of the motor.

Keep the tractor clean and free of an accumulation of dirt, grease, etc., by an occasional cleaning.

•

All direct references to liquid measurements in this book are expressed in U.S. units. One U.S. gallon is approximately 5/6 of one British Imperial gallon.

EXTRA EQUIPMENT AT ADDITIONAL COST

BELT PULLEY—Carried by self-contained drive unit quickly attachable to rear of tractor. Pulley diameter—9", width 6.5". Speed—1352 rpm, belt speed—3190 ft. per minute at 2000 rpm engine speed. Pulley gear ratio to power take-off shaft 1.86. Rotates in either direction.

STANDARD A.S.A.E. POWER TAKE-OFF ADAPTER with safety shield is a self-contained drive unit quickly attachable. Has standard A. S. A. E. spline shaft 1.375". Shaft speed of 545 rpm at 1500 rpm engine speed. Engine to shaft ratio - 2.75 to 1.

LIGHTING KIT—Includes 2 headlamps, tail lamp with license plate bracket, switch and all necessary wiring.

SPECIFICATIONS

ENGINE—Four cylinder L-head. Bore 3.187 x 3.75. Piston displacement 120 cu. in. Compression ratio 6 to 1.

HORSE POWER—Maximum belt hp—23.87. Rated belt hp. (85% of maximum)—20.29. Drawbar—2-14" plow capacity with Ferguson hydraulically operated implements. Maximum draw bar without Ferguson hydraulic system of control —16.90 hp. Rated draw bar hp (75% of maximum)—12.68.

GOVERNOR—Variable speed, mechanically operated, centrifugal type. Governor regulation from 400 to 2000 rpm.

LUBRICATION—By gear pump supplying direct pressure oiling to crankshaft, camshaft and connecting rod bearings, also to timing gears. Crankcase oil capacity—6 quarts. (5 Br. Imp'l qts.)

OIL FILTER—Replaceable cartridge type of large capacity.

IGNITION—Direct-driven distributor in unit with coil in waterproof housing. Fully automatic spark advance.

GENERATOR—6-volt type with third brush control.

STARTER—6-volt conventional type automobile starter. Safety starter switch mechanically interlocked with gear shift lever.

BATTERY—6-volt—85 ampere-hour capacity —13 high plates.

COOLING—Pump circulation of water through tube and fin type of radiator with pressure system. Fan—6-blade 16" driven by belt. Pump is packless type with prelubricated bearings. Cooling system capacity—12 U.S. quarts. (10 Br. Imp'l qts.)

FUEL SUPPLY—Welded steel tank carried in engine hood, capacity 10 U.S. gallons (8.4 Br. Imp'l gals.). By means of a two-way valve on sediment bulb, 1 gallon may be held in reserve for emergencies.

CARBURETOR—Up draft, plain tube type of sturdy, dustproof construction.

AIR CLEANER—Oil bath type with dust receptacle easily removable for cleaning.

MUFFLER—Reverse-flow type. Fitted as standard equipment to carry exhaust to the rear of the tractor.

CLUTCH—Single dry plate 9" effective diameter. Clutch plate pressure increased by centrifugal force as engine speed is increased.

TRANSMISSION—Sliding gear—3 speeds forward and one reverse. All shafts mounted on tapered roller bearings.

FINAL DRIVE—Spiral bevel gear drive with straddle-mounted pinion 6.66 to 1 ratio. Four pinion differential mounted on tapered roller bearings. Drive axle of the semi-floating type with integral axle shafts and wheel hubs, also mounted on tapered roller bearings.

TRANSMISSION SPEEDS

	Final Gear Reduction	Speeds At 1500 RPM	Speeds At 2200 RPM
Low	73.3 to 1	2 5/8 mph	4 mph
Intermediate(plowing)	57 to 1	3 1/2 mph	5 1/8 mph
High	24.6 to 1	8 mph	11 3/4 mph
Reverse	68.4 to 1	2 7/8 mph	

STEERING—Bevel pinion and twin bevel sectors controlling both front wheels independently. Tread of front axle adjustable without disturbing any steering connections. Rubber covered steel steering wheel 18" diameter.

POWER TAKE-OFF SHAFT for Ferguson Equipment extends from rear of axle housing—1.125" spline. Shaft speed of 545 rpm at engine speed of 1500 rpm.

BRAKES—14" x 2" internal expanding, two-shoe, fully energizing type. One simple accessible adjustment on each brake. Brakes operate independently on each rear wheel controlled by separate pedals to facilitate short turning.

WHEELS—Front—Steel disc fitted with 4x19 single rib pneumatic tires on drop center rim, 26 lbs. tire pressure. Rear—Steel disc fitted with 10x28 traction tread pneumatic tires on drop center rim, 12 lbs. tire pressure.

HYDRAULIC IMPLEMENT CONTROL—Consists of 4 cylinder pump supplying oil under suitable pressure to ram cylinder. Valve has manual and automatic control. Control lever convenient to the operator's right hand gives him instant control of the implement.

DRAWBAR—Adjustable type. Included as standard equipment.

DIMENSIONS of Tractor—Wheelbase—70".

Normal Tread—Front 48" and rear 52".

Front Tread—Adjustable, by means of extending axle ends and reversing front wheel discs, to 76" in 4" steps.

Rear Tread—Adjustable, by means of reversible wheel disc and reversible tire rims, to 76" in 4" steps.

Over-all length—Front tire fin to end of lower link—115".

Over-all width—64".

Over-all height—52".

Ground clearance—13" under center. 21" under axles.

Turning circle—16 ft. diameter with use of brakes.

The Ford Motor Company, whose policy is one of continuous improvement, reserves the right to change specifications, design, or prices, without incurring obligation.

A FEW OF THE MANY IMPLEMENTS OPERATED WITH THE FORD TRACTOR FERGUSON SYSTEM

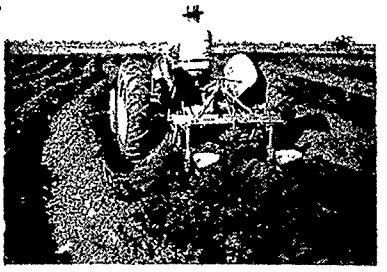
The manufacture of this tractor and its equipment will become by far the largest industry in the world. It will create employment for millions of people, and offer endless opportunity for youth and capital.

The slavery will be taken out of agriculture. It will become attractive and profitable and put an end to the disastrous drift of youth from the land.



Cultivating

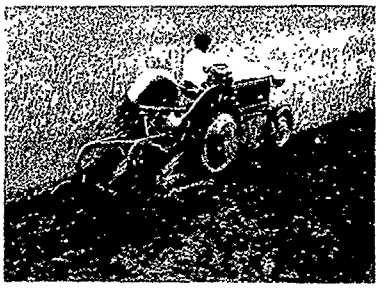
Middlebusting

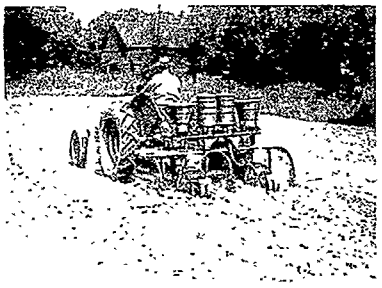




Ridging

Plowing





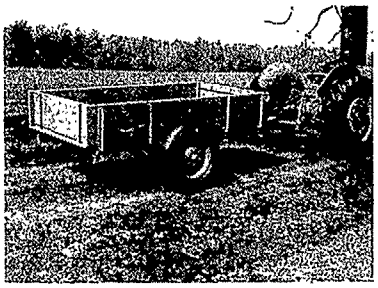
Planting

Tilling

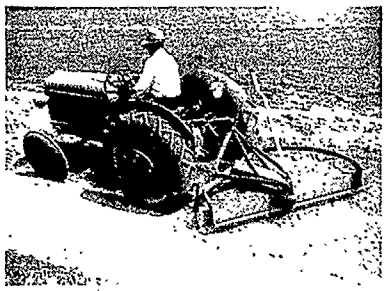




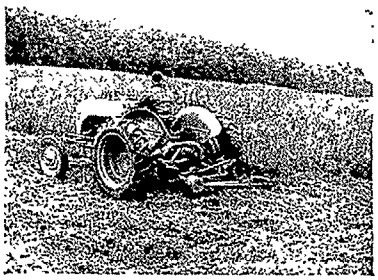
Sawing



Hauling



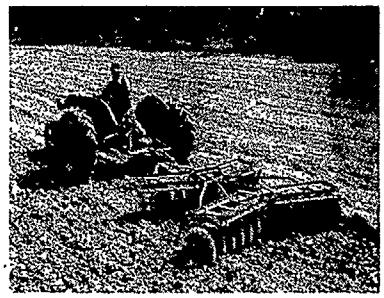
Terracer-Grader



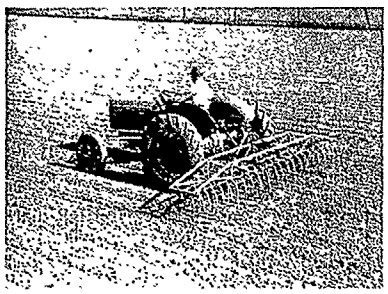
Mowing



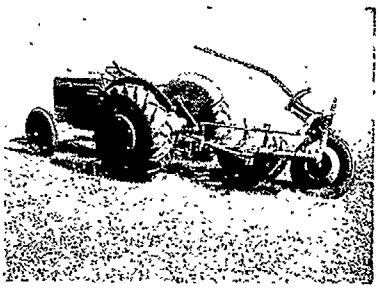
Corn Picking



Harrowing



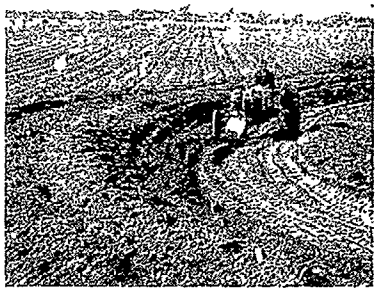
Weeding



Disc Plow

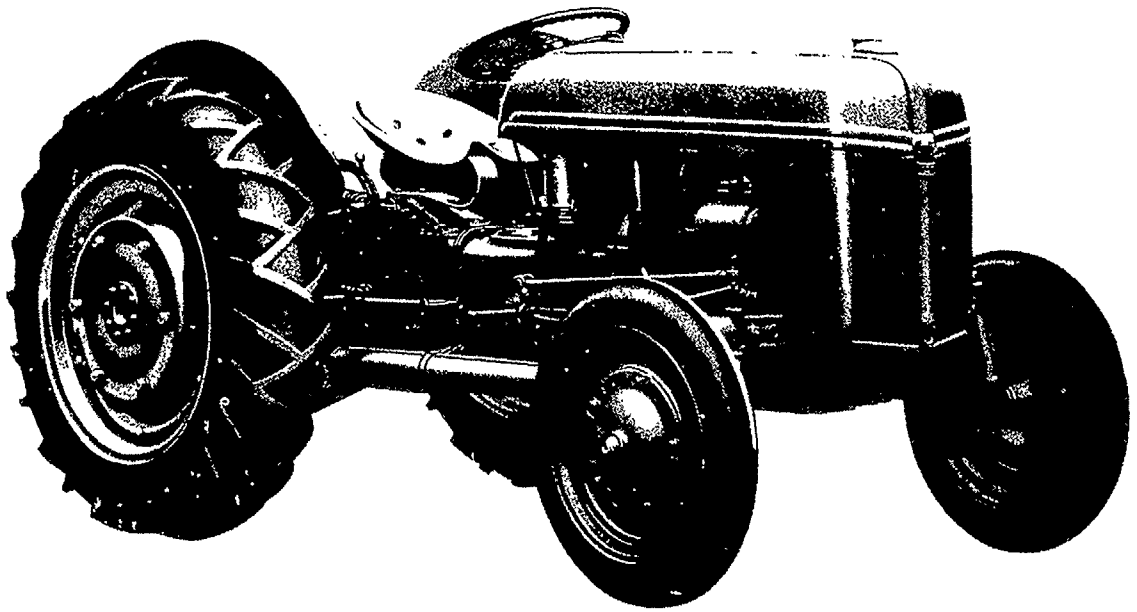


Irrigation Work



Terracing

THE FORD - FERGUSON TRACTOR



• The entirely new system of land cultivation made possible by the Ford-Ferguson Tractor was developed to give effect to four fundamental principles:

1. To so cut the cost of farm products that farming can be made prosperous *without increasing the cost to the consumer.*
2. To make farming attractive to youth and stop the drift from the land.
3. To assist all other industries through a prosperous agriculture and *stimulate greater industrial use of farm products* by cutting costs, thus increasing the total farm market.
4. To lay the foundation for a greater National Security.

The present relatively high cost of farm production rests on the fact that, in the main, the nation's farms have not been able to adopt the principles of mechanization which have made other industries prosperous.

It was with this challenge in mind that the manufacturing resources of The Ford Motor Company were placed behind the genius and practical experience of Mr. Harry Ferguson to produce a tractor designed to replace the horse. To replace him because he is a waster of land and time.

A generation of tractor experience has proved the horse cannot be replaced by substituting a good machine in front of the same old tools.

So, all the old ideas about pulling and controlling implements were thrown overboard and a *new principle* was developed.

This new principle is so efficient that the Ford-Ferguson Tractor can work profitably, under the most difficult conditions. It will not only pull tools for which a heavy tractor previously was necessary, but it will go everywhere and do all the work the horse will do . . . and do it *better* and *cheaper*.

It is a new system of land cultivation that every progressive farmer will take great pride in using on his farm.

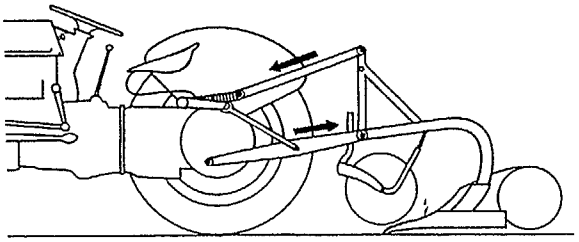
In addition to the many mechanical refinements built into the Ford-Ferguson Tractor, features providing for the comfort and convenience of the operator also are to be found. Features that save his time—such as one-minute implement change. Features that save his strength—such as finger tip implement control. Features that protect his safety—such as an electric starter that will not operate unless the tractor is in neutral gear.

A study of these features, described on the following pages, will clearly show how the Ford-Ferguson Tractor has met the challenge to provide the farmer with a means for reducing costs . . . saving time . . . protecting health . . . and producing greater yields.

THE FORD - FERGUSON TRACTOR

ENTIRELY NEW PRINCIPLES

TOP LINK (PUSHING)



BOTTOM LINKS (PULLING)

• The Ford-Ferguson Tractor, which is built around the Ferguson System—together with its close-coupled lightweight wheel-less plow—is represented in the drawing above.

The plow is pulled by two lower links, which are in tension or *backward pull.* Top link shown in the diagram is in compression, *pushing forward.*

The top link holds the implement in a fixed position, preventing it from rotating and the forward motion of the tractor literally pulls the plow into the ground.

HYDRAULIC CONTROL

• A hydraulic mechanism is provided to control automatically the depth of the plow while it is in the ground.

The manual control is part of the hydraulic mechanism, so that the operator can raise the implement out of the ground or lower it instantly, at the slightest movement.

The top link in compression puts a forward thrust on the tractor that tends to keep the front end down.

NEED FOR WEIGHT ELIMINATED

• The result of this is that excess weight built into the tractor is not needed to hold the tractor in proper balance, while plowing with the unit implement.

Weight is properly distributed over the four wheels by the Ferguson System itself. Consequently, it is now possible to have a lightweight tractor, requiring less power to move its lighter weight and still do the work of heavier tractors.

PENETRATION WITH A LIGHTWEIGHT PLOW

• Since it is the Ferguson principle and not weight that gives the plow its penetration, the Ferguson plow is a lightweight tool in contrast to pull type plows of the same capacity.

DEPTH MAINTAINED IN UNEVEN GROUND

• Although the plow is held in a fixed position while plowing level ground it is not lifted and lowered each time the front wheels drop into a hollow or climb a high spot as is the case of rigidly mounted implements. With the Ferguson System, the plow automatically works at the depth to which it is set. It is able to do so because any slight variation in the ground which the front or rear wheels must follow, will always cause an extension or compression of the master control spring. This in turn acts on the valve to build up or reduce the solid column of oil that holds the plow to its fixed depth.

Under normal working conditions, the control valve is moving back and forth a slight amount almost continuously to maintain the balance originally set for the operation.

HOW THE FERGUSON SYSTEM SUPPLIES TRACTION

• When plowing tight, heavy soils, weight is automatically built into the Ford-Ferguson Tractor by the texture of the soil to provide the necessary traction. This is because the plow is actually carried by the tractor and therefore any weight on the plow, such as soil and the "suck" of the plow moving the soil, actually adds weight across the rear end of the tractor to provide increased traction. The heavier and tighter the soil texture the greater the weight transmitted and the greater the traction.

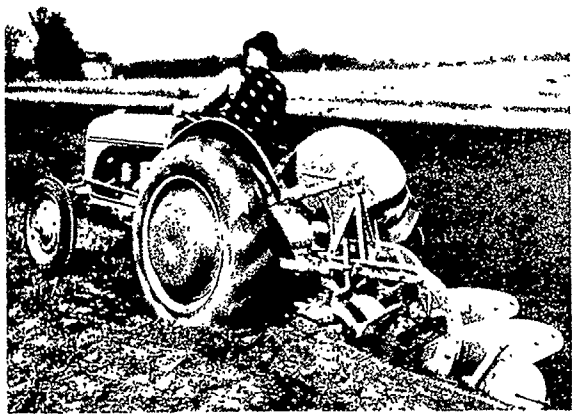
When plowing soft ground where the soil texture is light, the weight is correspondingly light on the rear end of the tractor. This is the reason why the lightweight Ford-Ferguson Tractor can work without difficulty in soil where heavier equipment would soon bog down.

THE FORD - FERGUSON TRACTOR

ACTS AS OWN SAFETY DEVICE

• One of the major advantages of the Ford-Ferguson Tractor is the way it acts when the unit implement meets with a rock, root or other obstruction when plowing. Fields which might otherwise be left unplowed can now be worked with comparative ease.

When the impact takes place the top link instantly reduces weight on the rear wheels by shifting weight to the front wheels. Traction effort is thus relieved on the rear wheels, allowing them to spin so that the strain on both tractor and implement is minimized instantly.



Actual photograph showing how rear wheels can spin as plow hits buried obstruction

With conventional tractors equipped with a conventional draw bar pulling wheel type or drag type implements, the effect is just the opposite of this. When the plow strikes an obstruction, weight is added to the drive wheels and the traction effort is increased. This usually results in damaging the implement or putting an excess strain on all the moving parts of the tractor.

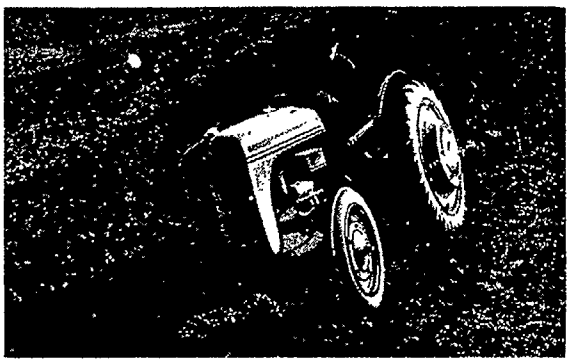
This comparison is even more pronounced when the impact takes place on a hillside. By comparison, the Ford-Ferguson Tractor with Ferguson System establishes new standards of safety for the tractor, implement and operator. Farmers appreciate the increased safety, particularly when the tractor is operated by the younger and inexperienced members of the family.

To explain more fully the action of the Ferguson System when the implement meets an obstruction, the sudden increase of pushing force in the top link shifts the control valve into the lowering position.

This relieves the tractor of the weight of the implement and the soil Weight is transferred to the front end of the tractor and the spinning of the rear wheels indicates to the operator that he should stop the tractor and prepare to clear the obstruction.

All the operator has to do is back up, clear the obstruction by raising his implement hydraulically and then continue on his way—no unhitching—no circling around to get lined up again.

WORKS ON HILLSIDES WITH GREATER SAFETY AND EASE



• The Ford-Ferguson Tractor is ideal for working on hillside or contour. Easier and more accurate steering are made possible because the front end of the tractor is held down by the action of the Ferguson System.

Its four wheels and compact design give it greater stability and reduce side slip. Then, too, the linkage between tractor and implement results in better control of the implement with less tendency for it to fall away on slopes.

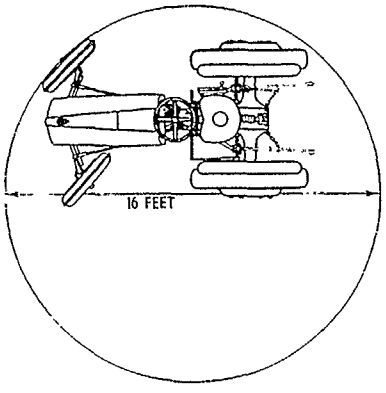
These same principles, plus the fact that extra traction is provided as needed, explain the unusual ability of the Ford-Ferguson Tractor to work up hillsides—although, of course, this is not recommended soil conservation practice.

THE FORD - FERGUSON TRACTOR

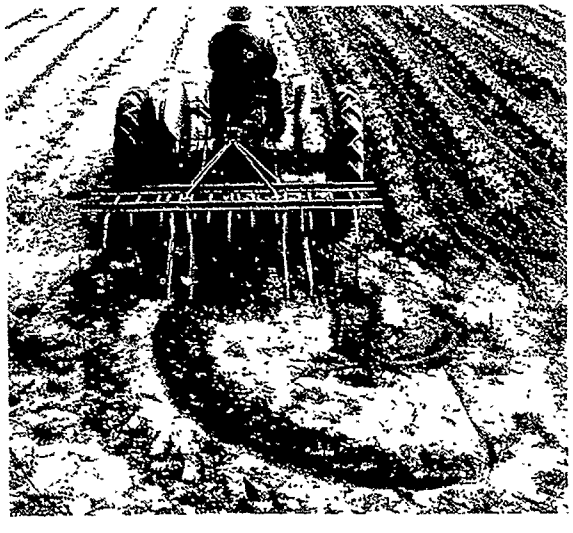
GETS MORE WORK DONE

• The Ford-Ferguson Tractor is so flexible in working various types of soil, different shapes and sizes of fields—so flexible in handling, changing and using implements—so flexible in supplying power with belt, drawbar and power take-off—that it will fit into any change in farming plans which is made to meet today's swiftly changing conditions.

TURNS INTO NEXT ROW



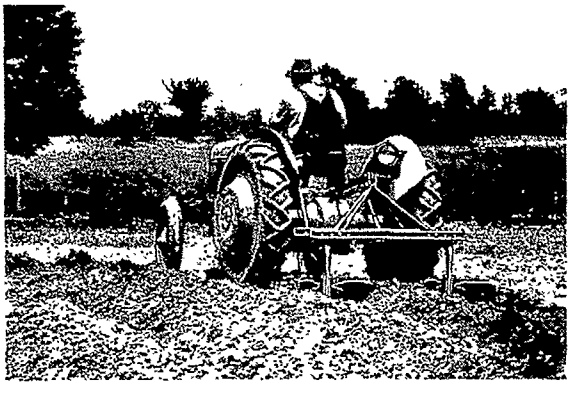
The illustrations above and below show how short you can turn the Ford-Ferguson Tractor using the independent rear wheel brakes. At the end of a row you swing into the next with practically no lost travel. That cuts down on the time it takes to get into the next row—means that more cultivating can be done in a given time.





WORKS IN FENCE CORNERS

Unit type implements and compact design of the Ford-Ferguson Tractor make it possible to plow or cultivate in garden plots and fields too small for equipment of other types, or difficult even with horse-drawn equipment. Also, because of its short turning radius, easy handling and unit design, this tractor will work irregular-shaped fields and fence corners just as readily as it works in large fields.



HAS MORE PULL WITH LESS WEIGHT

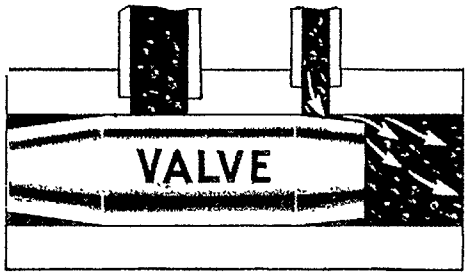
Because this new principle provides traction without the use of built-in weight, every ounce of the Ford-Ferguson Tractor is used as muscle, not ballast.

In hard pulling with a unit implement the Ferguson System automatically increases traction. In light pulling, where extra traction is not needed, the fuel that would be used to pull the excess dead weight is saved . . . and soil packing is reduced.

CONTROLS DEPTH AND RAISES IMPLEMENTS

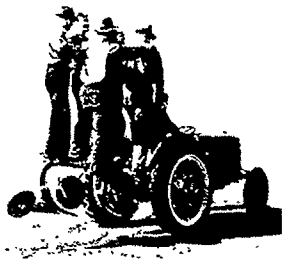
• The hydraulic mechanism of the Ford-Ferguson Tractor is not just a power lift but a mechanism built into the tractor for regulating the working depth of the implement in the ground. It also provides an easy, simple means for raising and lowering the implements.

In operation, the control lever is moved forward to whatever depth the implement is to operate. This reacts on the valve enabling the implement to drop until the pressure of the top link on the master spring compresses the spring enough to move the valve into neutral position, keeping the implement from going any deeper.

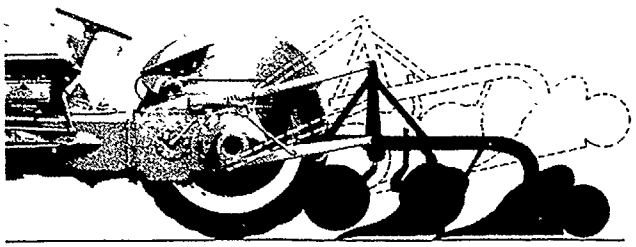


Valve (actual size) is typical of simplicity of Ferguson design.

• By moving back and forth less than 1 inch, this small simple valve automatically controls the implement in the ground.

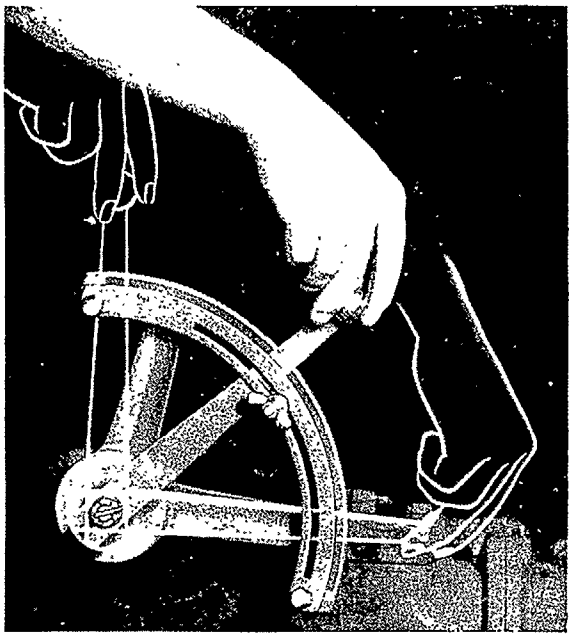


To demonstrate the ruggedness of the hydraulic mechanism, five men standing on the plow were lifted and lowered with ease.



Dotted lines indicate highest position. The simple movement of the manual control lever will adjust to any intermediate position.

HYDRAULIC CONTROL LEVER EASY TO USE



• One of the outstanding features of the Ford-Ferguson Tractor is the ease with which the implement can be raised and lowered. The illustration, here, shows the lever, mounted alongside the driver's seat, which controls the implement.

All that's necessary to lower the implement is an easy downward thrust of the lever. This requires hardly more than fingertip pressure. Pulling the lever back, an equally effortless operation, raises the implement for turning or transport.

Wing Nut Fixes Depth

To fix the implement at the desired depth, there is an adjustable stop for the lever. This stop moves on the slotted quadrant, and may be tightened by means of a wing nut.

Once the desired depth is determined, the stop is set and the implement then stays at the fixed depth.

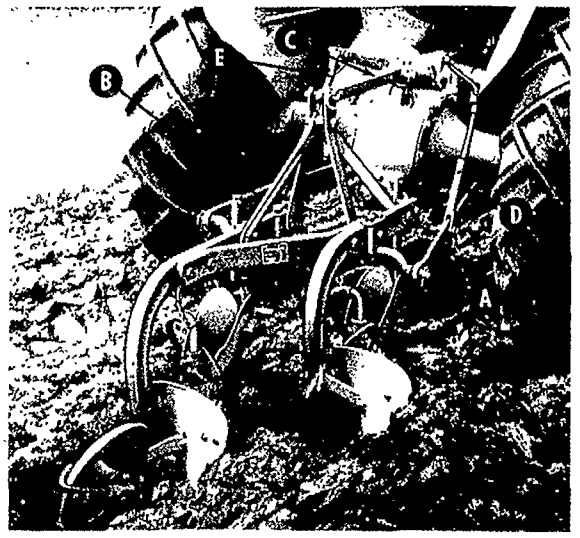
Should greater depth be desired, the lever can easily be moved past the stop and pushed farther down, as indicated by the phantom arm in the drawing.

THE FORD - FERGUSON TRACTOR

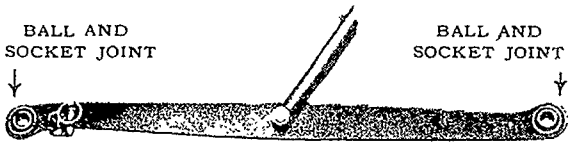
FLEXIBLE LINKAGE

• It was not until the Ferguson System was developed, with complete flexibility of linkage and hydraulic depth control, that the use of the tractor and implement as a unit became completely successful for all purposes.

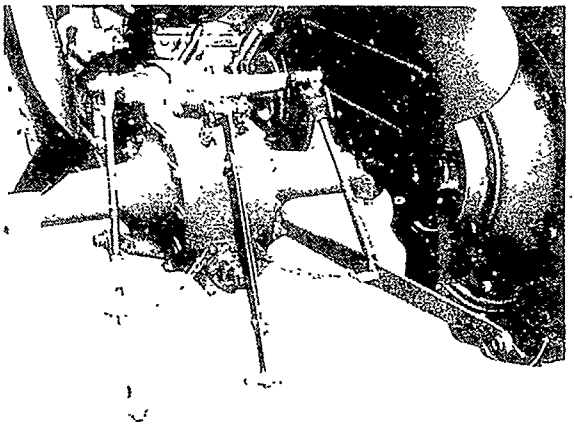
The illustration at right shows the Ferguson linkage with plow attached to the tractor. All Ferguson unit implements, operate in the same way as the plow. There is no connection between the plow beam and the tractor. The bottom links which pull the implement are lettered A and B. The top link C, pushes against the tractor. The master control spring which can be seen at the front end of the top link, expands or compresses according to the forces transferred to it from the implement through the top link. Rods D and E connect the lower links with lift arms which lower and raise the implement.



LINKS AND LIFT ARMS—FLEXIBLE AS YOUR WRIST

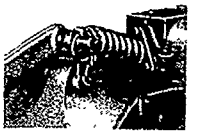


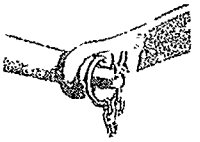
• To allow free movement and maximum flexibility, the top and bottom links have ball and socket joints. The connections at the lift arms are designed to permit universal action—motion in all directions. Ball and socket joints are hardened to avoid cutting action caused by grit. All parts are ruggedly designed for long hard service.



• In operation, the top link is under pressure at all times, transmitting its load through the master control spring which regulates the automatic control of the Ferguson System. Here again precision made ball and socket joints provide complete freedom of action and immediate response to changes in load.

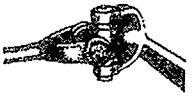
Close up view showing the yoke connecting top link ball and socket to master control spring plunger.





Simple lynch pin connection at ball and socket joint allows free, unobstructed movement. Chain prevents loss of pin.

Complete freedom of movement is provided by open universal joints at the upper end of each lift arm.

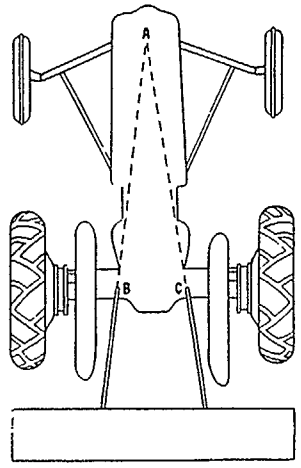


UNIT IMPLEMENTS FOLLOW FRONT WHEELS

A. B. C.
OF REAR
CULTIVATION

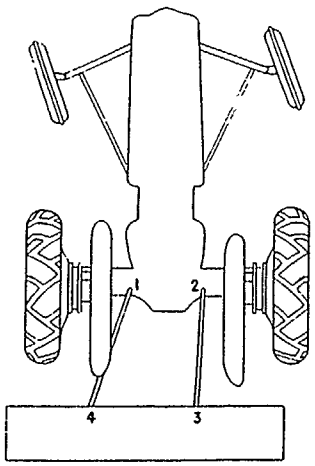
A.

Bottom links which pull cultivator are not parallel. If projected forward beyond attaching points "B" and "C" they would meet at "A"—approximate center of front axle. This causes implement to follow front wheels provided . . .



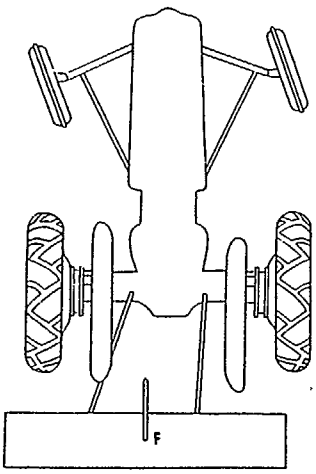
B.

. . . implement is flexibly attached to tractor. The ball and socket joints on ends of bottom and top links permit free action. The implement is kept under perfect control, however, by the . . .



C.

. . . steering fin "F" as it moves through the soil. When the front wheels are steered to right or left, the soil deflects the fin . . . and instantly moves the sweeps in the same direction.



• Flexible linkage of the Ferguson System eliminates the pivot action that makes ordinary rear-mounted implements tend to swing out on turns rather than follow in the direction of the front wheels.

Now cultivation with rear-mounted implements becomes practical for the first time. The Ferguson rear-mounted cultivator moves WITH the front wheels. If the wheels are steered away from the row, the sweeps will move toward the row. Wherever the front wheels go, the Ferguson rear-mounted cultivator follows them like shadow.

The secret of this operation lies in three points;

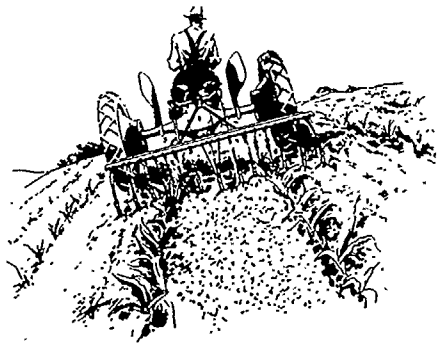
A. Angle of attachment of lower links.

B. Flexibility of linkage system.

C. Action of special steering fin on cultivator.

In the opposite column, these A-B-C's of rear cultivation are illustrated.

NO SIDE SLIPPING ON HILLS



• Working on the contour or across hillsides is easier—and better—with Ferguson rear-mounted implements. On the cultivator, for example, a semi rigid fin, which runs in the soil, holds the sweeps to their course. They follow the front wheels—not the slope of the hill. Penetration of the fin may be adjusted for use in light or heavy soil.

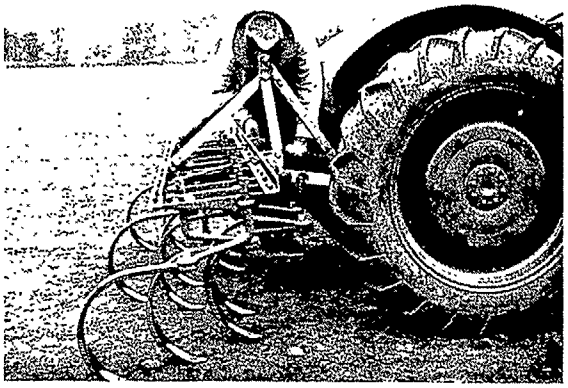
THE FORD - FERGUSON TRACTOR

IMPLEMENTS QUICKLY ATTACHED OR REMOVED

• Another big time and effort-saving feature of the Ford-Ferguson Tractor is the speed and ease with which unit implements can be attached or removed. Reducing attaching time to less than one minute is a big forward stride in tractor and implement design. There are but three links to attach by means of three pins and the job is done. Ball and socket joints at each end of each link make the holes easy to align without placing any strain on the links. No tools are necessary.



Illustration shows the pin being slid into the top link when attaching the link to the plow in the simplified method of attaching any one of the Ferguson implements to the Ford-Ferguson Tractor.

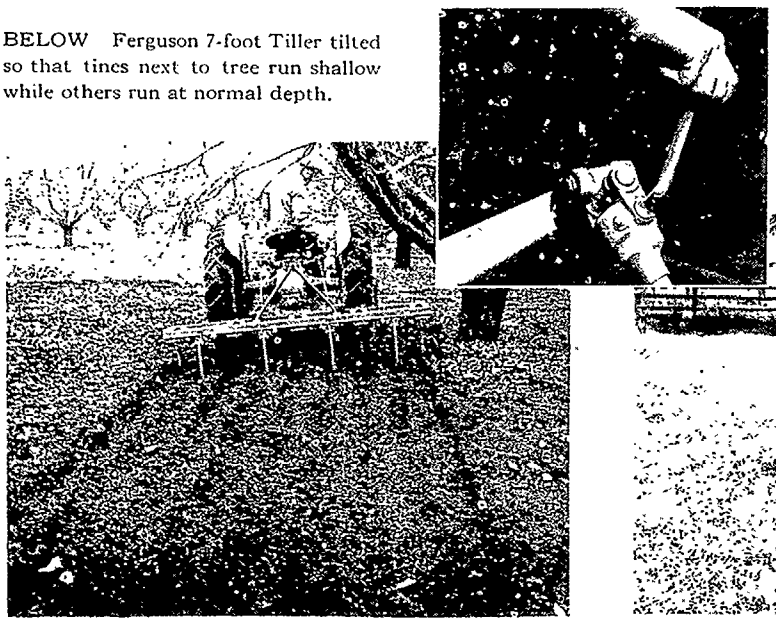


This rear-mounted cultivator attaches to the tractor exactly the same way as the plow. In less than 60 seconds after the operator backs the tractor up to the cultivator he can have it attached—another example of saving time and making farming easier.

EASILY OPERATED LEVELING CRANK

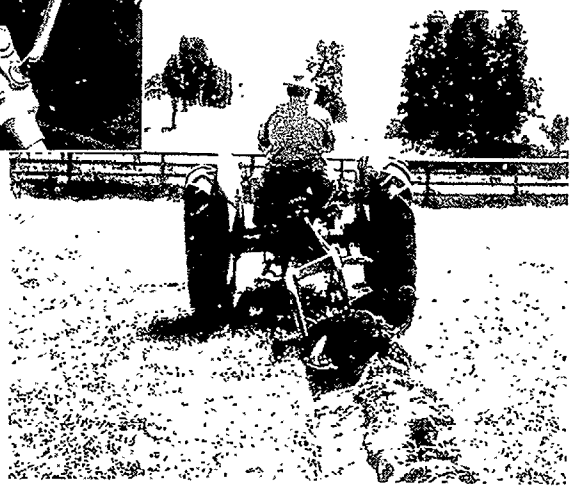
• Turning a crank changes the tilt of the implement. This is done right from the seat. The crank operates a small gear box on top of right lift rod and lengthens or shortens the rod, lowering or raising one side of the implement. This makes it easy to adjust plows for headland furrows and to tilt other implements for proper operation under various conditions.

BELOW Ferguson 7-foot Tiller tilted so that tines next to tree run shallow while others run at normal depth.



LEFT—Easily operated leveling crank is located close to operator.

BELOW—Plow tilted for opening headland furrow.

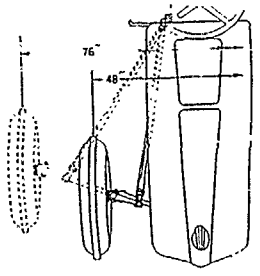


THE FORD - FERGUSON TRACTOR

WHEEL TREADS FROM 48″ TO 76″ — QUICKLY, EASILY

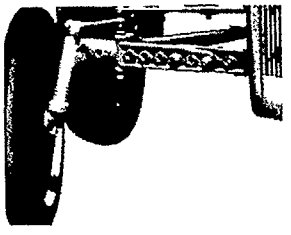
• Fast, easy changes of wheel treads in 4″ steps from 48″ to 76″ makes the Ford-Ferguson Tractor a truly practical row crop tractor with all the advantages of four wheel construction.

One important time saving feature in changing treads is that no adjustment of steering linkage is required when front tread is changed. Diagram shows why. The axle ends move rearward as they are extended—distances between points where ends of radius rods and drag links are attached remain constant. Therefore wheel alignment always remains correct regardless of tread setting. This also makes possible offset front wheel for special work.



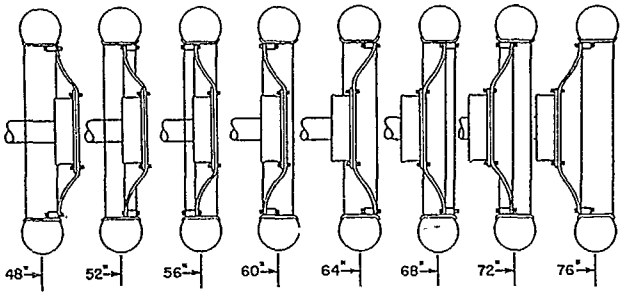
FRONT TREAD

• Center and end sections of the front axle are provided with a series of holes which permit the axle ends to be extended up to 72″ in 4″ steps. Change from 72″ to 76″ is made by reversing front wheels so disc is outward.



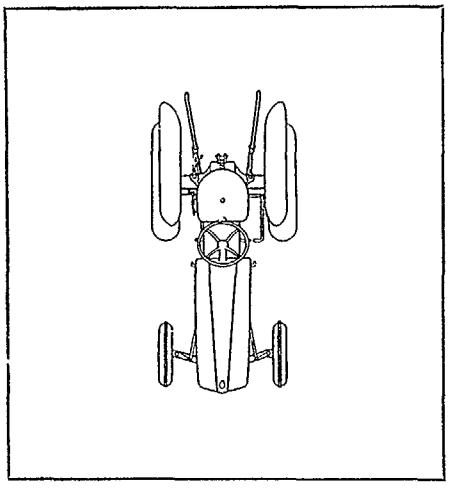
REAR TREAD

• The rear tread is widened by changing the position of the rims on the wheels in combination with changing or reversing the discs of the wheels, as illustrated below. Tread widths are possible from 48″ to 76″ in 4″ steps. Switch wheels, when necessary to permit tire tread to run in right direction.



EIGHT WHEEL WIDTHS IN 4 INCH STEPS

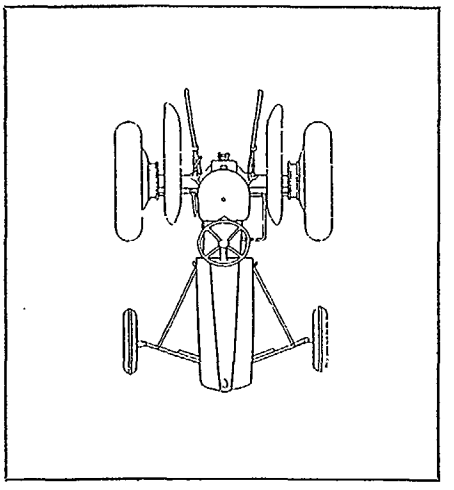
From



NARROW

48″ tread (52″ rear tread recommended for plowing and general work.)

To



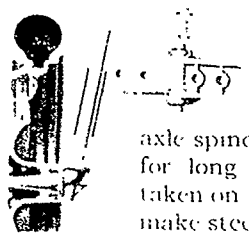
WIDE

Up to 76″ tread for row crop work.

FRONT AXLE



• The front axle consists of a center section, pivoted directly to the engine, and two axle ends. All three parts are alloy steel, designed for high strength. Axle ends are adjustable on the center section, each being fastened by two bolts. Tubular radius rods extend from the axle ends to the transmission case to strengthen the axle against thrust forces. Cross section illustration shows the large vertical axle spindle and bushings provided for long wear. Spindle thrust is taken on an anti friction bearing to make steering easier. Hub spindle is pre packed for lubrication. Special thrust face seal prevents dust from entering and greases from leaking out.



STEERING



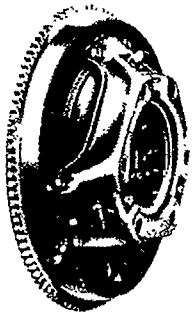
• To reduce steering effort and make the front wheels respond quickly when steering wheel is turned, a bevel pinion and twin bevel sectors are used. Each sector is linked independently to one of the front wheels. To minimize friction, the steering column is mounted on two tapered roller bearings. The 18-in. steering wheel is made of hard rubber with a steel core.

CLUTCH

• This semi centrifugal clutch has two outstanding advantages. It is capable of transmitting much higher torque than the engine develops, and yet a light pedal pressure is maintained through the use of centrifugal weights.

The clutch is a single plate type and is composed of two major units, the pressure plate and cover assembly and the clutch disc. The pressure plate is arched and triangular shaped so as to give correct ventilation which is vitally necessary for good clutch operation.

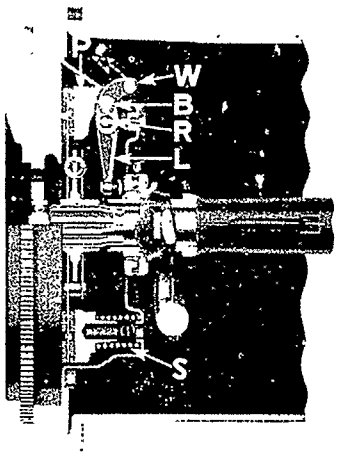
The steel clutch disc has friction facing rings riveted on each side. There are six crimped steel segments interposed between one lining and the disc which give the required amount of cushioning to insure smooth clutch engagement and long life of the friction facing.



A mechanical dampener incorporated in the hub of the driven member serves to insure quiet operation of the transmission and absorbs the shock of sudden clutch engagement.

• In cutaway illustration, *L* is one of the three release levers with weighted outer end *W*. Levers are mounted on pressure plate by needle roller bearings *B* and attached to cover plate by flattened pin and roller *R*. As engine speed increases, centrifugal force causes weighted outer ends of levers to attempt to assume a position in the vertical plane passing through *R*, which increases pressure against the clutch plate *P*. This adds to the pressure exerted by the six clutch springs *S*.

Clutch disc diameter .....9 inches
Friction area.....75.3 sq. in.



Both the clutch release bearing and pilot bearing are prelubricated type ball bearings and require no further lubrication.

• The clutch pedal works so easily that it can be operated by a small boy or girl. The long pedal provides increased leverage which reduces the pressure required. Clutch pedal and left brake pedal are side by side. The clutch pedal also applies the left brake when it is depressed past the point where clutch is completely disengaged.

No adjustment is required on the clutch other than to maintain a required amount of free travel in the clutch pedal.

THE FORD - FERGUSON TRACTOR

WHEELS AND TIRES

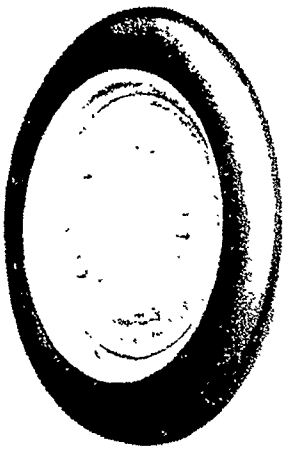


• The rear wheels are pressed steel discs so designed that the tread may be changed by changing the position of the rims on the discs and by reversing the discs on the axle shaft flanges.

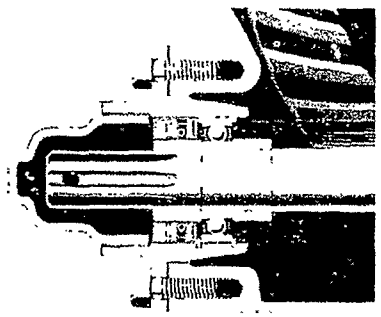
Front wheels with drop center are bolted to large diameter flanges cast integral with the hubs.

Because of the way their pressed steel discs are formed, both front and rear wheels possess high strength with comparatively light weight.

Front tires are 4" x 19", single rib type. Rear tires are 10" x 28" with traction tread. Dual rear wheels and tires are available at extra cost.



POWER SHAFT





Control lever for engaging Power Shaft.

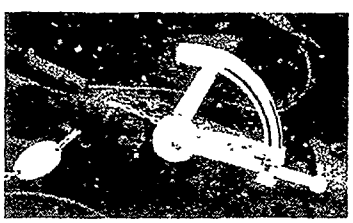
• A power shaft is furnished as standard equipment on the Ford-Ferguson Tractor. In addition to providing a power take off for trailed machinery, this power shaft also drives an easily attached rear-mounted belt pulley. (See Accessories).

Shaft is supported by ball bearings and lubricated by oil from the transmission. An efficient oil seal prevents oil from seeping through the bearing.

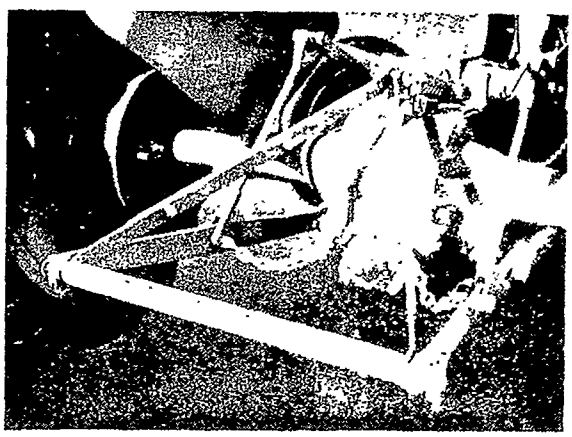
Engaging lever for the power shaft is conveniently located on the left side of the tractor below the driver's seat.

ADJUSTABLE DRAWBAR

• The drawbar, furnished without extra cost, is supplied with two adjustable braces so it can be set at the most advantageous height for attaching various pull type implements. Farmers who have used tractors will appreciate this feature. A series of holes in the drawbar adapt it for various hitches. Ends of the drawbar fit into the ball and socket joints in the ends of the tension links.



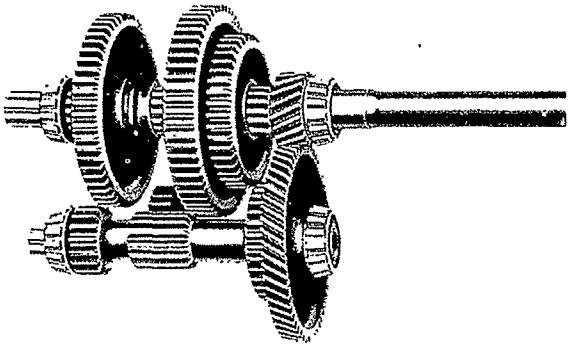
When using the drawbar a safety chain is installed on the quadrant to prevent the operation of the hydraulic lift as is shown.

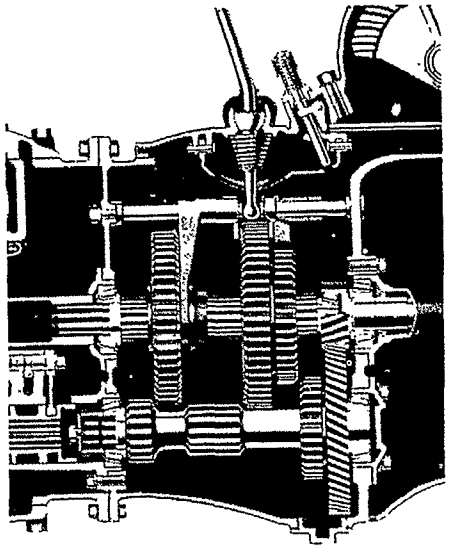


TRANSMISSION

• The Ford-Ferguson Tractor transmission is designed for long, hard service, built to withstand the strain of continuous operation in intermediate gears. Gears are forged alloy steel. The mainshaft is forged from oil-hardening chromium steel. Careful heat treatment provides high strength. The gear teeth are case hardened to obtain an exceptionally hard, wear-resisting surface. Under this hard surface is a strong, tough core to resist shock.

Note that the countershaft, as well as the mainshaft, is mounted on big tapered roller bearings. The use of tapered roller bearings on the countershaft greatly reduces friction and minimizes power loss when the tractor is driven in the intermediate gears.





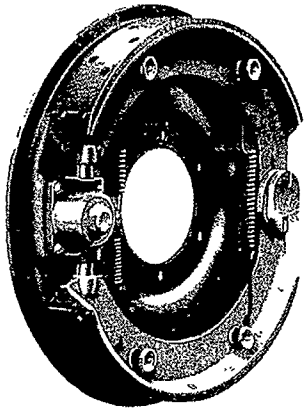
In cross-section illustration above, the main drive gear has been cut away to show that a tapered roller bearing also is used to support the front of the transmission main shaft.

BRAKES

• Big powerful brakes make it easy to stop the tractor with low pedal pressure. Brake drum diameter is 14 inches. Brake shoes are 2 inches wide with total lining area of 186.8 square inches. This exceptionally large lining area means a very low rate of wear so that the average farmer seldom, if ever, has to spend money for new brake lining.

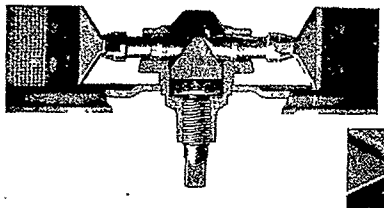
As can be seen in the illustration, brake design is very simple. This is a two-shoe type of brake. Braking force is increased in either direction, an action which reduces the amount of pedal pressure required. The brake shoes are expanded outward against the drum by a cam on the brake cross shaft.

Adjusting the brakes is an easy task and requires only a few minutes time. It is accomplished by turning a single adjusting screw on each backing plate the desired number of notches to compensate for wear.

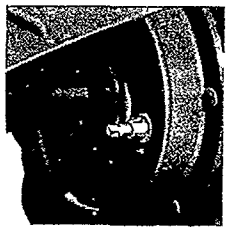




Each of the long brake pedals is provided with a pawl which can be held against a ratchet when the pedal is applied. This will hold the brakes on when the tractor is parked on a grade.

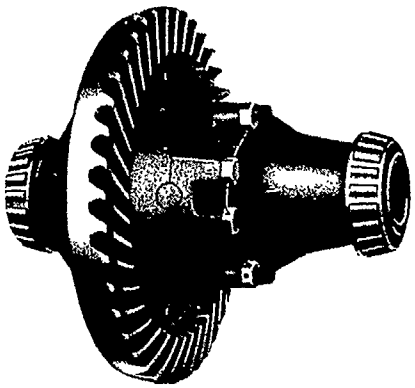


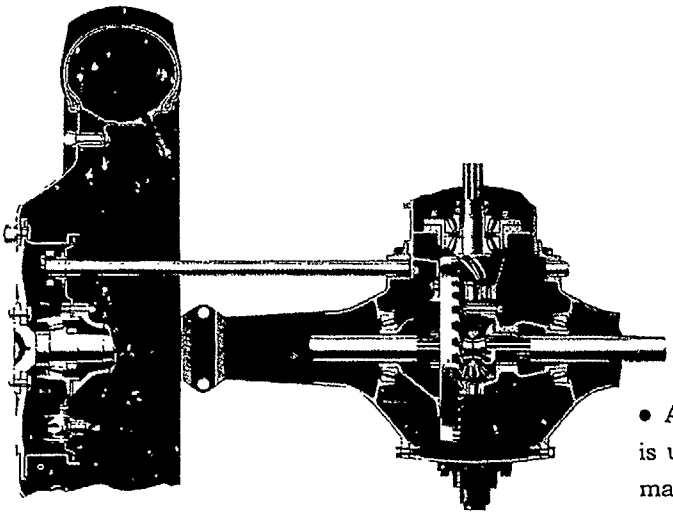
Shown here is the adjusting screw and the wedge which expands the two brake shoes when the screw is turned clockwise. The wedge floats on the end of the screw so that braking force is transferred from one shoe to the other, depending upon the direction of wheel rotation.



REAR AXLE

• The massive rear axle is built to handle peak engine power with minimum friction loss. It is semi-quarter floating type with a spiral bevel gear drive. The pinion shaft is straddle-mounted. There are two large tapered roller bearings in front of the pinion and another roller bearing directly in back of the pinion to prevent it from deflecting under severe stress.

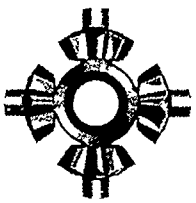




In the semi-float type of axle the weight of the tractor is carried by the big diameter axle shaft. This axle shaft is supported by a large tapered roller bearing mounted directly in the axle housing. Axle shaft flanges are made integral with the shafts, eliminating need for splines or keys which would be likely to wear.

• The differential assembly is supported on two big tapered roller bearings. The ring gear is cut from a forged blank of alloy steel.

PINION



• A four pinion differential is used in place of the customary two pinion type. Since driving force is applied to the axle shafts through the pinions and differential side gears, the use of four pinions reduces tooth pressure on both pinions and gears. Spider pins, the small axle-like projections on each of the four pinions, are center drilled allowing oil to pass through easily and lubricate the ends of the axles.

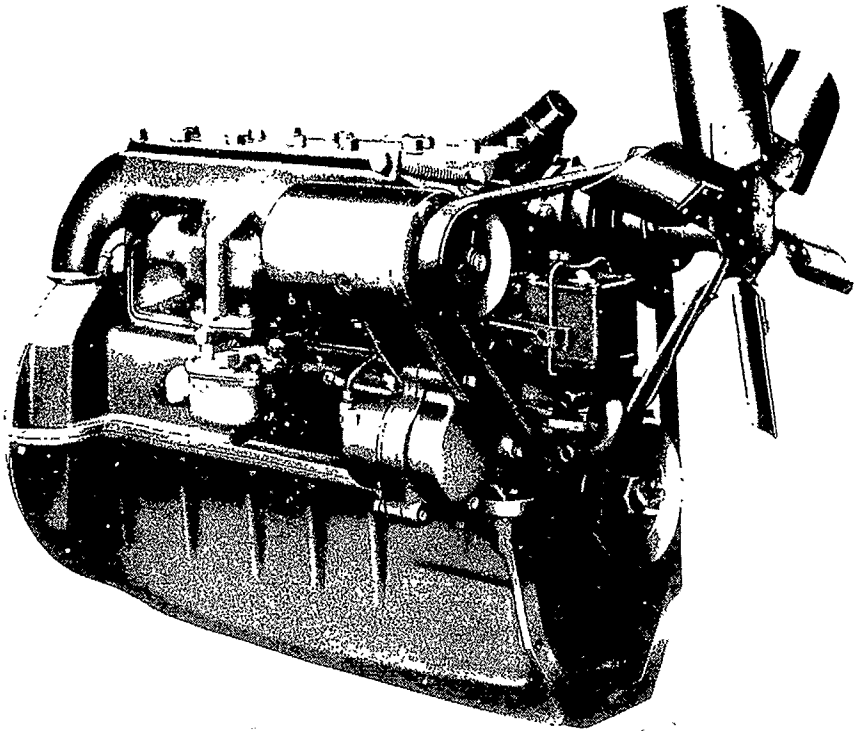
FINAL GEAR REDUCTIONS

Transmission Speeds	Final Gear Reductions	Tractor Speeds at 1500 rpm.	at 2000 rpm.
Low	73.3 to 1	2⅝ mph.	3½ mph.
Intermediate (for plowing)	57.0 to 1	3½ mph.	4⅝ mph.
High	24.6 to 1	8 mph.	10¾ mph.
Reverse	68.4 to 1	2⅞ mph.	

AXLE RATIO 6.66 to 1

THE FORD - FERGUSON TRACTOR

TRACTOR ENGINE



GENERAL SPECIFICATIONS

Engine Type—4 cylinder L-head

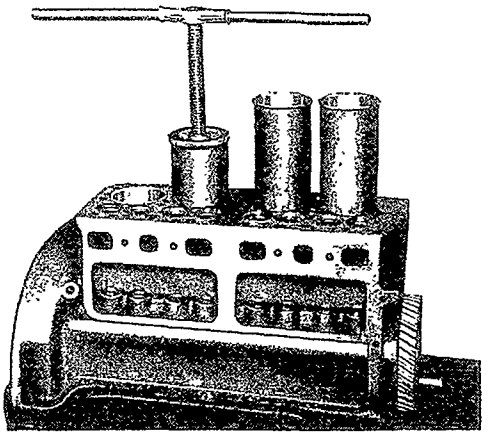
Bore 3.187 inches	Brake Horsepower 22 at 1500 rpm
Stroke 3.75 inches	Brake Horsepower 28 at 2000 rpm
Piston Displacement 119.7 cu. in.	Torque 84 ft. lb. at 1500 rpm
Compression Ratio 6 to 1	Load governed at all speeds up to 2200 rpm

The tractor engine is built in the Ford Highland Park Plant—a plant noted the world over for its highly developed methods of precision manufacturing. Back of the tractor engine is the knowledge and experience gained in building millions of Ford car and truck engines. Some of the many quality features of the tractor engine are shown on this and following pages.

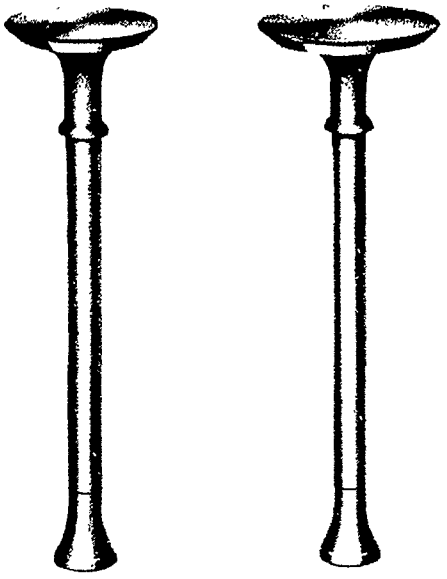
ONE-PIECE ENGINE CASTING WITH REMOVABLE CYLINDER LINERS

Conforming to the modern practice originally developed by Ford, the engine casting comprises cylinders, crankcase, flywheel housing, all cast in one piece.

To reduce cylinder wear and increase engine life, liners of hardened steel are used. The cylinder liners are removable and when they become worn, after long service, they can be quickly replaced. This eliminates costly reboring or honing and makes it possible to restore high engine efficiency at low cost to the owner.

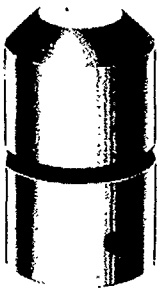


VALVES



• Valves are chrome-nickel alloy steel—a material that withstands corrosion and warping under high exhaust-gas temperatures. Intake valves are of this same costly material that is not affected by the continual pounding action of the valves on their seats. The hardened valve stem ends are enlarged to increase the area in contact with the lifters and thus minimize wear.

SHOCK PROOF VALVE LIFTERS

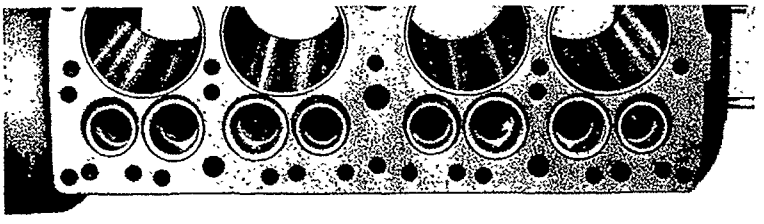


• Because of their design and material, these valve lifters will withstand valve pounding and remain true without cracking or distorting. A single piece head is welded to a base of hard alloy steel. For lightness the lifter is hollow. Being large in diameter, these lifters provide more bearing surface to withstand the side thrust of the cams. This is one of several engine parts that are inspected on machines whose unfailing automatic rejection of parts not meeting the required high standards amazes visitors at the Ford plants.

Valve, Valve Lifter and Timing Specifications

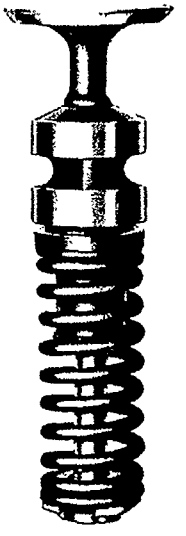
Valve head diameter:	
Intake	1.537 inches
Exhaust	1.280 inches
Angle of seat	45 degrees
Diameter of valve stem	0.3105 to 0.3115 inch
Diameter of valve stem end	0.548 inch
Clearance setting	0.0125 to 0.0135 inch
Valve lifter diameter	0.9994 to 0.9996 inch
Valve timing: (Cold at .0100 to .0115 clearance)	
Intake opens	6° before top center
Intake closes	22° after bottom center
Exhaust opens	38° before bottom center
Exhaust closes	6° after top center

TUNGSTEN STEEL VALVE SEAT INSERTS



• Only in the most expensive engines do you ordinarily find valve seat inserts for intake as well as exhaust valves. In the exhaust seats they withstand high temperatures without oxidizing and pitting and retain their hardness. They minimize the need for valve grinding. In the intake seats they also reduce wear. Thus, constant clearance between cam and valve lifter is maintained to assure accurate valve timing throughout long periods of operation.

UNIT VALVE ASSEMBLIES



• To simplify removal and replacement, the valve, valve guide, spring and retainer are assembled as a unit and then installed in the engine. Because of the enlarged valve stem end, the valve guide is made in two halves to permit unit assembly.

CONNECTING RODS

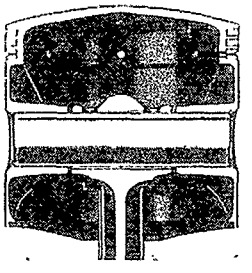


• One feature of Ford connecting rods is that the bolts for the caps are forged integral with the rod. Connecting rod bearings are easy to replace as they are the inserted type with bearing material bonded to a steel backing. Each end of the rod is accurately weighed and they are matched in sets. Piston pin bushings are special bearing bronze.

SPECIFICATIONS

Weight, Rod with Cap	580 grams
Diameter of bearing	2.0935 to 2.0945 inches
Length of bearing	1.120 to 1.130 inches
Diameter of piston pin bushing	.7503 to .7506 inches
Length of piston pin bushing	1.34 inches

CAST STEEL PISTONS



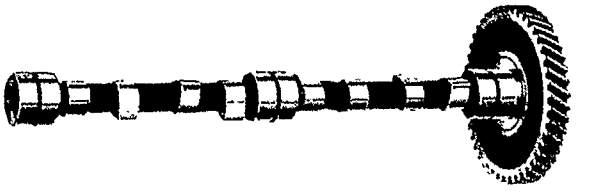
• A new process was developed by Ford to manufacture steel pistons which are light in weight, strong and wear-resisting. Having approximately the same rate of expansion as the cylinders and sleeves, the pistons can be more closely fitted to reduce oil consumption and increase piston life. Pistons are cadmium plated to prevent scuffing.

Floating type piston pins have bearing surface in the piston and in the bronze bushing in connecting rod. Each piston is fitted with two compression rings and an oil control ring.

Piston, Pin and Ring Specifications

Weight of piston	360 grams
With pin and rings	482 grams
Piston pin diameter	.750 inch
Width of compression ring	.092 inch
Width of oil control ring	.155 inch

CAST ALLOY IRON CAMSHAFT

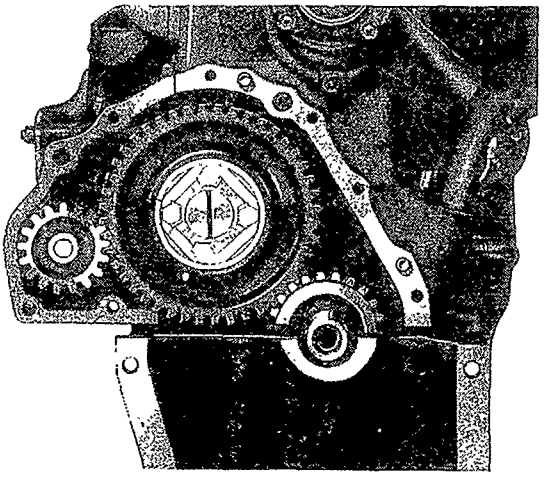


• Made from another Ford developed alloy, camshafts possess cam and bearing surfaces which are exceptionally hard and highly resistant to wear.

SPECIFICATIONS

Camshaft bearing dia.	1.7965 to 1.7970 inches
Bearing length	
Front	1.54 inches
Center	1.48 inches
Rear	1.48 inches

TIMING GEARS

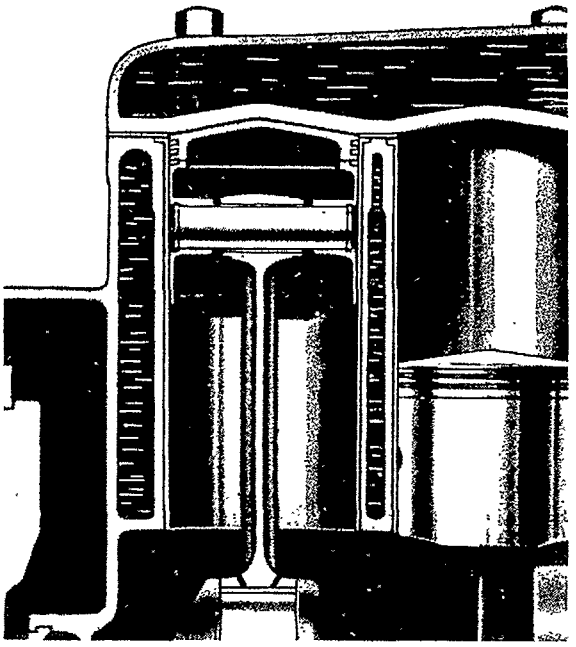


• A cast-iron gear on the crankshaft drives a camshaft gear which is made of cast aluminum.

Timing gears are continuously supplied with oil, by-passed from the pressure regulating valve.

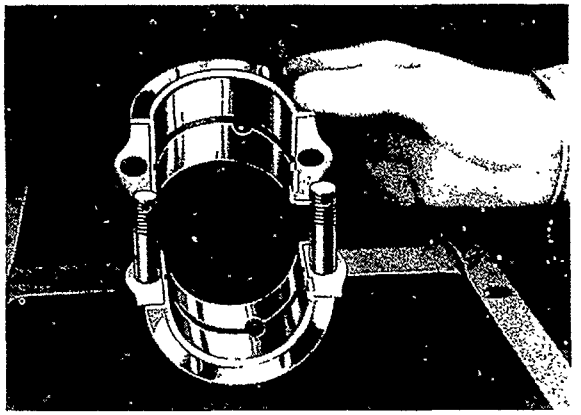
The cast-iron gear to the left of the camshaft gear drives the governor.

FULL-LENGTH WATER JACKETS



• Water jacketing completely surrounds each cylinder and extends all the way down to the crankcase to insure more even expansion of the cylinders. Ample circulation of water also is provided around the exhaust valves for efficient cooling when the engine is developing maximum power.

MAIN BEARINGS

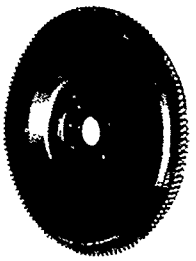


• For low replacement cost, the main bearings are removable type with a special anti-friction alloy bonded to a steel backing. New bearings can be installed without removing engine from tractor.

Crankshaft and Main Bearing Specifications

Weight of crankshaft	41 pounds
Diameter of journals	2.25 inches
Diameter of crank pins	2.1 inches
Length of main bearings:	
Front	1.6 inches
Center	1.66 inches
Rear	1.6 inches
Diameter of main bearings	2.25 inches

STEEL STARTER GEAR ON FLYWHEEL



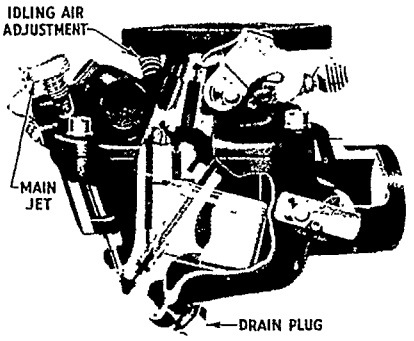
• To obtain gear teeth of high strength and wear-resistant qualities, a steel starter gear is heated electrically and shrunk onto the flywheel. This reduces the possibility of chipped or broken teeth. The gear fits into a groove machined in the flywheel.

CAST ALLOY STEEL CRANKSHAFT



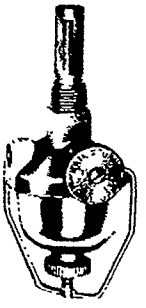
• A special alloy steel -- exceptionally hard and wear-resisting—was developed by Ford metallurgists to increase the rigidity of crankshafts and provide bearing surfaces for the journals and crankpins. Crankshaft is fully counterbalanced by four counter-weights for smooth engine operation. All bearing surfaces are highly polished and crankshaft is accurately balanced within close limit—three-tenths of an ounce inch.

CARBURETION



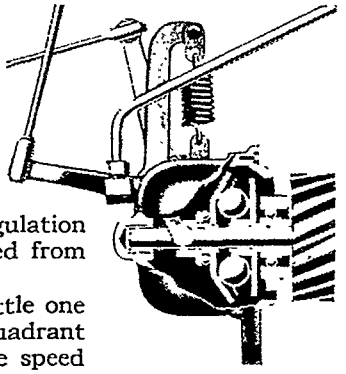
• Carburetor is plain tube, up-draft type. It is completely sealed against dust, even to the air intake for idling adjustment. Another feature is that although quite simple in design, it contains all the elements, such as an accelerating well and economizer, which are essential to good carburetion and fuel economy. A main jet adjustment is provided to change the fuel mixture ratio slightly for varying conditions. To prevent incorrect adjustment from causing excessive fuel consumption, a restriction jet limits the maximum amount of fuel used regardless of how far the main jet adjustment screw is opened.

FUEL SYSTEM



• Fuel is carried in a welded steel tank which is formed in the engine hood. It holds 9 gallons plus one gallon in reserve. Sediment and water are filtered out of the fuel. The valve which controls the main and reserve fuel supply is built into the fuel filter casting.

GOVERNOR

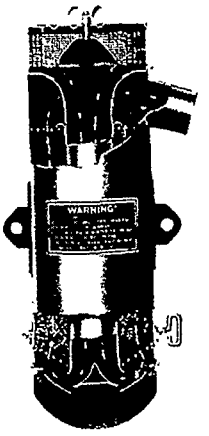


• A variable speed, mechanically operated governor, is interconnected with the throttle lever and carburetor which enables the operator to have governed regulation at any desired speed from 800 to 2200 rpm.

Moving the throttle one notch on the quadrant results in an engine speed change of approximately 75 to 80 rpm.

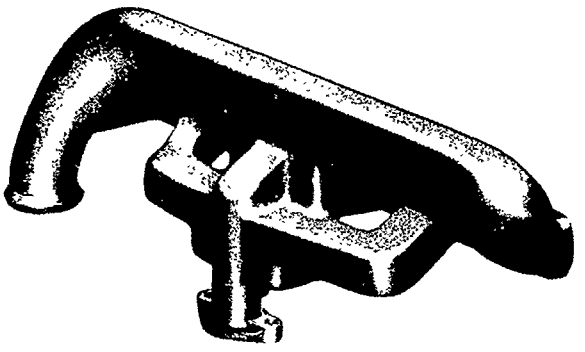
Automatic lubrication and freedom from condensation of crankcase vapors is provided by a constant flow of fresh clean oil returning from the oil filter through the governor housing.

OIL BATH AIR CLEANER



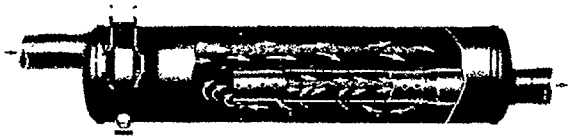
• All air for the sealed intake system must pass through a large oil bath air cleaner, cross-section of which is shown. The pre-cleaner which prevents chaff and leaves from entering the cleaner is included as standard equipment. This cleaner is highly efficient in filtering dust particles out of the air prior to entering the carburetor. It is designed for easy servicing.

INTAKE AND EXHAUST MANIFOLDS



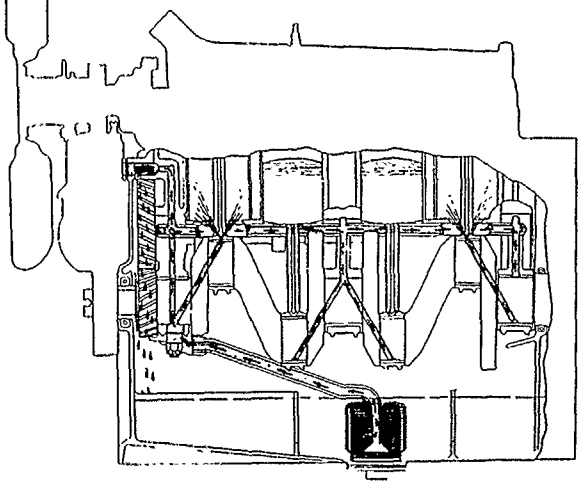
• Intake and exhaust manifolds are cast in one piece and a hot spot is provided for the intake riser to better volatilize the fuel.

MUFFLER



• Exhaust is conducted from the manifold to a muffler of the reverse-flow type and passes out into the air at rear of tractor. The reverse-flow principle utilizes expansion chambers and change of direction of gases, instead of baffles, as a means of reducing back pressure.

EFFICIENT ENGINE LUBRICATION



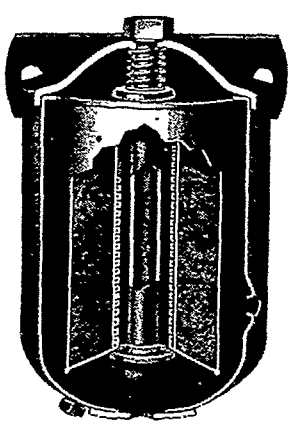
• All main, connecting rod and camshaft bearings are pressure lubricated. A gear type oil pump is driven by a wear-resisting composition gear which meshes with the cast iron gear on the crankshaft. Oil is delivered to the bearings by built-in passageways and holes drilled in the engine casting. These eliminate the conventional tubing. The cross-section illustration shows how the oil is circulated.

Timing gears are continuously lubricated by oil which is by-passed from the pressure regulating valve. A pressure gage is mounted on the instrument panel. Normal oil pressure is 25 pounds at 1400 rpm.

To facilitate cleaning, the oil pump screen is attached to the drain hole nut on the bottom of the oil pan.

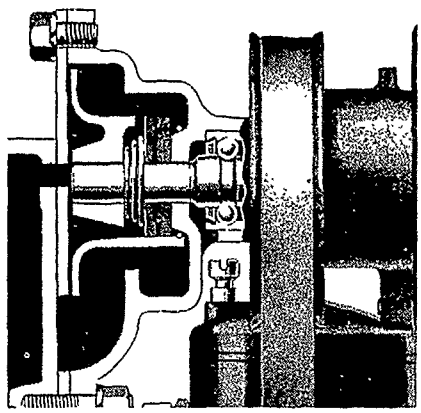
Oil measuring rod on side of crankcase is provided with a gasket to seal against dust. Crankcase oil capacity is 6 quarts.

OIL FILTER



• Cross-section illustration shows oil filter which is a replaceable cartridge type. Filtering abrasives and other foreign substances out of the oil prevents them from getting onto the bearing surfaces of the engine. This reduces wear and increases engine life.

COOLING SYSTEM

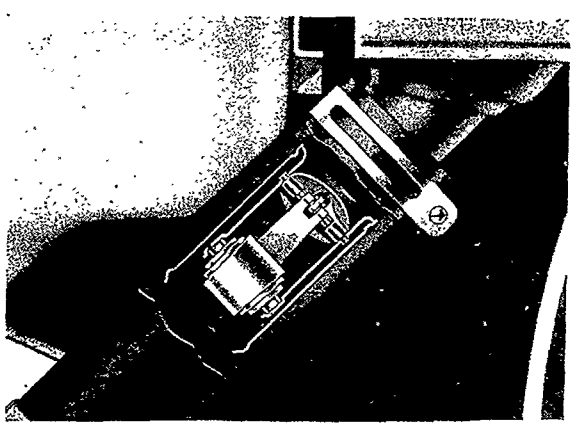


• Water is circulated through the engine and radiator by a centrifugal water pump which is driven by the fan belt. Pump is self-sealing, packless type with shaft mounted on a prelubricated, double row ball bearing. By eliminating the conventional, manually tightened packing nut, pump service is minimized. Pumping capacity ranges from 5 gals. per minute at 500 rpm to 25 gals. per minute at 2000 rpm.

Radiator is all copper tube and fin type, mounted on rubber to relieve the core of any twisting strains. Cap. of cooling system is 12 qts.

Air is forced through the radiator by a 16 inch, 6 blade, blower-type fan. This keeps dust and engine heat away from the driver in hot weather. If desired, a suction-type fan can be supplied at extra cost. This type draws air in through the front of the radiator as on an automobile.

THERMOSTAT



Temperature of water in the cooling system is controlled by a thermostat in the upper radiator hose.

THE FORD - FERGUSON TRACTOR

SPECIFICATIONS—FORD-FERGUSON TRACTOR

ENGINE—Four cylinder L-head. Bore 3.187x3.75 stroke. Piston displacement 120 cu. in. Compression ratio—6 to 1. Removable cylinder liners. Steel valve inserts for both intake and exhaust ports. Full floating piston pins. Fully counterbalanced cast alloy steel crankshaft. Replaceable shell type main and connecting rod bearings.

HORSEPOWER—Maximum belt hp—23.87. Rated belt hp (85% of maximum) 20.29.

DRAWBAR CAPACITY—2—14″ plows with Ferguson hydraulically operated implements. Maximum drawbar without Ferguson hydraulic system of control—16.90 hp. Rated drawbar hp (75% of maximum) 12.68.

GOVERNOR—Variable speed, mechanically operated, centrifugal type. Lubricated by direct line from oil filter. Governor regulation from 400 to 2000 rpm.

LUBRICATION—By gear pump supplying direct pressure oiling to crankshaft, camshaft and connecting rod bearings, also to timing gears. Crankcase oil capacity—6 quarts. Pressure gauge on instrument panel.

OIL FILTER—Replaceable cartridge type of large capacity.

IGNITION—Direct-driven distributor in unit with coil in water-proof housing. Fully automatic spark advance. Standard 14 m.m. spark plugs.

GENERATOR—6-volt type with third brush control.

STARTER—6-volt conventional type automobile starter. Safety starter switch mechanically interlocked with gear shift lever.

BATTERY—6-volt—85 ampere-hour capacity. 13 high plates.

COOLING—Pump circulation of water through tube and fin type of radiator. Fan—6-blade 16″ driven by belt. Pump is packless type with pre-lubricated bearings. Cooling system capacity—12 U.S. quarts. Thermostat temperature control.

FUEL SUPPLY—Welded steel tank carried in engine hood, capacity 10 gallons. By means of a two-way valve on sediment bulb, 1 gallon can be held in reserve for emergencies.

CARBURETOR—Up draft, plain tube type of sturdy, dustproof construction. External adjustments for both main and idling jets.

AIR CLEANER—Oil bath type with dust receptacle easily removable for cleaning.

MUFFLER—Reverse-flow type.

CLUTCH—Single dry plate 9″ effective diameter. Clutch plate pressure increased by centrifugal force as engine speed is increased.

TRANSMISSION—Extra heavy duty, easy shifting, sliding gear type. Three speeds forward and one reverse. All shifts mounted on tapered roller bearings. Alloy steel gears with case-hardened teeth for wear resistance and quiet operation.

FINAL DRIVE—Spiral bevel gear drive with straddle-mounted pinion 6.66 to 1 ratio. Four pinion differential mounted on tapered roller bearings. Drive axle of the semi-floating type with integral axle shafts and wheel hubs, also mounted on tapered roller bearings.

Transmission Speeds	Final Gear Reduction	Speeds At 1500 RPM
Low	73.3 to 1	2⅝ mph
Intermediate (plowing)	57 to 1	3½ mph
High	24.6 to 1	8 mph
Reverse	68.4 to 1	2⅞ mph

Note: At top governed speed (2000 rpm) the tractor can be operated at 4⅝ mph in low gear, 3½ mph in intermediate, and 10¾ mph in high.

STEERING—Bevel pinion and twin bevel sectors controlling both front wheels independently. Tread of front axle adjustable without disturbing any steering connections. Rubber covered steel steering wheel 18″ in diameter.

POWER SHAFT—Extends from rear of axle housing. Has 1.125″ spline end. 545 rpm at engine speed of 1500 rpm—2.75 to 1 ratio.

BRAKES—14″x2″ internal expanding, two shoe, fully energizing type. One simple accessible adjustment on each brake. Brakes operate independently on each rear wheel controlled by separate pedals to facilitate short turning.

WHEELS—Front—Steel disc fitted with 4x19 single rib pneumatic tires on drop center rim, 26 lbs. tire pressure. **Rear**—Steel disc fitted with 10 x 28 traction tread pneumatic tires on drop center rim, 12 lbs. tire pressure.

HYDRAULIC IMPLEMENT CONTROL—Consists of 4-cylinder pump supplying oil under suitable pressure to ram cylinder. Valve has manual and automatic control. Control lever convenient to the operator's right hand gives him instant control of the implement.

DRAWBAR—Adjustable type. Included as standard equipment.

DIMENSIONS—

Normal Tread—Front 48″ and rear 52″.

Wheelbase—70″.

Over-all length—Front tire fin to end of lower link—115″

Front Tread—Adjustable, by means of extending axle ends and reversing front wheel discs to 76″ in 4″ steps.

Rear Tread—Adjustable, by means of reversible wheel disc and reversible tire rims to 76″ in 4″ steps.

Over-all width—64″ with normal tread.

Over-all height—52″.

Ground clearance—21″ under axles—13″ under center.

Turning Radius—8 ft. with use of brakes.

Shipping Weight—Approximately 2340 lbs.

STANDARD A.S.A.E. POWER TAKE-OFF ADAPTER (Extra Equipment) with safety shield is a self-contained drive unit quickly attached. Has standard A. S. A. E. spline shaft 1.375″. Shaft speed of 545 rpm at 1500 rpm engine speed. Engine to shaft ratio—2.75 to 1.

BELT PULLEY POWER TAKE-OFF ADAPTER (Extra Equipment)—Carried by self-contained drive unit quickly attachable to rear of tractor. Pulley diameter—9″; width—6.5″. Speed 1352 rpm, belt speed 3190 ft. per minute at 2000 rpm engine speed. Pulley gear ratio to power take-off shaft—1.86. Rotates in either direction.

The Ford Motor Company, whose policy is one of continuous improvement, reserves the right to change specifications, design or prices without incurring obligation.

TRACTOR OPERATOR SAFETY



TO THE OPERATOR:

Please read and follow these Safety Precautions to prevent your possible injury when operating your Ford Tractor.

TRACTOR OPERATOR SAFETY

The following precautions are suggested to help prevent personal injury

A careful operator is the best operator. Most accidents can be avoided by observing certain precautions. Read and take the following precautions before operating this tractor to help prevent accidents. Equipment should be operated only by those who are responsible and instructed to do so.

THE TRACTOR

1. Read the Operator's Manual carefully before using the tractor. Lack of operating knowledge can lead to accidents.
2. Use an approved Rollbar and Seat Belt for safe operation. Overturning a tractor without a rollbar can result in death or injury. If your tractor is not equipped with a rollbar and seat belt, see your Ford Tractor-Equipment Dealer.
3. Always use the seat belt when the rollbar is installed. Do not use the seat belt if the rollbar is removed from the tractor.
4. If a front end loader is to be installed, always use a FOPS canopy to avoid injury from falling objects. See your Ford Tractor-Equipment Dealer for a FOPS.
5. Use the handholds and step plates when getting on and off the tractor to prevent falls. Keep steps and platform cleared of mud and debris.
6. Do not permit anyone but the operator to ride on the tractor or implement. There is no safe place for extra riders.
7. Replace all missing, illegible, or damaged safety decals. (Safety decal kit is available from your dealer.)
8. Keep safety decals clean of dirt and grime.

SERVICING THE TRACTOR

1. The cooling system operates under pressure which is controlled by the radiator cap. It is dangerous to remove the cap while system is hot. Always turn cap slowly to the first stop and allow the pressure to escape before removing the cap entirely.
2. Stop engine, wait for engine to cool down and remove cap slowly before refueling. Do not smoke or have an open flame.
3. Keep the tractor in good operating condition for your safety. An improperly maintained tractor can be hazardous.
4. Keep open flame away from battery or cold weather starting aids to prevent fires or explosions. Use jumper cables according to instructions to prevent sparks which could cause explosion.

TRACTOR OPERATOR SAFETY (Cont'd.)

The following precautions are suggested to help prevent personal injury

SERVICING THE TRACTOR (Cont'd.)

5. Stop the engine before performing any service on the tractor.

6. Do not attempt to service air conditioning system. It is possible to be severely frostbitten or injured by escaping refrigerant. See your dealer for service.

7. Do not modify or alter or permit anyone else to modify or alter this tractor or any of its components or any tractor function without first consulting a Ford Tractor-Equipment Dealer.

8. The fuel oil in the injection system is under high pressure and can penetrate the skin. Unqualified persons should not remove or attempt to adjust a pump, injector, nozzle or any part of the fuel injection system. Failure to follow these instructions can result in serious injury.

9. Never inflate tires to over 35 psi (2.4 bar) to seat beads. Over inflation may break bead or rim with explosive force sufficient to cause serious injury. See Operator's Manual for correct pressure.

OPERATING THE TRACTOR

1. Apply the parking brake or brake lock, place the P.T.O. lever in the "OFF" position, the lift control lever in the down position, the remote control valve levers in the neutral position, and the transmission in neutral before starting the tractor.

2. Do not start the engine or operate controls while standing beside the tractor. Always sit in the tractor seat when starting the engine or operating controls.

3. Do not bypass the safety start switch. Consult your Ford Tractor-Equipment Dealer if your safety start controls malfunction. Use jumper cables only in the recommended manner. Improper use can result in tractor runaway.

4. Avoid accidental contact with the gear shift lever while engine is running. Unexpected tractor movement can result from such contact.

5. Do not get off the tractor while it is in motion.

6. Shut off the engine, place P.T.O. in "OFF" position, completely lower all hydraulic lift equipment and apply the parking brake before getting off the tractor.

7. Do not park the tractor on a steep incline.

TRACTOR OPERATOR SAFETY (Cont'd.)

The following precautions are suggested to help prevent personal injury

OPERATING THE TRACTOR (Cont'd.)

8. Do not operate the tractor engine in an enclosed building without adequate ventilation. Exhaust fumes can cause death.

9. If power steering or engine ceases operating, stop the tractor immediately.

10. Pull only from the drawbar. Use only a drawbar pin that locks in place. Pulling from the tractor rear axle or any point above the axle may cause the tractor to upset rearward. If pulling from linkage drawbar, be sure stay braces are properly installed.

11. If the front of the tractor tends to rise when heavy implements are attached to the three-point hitch, install front end or front wheel weights. Do not operate the tractor with a light front end.

12. Always set the hydraulic selector lever in position control when attaching equipment, and when transporting equipment. Be sure hydraulic couplers are properly mounted and will disconnect safely in case of accidental detachment of implement.

13. Do not leave equipment in the raised position.

14. Use the Flasher/Turn Signal Lights and SMV signs when traveling on public roads both day and night unless prohibited by law.

15. Dim tractor lights when meeting a vehicle at night. Be sure the lights are adjusted to prevent blinding an oncoming vehicle operator.

DRIVING THE TRACTOR

1. Watch where you are going especially at row ends, on roads, around trees and low hanging obstacles.

2. To avoid overturns drive the tractor with care and at speeds compatible with safety, especially when operating over rough ground, when crossing ditches and slopes, and when turning corners.

3. Lock tractor brake pedals when transporting on roads to provide two wheel braking.

4. Keep the tractor in the same gear when going downhill as used when going uphill. Do not coast or free wheel downhill.

5. Any towed vehicle whose total weight exceeds that of the towing tractor must be equipped with brakes for safe operation.

TRACTOR OPERATOR SAFETY (Cont'd.)

The following precautions are suggested to help prevent personal injury

DRIVING THE TRACTOR (Cont'd.)

6. When the tractor is stuck or tires frozen to the ground, back out to prevent upset.

7. Always check overhead clearance especially when transporting the tractor.

OPERATING THE P.T.O.

1. When operating the P.T.O. driven equipment, shut off the engine, shift P.T.O. control to neutral and wait until the P.T.O. stops before getting off the tractor and disconnecting the equipment.

2. Do not wear loose clothing when operating the power take-off, or when near rotating equipment.

3. When operating stationary P.T.O. driven equipment, always apply the tractor parking brake or brake lock and block the rear wheels front and back.

4. To avoid injury, do not clean, adjust, unclog or service P.T.O. driven equipment when the tractor engine is running.

5. Make sure the P.T.O. master shield is installed at all times and always replace the P.T.O. shaft cap when the P.T.O. is not in use.

6. When operating rotary cutters, flail mowers or other equipment with rotating members, keep all shields in place and do not allow persons to be near the equipment.

LOADER/BACKHOE OPERATION

1. Always be sure of water, gas, sewage and electrical line locations before you start to dig.

2. Watch out for overhead and underground high-voltage electrical lines when operating the loader or backhoe.

3. Operate the loader or backhoe controls only when properly seated at the controls.

4. Never attempt to lift loads in excess of loader or backhoe capacity.

5. Always lower the loader and backhoe buckets to the ground, shut off the engine and apply the parking brake or brake lock before getting off the unit.

TRACTOR OPERATOR SAFETY (Cont'd.)

The following precautions are suggested to help prevent personal injury

LOADER/BACKHOE OPERATION (Cont'd.)

6. Always be watchful of bystanders when operating the loader, when lowering the stabilizers, or when operating the backhoe.
7. Use care when operating on steep grades to maintain proper stability. Always carry the bucket as low as possible.
8. Never attach chains, ropes, cables, etc., to the loader or backhoe for pulling purposes.

LOADER OPERATION

1. Do not transport anyone in the loader bucket.
2. Always carry the loader bucket low for maximum stability and visibility, whether the bucket is loaded or empty.
3. Always use the recommended amount of counterweighting to ensure good stability.
4. Be careful when handling large objects such as round bales, logs, poles, etc. Lifting too high or rolling bucket too far back could result in these objects rolling or sliding rearward down the loader arms on the operator.
5. Never allow anyone to get under the loader bucket or reach through the lift arms when the bucket is raised unless the lift arms are properly supported.
6. Exercise caution when operating the loader with a raised loaded bucket or fork.

BACKHOE OPERATION

1. Never allow anyone to get under the backhoe bucket when the bucket is raised.
2. To prevent upsets, avoid full reach and swinging the backhoe bucket to the downhill side when operating on a slope.
3. Watch out for overhead and underground high-voltage electrical lines when operating the backhoe.
4. Do not enter the platform from the rear.
5. Always attach the backhoe transport chains or other locking devices before transporting.
6. Always place all transmission controls in neutral before operating backhoe.

TRACTOR OPERATOR SAFETY (Cont'd.)

The following precautions are suggested to help prevent personal injury

MAINTENANCE

1. Whenever servicing or replacing pins in cylinder ends, buckets, etc., always use a brass drift and a hammer. Failure to do so could result in injury from flying metal fragments.
2. Always keep the brakes and power steering system in good operating condition.
3. Always wear safety goggles when servicing or repairing the machine.
4. Hydraulic oil escaping under pressure may be nearly invisible and have enough pressure to penetrate skin. Always use cardboard, etc. to locate leaks; never use your hand.

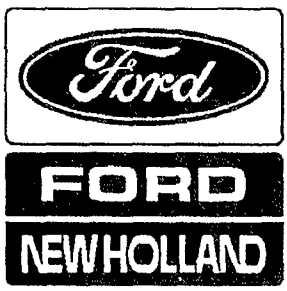
DIESEL FUEL

1. Under no circumstances should gasoline, alcohol or blended fuels be added to diesel fuel. These combinations can create an increased fire or explosive hazard. Such blends are more explosive than pure gasoline in a closed container such as a fuel tank. **Do not use these blends.**

GASOLINE AND GASOHOL FUEL

1. Gasohol (10% ethyl and 90% gasoline) is more volatile than gasoline alone. It is more hazardous to use and extremely dangerous to mix yourself. Handle it more carefully than gasoline.
2. Never remove the fuel cap or refuel the tractor with the engine running or hot.
3. Do not smoke while refueling or when standing near fuel.
4. Maintain control of the fuel filter pipe nozzle when filling the tank.
5. Do not fill the fuel tank to capacity. Allow room for expansion.
6. Wipe up spilled fuel immediately.
7. Always tighten the fuel tank cap securely.
8. If the original fuel tank cap is lost, replace it with the Ford cap approved for your model tractor. A non-approved cap may not be safe.
9. Do not drive equipment near open fires.
10. Never use fuel for cleaning purposes.
11. Arrange fuel purchases so that winter grade fuels are not held over and used in the spring.

When you see this symbol it means: ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!



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