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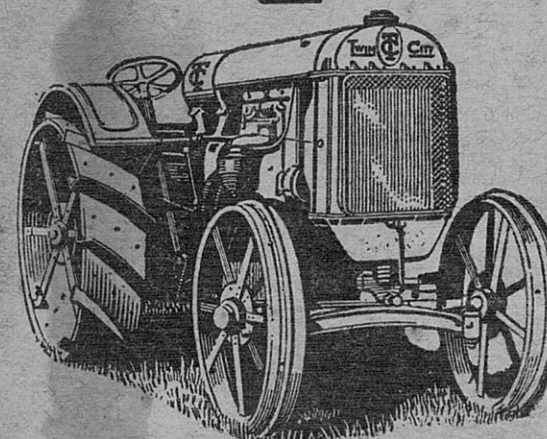
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INSTRUCTION BOOK

NINTH EDITION, AUGUST 1926

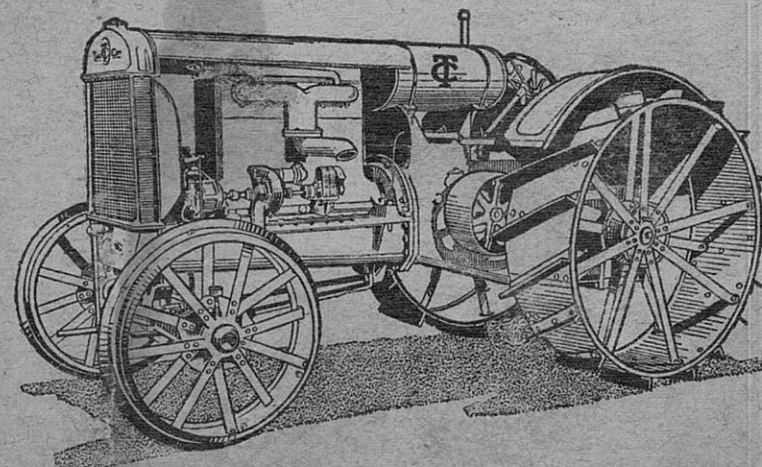
FOR

TWIN CITY



Lavern O. Steinert
236 E. 7th
Russell, Kansas 67665

17-28 (Formerly 12-20)
AND



27-44 (Formerly 20-35)

MINNEAPOLIS STEEL AND MACHINERY COMPANY
Minneapolis, U. S. A.

Conscientious Study of the following
Instructions will mean long life to
your engine and maximum service with
the minimum of worry and expense.
It's worth your while.

LUBRICATING INSTRUCTIONS

ENGINE

OIL PRESSURE—OIL GAUGE SHOULD REGISTER
FROM 10 TO 20 LBS. WHEN ENGINE IS
RUNNING AT NORMAL SPEED.

TAPPETS — OIL DAILY BEFORE STARTING
ENGINE.

CRANK CASE — NEVER LET OIL GAUGE SHOW
LESS THAN HALF FULL. DRAIN CRANK
CASE AFTER EVERY 4 OR 5 DAYS WORK.
REFILL WITH FRESH OIL OF GOOD GRADE.

TRANSMISSION

USE SIGHT FEED CUP FOR BELT WORK
ONLY.

GREASE CUPS — SCREW DOWN AT LEAST
TWICE DAILY

TRANSMISSION — FILL TO OIL LEVEL
PLUG WITH HEAVY STEAM ENGINE OIL.

NOTICE

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY
reserves the right to make changes or improvements at any
time without thereby incurring any obligations either to install
the same on tractors previously sold or to install the old part,
which has been changed, improved or omitted in new tractors
subsequently sold.

Introduction

In preparing and placing in your hands this Instruction Book, which might properly be entitled, "HOW TO CARE FOR AND OPERATE YOUR TWIN CITY TRACTOR," it is our intention to have the care and operation of every part of this tractor as thoroughly understood as possible.

It is only under these circumstances that it will give the maximum satisfaction and service. Anyone can "run" a TWIN CITY TRACTOR, but your success as well as ours depends upon your CARE AND OPERATION.

KNOWLEDGE of the Tractor is NECESSARY; PROPER TREATMENT by you is ESSENTIAL. USE COMMON SENSE. STUDY this book CAREFULLY; it is by no means a difficult or time-consuming task. ACCEPT COMPETENT COUNSEL. Profit by knowledge gained through our experience which we have endeavored to impart as fully and as simply as possible.

You can learn from the following pages the best, easiest and quickest way to care for, operate and adjust your tractor.

By reading this book you will find it surprisingly easy to obtain the best results.

When a TWIN CITY TRACTOR comes to you, it has been thoroughly tested and is ready to give the kind of service you have a right to expect from the best material and workmanship and design. BUT, you must take care of it; set aside each day a certain period to oil and examine your tractor; inspect it with care, do not let your engine knock, or working parts grind and rattle, something is wrong when they do. By careful inspection every day, adjustments can be made in time. DO NOT DELAY. This practice will save much expense.

It is our mutual interest to have your tractor run continuously with a minimum amount of trouble. You can do this by having a good working knowledge of its construction, care, adjustment and operation.

STUDY YOUR INSTRUCTION BOOK

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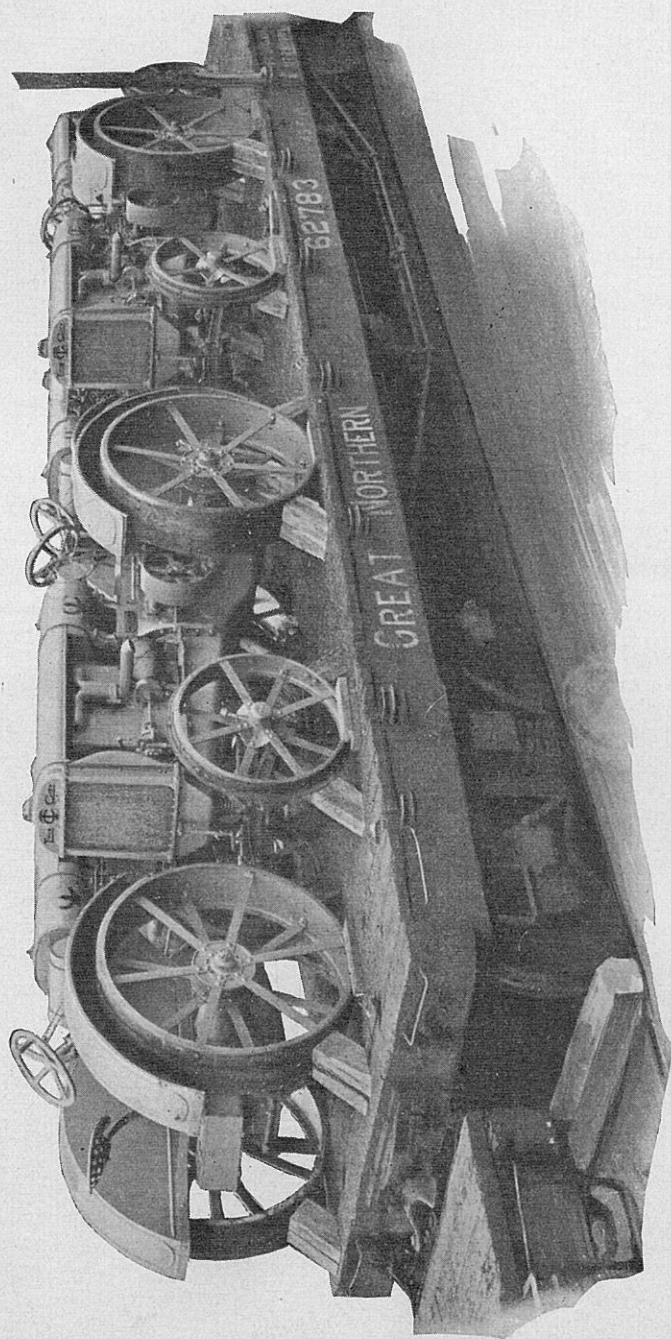


Fig. 1

"Examine All Crates and Boxes for Losses"

SECTION 1. WHEN YOUR TWIN CITY TRACTOR ARRIVES:

Have the station agent spot the car at the platform or other place convenient for unloading.

Thoroughly examine all boxes, crates and wrappings for breaks or shortages and if any such breaks or shortages are discovered, have them all noted on your freight receipt when you pay the freight.

Note: THE MINNEAPOLIS STEEL AND MACHINERY COMPANY is **not responsible** for goods damaged or stolen in transit.

Don't forget that a tractor is a heavy machine and great care must be taken in removing it from the car. It is important to see that the car is well blocked so that it cannot move. Successful unloading is only a question of care and good judgment on your part.

SEC. 2. UNLOADING THE TWIN CITY TRACTOR:

Remove all crating and wrapping from around the engine and knock the blocks from under the wheels. See Fig. No. 1.

Always be sure to see that everything is out of the way.

Now proceed to get the tools out of the tool box or from the box under the tractor on car, again check up the list and see if all the tools are there as listed on shipping statement.

SEC. 3. GETTING READY TO START THE ENGINE:

Get the spark plug wrench out of the box. Examine the spark plugs and see there is a gap of one thirty-second of an inch between points. The exact size of this gap is very important. Sec. 40.

Pour approximately one-fifth pint of engine oil into each cylinder through the spark plug holes A, Fig. 2. Then turn the engine over ten or twelve times by hand crank, to make certain that the cylinder walls are well coated with oil.

Wiring: Be sure the magneto cables are connected properly so as to give the right spark to the correct cylinder at the proper time. Read very carefully Sec. 36 to 40.

Radiator: Fill radiator with clean water. Always use soft water when available. Avoid water containing alkali, if possible. Never start engine without filling the radiator with water, since this will result in overheating—causing the pistons to stick. It will also score the cylinder walls. It is also apt to crack the cylinder head. Read Sec. 41.

SEC. 4. OILING ENGINE:

Before any oil is poured into the crank case, remove the oil pump strainer in the bottom of the crank case at D, Fig. 7. Thoroughly wash the screen in kerosene or gasoline, removing all dirt and sediment. This precaution is necessary on all new machines. After cleaning the oil pump screen replace same and pour through filler plug B, Fig. 2, on the side of crank case of the engine, three gallons of the best quality gas engine oil until the oil runs from upper pet cock C, Fig. 2.

Next fill all grease cups and screw them down until the grease squeezes out between the bearings and the shaft, Fig. 4. This may require two or three fillings of the grease cups. (Note Fig. 4, A, B, C.)

Oil the governor at O, Fig. 2.

Squirt some oil into oil cups on valve rocker arm bearing O, Fig. 6.

See that the transmission case is filled with gear oil.

This can be done by removing the cover plate C, Fig. 3.

"Always Have Plenty of CLEAN, SOFT Water in Radiator"

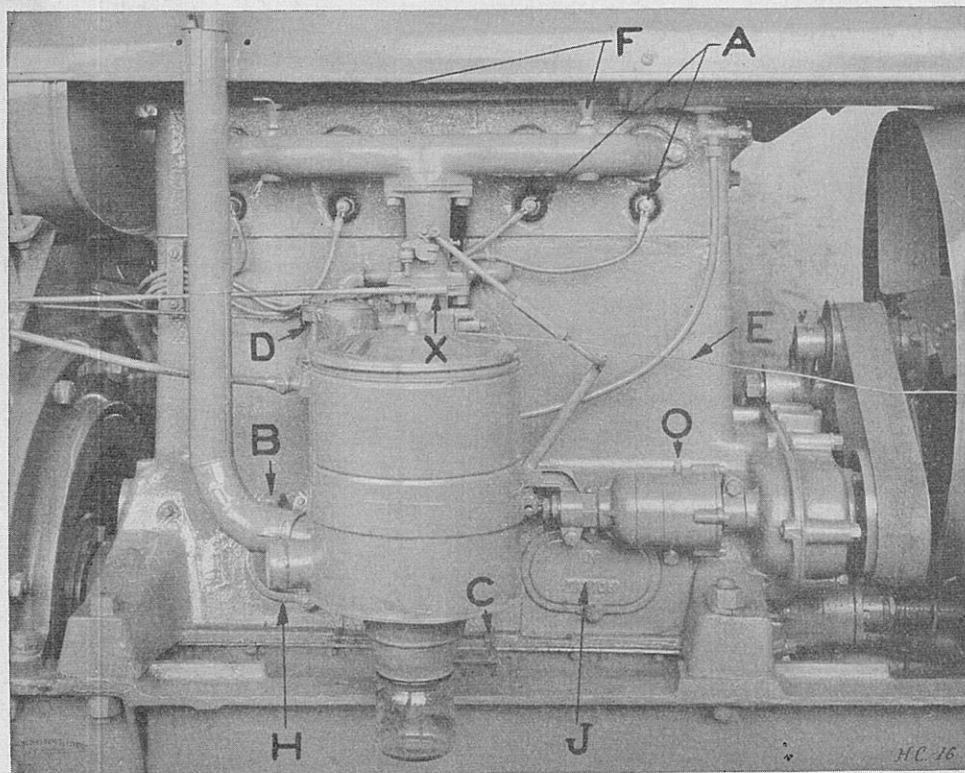


Fig. 2

SEC. 5. BELTS:

Adjust fan belt by tightening the spring at D, Fig. 8.

SEC. 6. FUEL: (Kerosene, Gasoline)

Be sure to strain fuel through a fine sieve or chamois skin. If fuels are not strained, you are sure to experience trouble since they contain some foreign matter which will clog pipes and valves and cause you a great deal of trouble. Read Sec. 32. Fill the small tank with gasoline, which is to be used for starting purposes, and the larger tank with kerosene, to operate on.

SEC. 7. STARTING ENGINE:

Open the valve from gasoline tank B, Fig. 3. Turn atomizer tube so that the indicator points to the position marked "Start No. 1" on the dial. D, Fig. 2. See Sec. 33.

Prime engine with two priming cups full at F, Fig. 2, in warm weather and more in cold weather. However, be careful not to flood engine cylinders.

Note: Close choke valve by pulling out on ring at E, Fig. 2, when cranking engine. Then release it when engine starts. If engine does not pick up at once, close again for an instant then open it again. After a few days work you will be able to crank engine by spinning. This is the quickest method of starting. (Cranking by spinning motor applies to 17-28 only.)

"Do Not Overload Your Tractor"

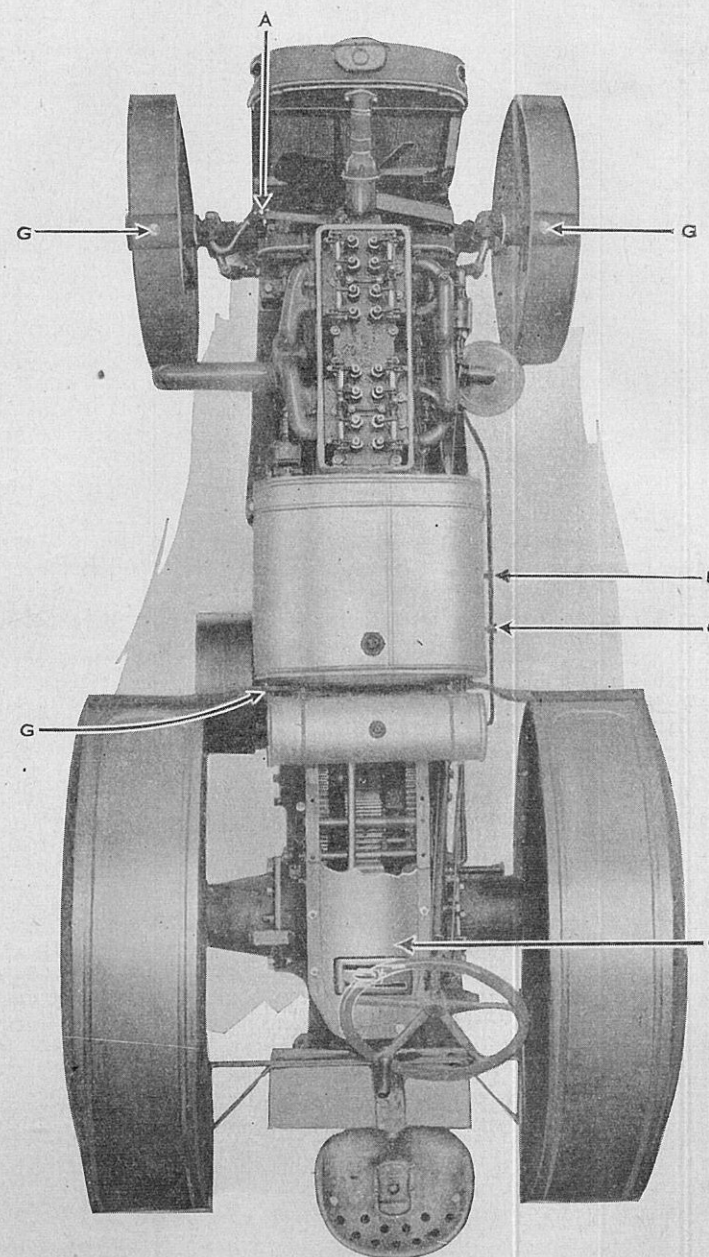


Fig. 3

"Keep Grease Cups Full"

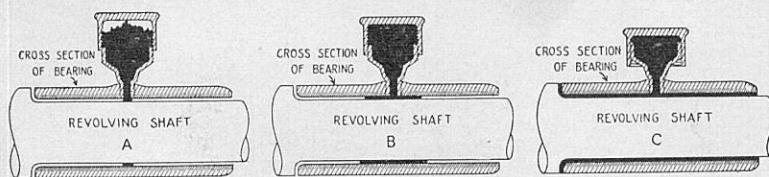


Fig. 4

Retard the spark by placing spark control lever E, Fig. 5, in the center of the quadrant D, Fig. 5, located near the driver's seat. (One end of the quadrant is full advanced and the other end is stop.)

Open hand throttle wide, B, Fig. 5, by pushing forward. When doing belt work throttle should be left wide open.

SEC. 7½. COLD WEATHER PROCEDURE:

In cold weather it will sometimes be necessary to use a mixture of ether and gasoline—2 parts gasoline to one of ether—to prime the motor. This will gasify quickly in the cylinder.

Another method is to heat the priming can, holding it in hot water.

If obtainable, the radiator should be filled with hot water before starting.

It is well to drain oil out of crank case when through at night and heat thoroughly before refilling the next time used.

It has been found necessary when operating during the winter months to drain the transmission of the heavy steam cylinder oil before the cold weather sets in and use a much lighter grade.

If the tractor remains out over night and the heavy oil has not been drained out and replaced with a lighter grade, it will not be possible to shift gears.

The oil pressure gauge should be watched at all times and more especially during the cold weather months.

ANTI-FREEZE COMPOUNDS:

These compounds which have gained a national reputation and which are guaranteed by the manufacturers should be used during freezing weather.

Full directions are usually printed with these products.

SEC. 8. TO CRANK ENGINE:

Note carefully. When cranking engine, stand in such a position that the crank C, Fig. 6, will not touch any part of the body. Turn crank over so as to bring one cylinder on almost full compression. Then take a new grip on engine shaft so that engine can be quickly and easily turned over dead center. Do not attempt to crank engine by bearing down or jumping on the crank.

Always remember three things are necessary before the engine will run:

First: Fuel. Second: Compression. Third: A Spark.

If the engine is slow to start, see Sec. 14 to 29, "Causes and Remedies." Remember all new engines have closely fitted bearings and are a little hard to crank the first few days.

SEC. 9. WHEN ENGINE IS STARTED:

See that Oil pressure gauge registers ten to twenty lbs., also see Sec. 7.

Turn fuel atomizer valve so that indicator points to "Lean No. 3" on the dial D, Fig. 2. If the engine is slow in picking up and discharges black smoke, turn indicator to "Lean No. 4", D, Fig. 2, on the dial or to any marked position on dial that engine will run best.

"Safety First!" "Use Personal Care in Cranking"

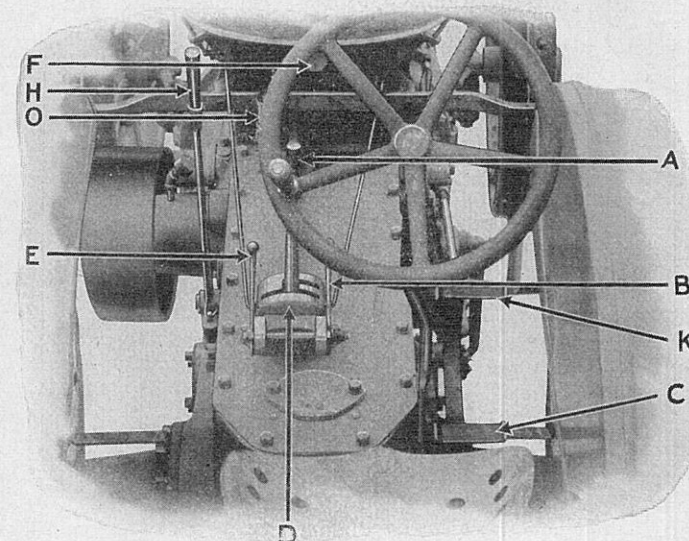


Fig. 5

Advance the spark on the quadrant D, Fig. 5, which is in front of the driver's seat, to a position where the maximum power is developed. This is usually short of extreme advance position when there is no exhaust smoke.

Remember: That the proper adjustment of this spark lever is a big factor in the successful operation and the fuel economy of your tractor.

Before changing to kerosene be sure that the engine is thoroughly heated up. On light or medium load, open exhaust heater, except in extremely warm weather.

SEC. 10. TO STOP ENGINE:

Shut off kerosene and turn the valve B, Fig. 3, on to gasoline. Run engine a few minutes until kerosene is used out of carburetor bowl. Then close hand throttle. This insures your carburetor vaporizing coil being full of rich fuel mixture for the next start. Then move spark lever E, Fig. 5, to "stop" position, short circuiting magneto.

SEC. 11. OPERATING ENGINE UNDER LOAD:

Open hand throttle wide, B, Fig. 5. Throw on load gradually by letting in clutch K, Fig. 5, slowly. When the engine has picked up the load, again adjust atomizer valve D, Fig. 2, so that the required amount of fuel necessary to develop needed power is supplied. Open heater when using kerosene, as less fuel is required when heater is on.

SEC. 12. TO OPERATE TRACTOR:

Push brake lever H, Fig. 5, forward as far as it will go. In this position the brake is released. Pull gear shift lever A, Fig. 5, back as far as it will go. Then push to the left. When in this position it engages the

"When Shifting Gears, Step on Clutch Pedal"

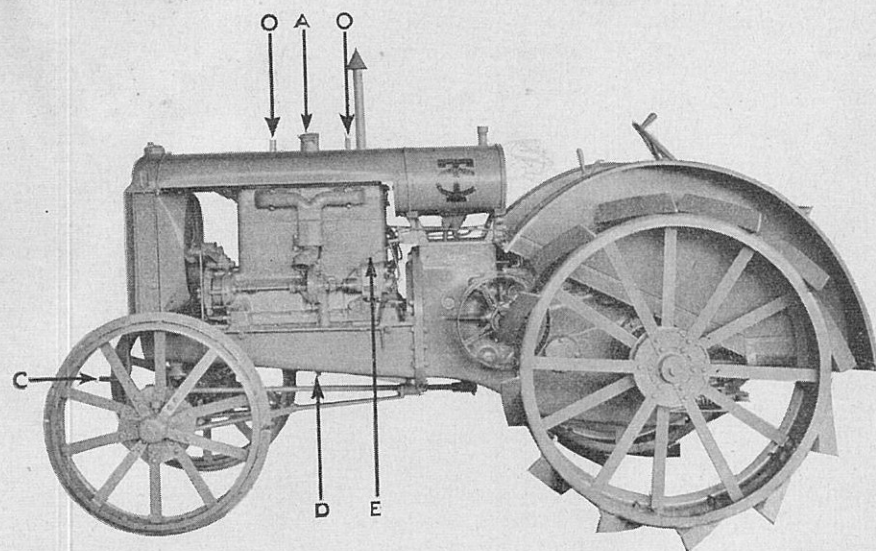


Fig. 6

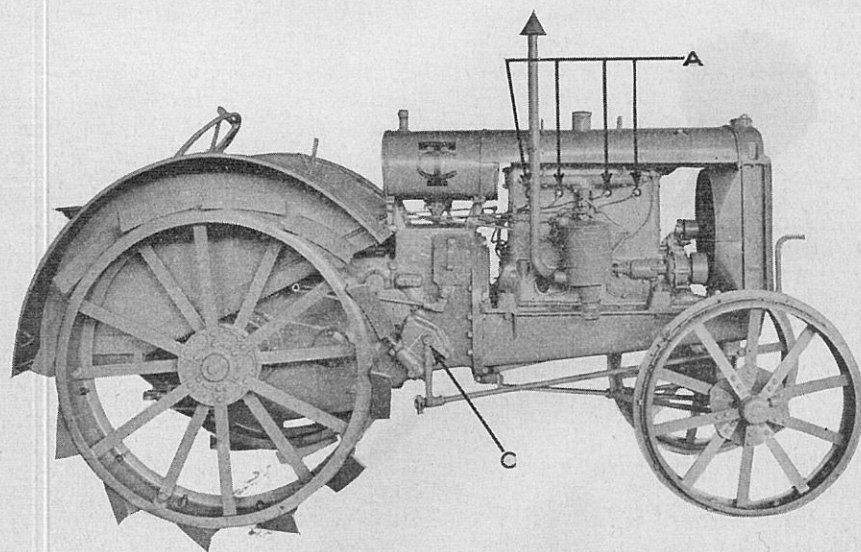


Fig. 6A

low gear. Now push clutch pedal K, Fig. 5, forward, thus allowing clutch to engage. The tractor will now move forward at low speed.

To change to high speed, step on rear pedal of clutch C, Fig. 5. Then pull gear shift lever A, Fig. 5, to center of quadrant D. Then push forward through the gate as far as it will go, throwing it to the right. Then push clutch pedal K, Fig. 5, forward. Now the tractor will move forward in high speed.

To back the tractor up or reverse. First push clutch pedal C, to rear,

"Study Your Engine"

thus disengaging clutch. Then pull gear shift lever A, Fig. 5, to center of quadrant D. When in this position proceed to pull it as far back as it will go, throwing it to the right. Now throw clutch pedal K, Fig. 5, forward, thus engaging clutch. The tractor will now back up on reverse gear.

SEC. 13. LOCATING ENGINE TROUBLE:

The owner or operator of a Twin City tractor must use some thought and judgment in handling troubles common to all internal combustion engines. You must take enough interest and pride in your Twin City and your ability to operate it successfully, to thoroughly familiarize yourself with it; it will surprise you the ease with which any necessary minor adjustments can be made after studying your tractor instruction book.

Most engine troubles are due to faulty carburetion, ignition, and lubrication, and the following suggestions of likely troubles will be found helpful in "checking up" the cause.

Never try to force your engine to run, because there is a reason why, and five turns of the crank will do as much good as five hundred. Save your cranking strength and find out "why." Remember: There are three general conditions necessary before a gas engine will run—a spark, compression, fuel mixture. Begin your examination with the simplest and most probable causes, fuel mixture, and gradually work up to the more difficult, ignition and compression; but be thorough and systematic—don't try a spark plug, and leave it to test the carburetor, coming back later to work on the ignition.

Caution: It will pay you to study special instructions on lubrication (Section 30, 1A to 22A) because the use of low grade oil may result in ruined piston rings, with scratched and scored cylinder walls, which in turn means loss of compression and power. Oil that is too light in body will work too freely past the piston rings and into the combustion chamber, causing smoking at the exhaust and a carbon deposit which soon develops knocking of the motor or pre-ignition.

SEC. 14. ENGINE REFUSES TO START:

Causes	Remedies
1. Magneto not properly timed...	Not probable unless it has been removed. See Sec. 37.
2. Magneto defective.....	Not probable.
3. Broken electrical circuit.....	Look over high tension wire. See Sec. 37.
4. Fouled or broken spark plugs..	Test and clean. See Sec. 40.
5. Forgot to prime with gasoline .	Prime with gasoline only.
6. No gasoline in carburetor.....	Test fuel feed pipes, open fuel feed valve.
7. Poor carburetion.....	See Sec. 33.
8. Atomizer at-Stop Position.....	Turn to Start Position.
9. Water in fuel.....	Drain carburetor and re-strain fuel.
10. Stuck inlet or exhaust valve...	See Sec. 42, Par. 13P to 22P.
11. Poor compression.....	See Sec. 42.
12. Air leak in manifold.....	Examine gaskets. See Sec. 44.

SEC. 15. ENGINE SMOKES:

Causes	Remedies
1. Poor Lubricating Oil.....	Change to good quality oil. See Sec. 30.

"Use Good Quality of Oil"

- | | |
|-------------------------------------|---|
| 2. Too much oil..... | Readjust oil pump. See Sec. 31. |
| 3. Worn or broken piston rings... | Put in new ones at once. See Sec. 42, Par. 1P to 13P. |
| 4. Piston rings stuck in grooves... | See Sec. 42, Par. 1P to 13P. |
| 5. Racing of engine..... | Examine governor. See Sec. 43. |
| 6. Incorrect fuel mixture..... | See Sec. 32. |
| 7. Spark advanced too far..... | Retard spark. |

SEC. 16. REGULAR BUT WEAK EXPLOSIONS:**Causes****Remedies**

- | | |
|---|---|
| 1. Ignition system out of adjustment..... | Examine timing of magneto. See Sec. 37, Par. 8J to 14J. |
| 2. Loose spark plugs..... | Tighten. |
| 3. Valve leak..... | See Sec. 42, Par. 13P to 22P. |
| 4. Fuel mixture "too lean"..... | Examine and adjust carburetor. See Sec. 33. |
| 5. Fuel mixture "too rich"..... | Examine and adjust carburetor. See Sec. 33. |

SEC. 17. LOSS OF COMPRESSION:**Causes****Remedies**

- | | |
|------------------------------------|--|
| 0. Valve tappets set too tight.... | Adjust 12 to 15M on inlet and 15 to 18 M on exhaust. |
| 1. Leaky valves..... | See Sec. 42, Par. 13P to 22P. |
| 2. Leaky piston rings..... | See Sec. 42, Par. 1P to 12P. |
| 3. Valves incorrectly timed..... | See Sec. 42, Par. 13P to 22P. |
| 4. Scored cylinders..... | See Sec. 42, Par. 2P to 4P. |

SEC. 18. EXCESSIVE FUEL CONSUMPTION:**Causes****Remedies**

- | | |
|--------------------------------|--|
| 1. Leaks in fuel tanks..... | Examine fuel system. |
| 2. Incorrect fuel mixture..... | Adjust carburetor. See Sec. 33. |
| 3. Defective ignition..... | See Sec. 36, 37, 38. |
| 4. Leaky valves..... | See Sec. 42, Par. 13P to 22P. |
| 5. Poor lubrication..... | Examine quantity and quality of oil, and pump adjustment. Sec. 30. |
| 6. Retarded spark..... | Retime magneto. |

SEC. 19. ENGINE MISSING:**Causes****Remedies**

- | | |
|-----------------------------------|---|
| 1. Spark plug broken..... | Renew. See Sec. 40. |
| 2. Cylinder head gasket defective | Renew. See Sec. 42, Par. 2P to 4P, See Sec. 44. |
| 3. Intake manifold leaks..... | Examine gasket. See Sec. 44. |
| 4. Exhaust valve stuck..... | Examine and clean. See Sec. 42, 13P to 22P. |
| 5. Screen in carburetor choked... | Clean screen. |
| 6. Valve spring weak..... | Put on new valve spring. |

SEC. 20. IRREGULAR ACTION OF ENGINE:**Causes****Remedies**

- | | |
|------------------------------------|----------------------------------|
| 1. Cracked spark plug..... | Examine and test. See Sec. 44. |
| 2. Gap of spark plugs incorrect... | Examine and adjust. See Sec. 44. |
| 3. Defective wire insulation..... | See Sec. 39. |
| 4. Defective connections..... | See Sec. 39. |
| 5. Poor contacts of breaker points | See Sec. 37, Par. 8J to 14J. |
| 6. Fuel mixture too lean..... | Adjust carburetor. See Sec. 33. |
| 7. Fuel mixture too rich..... | Adjust carburetor. See Sec. 33. |

- | | |
|------------------------------------|--|
| 8. Intake manifold leaks..... | Examine gaskets and manifold for cracks. See Sec. 44. |
| 9. Water in fuel..... | Drain carburetor bowl and re-strain fuel. See Sec. 33. |
| 10. Carbon on sparks plugs..... | Clean. |
| 11. Insufficient fuel supply..... | Examine fuel supply system, and carburetor adjustment. |
| 12. Worn or broken piston rings... | See Sec. 42, Par. 1P to 12P. |
| 13. Governor faulty..... | See Sec. 43. |

SEC. 21. ENGINE BACKFIRES:**Causes****Remedies**

- | | |
|---|--------------------------------------|
| 1. Delayed burning of mixture... | Examine for poor spark. See Sec. 40. |
| 2. Incorrect mixture, generally weak..... | Adjust carburetor. See Sec. 33. |

SEC. 22. ENGINE STOPS:**Causes****Remedies**

- | | |
|-----------------------------------|--|
| 1. Broken electrical circuit..... | Examine wiring, magneto. See Sec. 36, 37, 38, 39. |
| 2. Ignition defective..... | Examine wiring, magneto. See Sec. 36, 37, 38, 39. |
| 3. Poor breaker point contact.... | See Sec. 37, Par. 8J to 14J. |
| 4. Engine overheated..... | Examine water in circulating system. See Sec. 41. |
| | Examine lubricating system, oil, etc. See Sec. 30. |
| | Look for retarded spark. |
| 5. No fuel..... | Fill tank. |

SEC. 23. ENGINE OVERHEATING:**Causes****Remedies**

- | | |
|---|--|
| 0. Mixture too lean..... | Adjust carburetor. |
| 1. Over-retarded spark..... | Set spark at $\frac{3}{8}$ advance. |
| 2. Incorrect timing of valves..... | See Sec. 42, Par. 13J to 22J. |
| 3. Restricted exhaust..... | Examine exhaust ports and manifolds for excessive carbon deposits. |
| 4. Overload on engine..... | Lighten the load. See Sec. 76. |
| 5. Clogged radiator..... | Examine cooling system. See Sec. 41. |
| 6. Water circulation clogged.... | Examine cooling system. See Sec. 41. |
| 7. Racing of engine..... | Examine governor. See Sec. 43. |
| 8. Slipping fan belt..... | Adjust fan belt. See Sec. 41. |
| 9. Insufficient lubrication..... | Examine oil for quantity and quality. See Sec. 30. |
| 10. Carbon deposit..... | See Sec. 35. |
| 11. Piston and piston rings too large for cylinders..... | Refit. See Sec. 42, Par. 4P to 13P. |
| 12. Defective or loose water circulating pump impeller..... | Put in new pump impeller. See Sec. 41. |

SEC. 24. SLUGGISH ACTION OF ENGINE:**Causes****Remedies**

- | | |
|--------------------------------|--|
| 1. Retarded spark..... | Advance spark. |
| 2. Incorrect carburetion..... | Adjust carburetor. Cut down fuel. See Sec. 33. |
| 3. Incorrect valve action..... | Examine. Grind or re-time. See Sec. 42, Par. 13P to 22P. |
| 4. Incorrect lubrication..... | See Sec. 30. |

SEC. 25. LOSS OF POWER:

Causes	Remedies
1. Late spark.....	Advance spark. Examine magneto timing. See Sec. 37.
2. Incorrect valve timing.....	See Sec. 42, Par. 13P to 22P.
3. Loss of compression.....	See Sec. 42.
4. Incorrect lubrication.....	Examine for quantity and quality of oil and pump adjustment. See Sec. 30.
5. Too rich a mixture.....	Adjust the carburetor. Cut down the fuel. See Sec. 33.
6. Overheating of engine.....	Adjust carburetor. Examine cooling system and lubrication. Look for over-retarded spark. See remedies under Sec. 30, 33, 37, 41.
7. Overloaded.....	Cut down the load. See Sec. 75.
8. Exhaust valve springs weak...	Renew.

SEC. 26. ENGINE KNOCKS:

Causes	Remedies
1. Spark advanced too far.....	Retard.
2. Carbon deposit.....	Examine for carbon—Remove. See Sec. 35.
3. Fuel mixture too rich.....	Adjust carburetor. Cut down fuel. See Sec. 33.
4. Loose bearings.....	Examine and adjust. See Sec. 45.
5. Bearings worn.....	Examine and adjust. See Sec. 45.
6. Piston Slap.....	Examine for worn piston. See Sec. 42, Par. 4P to 13P.
7. Piston rings loose in grooves...	New rings, refit. See Sec. 42, Par. 4P to 13P.

SEC. 27. EXPLOSIONS IN EXHAUST PIPE:

Causes	Remedies
1. Over-retarded spark.....	Advance.
2. Fuel mixture too rich.....	Adjust carburetor. Cut down fuel. See Sec. 33.
3. Exhaust valve stuck.....	See Sec. 42, Par. 14P to 22P.

SEC. 28. ENGINE SPEED REGULATION AND ENGINE RACING:

Causes	Remedies
1. Worn governor mechanism....	Renew. See Sec. 43.
2. Looseness or misadjustment of Governor.....	Examine. See Sec. 43.
3. Incorrect mixture.....	Adjust carburetor—more or less gas. See Sec. 33.
4. Governor gummed.....	Clean with kerosene. See Sec. 43.

SEC. 29. CARE AND OPERATION OF THE TWIN CITY ENGINES:

(A) Lubrication, (B) Oiling System, (C) Fuel Supply, (D) Carburetor, (E) Air Cleaner, (F) Carbon Deposits, (H) Ignition, (J) Magneto, (K) Impulse Starter, (L) Wiring, (M) Spark Plugs, (N) Cooling System, (P) Com-

"Remember, One-Half Your Engine Troubles are Due to Poor Lubrication"

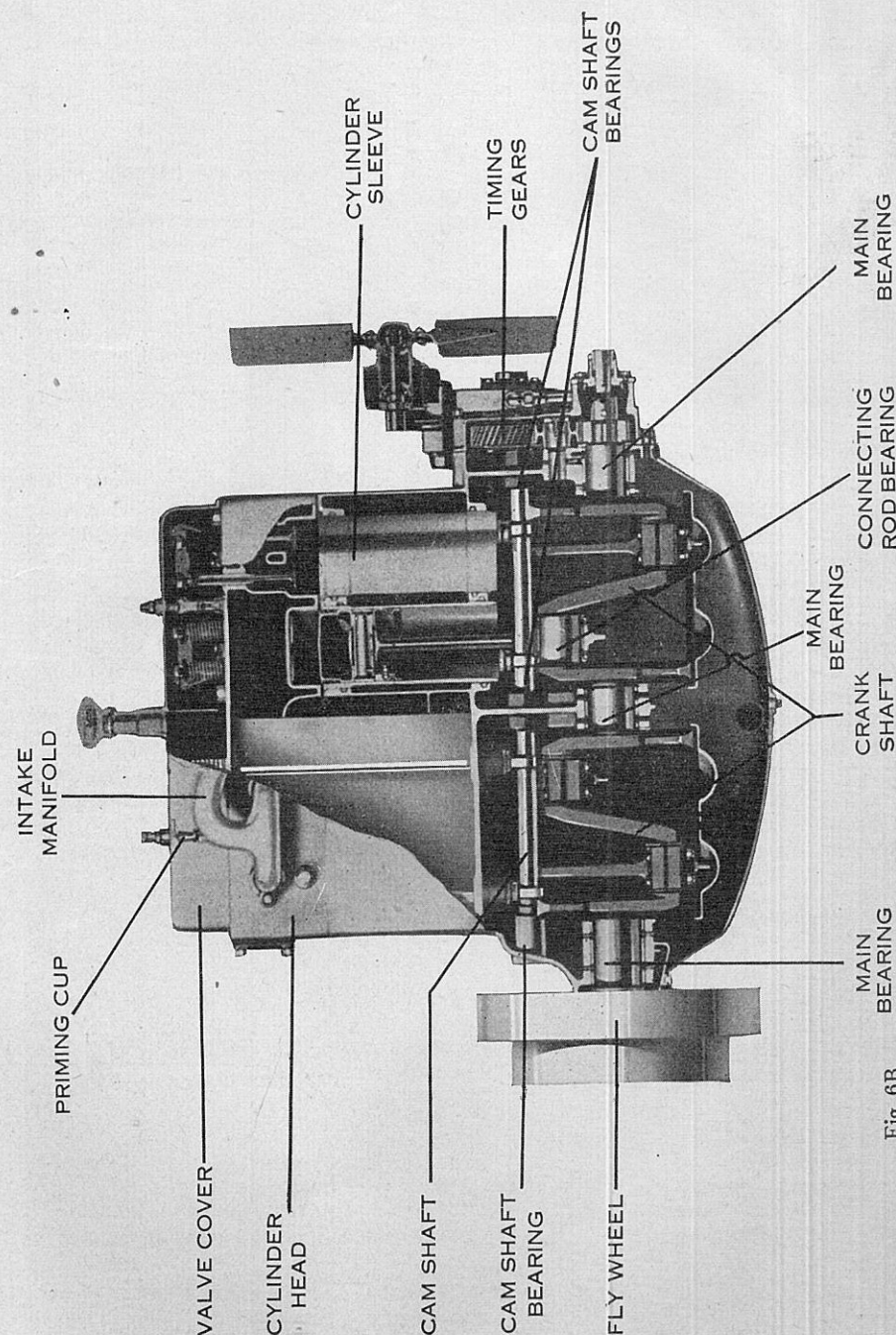


Fig. 6B

"Understand It"

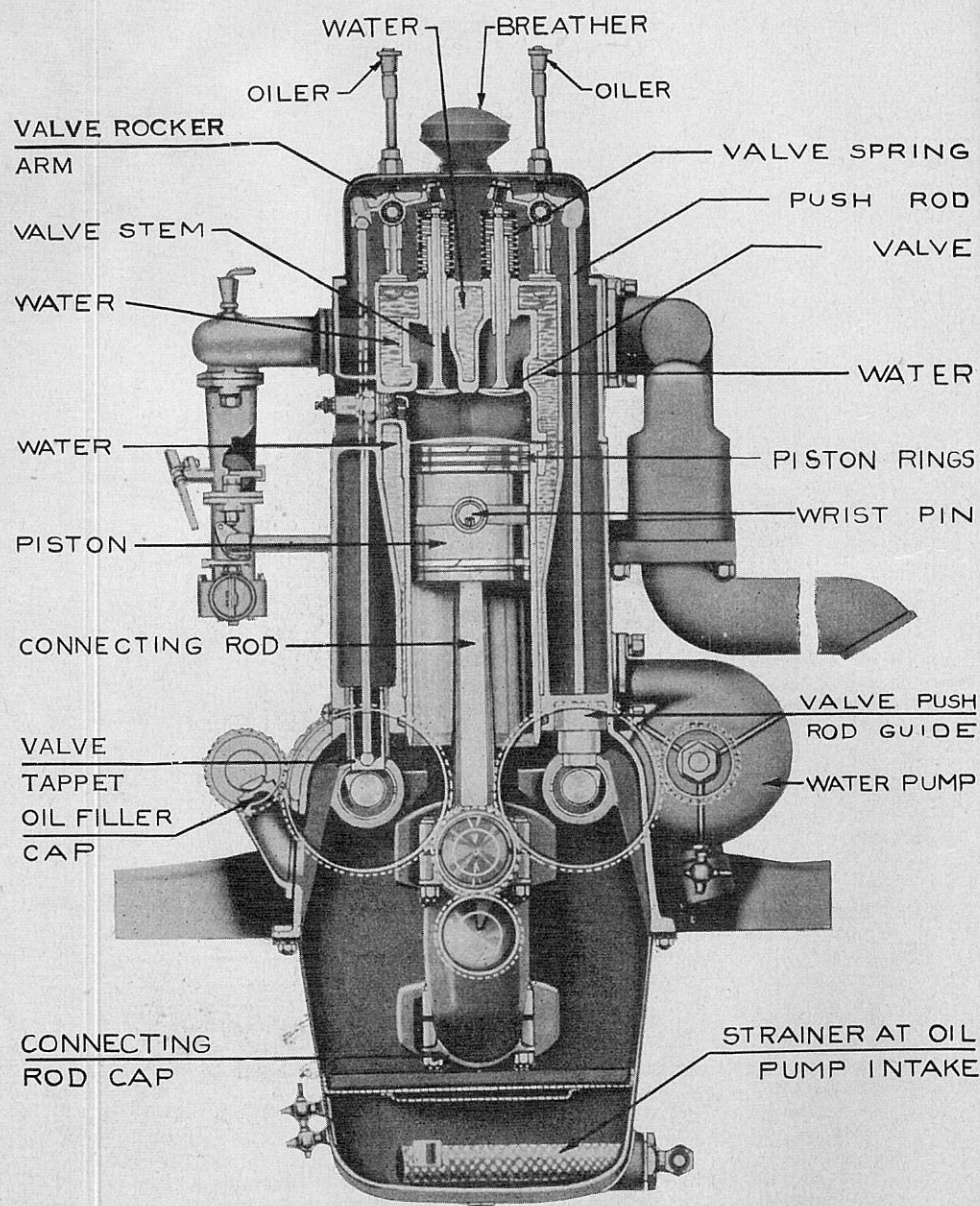


Fig. 6C

pression: Cylinders, Pistons, Piston Rings, Filing Piston Rings, Piston Lubrication, Purpose of Valves, Valve Timing, Valve Grinding, Tappets, (R) Governor, (S) Gaskets, (T) Bearings, Connecting rod, Shims.

SEC. 30. LUBRICATION: Its necessity and benefits.

1A. Nothing connected with the care and operation of your tractor deserves more careful study and attention than its lubrication. Proper oil, properly used, will save you money on your fuel bill, on your repair bill and on your lubricating bill; it will give you more and better work; and it will add to the life of your engine. You should know that when you plow one acre with a tractor it amounts to the same as driving your auto 100 miles or 20 acres with a tractor equals 2,000 miles with an automobile. This being so, it is worth while to understand what your lubricating oil has to do, and to follow the instructions closely, especially in regard to the grade of oil used.

2A. Remember that your lubricating oil must provide and maintain a thin film between all bearing surfaces to prevent friction and wearing. It must also provide a seal between the cylinder walls and piston rings to hold the gas in the combustion chambers during its compression and explosion.

3A. Your oil must be heavy enough and good enough to stand the heat that arises among the working parts.

4A. All low grade fuel engines are, in some respects, different from gasoline engines. For instance, kerosene is heavier and more dense than gasoline and burns slower and gives more heat to the cylinder and piston. This means that with the use of kerosene a much higher temperature results than with gasoline so that a heavier oil must be used to stand up against the greater heat without "cooking" away.

5A. "Don't forget that authorities claim that more than one-half of all engine troubles are due to incorrect lubrication."

6A. When buying lubricating oil for your motor do not always take the dealer's word as to a certain grade of oil nor take an oil salesman's word as to his particular oil simply because he thinks his oil is the best. They may be honest in their conviction, but may not be reliably informed. Many reliable oil companies are selling oils especially for use in tractors and publish recommendations for each type and make of tractor, and it is much safer to buy a well known oil, prepared and recommended by a reliable company than to choose an oil at random which is not well known.

7A. Before the tractor is started, the oil pump screen in the bottom of the crank case must be removed at D, Fig. 7, and thoroughly washed in kerosene or gasoline, removing all dirt and sediment. This strainer must be removed very often at first, or until such time that there is no more dirt lodging in it. The oil pressure gauge should be watched very carefully, and the engine should never be allowed to run either idling or on load unless this gauge shows at least 10 pounds, and not more than 20 pounds.

8A. On top of the oil pump there is a plug for priming the pump C, Fig. 8, should it be necessary to do so at any time. This should only be necessary when having drained the crank case of oil, the pump thereby loses its seal and thus refuses to pump until primed which is quickly accomplished through this plug.

9A. In all new motors there is a possibility of enough sediment accumulating to stop up the oil strainer and prevent the oil from getting to the oil pump. Therefore, by removing this strainer before any damage has happened and keeping it clean will remove all danger from burned out bearings. Our motto, therefore, is "Keep the oil strainer clean and know that it is clean." If the oil gauge does not show any pressure the first place to look for this trouble is in the oil strainer and not the oil pump. The oil pump should not be tampered with until the oil pump strainer has been first examined.

10A. Remember our recommendation, to use **high grade** oil and **grease**. Using cheap or low grade oil in your tractor is like cutting down the feed of your best horse to save money. **It is false economy.**

11A. Keep all oils in a cool place, laying the barrels on their side. This keeps the barrels tight longer and makes them easier to handle. Keep all bungs and vent plugs closed, to keep out dirt and moisture.

12A. Periodic Oiling and Inspection:

Once a Day—

Oil tappets.

Test oil level in crank case.

See radiator is full.

Wipe dust and dirt off magneto.

Test connecting rods and main bearings, Fig. 38.

Once Every 5 Days of Work—

Wash out crank case thoroughly and renew with the best gas engine cylinder oil obtainable.

Examine alignment of front wheels.

Once Every 10 to 20 Days of Work—

Remove cylinder head.

Clean out carbon.

Grind valves.

After First 30 to 40 Days of Work—

Remove rear wheels and rear axles.

Remove Hyatt roller bearings from axle housings and clean thoroughly with kerosene.

Replace and fill with steam cylinder oil.

Remove front wheels.

Wash bearings and hub with kerosene.

Repack with grease.

Every Season—

Take apart all steering gear.

Examine and wash in kerosene.

Repack with small quantity steam cylinder oil.

Clean out transmission case and refill with heavy steam cylinder oil.

"Keep Your Oil Free From Dirt and Dust"

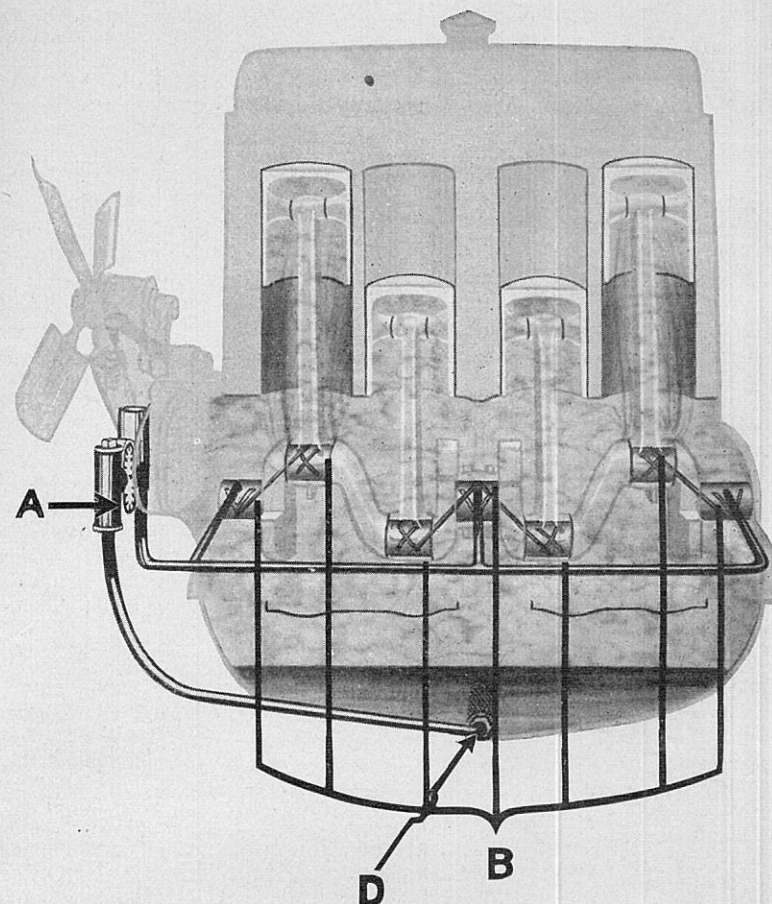


Fig. 7

13A. The cylinder oil drained from the crank case can be used to oil other farm machinery if it is strained through a filter.

14A. Do not mix oils of different makes, and do not change grade of oil without some good reason.

15A. Watch the bearings closely and see that the oil or grease gets there. Oil holes are liable to plug and should be cleaned frequently clear down to the shaft.

16A. Keeping your lubricating oil up to a high quality will prevent scored cylinder walls, scored pistons and broken piston rings, and many other expensive troubles.

17A. If too little oil is used, one of the common results is an overheated engine which results in scored pistons, piston rings and cylinders. It is always better to use too much oil than too little, especially in a new engine.

18A. Piston rings that leak not only lower compression, but allow oil to

"Clean Strainer When Oil is Changed"

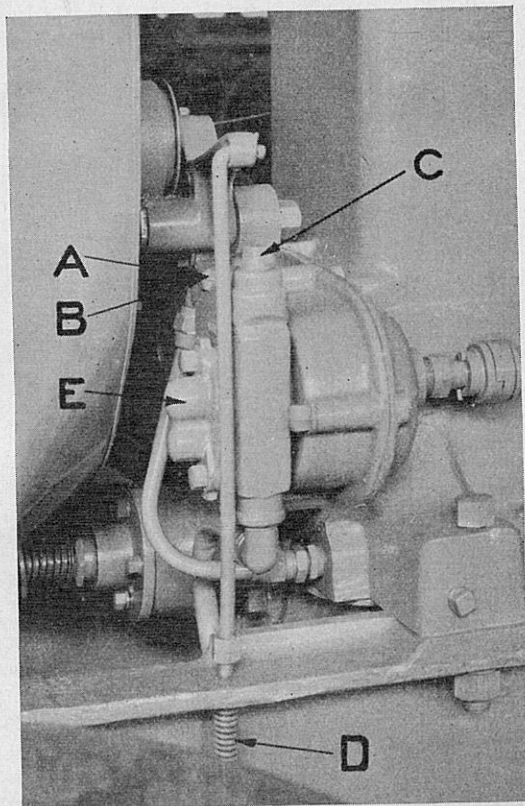


Fig. 8

pass into the combustion chamber where it quickly turns into carbon. The result is loss of oil, fouled spark plugs and carbon deposits—LOSS OF POWER.

19A Running an engine without oil will ruin it in a few minutes time.

20A. **IMPORTANT:** Never run engine unless oil runs from lower pet cock or right-hand side of motor base pan C, Fig. 2. If you continue running the engine, it will develop a hard, metallic knock and the heat will cause the piston to stick in the cylinder. Result—burned out bearings.

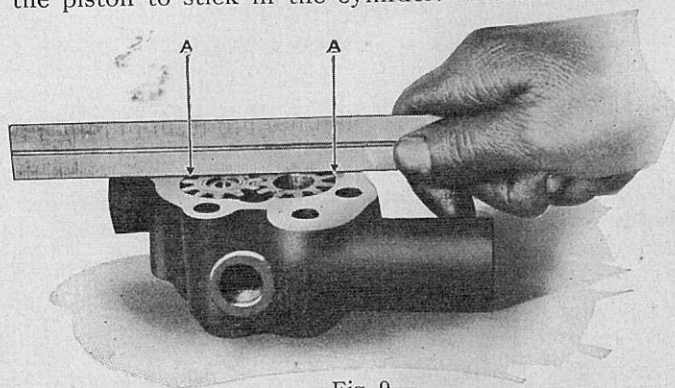


Fig. 9

"Running Your Engine Without Oil Will Ruin it in a Few Minutes"

21A. Stop at the first sign of a knock in your engine. Let everything cool down. Look for damage to the engine and also to the bearings. If you cannot find the trouble start the engine. If it still pounds or knocks, it is a certain sign of burned bearings or scored cylinder walls.

22A. When the oil pump is in proper working order, the adjusting plug C, Fig. 8, is approximately $\frac{3}{4}$ -inch down with the oil pressure at 10 pounds; if it is necessary to screw the plug down more than one inch to get 10 pounds oil pressure, the pump should be examined for air leaks in the suction line or leakage past the pump gears.

SEC. 31. OILING SYSTEM:

1B. When the oil runs from upper pet cock C, Fig. 2, the pressure oil gauge should register ten to twenty pounds.

2B. The oil is pumped from the base pan by pump A, Fig. 7, from there through the hole in the crank shaft cheek B, Fig. 7, to the crank pin, where it lubricates the connecting rod bearings. The oil is squeezed out of the sides of the connecting rod bearings, which, being in motion, whip an oil vapor up into the cylinders, thus lubricating the cylinder walls, pistons and wrist pins. In fact, the whole interior of the crank case is an oil mist, which thoroughly lubricates all the interior parts, such as cam shaft, bearings, cams, valve push rods and guides.

3B. Should too much oil work into the combustion chamber and foul the spark plugs, it is due to an excessive amount of oil being forced out thru the bearings; the cylinder which gives the trouble will indicate the bearing that is supplying too much oil. Viz: If number one cylinder shows excessive carbon deposits, it is an indication that the front main bearing and number one connecting rod bearing need attention. If more than one cylinder causes trouble a general take-up of the bearings and shims is necessary. The shims must fit close to the shaft.

(POOR OIL IS FALSE ECONOMY AT ANY PRICE)

5B. You must keep your eye on the oil pressure gauge, if you do not maintain 10 lbs. pressure oil will not reach all the bearings, pistons and cylinders.

6B. When the pressure gradually goes down, it is a good indication that the pump adjustment has worked loose. Should your gauge suddenly go to "0", the chances are your pump has lost its prime or the gauge is not functioning properly.

7B. Unscrew oil pipe at D, Fig. 7, remove screen and clean. Unscrew the plug at C, Fig. 8, and prime the pump with oil, then screw in plug and see that pressure gauge shows proper pressure. The pump E, Fig. 8, that maintains the pressure is a gear pump and its efficiency depends on how it is fitted to the timing gear housing. If for any reason the pump is taken off or taken apart, it must be fitted back with care. The gears in the pump body must be in line with edge of pump body as in A, Fig. 9. When a thin piece of paper is used for gasket, (nothing heavier than writing paper should be used) the proper end clearance of gears is secured. This fitting must be watched, as too much clearance here will cause the pump to lose its prime.

Watch the oil pressure gauge.

"Always Strain Your Fuel"

SEC. 32. FUEL SUPPLY:

1C. The fuel used in Twin City motors may be gasoline, distillate, naphtha, kerosene, or alcohol.

2C. Following is a table of comparison of the fuel value between the fuels listed:

	Gals.	Specific Gravity
Gasoline.....	1.00	.7449
Naphtha.....	1.07	.7639
Kerosene.....	1.24	.8098
Alcohol.....	1.38	.809

3C. **Kerosene as engine fuel:** Kerosene, which forms one of the more plentiful distillates of crude oil, furnishes an economical fuel substitute for gasoline and, being of a similar character, can be used in all Twin City engines without alteration and with equally satisfactory results.

4C. There are, however, several things of importance in the use of kerosene as fuel which you must observe if you are to gain the best results.

5C. Kerosene with a higher flash or vapor point does not vaporize until well heated and gives a greater heat over a longer period of time per explosion than gasoline and, while this does not increase the power, the greater heat created causes the engine cylinders to take on a higher temperature requiring the use of a grade of oil which will lubricate the cylinder wall without "cooking" away.

7C. Successful operation on kerosene is assured by the proper adjustment of the carburetor, the use of good, clean, lubricating oil, keeping the engine free from carbon, having good compression and good spark.

8C. Leaks in the pipe line are easily caused by fittings working loose and, in such event, they should be unscrewed and the threaded end portions covered with shellac, or common laundry soap. Then re-assemble. (Care should be taken not to strain valves in screwing them together. Use open end wrench on the flat surfaces over threads, not on the other end of valve or fitting. DO NOT USE PLIERS.)

9C. **IMPORTANT:** Strain fuel when filling tank, as this will eliminate future loss of time and unnecessary expense.

CARBURETION

13C. The amount of air that may flow through the carburetor is automatically regulated and the quantity of gasoline or kerosene that may flow past the atomizer valve is adjustable so that for a certain amount of gasoline or kerosene the proper proportion of air will enter.

14C. When the mixture is not correct; that is, when there is too much or too little air for the gasoline or kerosene flowing past the atomizer valve, the running of the engine is affected and it will not deliver its full power.

15C. When there is too much air for the gasoline or kerosene, the mixture is said to be "too poor" or "too lean"; when there is too little air, the mixture is said to be "too rich."

SEC. 33. THE CARBURETOR:

2D. **Instruction for operating Holley All-Fuel Carburetor.** Close shut-off valves to fuel tank B, Fig. 3. Open valve on fuel line to gasoline tank. Remove cover over float chamber; fuel level should not be over

"Start on Gasoline"

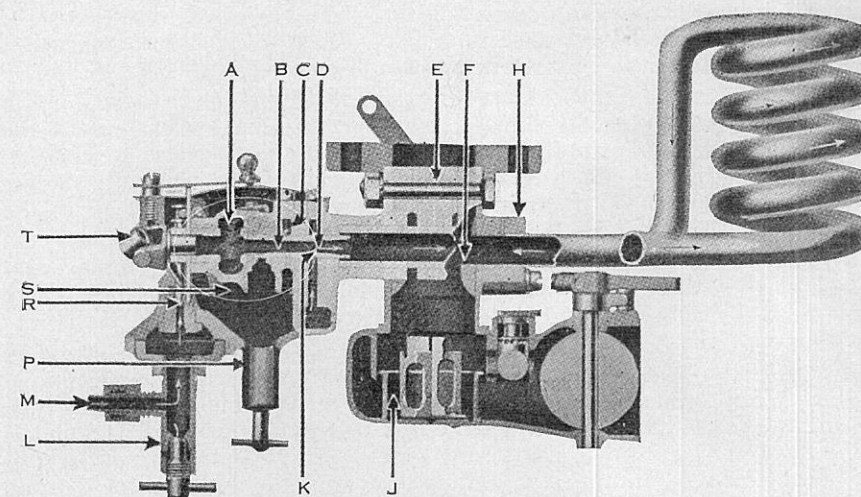


Fig. 10

ridge cast inside float chamber. Place pointer to position marked "START" on dial. This is the largest fuel opening and insures easy starting.

3D. **Starting:** Prime with gasoline through priming cups on intake manifold F, Fig. 2. Retard spark lever E, Fig. 5. Open throttle (B, Fig. 5,) wide. Close choker valve by pulling looped wire E, Fig. 2. Crank engine, releasing choker wire "E" as soon as engine starts. If engine falters, pull choker wire "E" but release immediately. Allow engine to run from three to five minutes on gasoline.

4D. **Fuel openings:** Turn valve B, Fig. 3, on fuel line to kerosene tank. Positions on dial marked No. 1, 2, 3 and 4 represent smaller fuel openings, the position marked No. 4 being the smallest.

5D. **Best operating position:** The position for best operation can be determined by shifting pointer to the different positions until engine runs properly.

6D. **Idling position:** When idling with hand throttle for any length of time, shift to gasoline and retard spark.

7D. **Drain valves:** Drain valves L and P, Fig. 10, are provided under float chamber and filter screen and should be opened each day before starting tractor, to allow any accumulation of water or sediment to escape.

8D. **To clean:** A cleaning opening is provided in vapor tube at X, Fig. 2. A small rod can be used to remove any dirt that may collect at this point.

9D. **Fuel for starting:** Always start engine on gasoline before turning on kerosene or other fuel. Any liquid fuel having a final boiling point not over 600 degrees Fahrenheit can be used in the Holley All-Fuel Carburetor.

10D. **How does the carburetor work:** The tractor having two fuel systems; that is, gasoline and kerosene, the fuel line to carburetor is provided with a three-way valve, which when turned to open into the gasoline tank closes off the kerosene tank and vice versa. After the motor has been

"Study Your Carburetor and its Adjustments"

running at least three minutes on gasoline, the three-way valve can be turned to open into the kerosene tank. The path of rich fuel mixture is shown on the illustration by white and black arrows. See Fig. 10.

12D. What is the purpose of the air valve? J, Fig. 10. It is located under mixing chamber at bottom of carburetor and automatically controls the quantity of air entering the carburetor. It is so proportioned that while on its seat it admits the air necessary for idling and lifts gradually as the throttle valve is opened. It maintains the correct proportion of air to the mixture at any speed or load.

13D. What is the purpose of the float? S, Fig. 10. It automatically controls the flow of fuel into the carburetor. The float should close the valve when the fuel reaches the proper level, indicated by a ridge cast inside the float chamber, about 1 inch below its top rim. The level must not be above this line or more than one-eighth of an inch below.

14D. What makes float needle leak? R, Fig. 10. The flow of kerosene entering the float chamber through the fuel pipe is automatically regulated by the float valve raising and lowering on its seat. Should any particle of dirt become lodged in the seat, which prevents the valve from closing, the fuel will overflow and leak out.

15D. How is the carburetor adjusted? Changing the position of pointer on the atomizer D, Fig. 10, to the different positions on the dial varies the amount of fuel being metered into the vapor tube at K, Fig. 10. Position marked "START" gives the richest mixture, position Number 1 slightly less and so on to position Number 4, which gives the leanest mixture.

16D. Cleaning of atomizer: Atomizer can be taken out by removing cotter pin at T, Fig. 10, on adjustment rod and pulling out atomizer which is held in place by a compression spring and ball at C, Fig. 10.

17D. When there is water in the carburetor—what? The presence of water in the gasoline or kerosene tank, even in small amounts, will prevent easy starting and may cause the motor to misfire and stop. As water is heavier than either gasoline or kerosene, it settles to the bottom of the tank and into sediment traps. It is advisable to frequently drain the sediment trap under carburetor and fuel tanks by removing drain plugs L and P, Fig. 10.

18D. If motor runs too fast or too slow with throttle retarded—what? (Idling at lower than governor speed). If the motor runs too fast with throttle fully retarded, unscrew the throttle lever adjusting screw, until the motor idles at suitable speed. If the motor chokes and stops when the throttle is fully retarded the adjusting screw should be screwed in until it strikes the boss, which prevents the throttle from closing too far. When proper adjustment has been made, tighten the lock screw, so that the adjustment will not be disturbed.

19D. Carburetion troubles: Incorrect mixture may be due to a too rich mixture in which there is too much fuel used or a too lean mixture in which there is too much air.

At altitudes above 3,500 feet there is a special venturi for the carburetor. This venturi is 15-16 inch in diameter. The standard venturi is $\frac{7}{8}$ inch in diameter.

The engine may be flooded from too much priming or too much unexploded gas formed from the liquid fuel drawn in. Crank engine until excess gas is exhausted.

"Do Not Let Carburetor Leak"

The engine may be so cold that the gasoline or kerosene does not vaporize, or the gas is not warm enough to be ignited by the spark.

Important: Remember a leaking float, S, Fig. 10, or a float that is out of adjustment, demands your immediate attention and is easy to adjust. The various parts of the carburetor should be fully understood as a knowledge of adjustment of the carburetor will save you a lot of time and money in the end.

NOTE: If the engine should stop, unless it is hot, be sure and drain carburetor of kerosene and start on gasoline.

20D. Cleaning Vapor Coils: If the vapor coil has been neglected and allowed to become carboned inside, the tractor will not function properly because sufficient gas cannot be drawn through to the motor. A clogged coil usually is indicated through the necessity of having to operate the engine with a partially closed choke valve.

The causes for burned coils are either leaky valves or the magneto set too high, or both. These conditions will cause excessive heat in the exhaust pipe sufficient to pit and scale the coil, and if allowed to continue will burn through making it unfit for use. Prolonged running with a partially clogged coil due to carbon deposit on the inside will also tend to burn it through.

How To Proceed With Cleaning: Detach coil from the motor. Remove the gas plug in the "tee" end of the coil directly over the end of the hole leading to the coil proper. This makes it possible to insert a special nozzle welding torch down into the tube. This special nozzle can be made of extra heavy copper tubing having $\frac{1}{4}$ " outside diameter and $\frac{1}{8}$ " inside diameter, and should be long enough to reach down to the curved portion of the coil.

The coil should be soaked over night in gasoline or benzine. This makes it easier to start the burning operation. After soaking, place coil in a can or tub of water where it can be entirely submerged except for the ends, which should be attached to a brace which will hold the coil in position with the ends just projecting above the surface of the water.

Use pure oxygen at a pressure of 50 to 75 pounds, pure oxygen is the only gas that will burn in the coil without leaving soot. The burning particles of carbon will be seen to burst from the end of the tube. On a very dirty coil it may be necessary to repeat the operation.

To test the coil insert a $\frac{5}{16}$ " steel ball in one end of the tube and apply air pressure. If the ball passes through the coil it has been cleansed sufficiently. Test for air leaks by submerging all but the ends of the coil in water. Now apply the air hose and any leak will be indicated by bubbles on the surface of the water. If there are leaks at the points where the straight tubes are joined to the coil, these may be repaired by brazing with bronze. After brazing, test again with steel ball to make certain that the inner passage is clear.

THE SCHEBLER CARBURETOR:

Before adjusting the carburetor, be sure that the fuel tank and all pipe connections are clean; see that the ignition is properly timed; that all connections between the intake valve of the motor and the carburetor are tight and that there are no air leaks of any kind.

See that the choker "C" in the air intake is connected for initial starting, so that when the choker on the dash is pulled out, all the air will be shut

"Do Not Remove Air Cleaner"

off. After the motor has been started, this choker should be returned to its original position as the motor warms up.

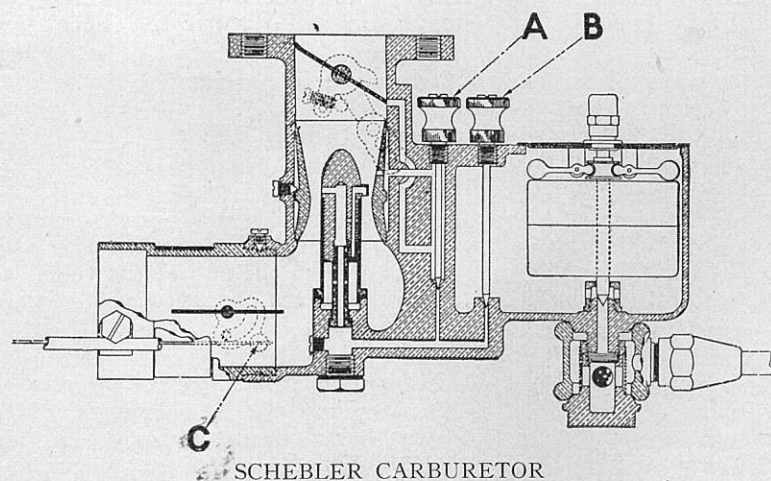
Open both gasoline needles "A" and "B" about 3 or 4 complete turns from the closed position.

Open throttle about one-eighth and start motor. Let the motor warm up thoroughly before making adjustments on the carburetor. After the motor has been thoroughly warmed, then adjust idle needle "A" until the correct mixture is obtained for idle running.

Next open throttle about one-quarter way and adjust gasoline needle "B."

Below the float chamber on the carburetor there is a wire screen to prevent dirt getting into the carburetor, and sticking in the fuel vents. This screen can be easily removed by taking off nut at the bottom and pulling it out. This should be done every week. If the motor spits back it is a sure sign that the fuel is either stopped at the needle valve "B" or the screen is clogged with dirt.

The Schebler carburetor is used only on motors equipped with hot-spot manifolds.



SEC. 34. AIR CLEANER:

1E. The engine is equipped with an air cleaner, Fig. 11, which keeps the dirt out of the engine. Dirt causes the pistons and rings to wear rapidly and a loss of power results.

2E. The action and construction of the Air Cleaner can be easily understood by reference to the illustration. The air is drawn by the piston suction

"Proper Lubrication and Carburetor Adjustments Reduces Carbon Deposits"

through the openings BB, Fig. 11, in the sides of the cleaner, into the spiral tubes E, Fig. 11. These spiral tubes have a downward pitch which gives the dust laden air a whirl so that centrifugal action and gravity throws the dust into the trap, C, Fig. 11, and allows the clean air to pass upward through the top opening A, Fig. 11, and into the carburetor.

3E. **Important:** Never remove mason jar D, Fig. 11, while engine is running, and do not loosen it as it destroys the function of the air cleaner and changes the action of the carburetor. The air cleaner must always be attached and in good condition. See that all connections are tight so that dirt cannot enter; wrap all joints with tape if not tight, as dirt goes through wherever air goes.

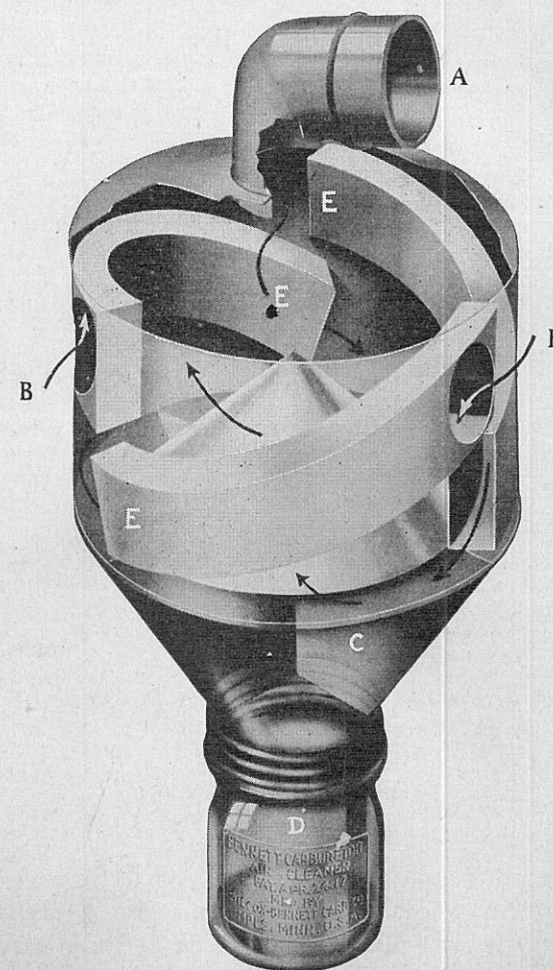


Fig. 11

Cleaning of Glass Jar: Empty dirt out of glass jar as often as necessary. Do not run motor with glass jar full of dirt or with jar removed.

"The Less You Do to Your Magneto the More It Will Do for You"

SEC. 35. CARBON DEPOSIT:

1F. Excessive carbon deposit will affect the operation of the engine. When this condition is brought about, pre-ignition will occur as the heated particles of carbon will set fire to the gases in the cylinder before the spark is formed during the compression stroke. The accumulation of carbon in the grooves of the piston and on the piston rings will prevent the rings from working freely and may cause loss of compression in that way. If carbon is deposited excessively, it will also affect the valves inasmuch as the small particles will collect upon the valves and valve seats and prevent them from seating properly which, in turn, will cause them to leak, meaning further loss of compression.

2F. **Remedy:** Prevention is better than cure for carbon deposit as well as for many other ailments of the gas or kerosene burning engine. To prevent the formation of carbon a good carburetor action is required. Always operate the engine on the opening to give the proper mixture so the motor doesn't smoke or crack at the exhaust. It is also found that an air cleaner is a necessary adjunct to the carburetor to clean the air before it is mixed with the gas. In addition to carbon deposit much foreign accumulation may be traced to dirty air. A good grade of gas-engine cylinder oil should be supplied and only enough oil should be used to thoroughly lubricate the engine. With these conditions, very little carbon will be deposited. Excess oil will show itself by blue smoke at the exhaust. Excess fuel by black smoke.

3F. There is only one real way to remove carbon. Take off cylinder heads and scrape carbon from combustion chamber and top of pistons.

4F. Care should be taken in removing the rings from the grooves in the piston as they are easily broken unless properly handled. See Sec. 42. If the rings are stuck, pour kerosene on them to soften the carbon before attempting to remove. Scrape all carbon from grooves in piston and piston head and combustion chamber.

5F. **Carbon deposits** result usually from one or more of the following causes:

- (a) Overfeeding of lubricating oil.
- (b) Poor grade of fuel.
- (c) Too rich a mixture of fuel.
- (d) Dust drawn into the cylinders through the air intake.
- (e) Badly fitting piston rings.
- (f) Delayed opening of either exhaust or intake valves.
- (g) Defective ignition.
- (h) Poor quality of lubricating oil.

"Know your magneto"

SEC. 36. PRINCIPLE OF IGNITION:

1H. While it is not our intention to give an exhaustive treatise on the principles of ignition and ignition troubles, still we do want to give enough instruction on the care and functions of the magneto and on the various phases of ignition trouble so that the average owner or operator of a Twin City engine will be able to intelligently take care of a lot of small difficulties which he will encounter and will not feel compelled to send his magneto to a service station to have work done which he is amply able to do himself. Read the following paragraphs carefully and understand them; they are very important to you.

2H. **Remember there are three things required** before the engine will run. These three things are absolutely essential. **First**, it is necessary to have a mixture of gasoline and air in the engine cylinders. **Second**, this mixture must be compressed; and **third**, there must be a spark to set fire to the compressed mixture. The third item required to make the engine run is the one which is most difficult to understand, if you are not familiar with electricity.

3H. In order that you may better understand the principles upon which the ignition system is built up and how this system is operated and maintained, it is well to start at the beginning—

4H. The ignition systems used on internal combustion engines at the present time are all electrical systems giving an electric spark which passes into the cylinder of the engine and sets fire to the compressed mixture.

5H. **How electricity is transmitted:** Electricity produced in one place may be transmitted to another place, provided a path is arranged so that it may return to where it started. It will not flow if there is no circuit; that is, a continuous path.

6H. If the circuit is broken, the flow will immediately stop and will not start again until the circuit is once more completed.

7H. If there is any way in which the current may leak from the "lead wire and return to the starting point without going through the entire circuit, it will do so, and this leakage is called a 'short circuit'."

8H. Anything that will permit a current of electricity to pass through it is called a conductor. All metals are conductors.

9H. Substances, such as rubber, china, porcelain, glass, wood, fibre, and mica are called non-conductors or insulators. A wire is insulated to prevent the current of electricity from escaping, by wrapping it with cotton or silk which is soaked with rubber.

SEC. 37. OPERATION OF MAGNETO:

1J. The operation of the magneto (which is the apparatus installed to generate or make the current used in supplying your engine with its ignition or spark), is mechanically automatic. It is installed and geared to your engine as it leaves our plant in such a way that it will supply **the needed current in the right quantity and at the proper time.**

2J. If your motor is not working right, don't jump at conclusions—don't take the magneto apart. Disconnect the high tension wires from spark plugs and hold the terminal A, Fig. 6A, not more than $\frac{1}{8}$ -inch from the plug. Turn the engine over and watch to see if there is a spark. If there is a spark, it is evident the cause of the trouble is in the spark plug. (See Sec. 40.) If there is no spark, it is necessary to inspect the wiring very carefully. Look for loose connections and short circuits.

3J. Inspect the insulation closely as some times the insulation gets worn off from friction so that the bare wire is touching the engine or frame, thus causing a short circuit.

"Study the Timing and Wiring With Care"

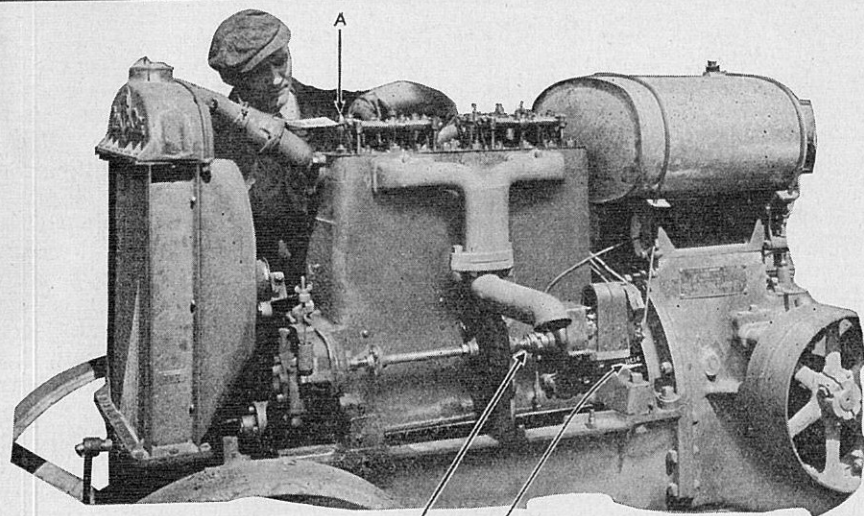


Fig. 12

4J. Ninety-nine per cent of the ignition troubles on any engine will be caused by defective spark plugs or wiring, for these magnetos are built for strength and durability.

5J. If you have any ignition trouble that you cannot correct yourself, take the matter up direct with the nearest magneto service station.

6J. **Important. Caution:** When testing for spark with high tension wire, A, Fig. 6A, removed from plug, do not hold it more than $\frac{1}{8}$ -inch from the plug. Under no circumstances should the wire be more than $\frac{1}{8}$ of an inch from the plug when the circuit is on and the engine turning over. This practice will ruin the coil in magneto.

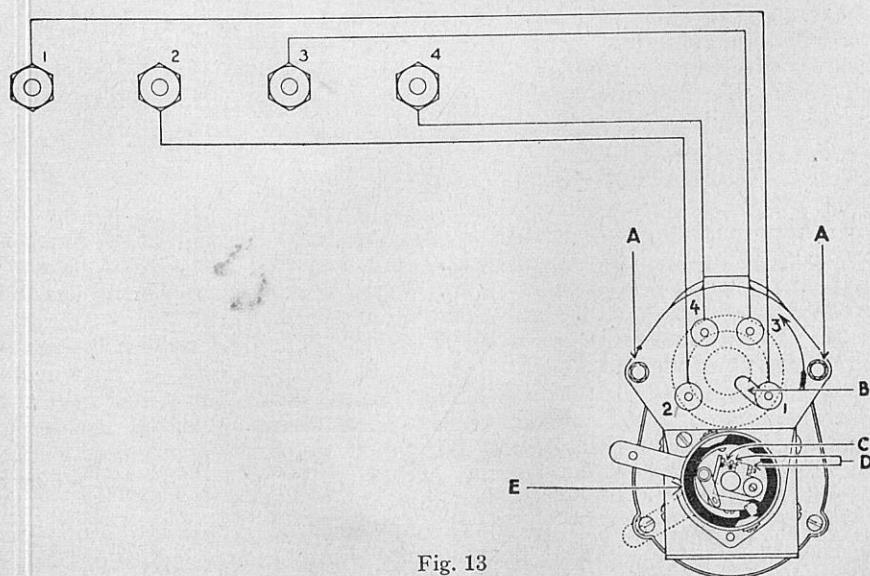


Fig. 13

"Have All Your Electrical Connections Tight"

7J. When the breaker points C, Fig. 13, fail to separate, or when the distance is too far apart, remove breaker box cover and adjust parts D, Fig. 13, with small wrench. The proper distance apart is $\frac{1}{64}$ of an inch. A gauge is sent with every magneto. Remember the firing point of the magneto is just when the points are beginning to open or break circuit, not when they close.

-To Time the Magneto:

8J. It will be necessary to take the hood from the top of the cylinders A, Fig. 6, and also remove the cover over the valves. Then turn the engine over until the mark on flywheel C 1 and 4 is in line with the pointer under magneto B, Fig. 12, and all the valves are closed in cylinder No. 1, A, Fig. 12. (Cylinder No. 1 is next to the radiator.) Take off distributor cover A, Fig. 13, and open circuit breaker cover. Place circuit breaker housing E, Fig. 13, in retard position. Moving breaker box in direction of rotation of armature shaft retards it, moving it against direction of rotation advances it. Then move magneto coupling by hand slowly to the left (direction of rotation) until contacts C, Fig. 13, are just beginning to separate and the distributor brush is opposite the lower left hand terminal post B, Fig. 13, which connects with cylinder No. 1, at this point the impulse starter also trips (See Sec. 38). This is the firing point of the magneto and the spark must occur through this contact when piston No. 1 is at its highest point. Secure magneto by tightening the three cap screws A, Fig. 16. A, Fig. 16, shows the construction of the coupling.

9J. Crank engine over and see that it trips just as the C2 and 3 mark on the flywheel is in line with the pointer under magneto B, Fig. 12.

10J. When timing a magneto or replacing one, first bolt magneto to the bracket and then bolt bracket to engine.

Important: Be sure to see that magneto shaft is in true line with pump shaft.

11J. When one cylinder is all right, proceed to connect the others as shown in Fig. 13. The firing order of the cylinders is 1-3-4-2, counting No. 1 cylinder from the radiator end of the engine. Replace parts on magneto seeing that all nuts and bolts are tight, then crank engine to test setting.

12J. When wiring the magneto to spark plugs, you will notice at the spark plug end of terminal file marks to indicate which cylinder the wire should be attached to. Thus, one file mark would mean that the wire should be attached to No. 1 spark plug which is the nearest one to the radiator. The opposite end of wire should be placed on No. 1 terminal on magneto, distributor block, Fig. 13; and so on until the four wires are attached to magneto face and to spark plugs, as shown in diagram, Fig. 13.

13J. Look into the distributor box and see that it is free from carbon dust.

14J. Open up the circuit breaker and see that there is no oil and that no oil is on the contact points. The proper adjustment for these points is $\frac{1}{64}$ of an inch maximum opening when they break.

Care of Magneto:

15J. Once a week clean out the distributor A, Fig. 13, with a soft cloth, removing any carbon dust that may have worn off the carbon brush B,

"Don't Tinker"

Fig. 13. Remove the circuit breaker E, Fig. 13, and clean out all surplus oil; make sure that the contact points are clean, and that no oil has lodged on them. Oil on the breaker points forms an insulation and will cause hard starting and engine missing at low speed. Replace parts and see that breaker points C, Fig. 13, are open 1-64 of an inch.

19J. A Few Don'ts:

(a) Don't take off the magnets unless absolutely necessary. When dis-assembling a magneto, a keeper (being any piece of steel) must be placed across the magnets before removal from the magneto. If, for any reason, it should be necessary to re-magnetize or repair a magneto, have the instrument returned to the nearest Bosch Service Station unless the service of a competent magneto man can be procured.

(b) Don't fill the breaker box with grease, vaseline or oil.

(c) Don't solder new contact points to the old parts of contact breaker as solder spoils the contacts. In replacing contact points, get entire new parts direct from the nearest Bosch Service Station.

(d) Don't get busy to adjust the breaker box as soon as trouble develops. The trouble is very rarely found in the adjustment of the circuit breaker of the magneto and if you take the time to check up the system completely, in nine cases out of ten the difficulty will be located elsewhere.

(e) Don't **tinker** with the circuit breaker adjustment unless the points either fail to separate or the gap is too great. The proper distance for the points to open is about 1-64 of an inch.

(f) Don't hammer on end of magneto shaft, nor attempt to force gears or couplings on if too tight, as this is liable to put bearings out of adjustment.

20J. When sending magneto to a Bosh Service Station for repairs, don't fail to prepay express and mark your name on box as well as write a letter giving serial number of the magneto.

21J. **"Advance" and "Retard" of Spark:** In regular operation, the spark is timed to ignite the compressed charge just an instant before the piston reaches the top of its compression stroke. Thus, when you "advance" the spark, you time the explosion to take place earlier than this; that is, while the piston is rising. When you "retard" the spark, you time the explosion to take place after piston has reached the top of its compression stroke and is descending again. For instance, if you are cranking by hand, you want the explosion to take place when the piston is descending so as to prevent any chance of back-kicking. Therefore "retard" the spark.

22J. Don't advance the spark or throw open the carburetor throttle too quickly. This is hard on the engine.

23J. If spark plugs are changed, be sure they are of proper length to reach cylinder. See Sec. 40. Always test plugs before placing in cylinder by passing current through them. Holding cable in hand, place threaded part of plug on engine and crank engine over. A hot, blue spark should show at spark plug points.

"Use the Right Type of Spark Plugs—It Makes a Difference"

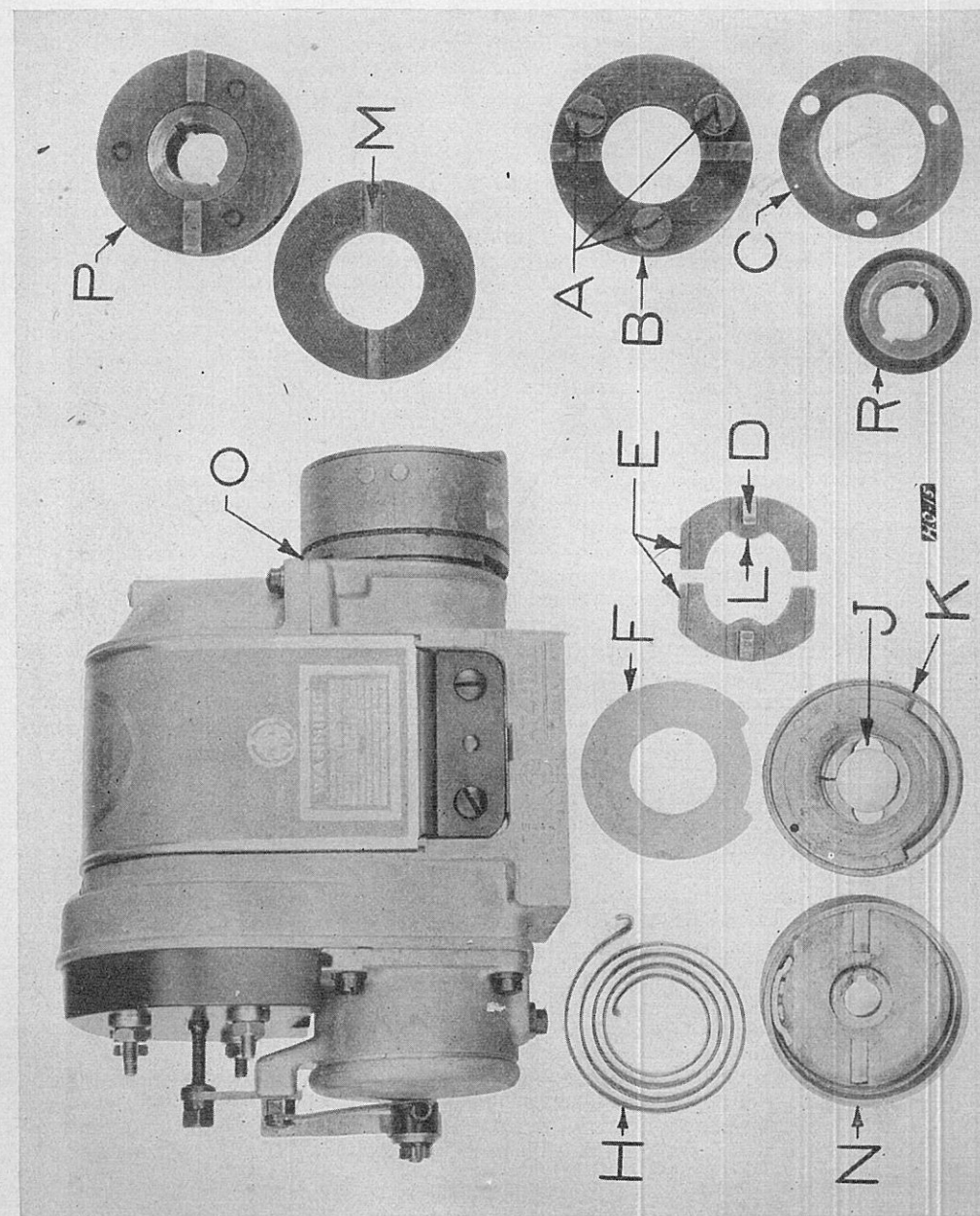


Fig. 16

"Listen for Impulse Starter to Trip"

MAGNETOS USED

All magnetos used on Twin City 17-28 (formerly 12-20) and 27-44 (formerly 20-35) Tractors are American Bosch; the different types used were as follows:

On Twin City 17-28 (formerly 12-20) Tractors, Type DU4 was used to Motor 15760; Type AT4 from Motor 15761 to Motor 18666, and Type ZR4 from Motor 18667 to the present time.

On Twin City 27-44 (formerly 20-35) Tractors, Type DU4 was used to Motor 5436; Type AT4 from Motor 5437 to Motor 200,008, and Type ZR4 from Motor 200,009 to the present time.

GENERATION OF CURRENT:

Like other high tension Magnetos manufactured by the American Bosch Magneto Corporation, the ZR types generate high tension current directly in the magneto armature (the rotating member of the magneto) without the aid of a separate step-up coil, and have their timer and distributor integral.

The armature winding is composed of two sizes of wire, one size comparatively heavy and the other very fine. The heavy wire constitutes the primary or low tension circuit, and the very fine wire the secondary or high tension circuit.

The rotation of the armature between the poles of strong permanent magnets sets up or induces a current in the armature primary circuit, and this is further augmented at regular intervals, in the rotation of the armature shaft, by the abrupt interruption of the primary circuit, by means of the magneto interrupter. At the opening of the primary circuit, the resulting discharge of current from that circuit induces a current of high voltage in the armature secondary circuit. The high tension current thus created is collected by the collector ring on the armature and passed through the collector brush, then to the various magneto distributor terminals, each of which is connected by cable to the spark plug in its respective cylinder. See circuit diagram.

THE SAFETY SPARK GAP:

In order to protect the armature and other current carrying parts, a safety spark gap is provided. This safety gap consists of two pointed metal electrodes, the one set inside the waterproof hood of the collector brush holder, the other set in the top of the magneto frame.

Under ordinary conditions, the current will follow its normal path to the spark plug, but if for any reason the electrical resistance in the secondary circuit is increased to a high point, as when a cable becomes disconnected or a spark plug gap too wide, the high tension current will discharge across the safety gap.

The current should never be allowed to pass across the safety spark gap for any length of time, and if the engine is operated on a second or auxiliary ignition system, the magneto must be grounded in order to prevent the production of high tension current. The snapping sound by which the passage of the current across the safety gap may be noted should always lead to an immediate search for the cause of the difficulty.

"Keep an Extra Set of Spark Plugs on Hand"

CARE AND MAINTENANCE:

Lubrication: Aside from keeping the magneto clean externally, practically the only care required is oiling of the bearings; of these, there are two ball bearings supporting the armature, and a single plain bearing supporting the shaft of the distributor gear.

Any good, light machine oil may be used for this purpose (never use cylinder oil), and each of the oilers should receive not more than two or three drops every week.

These magnetos are furnished with ball oilers and it is advisable to wipe off any dirt that may have accumulated before pushing the ball down with spout of the oil can. The interrupter is intended to operate without lubrication, and as oil on the platinum interrupter contacts will prevent good contact, cause sparking and burning, as well as misfiring, care should be exercised to prevent the entrance of oil to these parts.

STARTING THE ENGINE:

Engines equipped with ZR magnetos should be cranked with the spark lever slightly advanced. If the magneto has been timed according to instructions, the spark lever may be safely advanced about one-third.

TROUBLE:

Cause and Remedy: In case of defective ignition it must first be determined whether the fault is in the magneto, or as is more probable, elsewhere. In general when only one cylinder misfires, the fault is in the spark plug, the most common plug difficulties being as follows:

Plug Gap Too Wide: The distance between the electrodes of the spark plug varies according to the individuality of the engine, but normally this distance should not be less than 1-50th inch. On the other hand, however, too wide a gap increases the electrical resistance, and interferes with the proper generation of current at low speed. Difficulty in starting an engine and missing at low speeds are very often due to the spark plug gaps being too wide and, as the spark will have a tendency to burn the electrodes and thereby gradually increase the gap, it is especially important that the plugs be examined occasionally to see that the gap is not too great; any difficulty due to this cause may be readily overcome by readjusting the electrodes.

Plug Short-Circuited: This is usually caused by a cracked or porous insulator, or by fouling of the electrodes or insulator. Any of these conditions will cause misfiring by permitting the current to stray from its intended path.

Cables: Misfiring of one cylinder, either continuous or intermittent, may be due also to a chafed or broken cable or a loose cable connection. The metal terminals of the cables must not come into contact with any metal parts of the engine or the magneto, except those designated as being correct according to the instructions given.

Irregular Firing: If the cables and plugs are in good condition, and yet the ignition is irregular, the trouble is probably with the magneto, and the interrupter should be carefully examined. It should be seen that the interrupter lever moves freely on its pivot and that the hexagon headed fastening screw in the center of the interrupter is properly tightened.

Platinum Interrupter Contacts: The platinum interrupter contacts should be examined for the correctness of their adjustment, and they should be so set that they are separated by a distance of 0.4 of a millimeter (about 1-64th inch) when the fibre block in the interrupter lever is resting in the

"Study your Engine"

center of either of the cams in the interrupter housing. The strip of steel attached to the magneto adjusting wrench, which is furnished with each magneto, is to be used as a gauge for this distance. The adjustment of the platinum interrupter contacts may be made by loosening the lock nut of the long contact screw, which passes through the interrupter contact block, and turning the hexagon head of the screw itself with the magneto adjusting wrench. When the adjustment is made, care should be taken to tighten the lock nut firmly.

The platinum contacts of the interrupter should be clean and in proper alignment with each other, and any oil, grease or dirt that is deposited on them should be removed. If they are uneven or in bad condition (but only then) they may be smoothed by means of a fine, flat, jeweler's file.

Damaged Insulating Parts: As it sometimes happens that brush holders and other insulating parts of the magneto are damaged through accident or other carelessness, these parts should also be carefully examined for possible disarrangement or damage of the insulation which might permit leakage of current.

Return of Magneto: If your Bosch Magneto will not give a spark after you have made the adjustments outlined, DO NOT TAKE IT APART, but take it to the nearest Official American Bosch Service Station.

Driving Speeds—Installation: Since the magneto produces an ignition spark only at certain definite points in the rotation of its armature, it must be connected to the engine in such a manner that the spark is available always at the instant when required in the cylinder; i. e., about top dead center of the compression stroke. The magneto, therefore, must be positively driven from the engine by a chain or gears. The Type ZR 4 magneto must be driven at engine speed (crank shaft speed) for four cylinder, four cycle engines.

Timing the Magneto: The crank shaft is rotated to bring the piston of No. 1 cylinder (the nearest cylinder to the radiator) exactly on top dead center of the compression stroke, and the piston is to be maintained in that position. The magneto is then to be secured to its bracket or bed on the engine, and the timing control arm on the interrupter housing placed in the fully retarded position. With that done, the magneto distributor plate should be removed exposing the distributor gear and brush. The cover of the magneto interrupter housing is also to be removed to permit observation of the interrupter. The Armature should then be rotated by means of the exposed distributor gear in the direction in which it is to be driven, until the platinum interrupter contacts are just about to separate, which occurs when the interrupter lever begins to bear against one of the steel segments of the interrupter housing.

The armature should be held in that position while the magneto drive is connected to the engine, due care being taken that the piston of No. 1 cylinder is still exactly on top dead center of the compression stroke. The installation is completed by replacing the interrupter housing cover and distributor plate, and connecting the cables between the magneto and spark plugs.

The Guarantee is Cancelled on all Bosch Products that are repaired with imitation parts. The corporation cannot vouch for efficient or satisfactory operation when bogus parts are used. In fact, trouble may be expected soon after imitation parts are placed into service.

SEC. 38. INSTRUCTIONS FOR BOSCH IMPULSE STARTER:

1K. This impulse starter is automatic. Its action depends on centrifugal force like the flyball of a governor.

2K. At N, Fig. 16, is boss or projection which comes into contact with the trigger D, Fig. 16, on the back of the flyball weights E, Fig. 16. This holds the armature in the magneto from turning but permits the floating member K, Fig. 16, of the impulse starter to turn. This winds the spring H, Fig. 16, and the starter cam J, Fig. 16, on the floating member, comes in contact with the projection L, Fig. 16, on the weights. This raises the weights high enough to allow the trigger D, Fig. 16, to pass the projection N, Fig. 16, and the spring drives the armature forward at a rapid speed producing a good spark for starting. When the engine starts the speed of the coupling causes the weights E, Fig. 16, to fly apart and the trigger D, Fig. 16, on the weights, clears the projection D, Fig. 16, and the entire assembly revolves as a unit.

P, Fig. 16 is the complete coupling made up of the following parts: A is the three screws which hold the coupling together after it has been properly timed. B is the plate, C is the outer cover and R the inner cover. M is the friction plate.

3K. F, Fig. 16, is a space plate and goes between the weights and the spring so that the spring cannot bind the weights.

4K. **Care and Maintenance:** The Bosch Impulse Starter Coupling requires no attention whatsoever with the exception of a few drops of oil every four or five weeks through the opening at O, Fig. 16.

SEC. 39. WIRING:

1L. In making connections, a connection should be filed or scraped bright before attaching the wire.

2L. See that all binding posts, screws and the ends of the wire are scraped clean before the wire is attached.

3L. Make all connections as firm as possible and use pliers to tighten the binding screws. The best connections are made by brass or lead terminals soldered to the ends of the wires.

4L. **IMPORTANT:** Mark your wires and save yourself lots of trouble. It often happens that an owner looking for trouble in his ignition system disconnects several wires without realizing that he has work before him when it comes to replacing the wires upon their proper connections.

SEC. 40. SPARK PLUGS:

1M. Always keep an extra set of plugs on hand. Do not use too much leverage in screwing in spark plugs because a broken or cracked porcelain may cause lots of trouble.

2M. In placing the spark plugs care should be taken to have the end of the plug come flush with the inner surface of combustion chamber, Fig. 18. If this projects too far into the combustion chamber, Fig. 18, the end of the plug will be exposed to heat and is apt to cause pre-ignition. On the other hand, if end of plug does not come even with the inner surface, Fig. 18, it forms a pocket for carbon deposits.

3M. Care should be taken to see that upper part of plug and terminal project far enough ($\frac{1}{8}$ ") beyond cylinder head so that spark can not jump from the secondary cable connection to the cylinder wall, thus causing a short circuit under heavy load, A, Fig. 18.

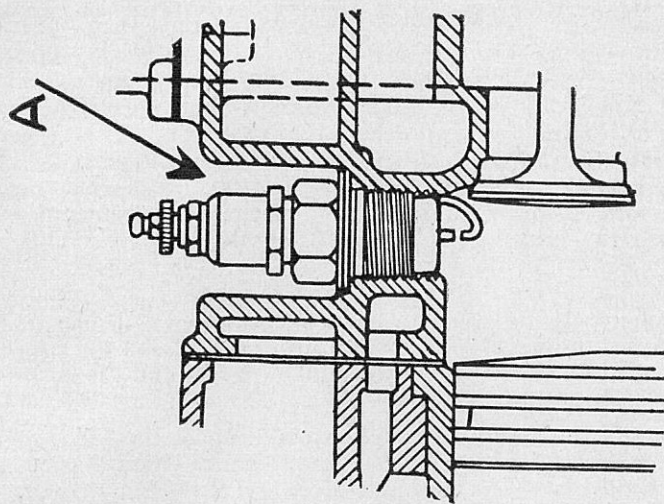


Fig. 18

4M. To test spark plugs, place them on the cylinder with cables connected and crank the engine slowly. If spark occurs at the gap, the plug is not faulty, although this should not be regarded as an absolute test.

5M. A plug placed on top of the cylinder and connected up electrically may spark all right at the gap, but when screwed in the cylinder and under compression, the current will leak through the defective porcelain and not jump the gap. The reason for this is that air is an insulator and when a cylinder has 68 pounds (cold air) compression, it would be five times as hard for the electric current to jump the gap as it would be in the open air.

6M. If the porcelain in the plug becomes coated with carbon, the electric current will follow the carbon and not jump the gap between the points. Defective porcelains are hard to detect.

7M. The following are common causes of spark plug trouble:

- A. Porcelain cracked.
- B. Insulation oil soaked.
- C. Carbon deposits.
- D. Porcelain loose.
- E. Gasket broken or leaking.
- F. Spark gap too close or too wide.
- G. Plug loose in cylinder.
- H. Points burned or corroded.
- I. Cable loose from terminal.
- J. Dirty spark plugs—remove and clean plug with gasoline.
- K. Oil or water between plug points.
- L. Poor lubricating oil (which causes carbon on end of plug and short-circuits spark.)

SEC. 41. COOLING SYSTEM:

1N. The proper cooling of an engine is a very important feature of its design and construction. To obtain the greatest degree of fuel economy and engine efficiency, the water in cylinder jacket should always be of a temperature slightly under the boiling point of water.

"Keep Your Fan Belt Adjusted"

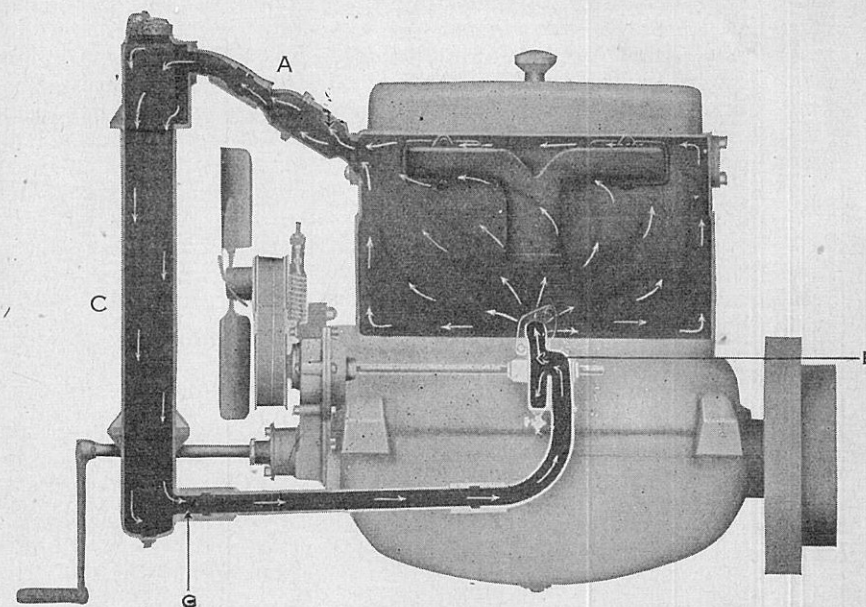


Fig. 19

2N. All Twin City engines are cooled by a forced circulating system using a centrifugal water pump, B, Fig. 19. This pump draws the water out of the radiator C, Fig. 19, and forces it into the engine through water connection, G, Fig. 19. The water then flows around through the cylinder water jackets, as shown by arrows and out through the water manifold located on top of the cylinder to the radiator, A, Fig. 19.

4N. Always keep the fan belt tight to insure that the fan performs its proper cooling action. Serious engine trouble may result if these parts are out of action for even a short period. To tighten fan belt, increase tension on spring, D, Fig. 8.

5N. **Water Pump:** Always keep water pump stuffing box screwed up to avoid leakage.

6N. **Note:** The packing in stuffing box should be renewed whenever necessary to avoid leaking.

7N. **Never fill radiator with cold water while engine is hot, cracked cylinder heads may result.** In cold weather, the water should always be drained through the valve located just below the radiator, when engine is shut down for long periods. Also open petcock and see that water flows out of the water pump.

8N. Cold weather offers certain problems to all tractor owners. These are not much of a handicap to the experienced tractor operator but are likely to be to the man who is running his tractor during the winter for the first time. These problems are:

"Watch Closely for Loss of Compression"

First—Danger of water in the cylinder jacket freezing with consequent cracking of the cylinder. Remedy: Drain thoroughly.

Second—Faulty lubrication due to the sluggish action of oils when cold. Remedy: Use lighter oil. (See Sec. 30.)

Once a month wash out Radiator. Dissolve $\frac{1}{2}$ # Sal Soda in a gallon of water. Drain radiator and fill with clean rain water. Add dissolved Sal Soda and run engine with Radiator covered about 30 minutes. Then drain and fill with fresh rain water.

Use rain water if possible in radiator.

9N. Cooling System Troubles: Causes

Remedies

- | | |
|--|-------------------------------------|
| A. Insufficient amount of water in radiator..... | Fill. |
| B. Suction hose collapses..... | New hose. |
| C. Circulation pump impeller becomes loose on shaft..... | Examine. Re-pin. |
| D. Fan belt may become loose and slip..... | Tighten spring. |
| E. Water jackets and passages may get clogged with foreign matter..... | Clean out and use clean rain water. |
| F. Radiator may freeze if not drained at night in cold weather..... | Important —Be sure to drain. |
| G. Fan blades sometimes get bent out of shape and thus do not work well..... | Examine and straighten. |

10N. The water may boil in radiator for any one of the following reasons:

Causes

Remedies

- | | |
|---|--------------------------------------|
| A. Spark is over-retarded..... | Advance spark. |
| B. Valves are not timed correctly. | See Sec. 42, Par. 13P to 22P. |
| C. Fan is not working..... | Examine belts and bearings. |
| D. Oil is too light, too thick, or thin..... | Examine. See Sec. 30. |
| E. Cylinders will not cool. This means scored cylinder sleeves with subsequent loss of power..... | Examine. If scored, replace sleeves. |
| F. Waterpump clogged..... | Examine and clean. |
| H. Dirt in system..... | Clean. |

SEC. 42. COMPRESSION:

1P. Compression is one of the most important factors in the power developed in internal combustion engines. Its greatest enemy, friction and wear, occur in all related parts such as cylinders, pistons, piston rings, valves and valve seats. The greatest cause of this friction and wear is improper lubrication or the use of poor oil due to carelessness or the indifference of the operator. (Other minor causes, which might induce loss of compression, have been covered in foregoing text.)

"Use Block on Cylinder Sleeve When Driving in New One"

2P. **Cylinders:** Proper adjustment and function of all related parts added to conscientious attention to your lubricating system and the use of good oils of proper body will lengthen their term of service.

3P. Recognizing that even under ideal conditions wear in the cylinder walls must occur, Twin City engines have been provided with removable sleeves, B, Fig. 21, and when these become worn, by removing the cylinder head and pistons these sleeves can be removed and replaced with new ones.

To remove cylinder sleeves:

It will be necessary to use Twin City sleeve puller, number TW-1515: for method of using same see Fig. 21 and Fig. 21A.

To put in new cylinder sleeves:

Place the sleeve in cylinder casting and see that it fits into the seat squarely, Fig. 21. Drive it lightly all around the circumference. Be sure to use a block of wood between the hammer and the sleeve. The sleeve is cast iron and if a block is not used to drive on, it will break. When the new sleeve is driven in as far as it will go, it will be about 1-64 of an inch higher than cylinder casting. This must be filed off very carefully, do not get it lower than top of cylinder casting and do not mar the cylinder casting. Use a straight edge for checking the height of the sleeve, this is a mechanical job and care must be exercised. Thus, by placing a new sleeve in the cylinder and fitting your pistons with new piston rings, you can maintain the compression in your engine at as high a point of efficiency as when the engine was new.

4P. **Piston and Piston Rings:** These must slide up and down the cylinder chamber many thousands of times, therefore, the pistons have been made a trifle smaller than the bore of the cylinders. This difference in sizes

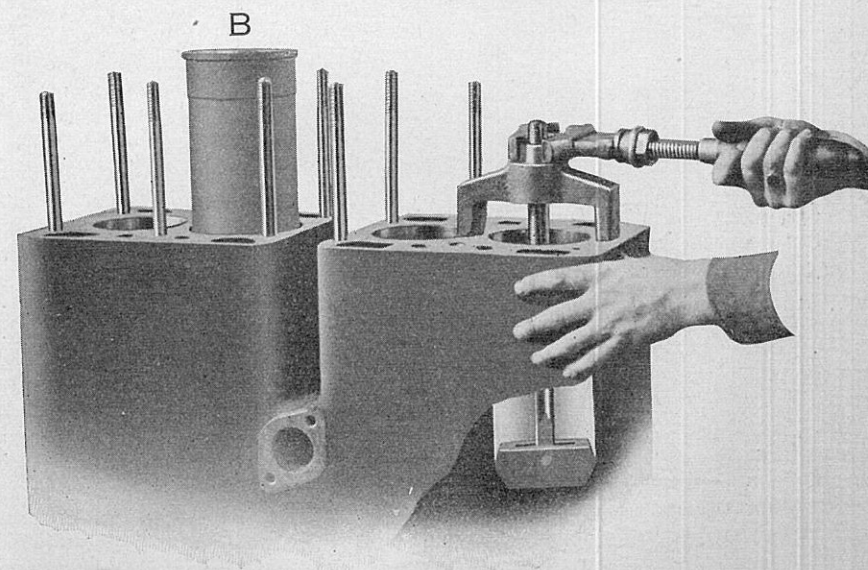


Fig. 21

"Do Not Use Pliers on Brass Fittings"

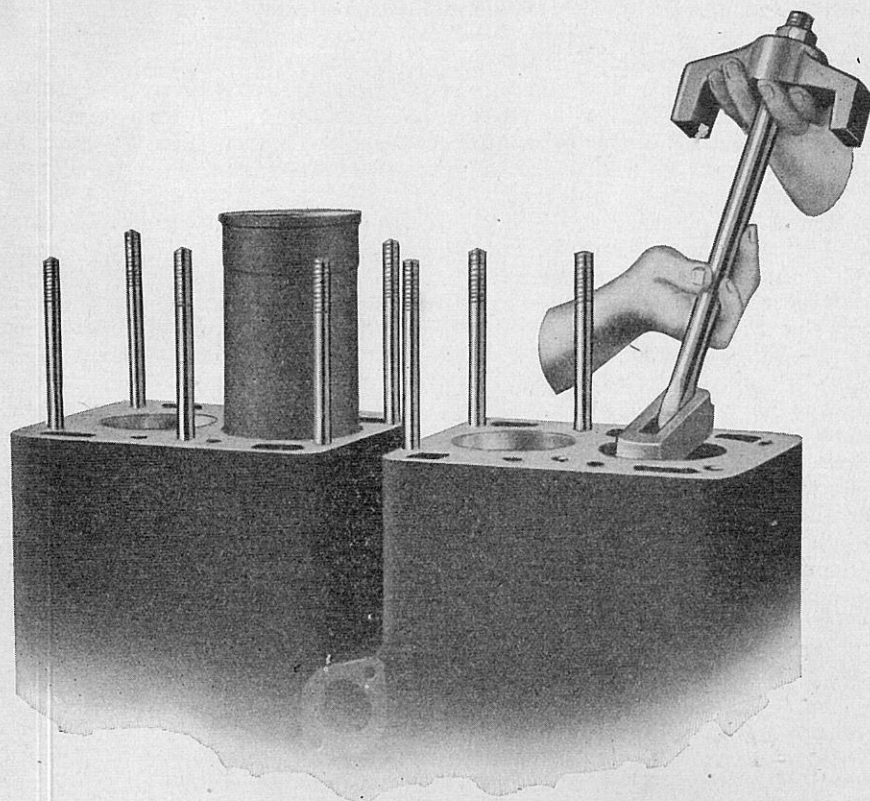


Fig. 21A

would result in allowing compressed fuel to escape down the cylinder walls. Therefore, fitted to each piston near its upper edge in small grooves are a series of rings called "piston rings." These rings are just a trifle larger in diameter than the inner walls of the cylinder chamber and, being made of a springy material with an opening in their side, when set into piston grooves, they form an adequate contact with inner cylinder wall and the compressed fuel (both during compression and firing) cannot escape. See Fig. 22.

5P. Loss of Compression: Should loss of compression occur, two causes are possible, leaky piston rings, or leaky valves or valve seats. (We will deal with the valves later.)

6P. To Determine Which Piston Is Leaking: Remove the side cover plates of crank case, H & J, Fig. 2, and listen carefully for the noise of escaping gas between the piston rings and cylinder wall while someone is turning over the crank of the engine against compression. Examination should be made after the engine has been running with everything in working order and properly lubricated. A small leakage may be stopped for the time being by giving the engine more oil.

7P. If a piston ring leak is found and it becomes necessary to remove a piston (providing there are no valves to be ground), it can be taken out without removing the cylinder head. First unbolt radius rod at H and B,

"Remember, Piston Rings Break Easily. Handle Them With Care"

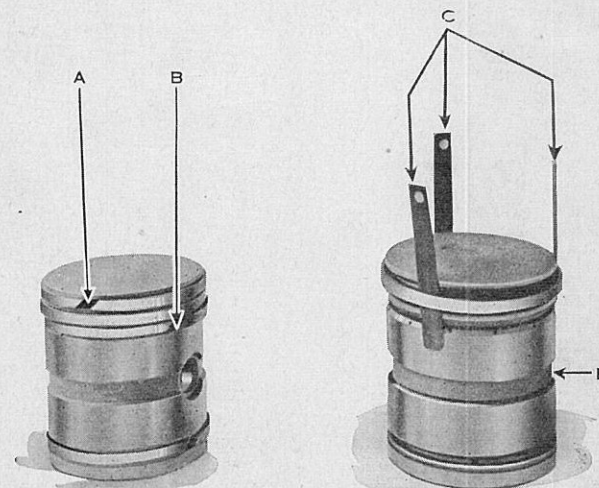


Fig. 22

Fig. 23, and take off reach rod, K, Fig. 23. Unscrew oil pipe at F, Fig. 23, (do not use a pair of pliers or pipe wrench in removing this pipe, use open end wrench), then proceed to unscrew the screws around the edge of motor base and base oil pan will come off exposing the crank shaft, connecting rods and cam shaft bearings. Now turn crank shaft so that the desired piston is down, then unscrew bolts on connecting rod cap and remove the cap. Then turn crank shaft so the pistons are in the middle of the cylinder. Push connecting rod to be removed up above crank shaft bearing, move it to one side. Now allow piston and connecting rod to drop below the cylinder walls and your connecting rod and piston is out. Fig. 24.

8P. If black spots are found on the rings, or if there are rough spots on the surface or at the ends where the ring joins together, the ring should be replaced by a new one. In replacing ring, the new ring should fit in the groove of the piston so that it will not bind. The end of rings where they join should have a clearance of 1-64 of an inch when fitted into cylinder. After replacing the defective ring, the piston may be put back in the engine in the same way in which it was taken out. On the lower inner edge of all cylinders will be found a slight taper. This taper is to compress the rings, but before attempting to force the piston in, see that the rings are placed centrally around piston groove and not out far enough to catch on the edge of cylinder; also see that openings are spaced equally as at A and B, Fig. 22.

9P. Replacing Piston Rings on Piston: Safe method of slipping rings into their grooves. Take three strips of metal (See C, Fig. 22). Slip the ring over these strips until opposite groove into which the ring is to go, then remove strips. These strips may also be used to remove rings. In placing the rings, care should be taken not to have the joints all on one side of the piston A and B, Fig. 22.

"Do Not Forget 'G' Means Grease"

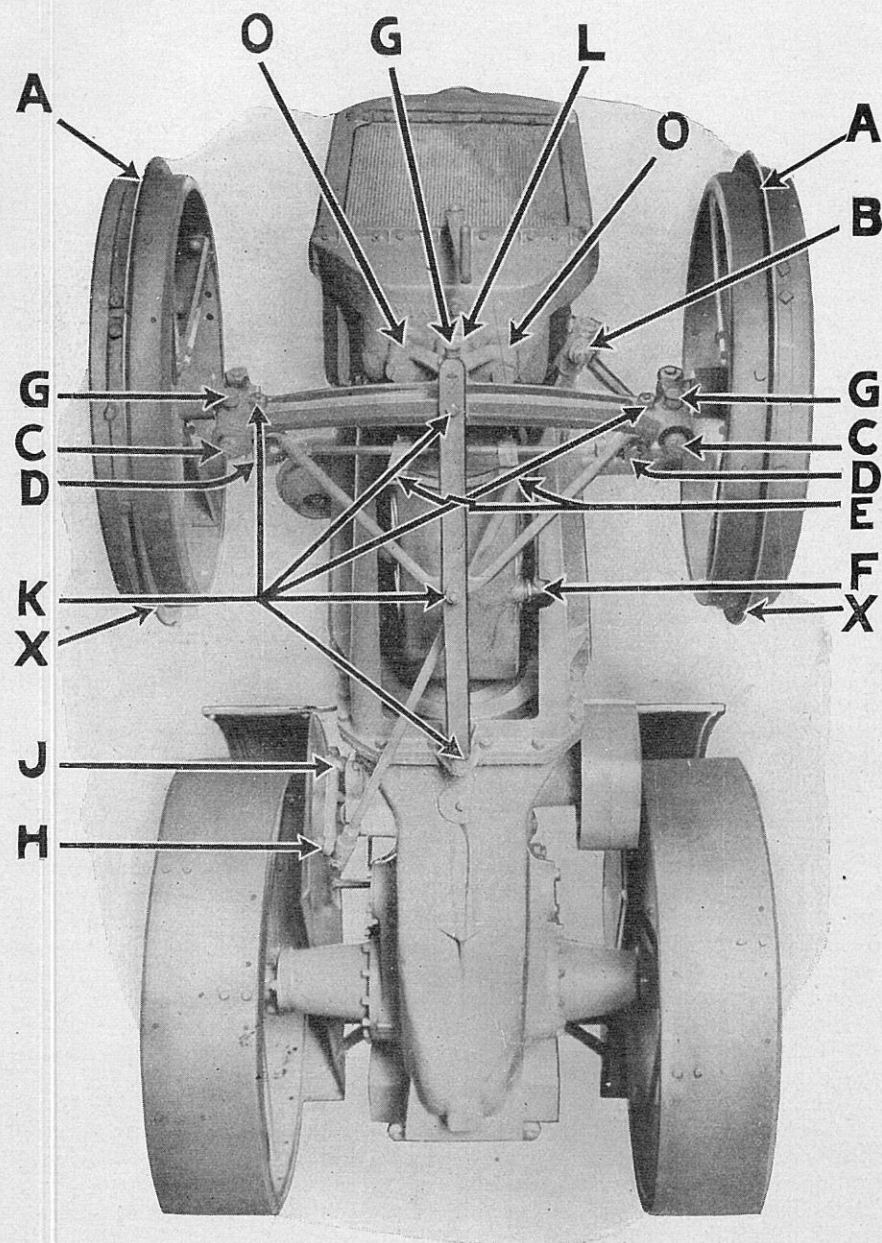


Fig. 23

"Study Your Valve Action Carefully"

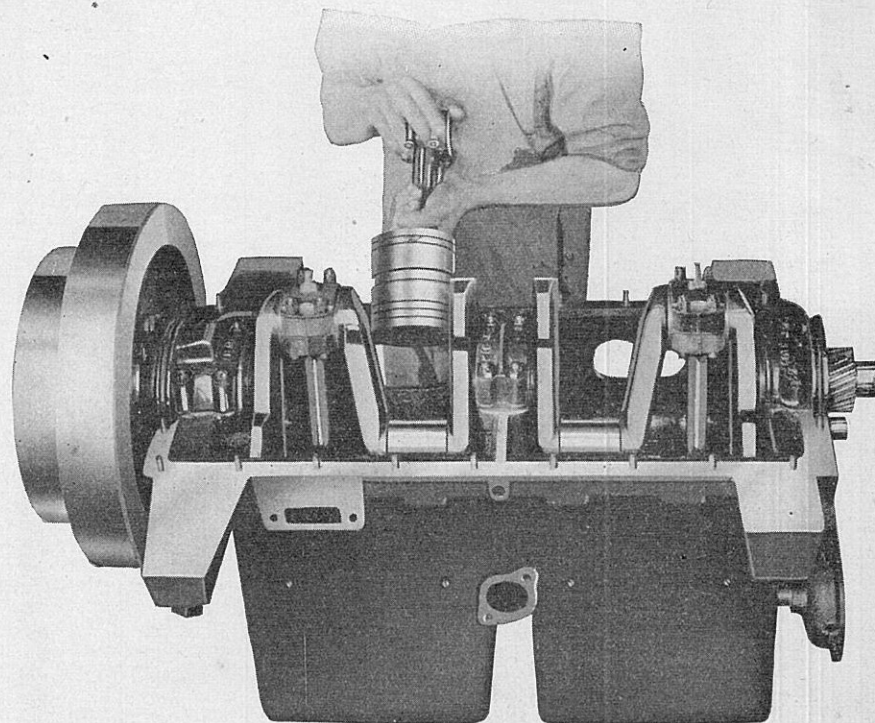


Fig. 24

10P. Fitting Rings to Cylinder: It is sometimes necessary to renew the rings after an engine has been run for some time. In this event it will be necessary to purchase over-sized rings for the reason that the grooves in the piston wear a little wider than the standard rings.

12P. Piston Lubrication: For the purpose of properly lubricating the piston pin, Fig. 25, the piston has a recess turned around the circumference of piston, at piston pin, E, Fig. 22. The piston pin is hollow and also has two holes, B, Fig. 25, through the under side near the center which lead to the bearing for the connecting rod.

This construction serves three purposes:

First—The recess conducts and distributes the oil evenly around the pistons.

Second—The surplus oil which would otherwise pass up into the combustion chamber and be carbonized is caught by this recess and is led into the hollow piston pin.

Third—The oil thus collected in the piston pin runs through the holes in the lower side and keeps the piston pin bearing perfectly lubricated under all conditions.

13P. Purpose of Valves: There are four valves to each cylinder, two inlet valves and two exhaust valves. The inlet valves admit fresh vaporized

"It's Simple to Understand"

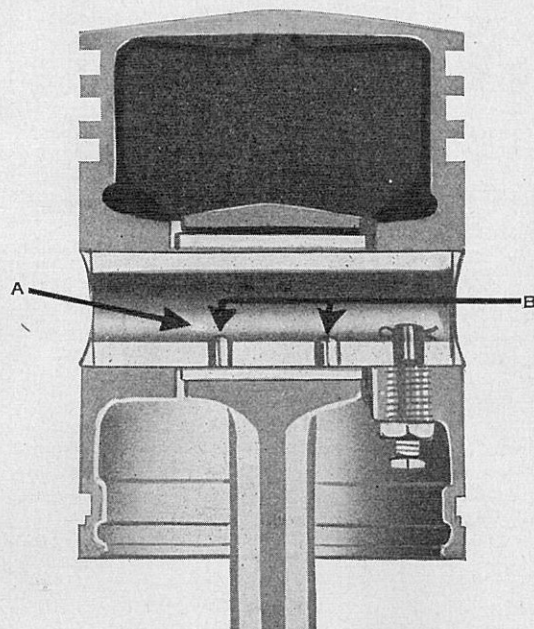


Fig. 25

fuel to the cylinder. As fresh fuel is going to the cylinder during only one stroke of every four the inlet valves are opened once during every cycle, or in other words, once during every two revolutions of the crank shaft. The exhaust valves permit the burned and useless gas to escape and are automatically opened by a cam shaft once in every two revolutions of the crank. To accomplish these functions properly, it becomes necessary to adjust or time the valves. This can be done in the following manner:

14P. Valve Timing: Twin City engines operate on what is known as the four stroke cycle. (Commonly called four cycle.) By a cycle is meant a succession of evolutions in a cylinder with a single charge of explosive mixture.

Fig. 26. Suction stroke down, the intake valves, A, are opened and the gas is drawn into the cylinder. Exhaust valves, B, are closed.

Fig. 27. Compression stroke up, the intake valves, A, are closed and the gas is compressed. Exhaust valves, B, are closed.

Fig. 28. Power stroke down, the spark is delivered through plug and gas burned. Both valves A and B are closed.

Fig. 29. Exhaust stroke up, the exhaust valves, B, are opened and the burned gases are forced out. Intake valves, A, are closed.

15P. To move a one cylinder engine through the evolutions of a cycle, would require two revolutions of the crank shaft which would then move the piston in the cylinder twice up and twice down. A four cylinder engine completes a cycle in one of four cylinders every one-half revolution. It must be remembered that there are four strokes to a cycle and there are four cylinders. The cams on the cam shafts are so arranged that when the piston in cylinder No. 1 goes down on power stroke, the piston in cylinder No. 2 comes up on exhaust and the piston in cylinder No. 3 comes up on compression and the piston in cylinder No. 4 goes down on suction stroke.

"Try Again"

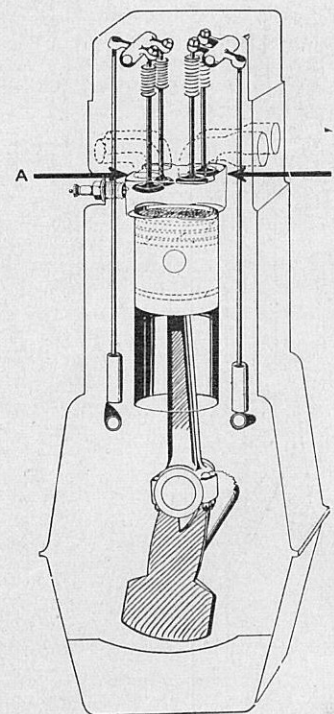


Fig. 26

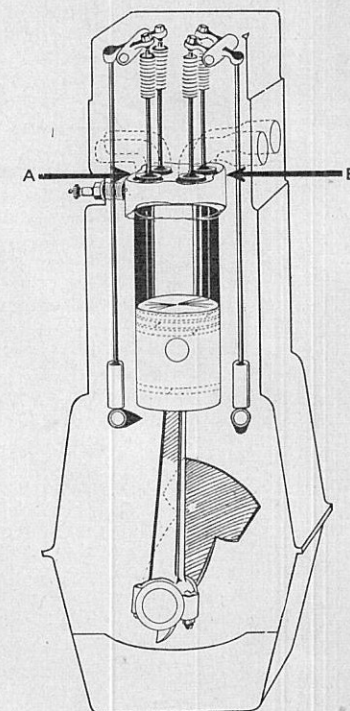


Fig. 27

17P. The opening and closing of valves are figured in degrees and the flywheel being a circle makes it a very convenient and practical place to mark the time when valves should open or when they should close.

Twin City engine flywheels are marked on the inner side next to engine as follows:

1. C. 1-4. Meaning Center 1 and 4.
2. C. 2-3. Meaning Center 2 and 3.
3. EX. OPN. 1-4. Meaning Exhaust Open 1 and 4.
4. EX. CLO. 1-4. Meaning Exhaust Closes 1 and 4.
5. INT. OPN. 1-4. Meaning Intake Open 1 and 4.
6. INT. CLO. 1-4. Meaning Intake Closes 1 and 4.
7. EX. OPN. 2-3. Meaning Exhaust Opens 2 and 3.
8. EX. CLO. 2-3. Meaning Exhaust Closes 2 and 3.
9. INT. OPN. 2-3. Meaning Intake Open 2 and 3.
10. INT. CLO. 2-3. Meaning Intake Closes 2 and 3.

"Valve Timing"

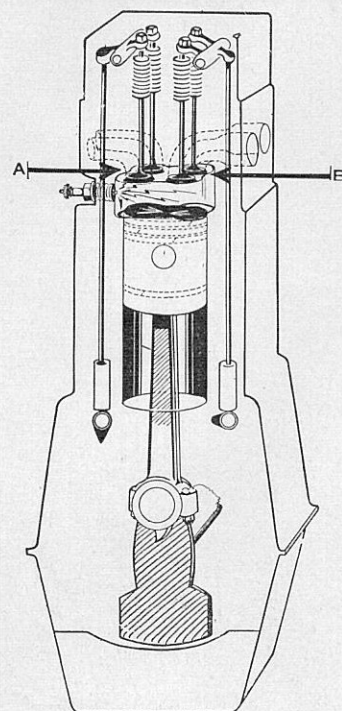


Fig. 28

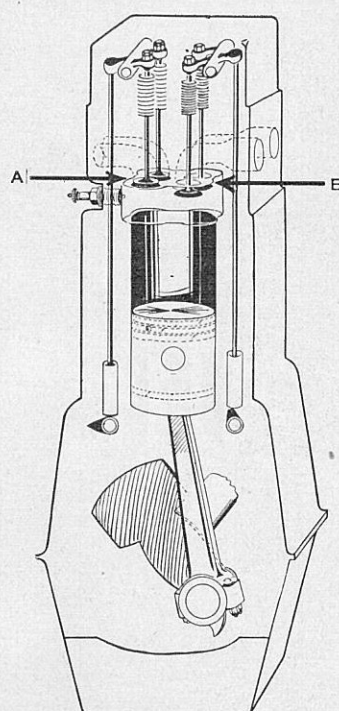


Fig. 29

18P. The engine is in time when any of the marks on the flywheel are in line with the pointer under the magneto, if the valves in that particular cylinder are starting to open or close corresponding to the mark on flywheel. It is not possible for the engine to get out of time unless a cam shaft or crank shaft is taken out, or, through carelessness in taking up crank shaft bearings.

19P. However, re-timing can be done very easily as follows:

Remove plate in front of the engine which covers the timing gears, Fig. 30. These gears are numbered. The gear on crank shaft, D, Fig. 30, is No. 1; the gear on intake cam shaft, A, Fig. 30, is No. 2; the gear on exhaust cam shaft, C, Fig. 30, is No. 3. The small idler gear, B, Fig. 30, is numbered in rotation 1-2-3. Mesh the gears so that No. 1 on the crank shaft gear, D, Fig. 30, is in line with No. 1 on the idler gear, B, Fig. 30. Mesh the gear on the intake cam shaft, A, Fig. 30, which is No. 2, with the No. 2 on the idler gear, B, Fig. 30. Mesh the gear on exhaust cam shaft, C, Fig. 30, which is No. 3, with No. 3 on idler gear, B, Fig. 30. The gears are now in correct position. Now adjust the screws on the valve rocker arms on the intake side so that the clearance is .012 between valve stem and adjusting screw. On exhaust side, adjust so that the clearance will be .015 between valve stem and adjusting screw. When these adjustments have been made, the valves are in correct time. However, the magneto will have to be re-timed. See Section 37, Par. 8J to 14J.

The position of the marks on the flywheel; measuring along the circumference, is as follows: Fig. 31.

"Study It Carefully"

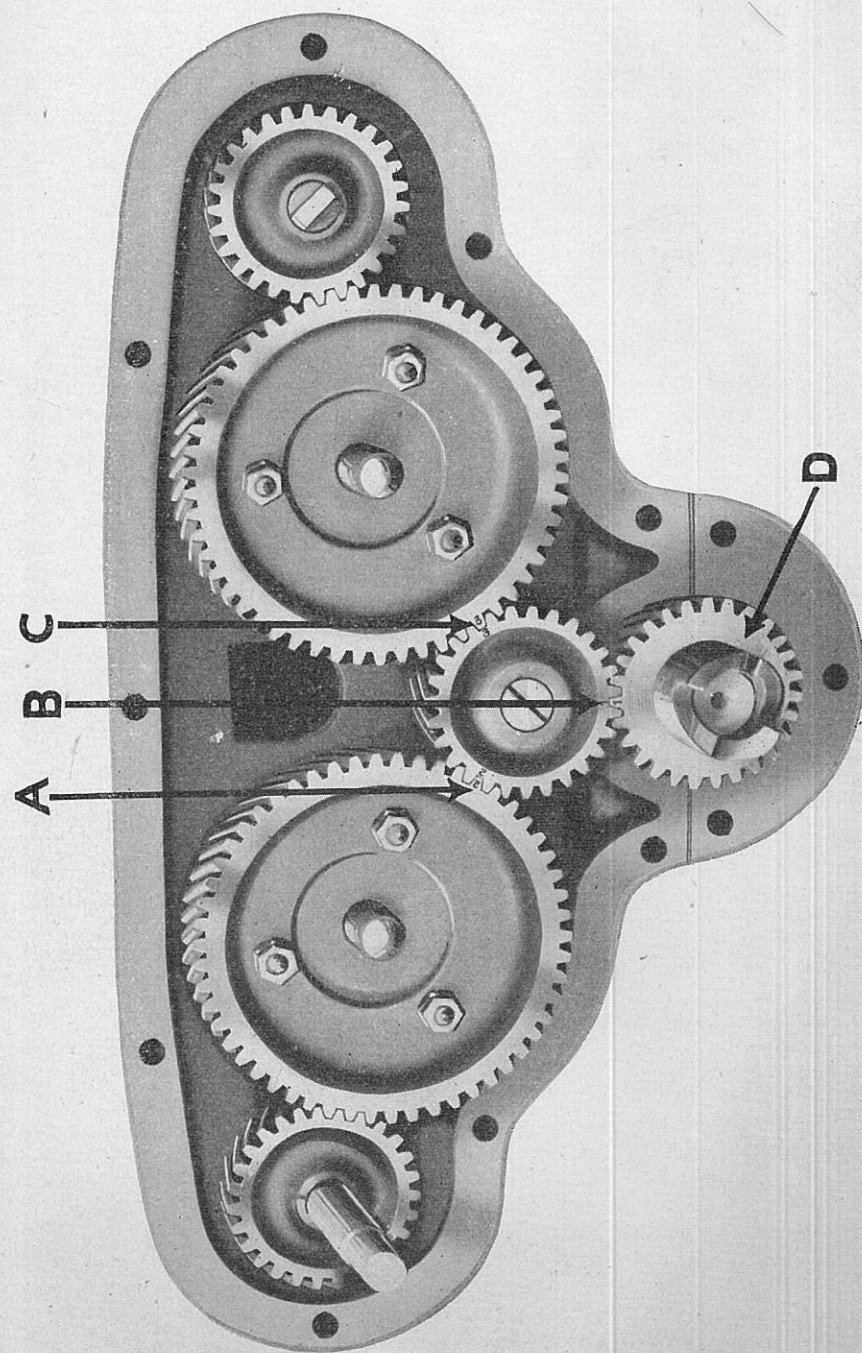


Fig. 30

"In Valve-Grinding Follow Instructions Carefully"

TWIN CITY "17-28"

Intake opens past top center.....1 11-16"
 Intake closes past lower center.....5 61-64"
 Exhaust opens before lower center...6 35-64"
 Exhaust closes after top center.....15-16"

TWIN CITY "27-44"

1 59-64"
 6 13-16"
 7 1-2"
 1 3-64"

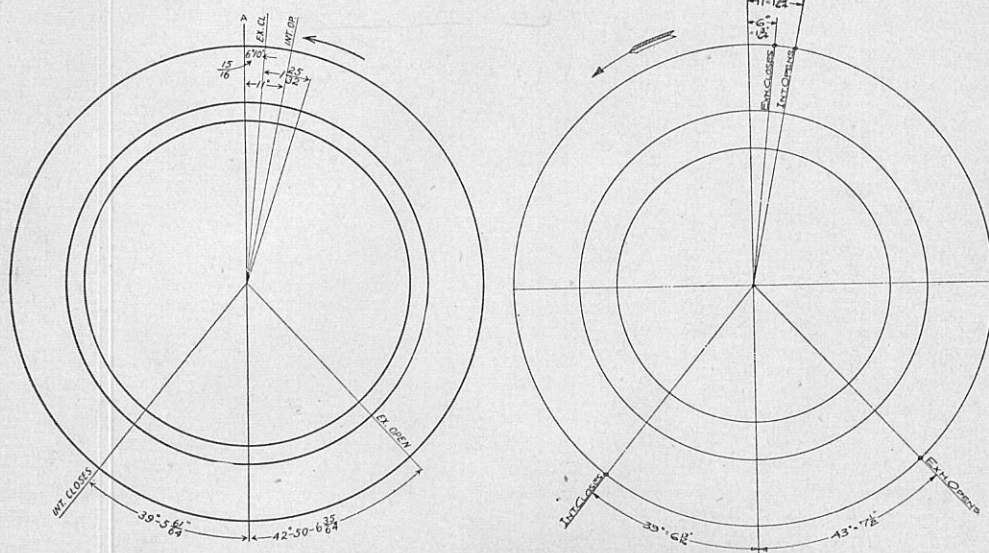


Fig. 31

20P. Care of Valves: If the valves are allowed to leak, it means not only the loss of power and waste of fuel, but it will soon ruin the valves and damage the seats so that it will be hard to get them in shape again.

The valves, especially the exhaust, B, Figs. 26-27-28-29, should be inspected at least once a month on a steady run, to see that they have a full seat and are not leaking. If they leak, the surfaces will soon show a burned and pitted condition, which may be easily ground out if taken in time. (Use valve grinding compound *only*.)

20½P. High Altitude Head: For altitudes above 3,500 feet a special cylinder head is provided. The height of the combustion chamber is $1\frac{5}{8}$ " in high altitude head, and $1\frac{25}{32}$ " in standard head. All 17-28 tractors, beginning No. 17932 are equipped with high altitude cylinder heads.

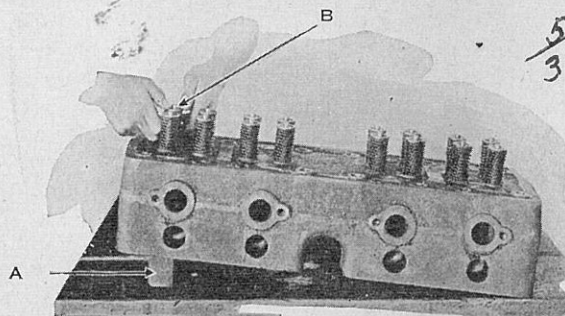


Fig. 32

"Oil the Governor—Oil, Oil"

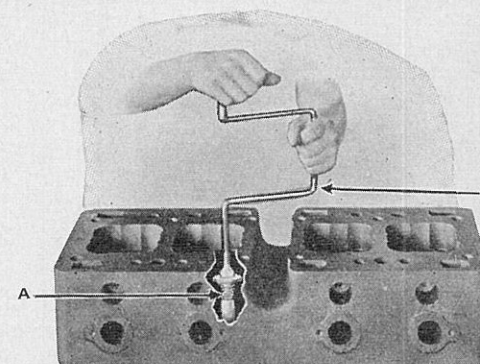


Fig. 33

21P. To Grind Valves and Clean Carbon: It is necessary to remove cylinder head and uncouple the valve springs. Place a block under cylinder head on the valve as at A, Fig. 32, depress spring B, Fig. 32, and remove the spring keeper and the valve comes out of its seat. Scrape all carbon deposits from around valve seat and from all related parts. Also remove all carbon from the combustion chamber, intake and outlet ports, piston heads, and both sides of the valve and valve stems. After lifting the valve from the cylinder, place a small amount of grinding compound on bevelled part of valve and seat. Before replacing valve for grinding, a spring, Fig. 33, should be placed on the valve stem to lift it from the seat during grinding. With an ordinary boring brace, and the screw driver bit, B, Fig. 33, press the valve into the seat, turning at the same time, but not in one direction. Reverse the motion back and forth, at the same time allowing the valve to lift from the seat at each reverse motion to prevent ridges. Continue this

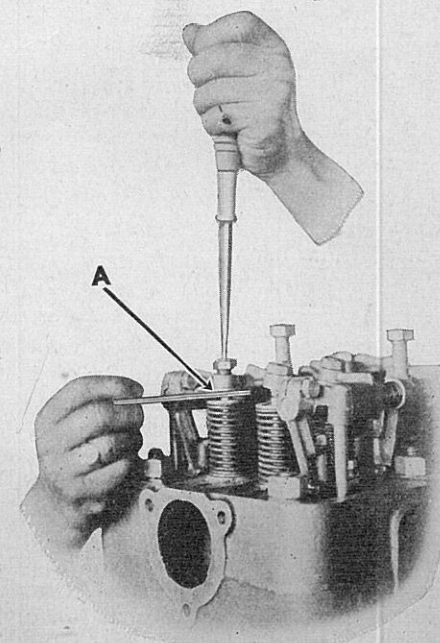


Fig. 34

"Gaskets Are Important"

until the valve is ground to its seat and shows a full, bright bearing. Before replacing the valve, wipe out the seat and stem guide perfectly clean and be sure that none of the grinding compound is sticking to the valve for it will damage the valve stem and guide. Clean intake port thoroughly.

22P. To Adjust Tappets: There is always a certain amount of clearance provided between the valve stem and tappet adjusting screw, A, Fig. 34, so that the valve will always close tightly. Clearance should be .012 on intake side and .015 on exhaust side. These clearances should be tested when engine is cold. After the first one hundred hours of running, the valves should be reground. After that every 30 days.

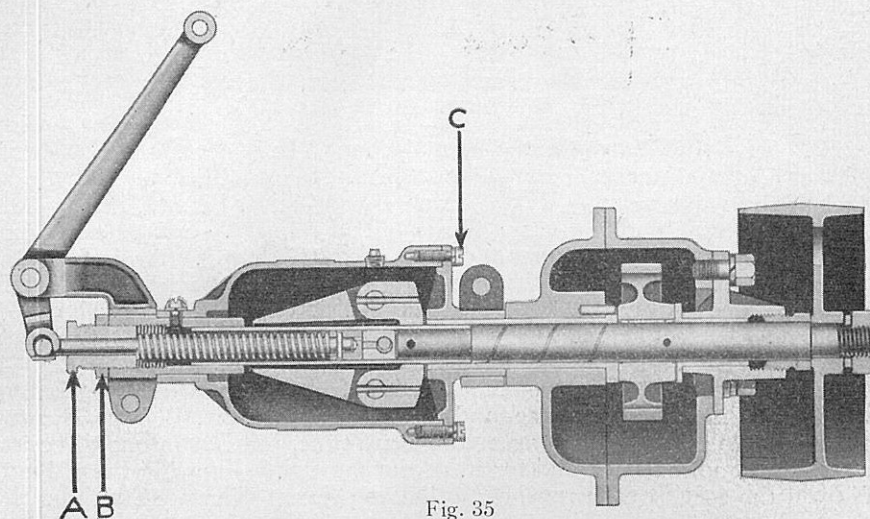


Fig. 35

SEC. 43. GOVERNOR:

1R. The intermittent load to which a tractor is subjected demands that some automatic device be provided that will enable the tractor to maintain a uniform speed regardless of the unevenness of the ground and whether your load is heavy or light. This device prevents the motor from "racing" if the load is suddenly released, and from "stalling" when the load or pull is suddenly applied.

2R. Nothing will ruin bearings, damage pistons and wreck the whole engine and tractor more quickly than excessive engine speeds or "racing," as it is usually termed.

3R. The governor valve is mounted between the carburetor and the intake manifold. In the governor valve box, the butterfly valve is normally in a position that does not obstruct the flow of gas to the carburetor until the pre-determined speed is reached. At this point it closes.

4R. The valve is controlled by what is known as the flyball principle. The two weights, Fig. 35, are mounted on a spider, which revolves on bronze and ball bearings and these weights are so pivoted that as their velocity increases, they will swing outward by centrifugal action, thus forcing a plunger forward, Fig. 35, which, in turn, operates the valve by closing or opening it.

The plunger, Fig. 35, is also forced against a spring, so that as the velocity of the weights is lessened, they return to a more normal position and the valve is opened.

"Watch Your Connecting Rod Bearings. Don't Let Them Knock"

5R. Oiling Governor: Before the engine is started which automatically puts the governor into active service, be sure that the governor case, Fig. 35, contains about 7 ounces of good light oil that has a sufficient body and is not affected by change of temperature.

6R. Note: Every week add oil through oiler on governor housing. (Take oil can and squirt oil through the oiler directly into the governor.)

7R. Caution: Do not oil governor with the engine running.

8R. Look over the governor equipment regularly to see that none of the connections work loose and that lock nuts are kept tight. Should governor fail to operate properly, or if changing of adjusting screw does not give desired speed, do not attempt to take governor apart; adjust so it will give a reasonable range of speed from no load to full load.

9R Governor Troubles—

- A. Lack of lubrication causing the governor to become worn out.
- B. Improper adjustment of the governor springs.
- C. Looseness or misadjustment or breakage of governor mechanism.

SEC. 44. GASKETS:

1S. The use of the correct style of gasket and the proper placing of the gasket is a much more important matter than is generally considered. In case it is necessary to remove gaskets for inspection or repairing at any time, especial care should be taken in replacing them. Inspection plate gaskets should be made of some heavy paper like building paper or tar paper. Inlet and exhaust manifold gaskets must be made from Perminite or Good-yearite or any non-burning packing and should always be shellacked on one

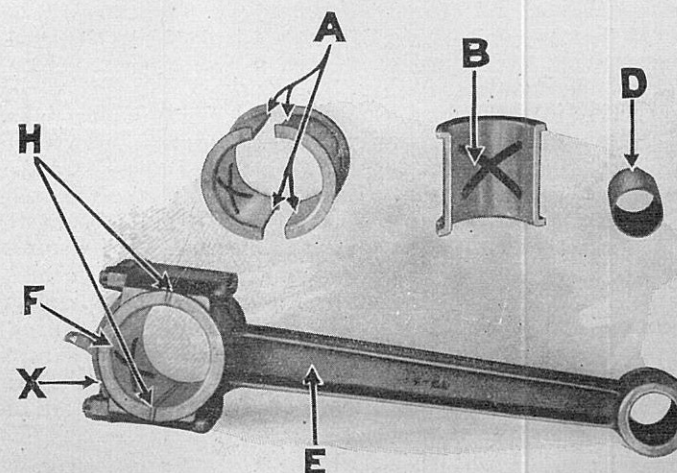


Fig. 36

"Don't Forget to Spread the Cotter Pins When Through Taking Up Bearings"

side only. The cylinder head gasket must be a copper gasket. Water manifold gaskets should be made of sheet rubber packing. Spark plug gaskets must be of copper-bound asbestos construction to withstand the heat from the cylinders.

2S. When removing old gaskets, care should be exercised so that all surfaces are thoroughly cleaned and scraped before new gaskets are applied. It is also important that every bit of the old gasket be removed.

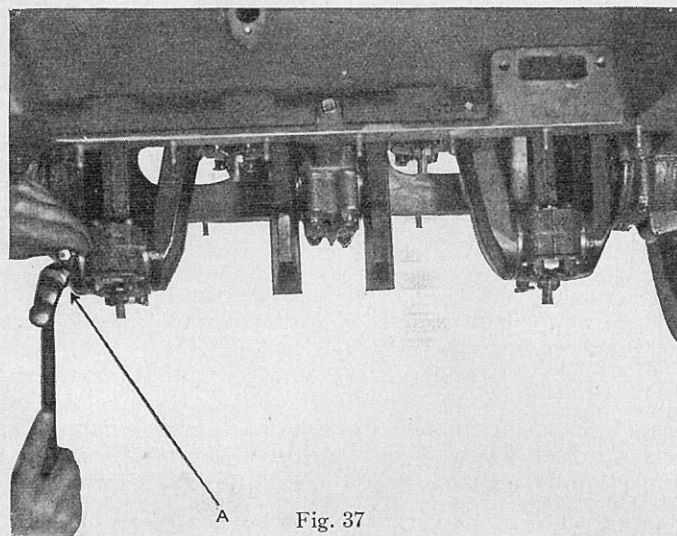


Fig. 37

SEC. 45. CONNECTING RODS AND CONNECTING ROD BEARINGS:

1T. The connecting rods, E, Fig. 36, are drop forged and accurately machined to receive interchangeable bronze back babbited bearings, F, Fig. 36, at the crank pin end and bronze bushings, D, Fig. 36, at wrist pin end. Their being interchangeable does not mean that in taking up bearings they can be put back on any crank pin. If you take up connecting rod No. 1, its shells must stay in connecting rod No. 1 and it must be put back on crank pin No. 1 exactly the same way it was taken off. It must not be put on crank pin No. 2, nor should the upper half of shell be put in the cap, and likewise the lower half should not be put in the rod. A good plan is to mark the shells and rods they belong to with a center punch or cold chisel, A, Fig. 37, before taking apart. If rods are not marked, mark them, starting with No. 1 from radiator end of motor with all markings on the same side. This is important because once a bearing has been run at a certain place and position, it will run better at that place than any other.

2T. Interchangeable means a new bearing can be used on any one of the rods.

"A Very Thin Layer of Color is Enough"

Adjustment of the Bearings—

3T. All bearings in the motor should be given careful attention at frequent intervals and looseness should not be allowed to occur until the attention of the operator is attracted by knocking sounds. Due to engine's enclosed construction, knocking will start before it can be readily heard. Watch this.

4T. The connecting rod bearings should be examined carefully for looseness. This may be done through the hand plates on the side of the crank case by turning the crank up until a small bar can be placed under the end of the connecting rod and any loose motion detected by prying up and down. Laminated Shims H, Fig. 36, are placed between the connecting rod cap, X, Fig. 36, and the rod proper, E, Fig. 36. The shims, H, Fig. 36 can, if there is loose motion, be peeled by layers and the bearing tightened up. When a portion of the shim has been removed and the cap replaced, the crank should be turned to determine whether the bearing has been made too tight. Also try the first test of determining whether it is too loose. (Note: Do not take off too much of laminated shims at one time. Shims must be fitted closely to shaft. If it is found that the bearing is too tight, it will then be necessary to remove the cap, X, Fig. 36 again and make a new shim. This work should be done carefully and thin shims added until the bearing works easily without any lost motion.

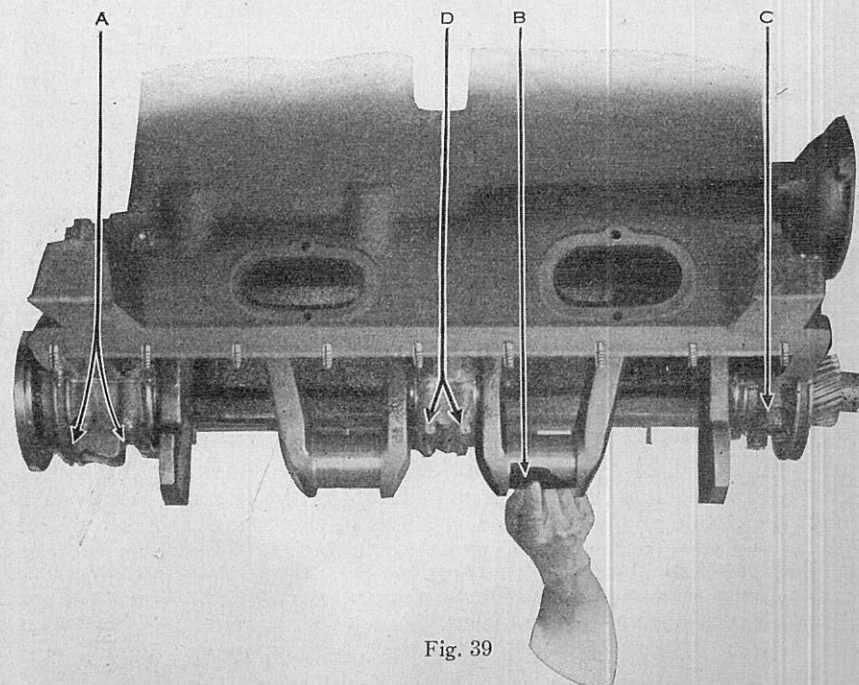


Fig. 39

"Be Sure to see that Bearing Shells have Oil Grooves"

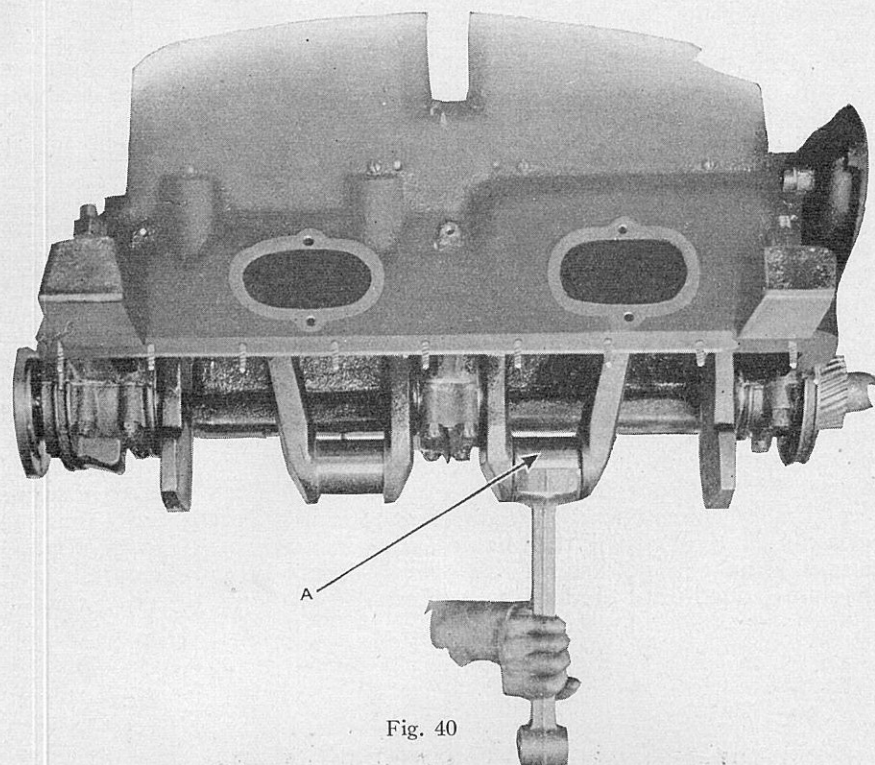


Fig. 40

5T. In replacing the cap, be sure and see that there is no grit in the bearings. Care should be taken not to place the cap back reversed from the way it was originally placed. Every cap and rod has a mark on one side to show the way cap should be replaced.

6T. It will be found, after getting the proper adjustment, that it will be easier to adjust the rod that is being worked on if the bolts are loosened up before trying to take up the next rod.

7T. **Important:** Before starting engine, be sure that all cap bolts are tightened and cotter pins in place and well spread. Use new cotter pins that fit the holes tight.

Fitting New Shells—

8T. See that new bearing shells have oil grooves before they are put in place. This can be done with a pointed chisel as in B, Fig. 36. This is very **important**. If the shells are put into the engine without these oil grooves and oil holes, the bearings will not get the proper amount of oil.

9T. Place one of the half bearing shells in the connecting rod and tap lightly so you are sure the bearing shell goes into the rod as far as it will go. Then file the edges off of shell at A, Fig. 36, so the edges are flush with connecting rod. Fit other half of bearing shell to connecting rod cap in the same way. Now the rod is ready to be fitted to the crank pin.

10T. Smear a thin layer of moistened lampblack, B, Fig. 39, (moisten lampblack with oil to a thick paste) or Prussian blue on the crank pin to be fitted; put connecting rod on crank pin in same position it came off, have your mark on the same side; rock the rod back and forth a few times until

"Again Be Sure to Spread Cotter Keys"

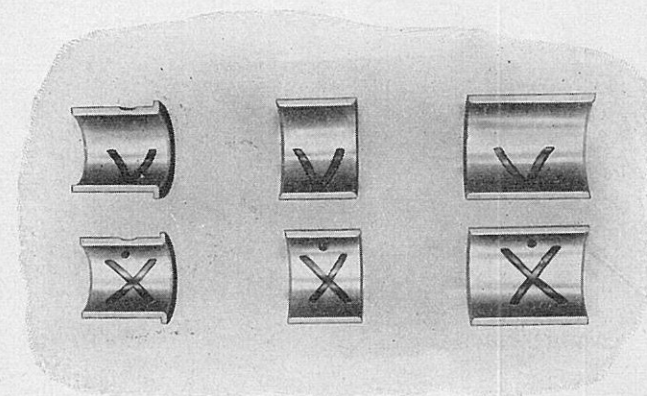


Fig. 41

the color shows on the bearing shell, A, Fig. 40. If the color shows up in the crown of the bearing shell, it is all right. If, however, the color shows on the sides of bearing shells or in spots, the bearing must be scraped.

11T. In A, Fig. 42, is shown a method of scraping a bearing. Where the color shows on the sides, a bearing scraper or a file is used to remove some of the metal; where the color shows in spots, these should be scraped with a scraper until the crank pin fits the bearing. A scraper, as shown in Fig. 42, is best suited for this work as it does a smoother and quicker job. A file can be ground and used in emergency.

12T. The bearing in connecting rod cap must be fitted in the same way. Smear a fresh layer of color on crank pin and bolt the rod together in running position. Crank engine over a few turns, disconnect the rod and note the result, if both bearing shells have a crown bearing. Put in the proper amount of shims; tighten bolts; replace cotters and spread them.

13T. **Taking Up Crank Shaft Bearings:** Crank shaft bearings can be tested for looseness in the same manner as the connecting rod by prying each bearing separately. Never take up more than one bearing at a time and always turn the shaft over to see that you do not get the bearing too tight. Be sure to get the bearing shells back in place just exactly the way they came off. This they will naturally do if you do not drop the bearing. A good plan is to mark the bearing and the bearing shell, A, Fig. 37, with a center punch or cold chisel before taking them apart.

14T. Crank shaft bearings are also bronze back babbited shells, Fig. 41, and are fitted exactly the same way as connecting rod bearings.

15T. **Important:** Before starting engine, be sure all stud bolts, A, C, D, Fig. 39, are tightened and cotter pins spread.

Wrist Pins and Bushings—

The wrist pin bushings, D, Fig. 36, are not adjustable for two reasons: First, the amount of wear at this point is very small. Second, it would make a very complicated and inaccessible rod to make this bearing adjustable. When after long service the engine gets noisy at this point, it is well to pull the pistons out through crank case and examine the wrist pin and bushings. The chances are that both pins and bushings should be renewed. A good way of determining is to take the pin out of the piston and use it

"Shims Are Important"

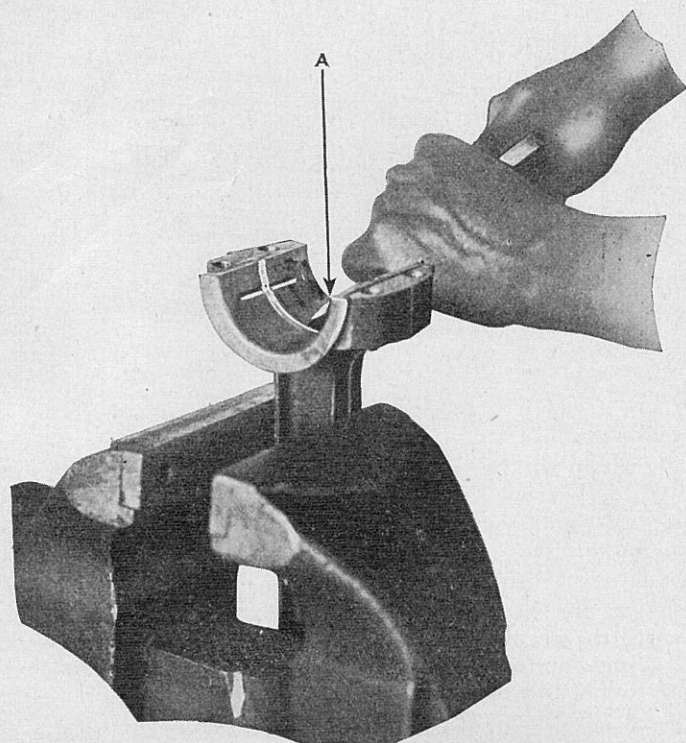


Fig. 42

for size plug. If the part of the pin that fits into the piston, fits snugly into the rod bushing, the job needs only new wrist pins. If the pin shows lots of wear where it fits on bushing and the part that goes into piston also fits loosely in bushing, both wrist pin and bushing will have to be renewed. If wrist pin shows no wear but still fits loosely in the bushing only, the bushing will have to be renewed.

16T. To renew bushings, first drive out old bushing but be sure to support that part of the rod where you do your driving; that is, do not grip center of rod in vise and drive on the end. The end of the rod should be set over an opening and bushing driven out. In driving in the new bushing, do not use a metal hammer directly on bushing, but use a block between hammer and bushing. After driving the bushing into the rod, the wrist pin should be tried. If it slips into bushing snugly, it is a good job; if it is tight, the bushing must be scraped so the pin fits freely.

17T. In fitting new or old wrist pin into piston it must be tapped lightly (See Fig. 25) otherwise the piston will warp and will not fit cylinder properly. **Do not drive wrist pins with a large heavy hammer.**

18T. If the wrist pin drives hard, take a piece of emery cloth and wrap it around wrist pin and hold in one hand while you turn wrist pin with the other hand. This operation is called "lapping" and must be continued until wrist pin can be driven lightly into piston. The wrist pins are hardened and cannot be filed.

"When Shifting Gears Step on Clutch Pedal"

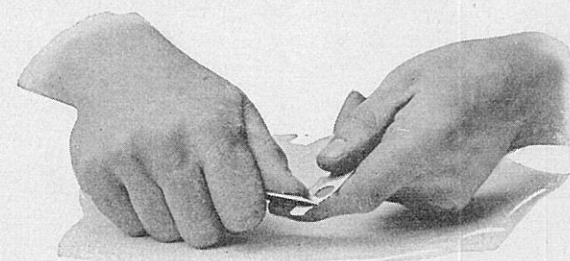


Fig. 43

Cam Shaft Bearings—

19T. These bearings are made of bronze in the form of a bushing and will run for a long time. When they become worn enough to require attention, they must be replaced with new ones. Before driving new bushings into place fit them to the shaft. If after being driven in they shrink, refitting will be necessary while in place. To replace these bearings, remove end cover plate, B, Fig. 14, and take out the cam shafts. The bushings can very easily be driven out and the new ones driven in.

20T. **Note:** Do not use a metal hammer or tool in driving these bushings in or out. Use mallet or block of hard wood.

To Move Push Rod Bushings—

20½T. This is accomplished by removing the base pan, cylinder head, and cam shaft, then lifting out push rod and tappet. The bushing can then be driven down from the top. Use a block of wood and a hammer.

The new bushing should be inserted from underneath and driven in so that the distance from base of cylinder at A, Fig. 6C, to bottom of bushing when driven in is exactly 6 5-16 inches.

21T. After taking up **any** of the bearings, do not run the engine to exceed one minute without examining the bearings taken up, to see that none were made too tight and are heating. After tightening bearings, always use a little more oil for a time until they get to running smoothly. Observe closely all taken up bearings for some time, to see they do not heat.

22T. **Shims:** All the shims on the engine are laminated, that is, they are composed of several thin metal strips soldered together at their ends and when the necessity for taking up a bearing arises, these shims can be removed from the bearing or bearing cap and peeled down by the use of a knife. Fit shims close to the shaft. See Fig. 43 and 44.

SEC. 46. TRANSMISSION:

A study of Fig. 45 will show the simplicity and compactness of this transmission system. The power from the motor is delivered through a 12" clutch. It then passes through a stub shaft, B, Fig. 45, to bevelled gear, S, Fig. 45, and to bevelled gear, R, Fig. 45, which is on the belt pulley shaft or first countershaft in the transmission, P, Fig. 45. On this splined countershaft, P, Fig. 45, there are two sliding pinions, C, Fig. 45, and N, Fig. 45. These pinions in Fig. 45 are shown in the neutral position.

By sliding pinion C, Fig. 45, to the right it becomes engaged with the slow speed intermediate gear E, Fig. 45. By sliding this same gear to the left until it bumps against the hub of bevelled gear, R, Fig. 45, it becomes engaged with the reverse idler gear, D, Fig. 45.

"Do Not 'Ride' the Clutch Pedal"

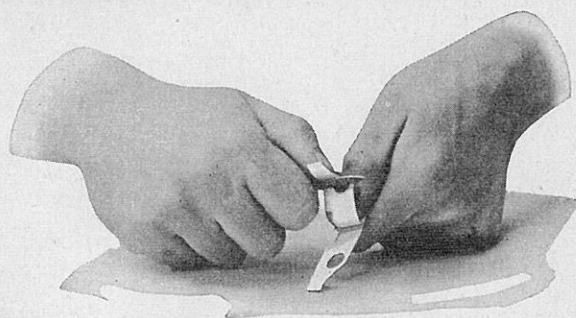


Fig. 44

By sliding pinions N, Fig. 45, to the left, it becomes engaged with high speed intermediate gear M, Fig. 45. These gears are connected to the main pinion F, Fig. 45, by means of jaw clutches on the ends of gear hubs and pinion and the whole assembly of gears revolves together. Pinion F, Fig. 45, meshes with differential gear H, Fig. 45. This gear is secured to the differential spider J, Fig. 45, by means of fitted bolts.

The power is conveyed to the spider and from there through the four differential bevelled pinions K, Fig. 45. The power is further transmitted into two differential bevelled gears L, Fig. 45, one being mounted on the splined inner end of the right hand and left hand rear axles. The power is then transmitted through the axles and into the hubs of drive wheels X, Fig. 45, and through the spokes of the drive wheels and into the rims.

It is not possible to have more than one pair of transmission gears in mesh at one time. Due to this construction, there is no possibility of stripping gears.

On the other hand, be sure to step on foot lever, C, Fig. 5. This disconnects power from the transmission, puts on brake, and allows the shifting of gears to be accomplished without danger of grinding off the edges of the gear teeth. In changing speeds, see that the shifting lever, A, Fig. 5, always goes to the bottom of slots in transmission quadrant. If this is not done, the transmission gears will not mesh the full width of teeth and undue wear on gear teeth will occur.

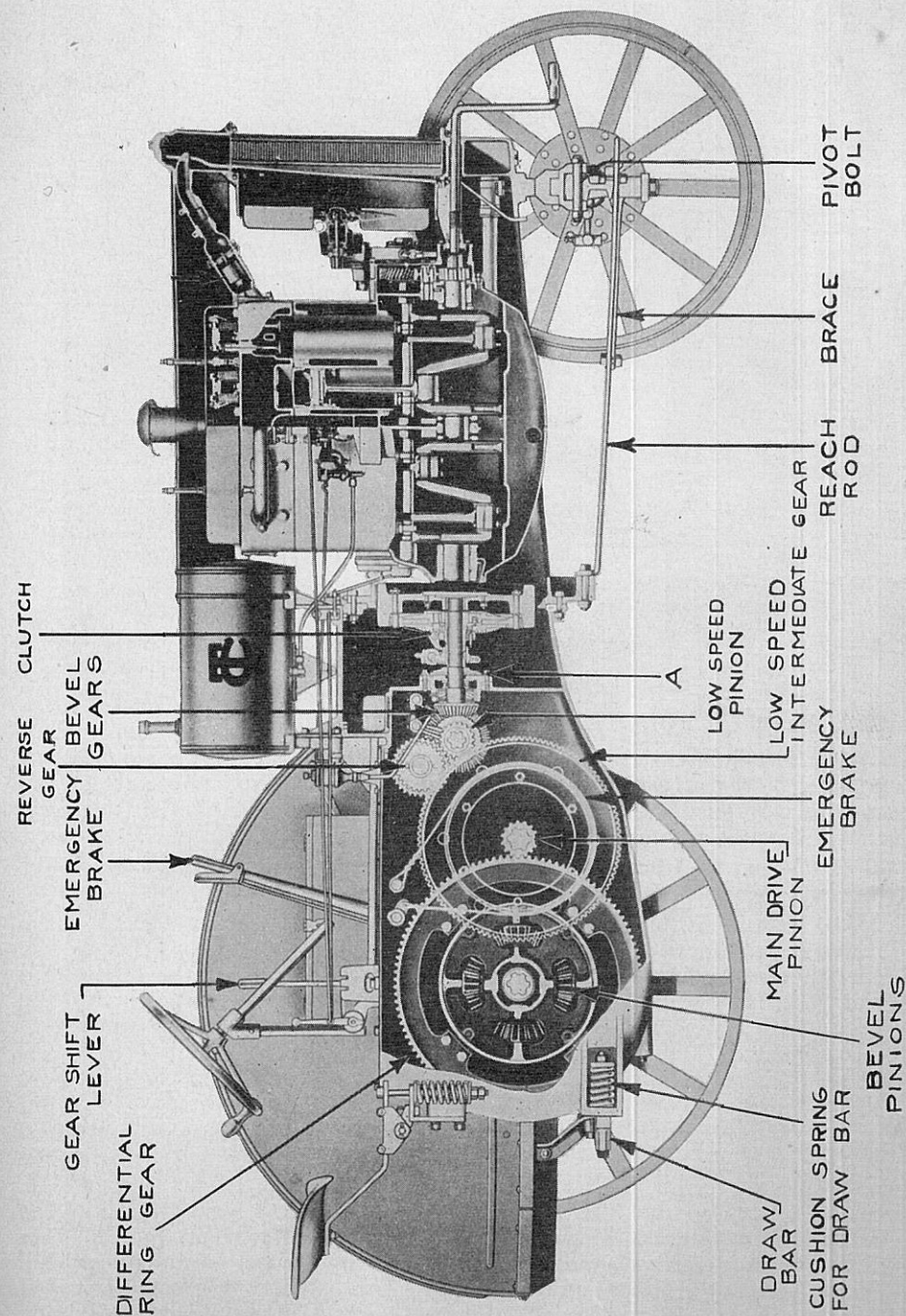
The bearings in the transmission are all Hyatt roller bearings and require no adjustment. The only repairs possible for them is to replace with new ones when worn.

SEC. 47. LUBRICATION OF THE TRANSMISSION:

The lubrication of the transmission in the tractor is most thorough and requires very little attention. Fill transmission case to oil plug level, with heavy transmission oil. We recommend a quality of 600 W. steam engine cylinder oil. The gears forming the transmission run in this oil and when the tractor is in operation, the revolving of these gears sprays this heavy oil over every working part inside of the transmission case including the rear axle bearings, thus a perfect lubrication results.

Two grease cups, G, Fig. 3, over the first countershaft on which is located the power belt drive pulley, T, Fig. 45, should be filled once a day, as these bearings are so located that the splash and oil spray which occurs in the transmission case do not reach them.

"Be Careful, Don't Drop Tools or Cap Screws into Transmission Case"



"These Tractor Parts Transmit the Engine Power to the Wheels and Ground. Understand It"

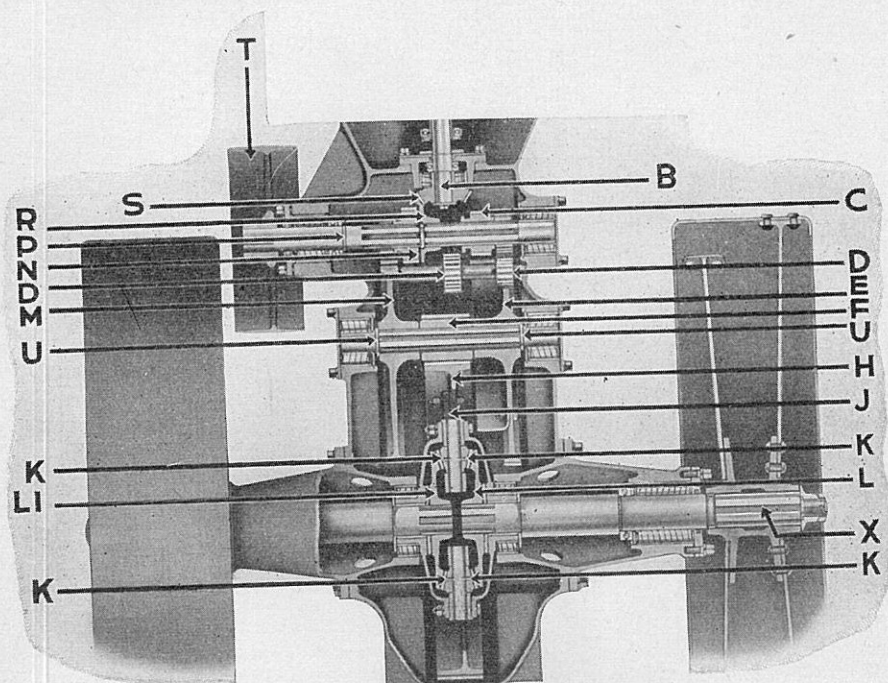


Fig. 45

SEC. 48. THE FUNCTION OF DIFFERENTIAL GEARS:

1. The differential gear is sometimes called a balance gear or a compensating gear. The arrangement of gears in this important part of the tractor, permits the rear wheels to turn at different speeds, and at the same time drives the tractor ahead.

2. When the tractor turns a corner the inner wheel must revolve slower than the outer one.

3. Assuming that all the gears are in mesh as shown in Fig. 45, if the resistance to traction is the same at both drive wheels or, in other words, the tractor is going straight ahead, the power applied at the differential ring gear, H, Fig. 45, will be directed to both drive wheels equally and the entire assembly of gears will revolve as a unit. This assembly comprises the differential spider, J, Fig. 45, the bevelled pinions, K, Fig. 45 attached to it and the bevelled gears, L, Fig. 45 and L1, Fig. 45, which are fastened to the axles.

4. Assuming that we turn the tractor to the right, the right hand wheel will cover less ground than the left hand which means that it will revolve slower as the turning occurs. The resistance is now greater, on the right side, than on the left side. The power being applied at F, Fig. 45, turns the differential ring gear, H, Fig. 45, and the bevelled gear, L, Fig. 45, now revolves more slowly than does L1, Fig. 45, and the left-hand drive wheel. This difference in speed is affected and transmitted by the small bevelled pinions, K, Fig. 45, turning on their studs, while at the same time driving the tractor ahead.

"This Combination of Gears Keeps Your Drive Wheels Turning in Proper Relation on Turns"

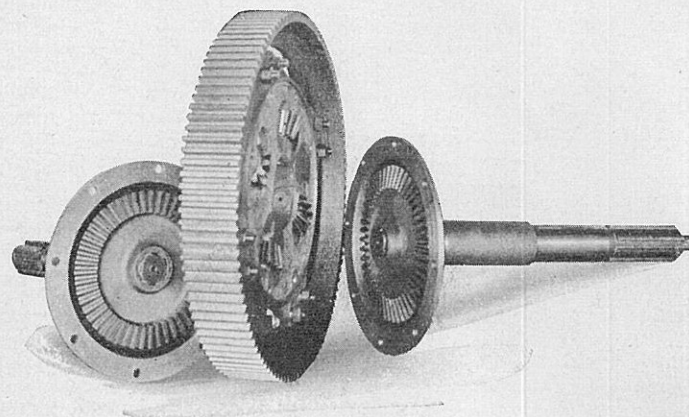


Fig. 45 A

5. In turning the tractor to the left, the greater resistance occurs on the left hand side and the related action of all the gear parts are reversed.

Note: The differential unit is submerged in oil at all times and lubricates itself.

6. The transmission is so constructed that any one of the shafts can be removed without disturbing the other shafts. In the same way, a gear can be removed by merely taking its shaft out through the side of the transmission case. To remove any of the shafts or any of the gears, it is first of all necessary to remove the cover thus exposing the whole transmission.

SEC. 48A. TO REMOVE STUB SHAFT AND MAIN BEVEL PINION:

Move engine to front of tractor as far as it will go. Unscrew cover plate, A, Fig. 44A, and pry it toward motor and it will come off together with roller bearing and main bevel gear.

SEC. 49. TO REMOVE REVERSE GEAR:

Unscrew headless set screw at A, Fig. 46, take cotter pin out of collar and drive shaft to the left, F, Fig. 46.

SEC. 50. TO REMOVE BELT POWER SHAFT:

Take out the reverse gear and shaft and take pulley off shaft, E, Fig. 46, unscrew covers off ends of the shaft, put high speed pinion, Fig 45, in mesh with high speed intermediate gear. Now drive the shaft from the right hand side of tractor to left hand side of tractor about 2 inches. With a bar drive off the bevel gear, R, Fig. 45. Now drive out shaft so the right hand roller bearing sleeve, A, Fig. 47, can be removed. Turn shaft so hole in bearing is up, B, Fig. 47, and with a screw driver, screw the set screw into shaft as far as it will go. (These set screws have a smaller head than body, making it impossible to work out, and when screwed into shaft as far as they will go, the bushing can slide over them.)

Fig. 47 shows method of driving off the bushing. Drive on right hand end of shaft until the bushing on left hand side comes out, and now the shaft can be pulled out, as in Fig. 48, and the gears on this shaft come out through top of transmission case.

"Keep Dirt Out of Transmission Case"

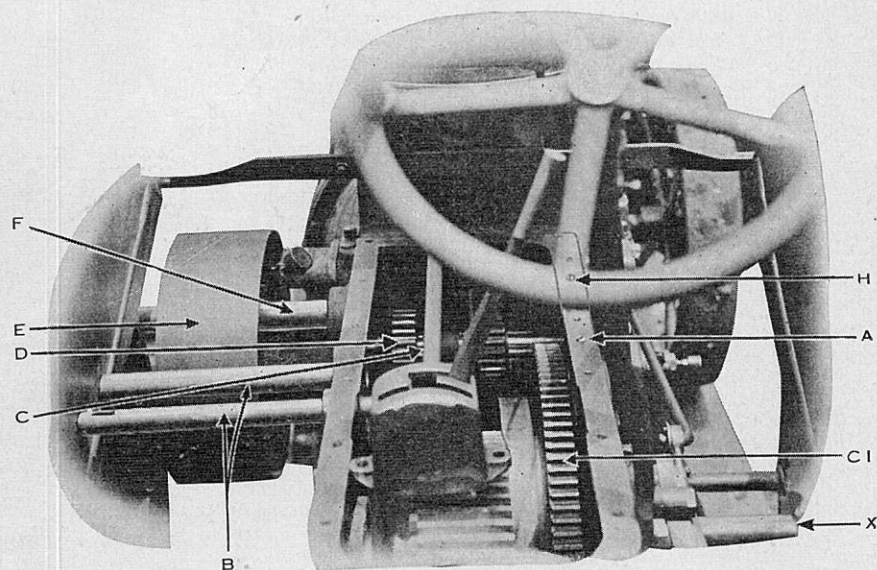


Fig. 46

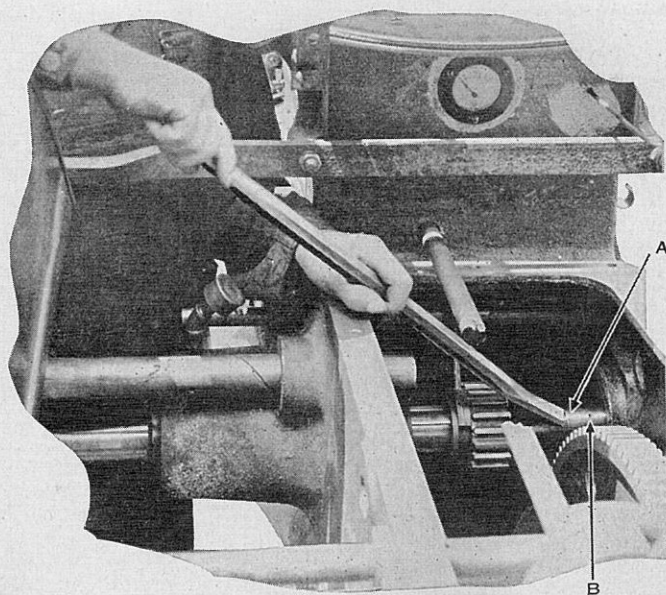


Fig. 47

"Safety First, Always Block Tractor Before Taking Off a Wheel"

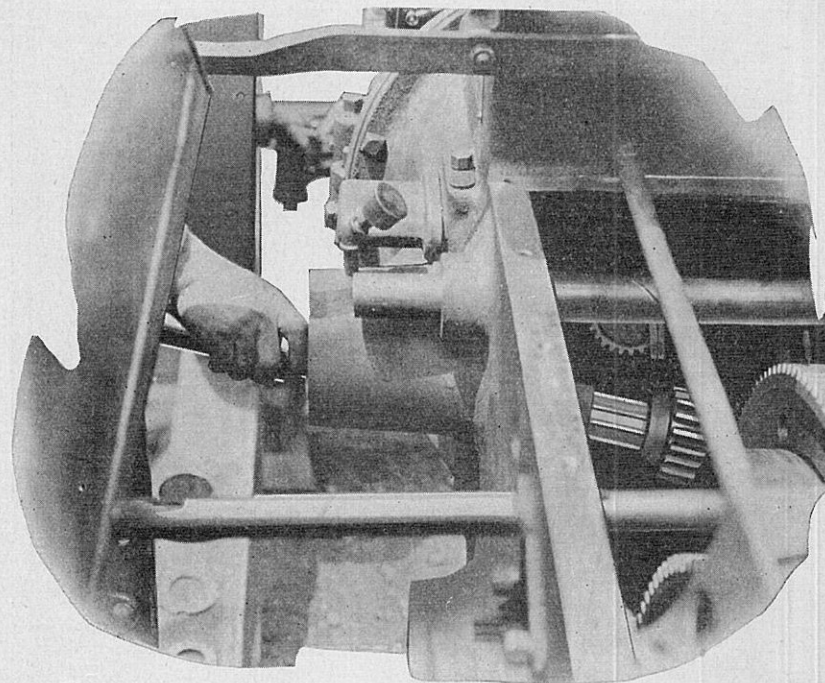


Fig. 48

SEC. 51. TO REMOVE INTERMEDIATE GEAR SHAFT AND MAIN DRIVE PINION:

Take out reverse gear and shaft, also the two shafts to which the brake band is attached, as in B, Fig. 46.

Remove the two end plates covering the bearings of the intermediate shaft and pry the snap ring, U, Fig. 45, which holds the left hand gear in place out of its groove.

This ring lies against outside surface of hub.

Drive the shaft out through right hand side of case, being careful to support gears when doing so, so as to avoid injury to teeth by falling into case.

SEC. 52. TO REMOVE DIFFERENTIAL:

Jack up tractor and block same. D, Fig. 49. Remove both drive wheels and both axles. Remove both axle housings from transmission case at C, Fig. 49, and differential assembly can be lifted out of transmission case.

SEC. 53. TO REMOVE AXLE:

Unscrew cap B, Fig. 49 from axle housing and pull out the shaft.

SEC. 54. TO REMOVE A DRIVE WHEEL:

Jack up tractor so wheel clears the ground, and be sure to block the tractor, D, Fig. 49, so when you start prying and jerking it won't slip off the jack. Remove nut A, Fig. 49, from axle and pry wheel off.

A Few Don'ts for the Transmission

Don't run tractor without oil in transmission.

Don't drop cap screws into transmission case.

Don't drive on shafts with a hard hammer, use a block between hammer and shaft.

"Steering Mechanism, Keep All Nuts and Bolts Tight"

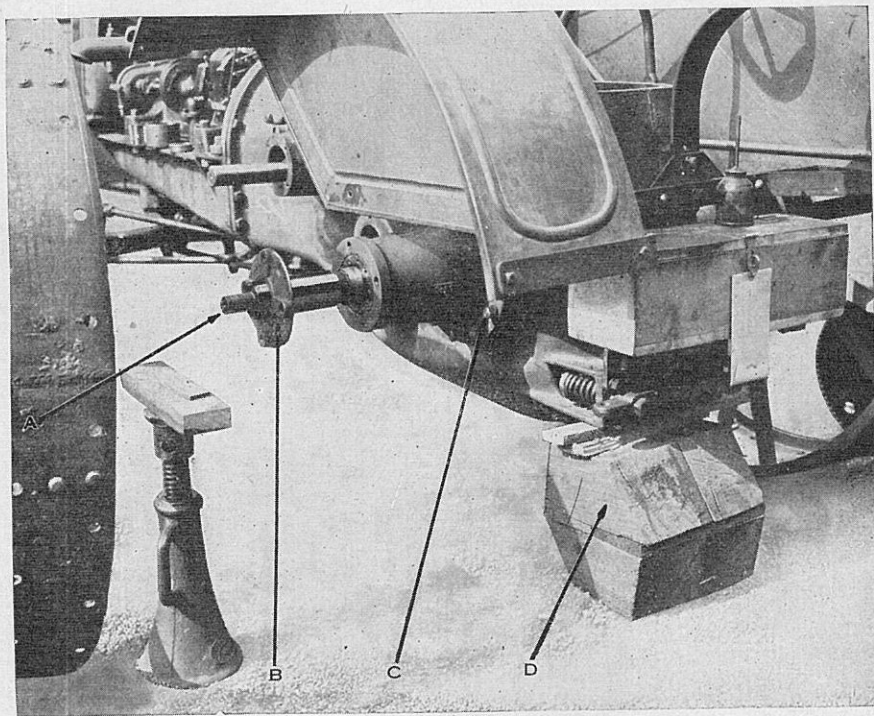


Fig. 49

Don't fail to set tractor on a good set of blocking before removing wheels.

Don't run tractor unless the gear shift gate is fastened to cover and cover is fastened to transmission case. If the tractor is run, the gears that are supposed to be in neutral may drift and get into mesh, causing a break.

SEC. 55. CARE AND OILING OF FRONT WHEEL AXLES:

1. Front wheel axles are of the knuckle automobile steering type. Keep knuckle pins, G, Fig. 23, well greased to avoid wear and to steer easily. The bottom nuts of knuckle pins, C, Fig. 23, should be pulled up tightly to avoid dropping the tractor. Wheel hubs require frequent oiling and should turn freely on axle stubs without excessive end play. In case end play is greater than $\frac{1}{8}$ ", steel washers should be inserted under outside axle collar. Always be sure every part of steering mechanism is securely fastened to avoid accident.

2. **Reach rod and brace**, (K, Fig. 23), should be securely bolted to front axle. The pivot bolt at rear of reach brace must permit turning of reach bar when front wheels ride over uneven ground.

3. Steering mechanism should be examined for wear, loose parts or play.

4. The steering worm is enclosed in a metal case bolted to the tractor frame through which an oil hole allows oil from the transmission case to enter. The steering gears and worm are thus automatically lubricated. In case the hub of worm gear, D, Fig. 49A, becomes worn, take up the worn parts by tightening up jam nut C, Fig. 49A. This will remove end play.

5. All the axle connections are provided with bushings which can be renewed when worn out.

"O" Means Oil

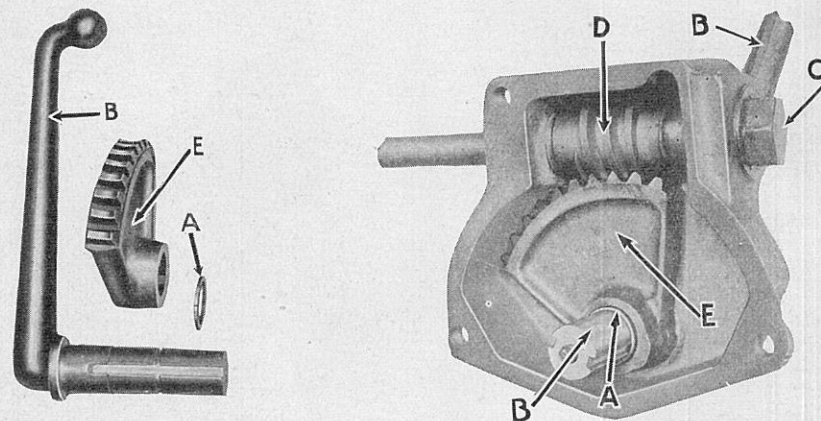


Fig. 49A

To Remove Steering Gears:

Loosen bolt in steering sector arm and pry it off, C, Fig. 6A.

Loosen set screw in casting on steering wheel support. Unbolt cover on side of tractor, raise up on steering wheel till casting clears steering wheel support. Pull or pry out on steering shaft until it comes off the transmission case.

To remove steering gears: Back off jam nut at C, Fig. 49A. Drive or pull out steering shaft from cover. Lift out worm D, Fig. 49A.

On arm B, Fig. 49A, at A there is a ring left in shaft at A to hold sector in place. Pry out this ring with screw driver. Remove sector E.

On the front axle there are two set screws which limit the angle at which the front wheels can be turned. These should be set so the wheels will not strike the frame when turning on an even ground.

SEC. 58. EMERGENCY BRAKE:

1. The emergency brake lever, H, Fig. 50, should be pushed as far forward as it will go when tractor is running. In using this brake to slow down or stop the tractor or hold it in position under belt power operation, pull the brake lever, H, Fig. 50, back as far as necessary.

2. The brake drum is bolted on the slow speed gear. A brake band encircles this drum, one end of which is fastened to a shaft, the other end to a short lever mounted on a shaft which is connected to a hand brake lever. This brake experiences very little wear, as it is constantly submerged in oil. It is, therefore, not provided with take up adjustments. The lining, when worn, can be renewed.

SEC. 59. POWER BELT OPERATION:

1. Line the tractor up with the machine to be driven. After putting on the belt, back tractor, to take up the belt slack. The transmission gear shift lever, A, Fig. 50, should then be placed in neutral or center of quadrant, D, Fig. 50.

2. Now push forward on clutch pedal at K, Fig. 50, until the clutch is fully engaged.

"Keep Clutch Well Lined and in Adjustment"

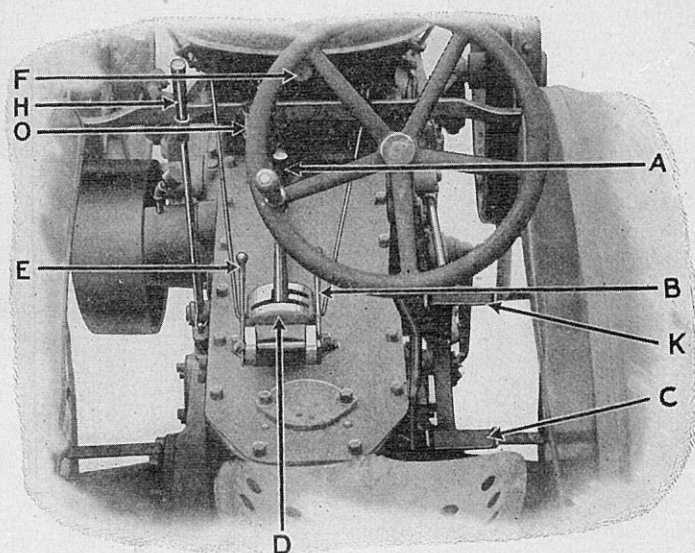


Fig. 50

3. **Note:** To stop your machine for minor adjustments, push clutch pedal to the rear, C, Fig. 50, until clutch is disengaged. The transmission will now stop while the motor is still running.

4. Glass oiler at O, Fig. 50, on transmission cover should be filled with oil of good quality. Oil should drip during belt work on the bevel gears which operate the belt power transmission. This is necessary as these gears are above the oil level in transmission case and, therefore, do not receive lubrication unless the entire transmission is running.

5. The power belt pulley is 16" in diameter with a 6" face and runs at a normal speed of 650 r. p. m.

SEC. 60. THE CLUTCH. ADJUSTMENT—RENEWING RINGS AND CARE:

To Adjust Clutch: The collar C, Fig. 53, is threaded so that it can be released or tightened on threaded shaft at D, Fig. 53.

The retaining pin B is the locking device and holds the adjustment in place by fitting into any one of the desired holes A, Fig. 53.

The four small springs E are to release the discs.

To tighten the clutch turn collar C to right or clockwise until the desired tightness is attained. Then lock with retaining pin B, Fig. 51, in one of the holes at A, Fig. 53.

To Renew Asbestos Rings: When the collar C, has been turned to its limit on shaft D, Fig. 51 and 53, and the adjusting range is all used and the clutch slips it is an indication that the asbestos rings G, Fig. 53, must be renewed.

TWIN DISC CLUTCH

For TC 17-28 Tractor

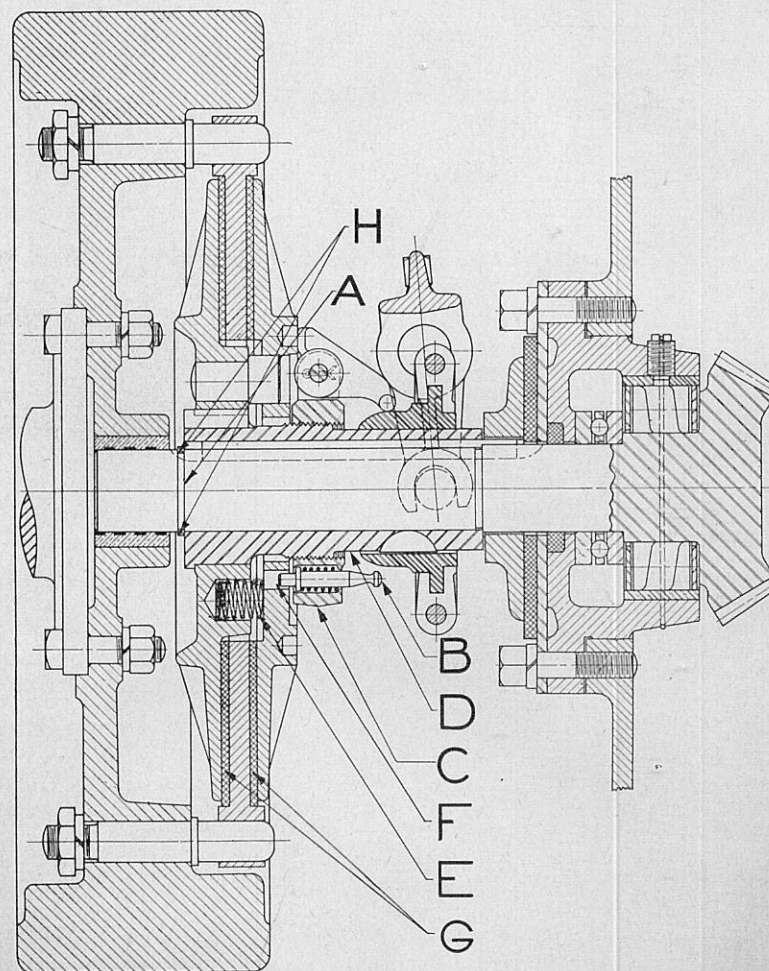
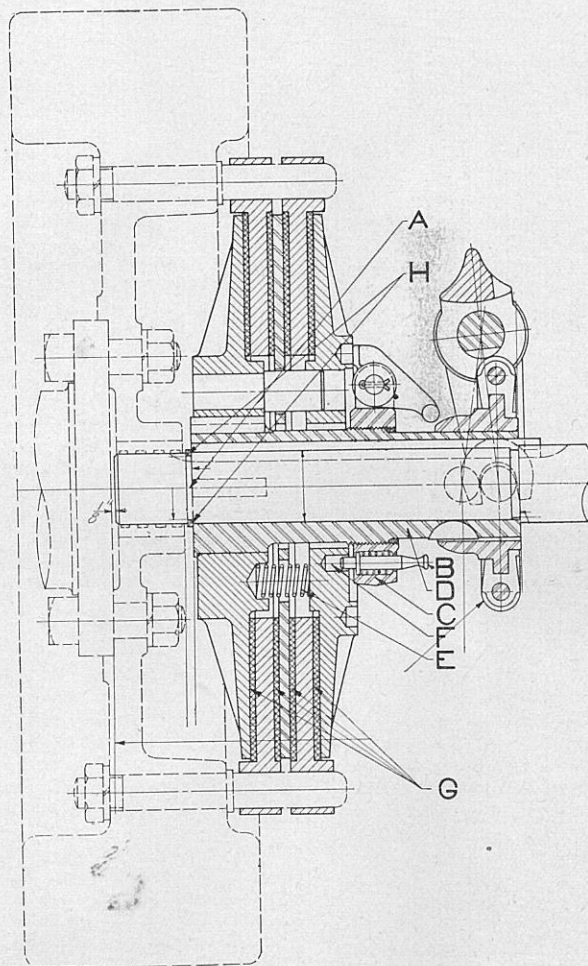


Fig. 51

TWIN DISC CLUTCH

For TC 27-44 Tractor



"Wheel Slip Cuts Down Amount of Work Done"

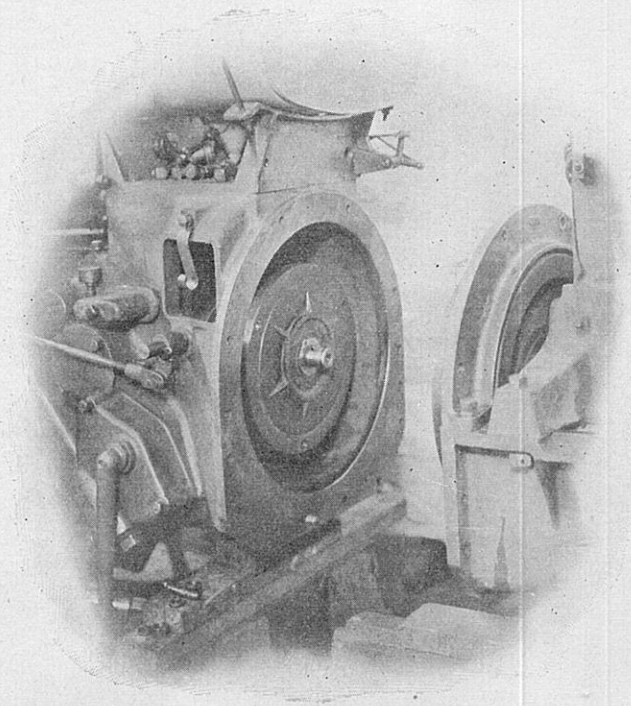


Fig. 54A

1. The method of removing the clutch is to remove hood, disconnect fuel pipe, control rods, steering knuckle and reach rods, then block up rear and front section of tractor and remove bolts holding same together. Now move rear section of tractor backward far enough to permit removal of clutch. See Fig. 54A.

At A, Fig. 51, there is a snap ring set into the shaft which holds the clutch on shaft. Force this ring out with screw driver. Pull out pin B, back off adjusting collar C, Fig. 51, so that the collar is free on shaft. The clutch can now be pulled off shaft and the asbestos rings renewed.

"This Equipment Will Make Lots Of Combinations"

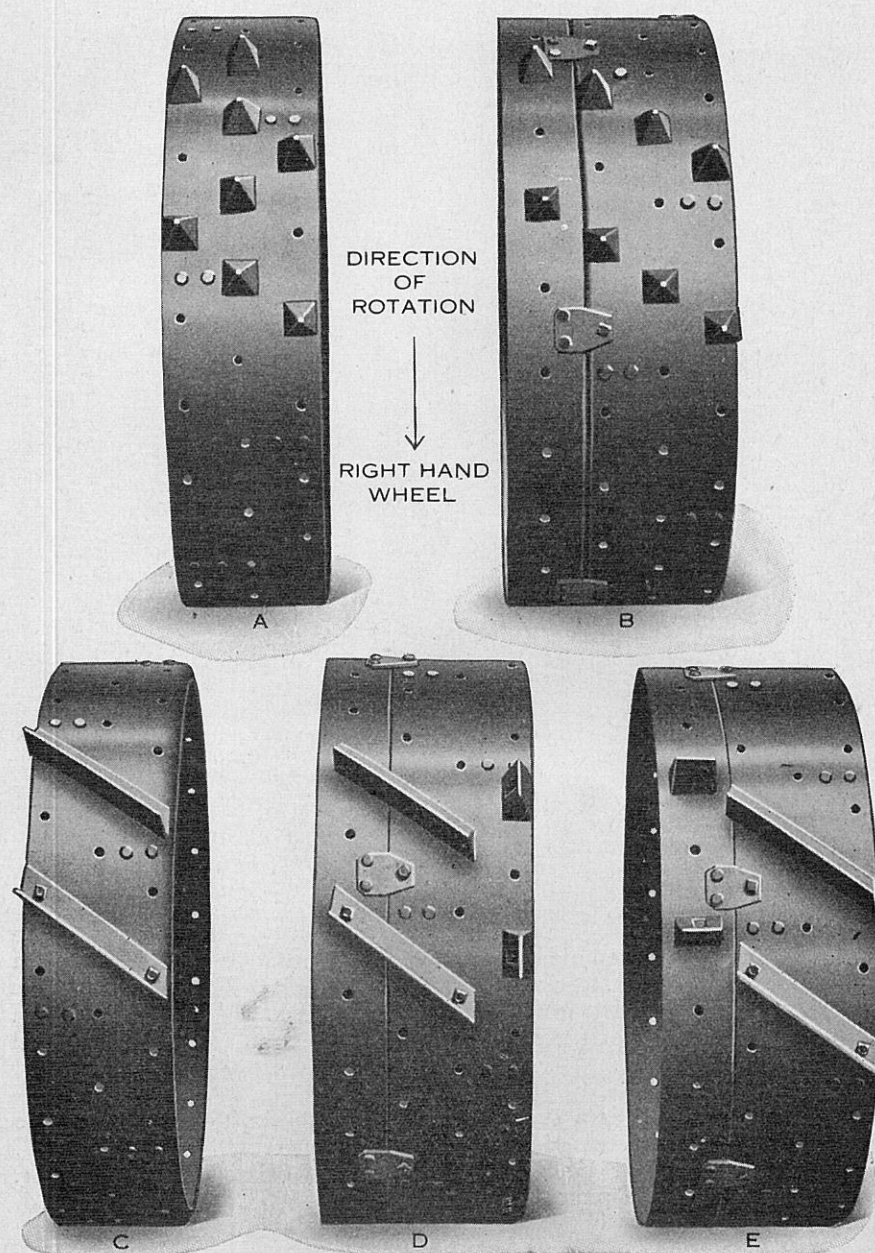


Fig. 56—A-B-C-D-E

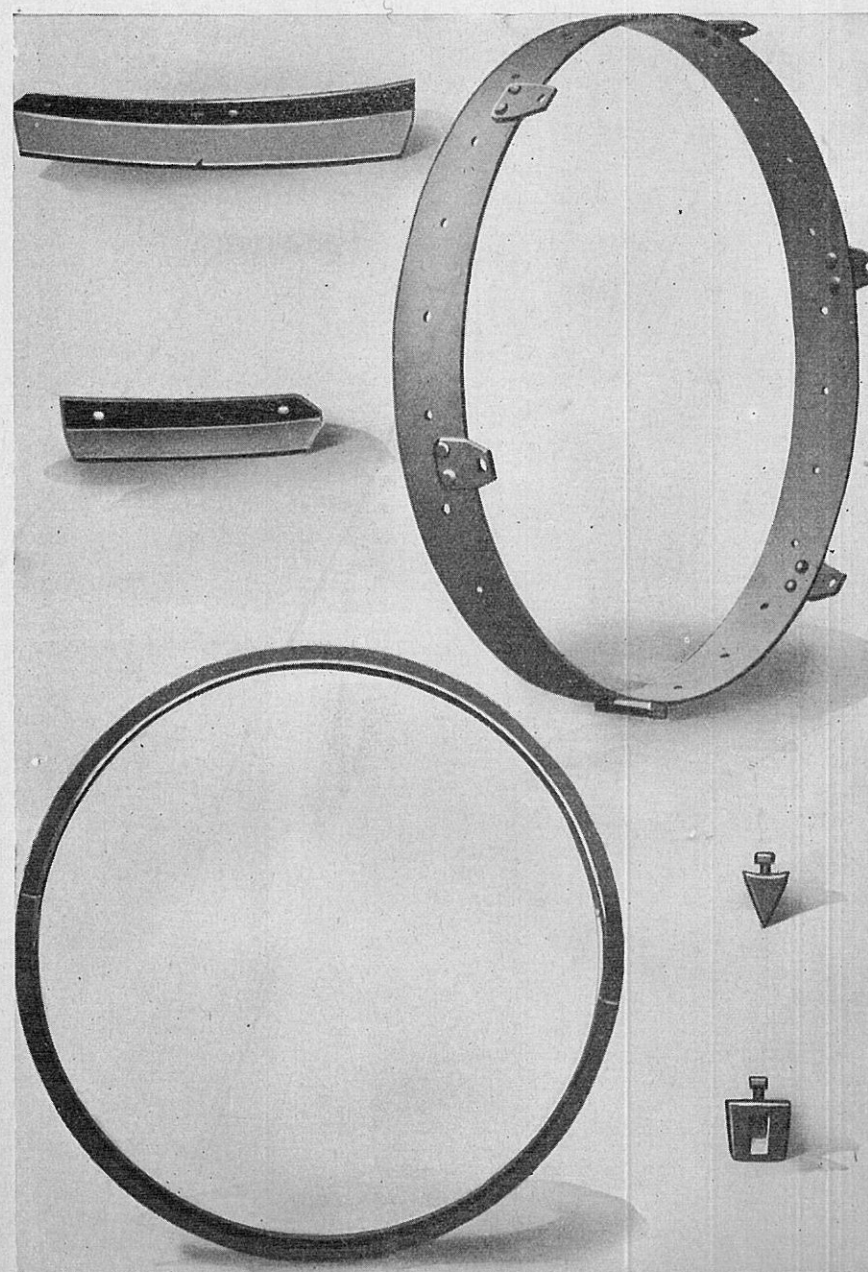
"Here They Are"

Fig. 55

"Some More"

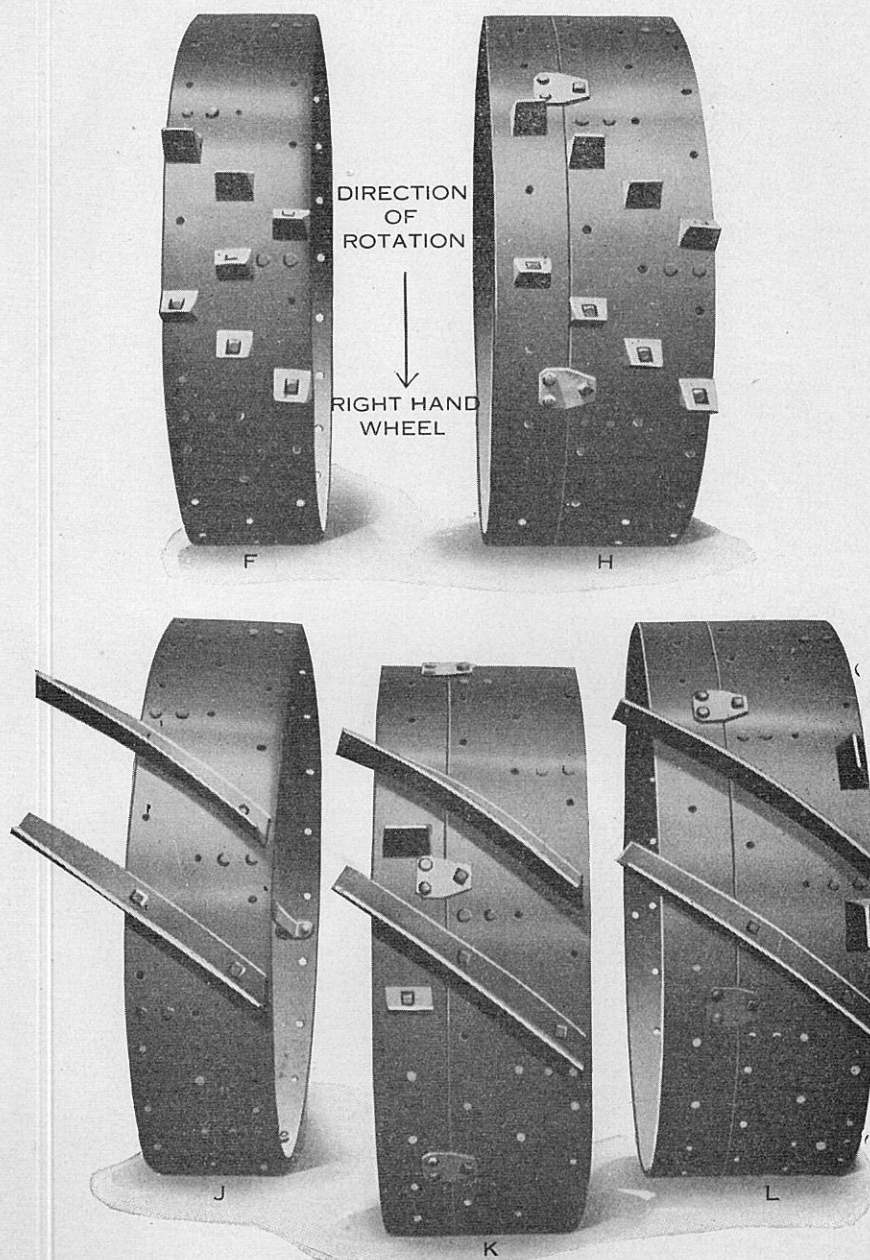


Fig. 56—F-H-J-K-L

"Some More"

Now insert the retaining ring in shaft at A, Fig. 51. Then the first asbestos ring, driving ring, second asbestos ring and thrust ring together in the order named and the clutch is assembled.

Now tighten the collar C, on shaft D, and the adjustment is made. Be sure the jaws on collar C, Fig. 51, are not turned under but fit snugly on thrust plate.

Now bring rear part back again, aligning the three pins with the three holes in clutch. Then adjust collar C, Fig. 51, until the clutch will hold without slipping.

Reassemble the various parts.

Do not slip clutch excessively.

Do not drive with foot on clutch pedal.

SEC. 61. WHEEL EQUIPMENT:

Owing to the different kinds of field and road conditions the proper kind of wheel cleats or grouters to use is a local problem. A tractor that is properly cleated will do very good work under most all conditions and a tractor improperly cleated will have lots of wheel slip, thereby cutting down miles per hour travel and amount of work done.

There are four kinds of standard wheel equipment for this tractor.

After considerable field work, we find the following combinations of wheel equipment and soil conditions work satisfactorily.

ORDINARY CONDITIONS:

Virgin Prairie

Soil Hard or Firm—3" Pyramid Grouter TX368, Fig. 55; 96 required for 2 drive wheels—See Fig. 56A.

Soil Medium or Loose— $3 \times 2\frac{1}{2} \times 5$ -16x17 $\frac{3}{4}$ " cleats TY180C and TY181C, Fig. 55. 12 of each required.—See Fig. 56C.

Turf or Old Ground Gone Back to Grass

Soil Hard or Firm—3" Pyramid Grouter TX368, Fig. 55. 96 required for 2 drive wheels—See Fig. 56A.

Soil Medium or Loose— $3 \times 2\frac{1}{2} \times 5$ -16x17 $\frac{3}{4}$ " cleats TY180C and TY181C, Fig. 55—See Fig. 56C.

Stubble Plowing, Gumbo or Firm Loam

$3 \times 2\frac{1}{2} \times 5$ -16x17 $\frac{3}{4}$ " cleats TY180C and TY181C, Fig. 55. 12 of each required—See Fig. 56C.

Sand or Volcanic Ash and Plowed Ground

$3\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8} \times 24\frac{1}{2}$ " long cleat TY180A, 181A, Fig. 55. 12 each required—See Fig. 56J.

96TY183 spade grouter—See Fig. 56F and N.

"Keep Wheel Equipment Bolts Tight"

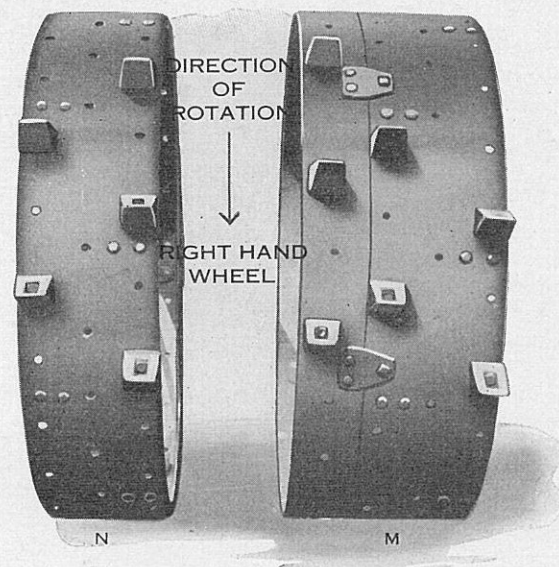


Fig 56

Road Work

3" pyramid grouser TX368, Fig. 55. 96 required—See Fig. 56A.

Rice Fields

$3\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8} \times 24\frac{1}{2}$ " cleats TY180A and TY181A, Fig. 55. 12 of each required—See Fig. 56J.

UNUSUAL CONDITIONS**Virgin Prairie**

Sandy Soil— $3 \times 2\frac{1}{2} \times 5-16 \times 17\frac{3}{4}$ " cleats TY180C and TY181C, Fig. 55. Twelve of each required.

Boggy Soil—6" extension rims, Fig. 55, TY183—See Fig. 56E.

Turf

Sandy Soil—Same as for Virgin Prairie.

Boggy Soil—Same as for Virgin Prairie.

This equipment works out very nicely on plowed ground.

Stubble Plowing, Loose Loam or Loose Sand or Volcanic Ash

$3\frac{1}{2} \times 2\frac{1}{2} \times 17\frac{1}{4}$ " cleats TY180 and TY181C, Fig. 55. 12 required and 6" extensions, 12 TY183—See Fig. 56E. Or 96 TY183 spade grouser, 96 required, 6" extension—See Fig. 56H and M.

This equipment works out very nicely on plowed ground.

Hill Side

Ordinary— $3 \times 2\frac{1}{2} \times 5-16 \times 17\frac{3}{4}$ " cleats TY180C and TY181C, Fig. 55. 12 each required. 6" extension rims, Fig. 55 with 24 Fig. 55—See Fig. 56D.

Loose— $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8} \times 24\frac{1}{2}$ " long cleats TY180A and TY181A, Fig. 55. 12 each required and $48 \frac{5}{8} \times 1\frac{3}{4}$ " machine bolts, hex nuts and lock washers.

6" extension rims, Fig. 55 with 24 TY183—See Fig. 56L.

"Plow Hitches are Important!"

Some conditions of road work require extension rims, then the pyramid grouters, Fig. 55, should be put on wheels as in Fig. 56B, and on sandy roads the equipment for sand or volcanic ash is the proper equipment.

When running tractor in the furrow, some soil conditions make it very desirable to have extension rims on the wheel on the land, that is the left hand; its equipment should be put on as in Fig. 56E.

SEC. 62. FRONT WHEEL RINGS:

The front wheel rings, TY228, Fig. 55, are bolted to the wheels and can be used in center of the wheel or on inner edge.

For ordinary conditions place rings in center line of wheels.

In gumbo or sticky soil the rings should be on inner edge of wheel as they will clean better there than in the center. Likewise working in plowed

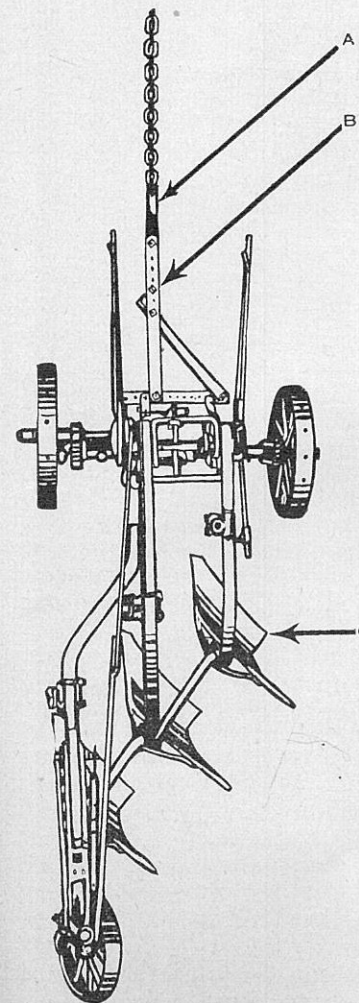


Fig. 57

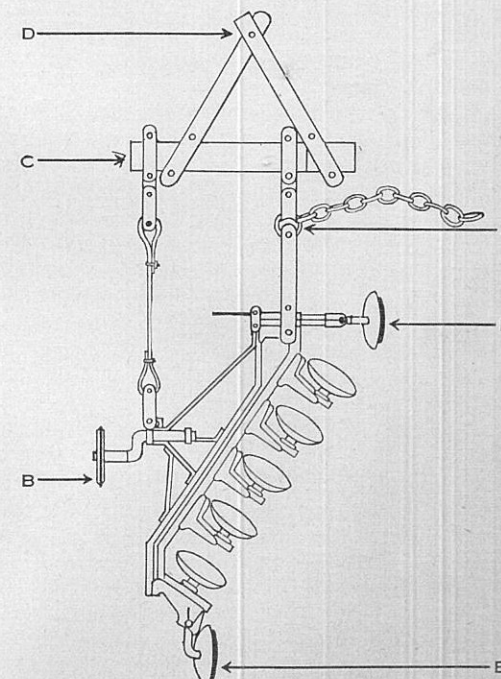


Fig. 58

"Study it Carefully"

fields, pulling discs, seeders, etc., it is advisable to have rings on inner edge of wheel; also for hillside plowing.

General: The wheel equipment should be inspected once in a while to see if any of the bolts are loose. They should be kept tight or you might tear off a mud guard.

SEC. 63. MOLD BOARD PLOW HITCH:

Set up and adjust according to directions sent with the plow. All plows for small tractors are equipped with a bar hitch. In opening up the land and for the first round in the field, hitch plow in the center of the tractor. On starting the second round, run the r. h. front wheel and drive wheel into the furrow and set the bars, B, Fig. 57, or move them so the first plow, C, Fig. 57, cuts full width, also hitch the bar, B, Fig. 57, so it is from 5" to 8" higher at the end that hitches to the tractor than at plow end when plow is in the ground.

SEC. 64. FOR HILLSIDE WORK:

Open up the land and make the first round with the plow hitched in center of tractor. On the second round run tractor on the land about 4" to 6" from the furrow. Couple a piece of chain, A, Fig. 57, 2 or 3 feet long between tractor and plow, then adjust the bar hitch, B, Fig. 57, and the furrow wheel, when necessary, so the plow cuts full width and steer tractor so the plow does not crowd away from the furrow. It is thought by some people that a long hitch pulls harder than a short hitch—this is an erroneous idea and does not apply to tractors.

SEC. 65. DISC PLOW HITCHES:

The method of hitching a disc plow to the tractor depends entirely on the nature of the soil you are to work in. Be sure to set up the disc plow and adjust it according to directions furnished with the plow. **This is very important.**

Open up the land and make the first round with the plow hitched to center of tractor. On starting the second round, where the soil is firm and even and does not contain loose sand or soft spots run the tractor on the land about 6 inches from the furrow and attach a piece of chain (2 to 3 feet long) between tractor draw bar and plow draw bar. Adjust plow wheels, B, Fig. 58, so they run straight and hold plow in the furrow.

For variable land and hillside, that is, where the soil is firm in some places and soft or sandy in others or hillside work, the hitch using a wooden draw bar between plow and engine as shown, C, Fig. 58, is a good one. The wooden draw bar is attached to engine draw bar by means of 4 pieces of bar iron, $\frac{1}{2} \times 2"$ as D, Fig. 58. This method of hitching permits your engine to be steered in and out on the land, depending on conditions and at same time permitting the furrow wheel on plow to guide the plow straight along furrow.

SEC. 66. LAYING OUT FIELDS:

The laying out of fields is a part of tractor operating that is entirely too often slighted for making the best possible time and economy. A field properly laid out will finish up without any loss of time in finishing triangular strips or ragged head lands.

The best system of laying out fields is where the loss of time in turning is reduced to a minimum and the smallest amount of unplowed ground is left.

For moldboard plows and where it is desirable to plow out all the land with the tractor, laying the field out in lands is the most convenient and practical method.

"Steering Carefully Counts on Hillsides"

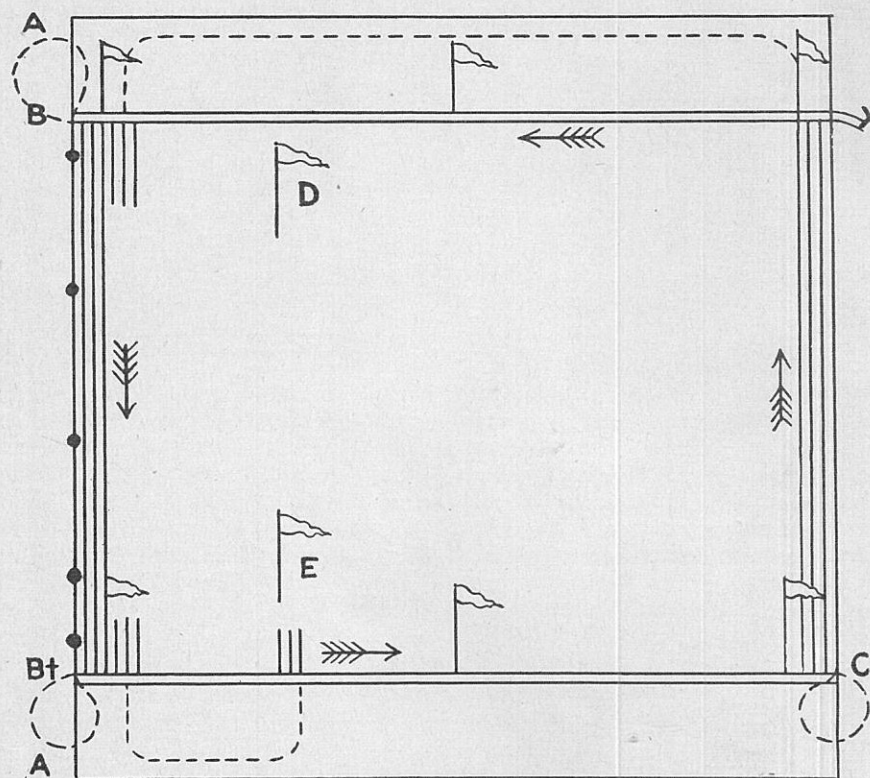


Fig. 59

Fig. 59 shows method of laying out fields into lands.

Measure the width the plow cuts and lay out the distance from A to B, Fig. 59, so that there is plenty of room to turn the outfit; at the same time this distance should be such that it could be finished in an even number of rounds. Put three flags across each end of the field, drive the tractor onto the field at X, Fig. 59, in line with the three flags, set the plow with depth lever so only two of the plows scratch the ground a couple of inches deep, and plow across the field from X to B, Fig. 59. Swing at B, Fig. 59, indicated by dotted lines. At the turn row, drop plow into ground to depth you want to plow and steer from B to B, Fig. 59, with all plows working. At B, Fig. 59, swing tractor, indicated by dotted lines. Set plow to scratch with two plows and steer across field to C, Fig. 59; at C swing and set plow working to depth and drive to X, Fig. 59. At X, Fig. 59 lift plow and run tractor without plows working, as indicated by dotted lines, to B, Fig. 59. Drop plows steering to B, Fig. 59. However, before proceeding to B, Fig. 59, stop and measure from last furrow to D, Fig. 59, an even number of rounds, and place a flag. Before pulling plow out at B, Fig. 59, stop and measure from last furrow to E, Fig. 59, same distance as at D, Fig. 59. Pull out plow at turn row and swing tractor, as indicated by dotted lines, to E, Fig. 59, and drop plow at turn row and steer from E to D, Fig. 59. At turn row lift plow and swing to B, Fig. 59, drop plow and steer to B, Fig. 59, and so on until the plowed ground at D and E, Fig. 59, is wide enough to permit plowing around it, lifting the plows at the turn rows.

"Lay Out Your Fields"

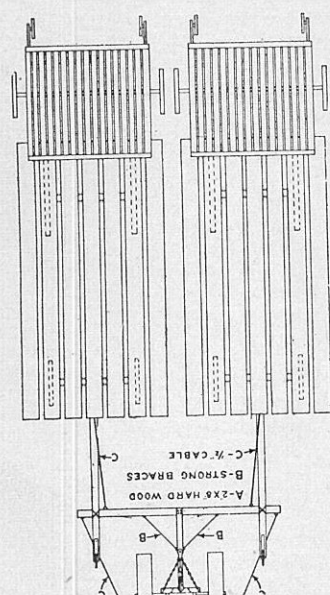


Fig. 64

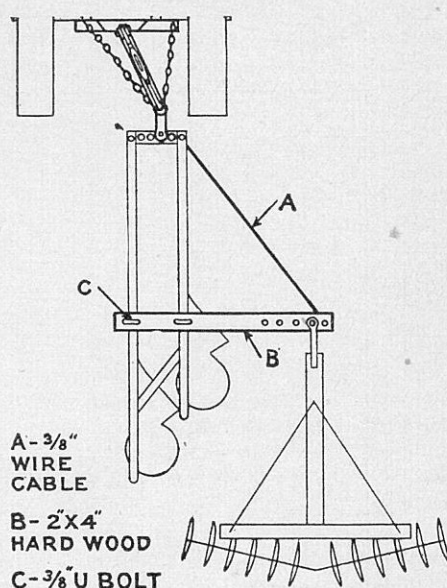


Fig. 65

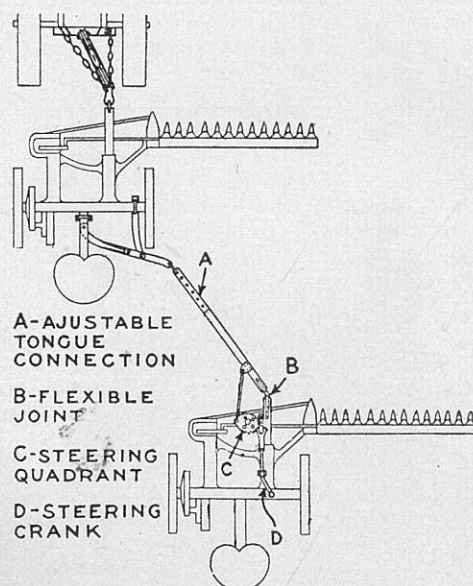


Fig. 67

When the unplowed ground between D and B, Fig. 59, is equal to the plowed ground, D and E, Fig. 59, swing back to B and B, Fig. 59, and finish this up. Lay out another land and so on until field is finished.

"Carefully, It Pays"

SEC. 72. HITCH FOR TWO HAY LOADERS: Fig. 64.

For loading hay on level ground there is nothing better than the steady power of a tractor. Again the general purpose draw-bar is easily adapted to the hauling of two hay loaders. The relative positions of the wagon poles on the draw-bar are governed by the regulation width of the windrows. It will be found an advantage here to have the ends of the draw-bar supported by caster wheels or wheels with stub axles to keep the draw-bar and wagon poles off the ground. It must be remembered that such a hitch as this (Fig. 64) offers no means of holding the wagons back on a hillside except by the friction of the rake teeth on the ground. It is not a difficult matter, however, to arrange brakes for the wagon wheels in places where the haying is done in hilly country.

SEC. 73. HITCH FOR PLOWS AND PEG OR DISC HARROWS:

The combination shown in Fig. 65 is intended for use with a three plow tractor where one of the plow bottoms is removed and a peg or disc harrow substituted for it and some places it is possible to do with three bottoms. The construction of this hitch is simple. A 2x4 hardwood piece is attached to the plow beams by means of U-bolts in such a manner that it extends over the furrow just turned. At the outer end of this draw-bar holes should be bored to allow for adjustments in the position of the harrow. A chain or wire cable running from the front end of the plow to the outer end of the draw-bar keeps the harrow in its proper position and tends to relieve the side strain on the plows.

SEC. 74. HITCH FOR TWO OR MORE MOWERS:

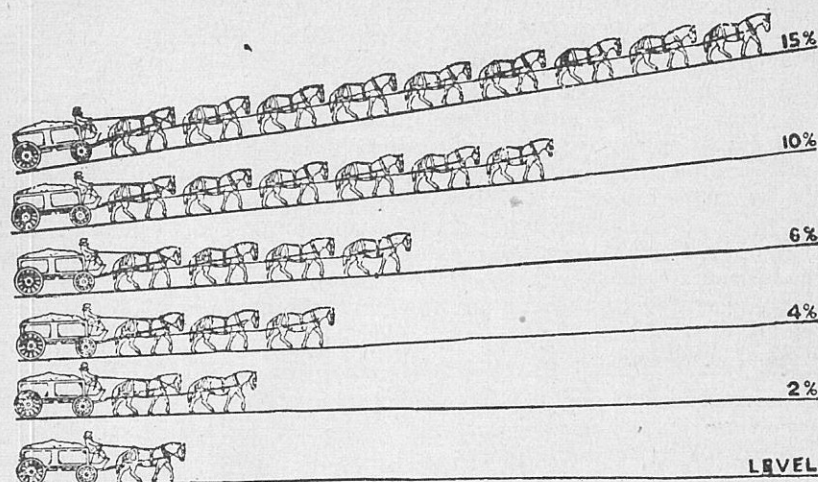
Fig. 67 shows the outlines of a hitch for attaching two or more mowers behind a tractor. The first mower is connected directly to the tractor draw-bar by means of a stub pole. The first mower requires no operator, for the operator of the tractor can raise and lower the cutter bar when necessary. The second mower is attached to the first by means of a bracket clamped to the axle of the first mower. From this bracket a flexible, adjustable tongue connection, marked A in the diagram, connects to the second mower. This tongue is adjustable to accommodate different widths of mower cutter bars. The attachment for the third mower corresponds to the attachment for the second. The proper width of cut is maintained by means of a crank and quadrant attached to the stub pole and flexible pole of the trailing mower. A series of mowers connected in this manner cannot, of course, be expected to turn a sharp corner; for a non-stop run the field should be laid out with rounding corners.

With a Trailer hitch the grain farmer can operate as many binders behind his tractor as the tractor has power to pull.

Various types of hitches have been designed to meet the requirements of the different lines of harvesting machines and mowers on the market. The first binder is connected directly to the tractor draw-bar by means of a stub pole. The poles on the trailing binders are pivoted to a rigid frame and controlled from the seat by a gear quadrant and pinion with a crank. This system of control enables the operator of the trailing binders to swing the platforms of their machines through a wide radius to or from the grain. Such a hitch can be attached to these machines without any alterations or extra holes in the binder frames.

By using a tractor hitch on a header or push binder, the machine is pulled rather than pushed. Such a hitch requires two operators, one on steering platform of the machine and one on the tractor.

"Proper Hitches Increase Production"



SEC. 75. HANDLING THE LOAD:

Do not overload your tractor. The tractor with similar horsepower ratings but with different travel speed will not pull the same load. The tractor which travels at a low speed will pull a larger load than one which travels at a higher speed but in a certain length of time, one will not do any more work than the other. When hauling with wagons, always take into consideration road conditions, whether or not there are grades to go up or sand to pull through. A loaded wagon will pull about six to eight times as heavy over sand as it will on a good hard road. When hauling up grade you can figure that one per cent of your load weight is added to the pull of your tractor at draw-bar for every one per cent of grade. If you have a load of say ten ton or 20,000 pounds, then hauling it up a ten per cent grade will require an additional pull equal to ten per cent of 20,000 or 2,000 pounds at draw-bar. This added pull or load has to be allowed for. **Be very careful not to overload your tractor.**

SEC. 76. IMPORTANT—PROTECTING ENGINE FOR WINTER:

If engine is to stand idle for any length of time during winter, run the engine under cover so it will be protected from the weather. Put a half-pint of thick oil in each cylinder, turn over flywheel several times, so as to get oil well worked between pistons and cylinder. Be sure that your priming cups are closed. Remove all electrical parts. Cover all exposed parts with thick oil so as to prevent rust. Be sure that all water is drained off. Turn off gasoline at tank and drain all pipes. This is a good time to make repairs so engine will be ready to start in the spring. Before starting engine again, clean out all oil with kerosene and prime the cylinder with good cylinder oil before starting motor.

SPECIFICATIONS OF TWIN CITY 17-28 TRACTOR

Tractor H. P.	17
Belt H. P.	28
Motor—Stroke Cycle	4
Cylinders—number	4
Cast	En Bloc
Cylinder Walls	Removable Sleeves
Bore	4 1/4"
Stroke	6"
R. P. M.	1,000
Number Main Bearings	3
Diameter and Length—rear	2 3/4" x 4"
Diameter and Length—center	2 1/16" x 2 3/8"
Diameter and Length—front	2 1/4" x 3 1/8"
Crank Pin Diameter and Length	2 7/8" x 2 7/8"
Piston Pin Diameter	1 1/4"
Number Cam Shafts	2
Diameter Cam Shaft	1 1/4"
Number Intake Valves	2
Number Exhaust Valves	2
Location of Valves	In Head
Cylinder Head	Removable
Oiling System	Gear Pump Pressure
Crankshaft	Counterbalanced
Speeds—forward	2.2 and 2.9 miles per hour
Speeds—reverse	1.75 miles per hour
Weight—without fuel, water or lugs	4,785 lbs.
Wheel Base	84"
Diameter of Drive Wheels	50"
Width of Drive Wheels	12" each
Number of Drive Wheels	2
Diameter of Front Wheels	34"
Width of Front Wheels	5 3/4" each
Type of Rear Axle	Live
Type of Front Axle	Automobile
Transmission Gears	Forged Steel, Hardened and Heat Treated
Transmission Shafts	Forged Steel, Heat Treated
Final Drive	Spur Gear, enclosed in Transmission Case, Running in Oil
Transmission—Type	Sliding Spur Gear
Number of Clutches	1
Type of Clutch	Single Disc—Dry Plate
Transmission Bearings	Hyatt High Duty
Thrust Bearings	Ball
Type of Radiator	Tubular
Radiator Construction	Truck Type Cast Tanks
Water Capacity	10 gals.
Size of Fan	20" diam.
Fuel Capacity—Kerosene	23 gals.
Fuel Capacity—Gasoline	3 1/2 gals.
Diameter of Belt Pulley	16"
Width of Belt Pulley	6 1/2"
Revolutions per minute	650
Belt Speed, feet per minute	2,700
Height of Drawbar	16"
Total Over All Length	134"
Total Over All Width	63"
Total Over All Height	63 1/2"
Clearance	10"

EQUIPMENT

Bosch High Tension Magneto with Impulse Starter and Adjustable Coupling.
 Lubrication—Pressure Oil Gauge.
 Air Cleaner.
 Holley Kerosene Carburetor.

SPECIFICATIONS OF TWIN CITY 27-44 TRACTOR

Tractor H. P.	27
Belt H. P. (on Kerosene)	44
Motor—Stroke Cycle	4
Cylinders—number	4
Cast	En Bloc
Cylinder Walls	Removable Sleeves
Bore	5½"
Stroke	6¼"
R. P. M.	900
Number Main Bearings	3
Diameter and Length—rear	3½"x5½"
Diameter and Length—center	3"x4"
Diameter and Length—front	2½"x3½"
Crank Pin Diameter and Length	3"x3½"
Piston Pin Diameter	1½"
Number Cam Shafts	2
Diameter Cam Shaft	1½"
Number Intake Valves	2
Number Exhaust Valves	2
Location of Valves	In Head
Cylinder Head	Removable
Oiling System	Gear Pump Pressure
Crankshaft	Counterbalanced
Speeds—forward	2 and 2.9 miles per hour
Speeds—reverse	1.87 miles per hour
Weight—without fuel, water or lugs	8,380 lbs.
Wheel Base	97"
Diameter of Drive Wheels	60" each
Width of Drive Wheels	20" each
Number of Drive Wheels	2
Diameter of Front Wheels	36"
Width of Front Wheels	8½" each
Type of Rear Axle	Live
Type of Front Axle	Automobile
Transmission Gears	Forged Steel, Hardened and Heat Treated
Transmission Shafts	Forged Steel, Heat Treated
Final Drive	Spur Gear, enclosed in Transmission Case, Running in Oil
Transmission—Type	Sliding Spur Gear
Number of Clutches	1
Type of Clutch	Single Disc—Dry Plate
Transmission Bearings	Hyatt High Duty
Thrust Bearings	Ball
Type of Radiator	Tubular
Radiator Construction	Truck Type Cast Tanks
Water Capacity	10 gals.
Size of Fan	24" diam.
Fuel Capacity—Kerosene	40 gals.
Fuel Capacity—Gasoline	1½ gals.
Diameter of Belt Pulley	21"
Width of Belt Pulley	8½"
Revolutions per minute	466
Belt Speed, feet per minute	2,570
Height of Drawbar	17"
Total Over All Length	153"
Total Over All Width	88"
Total Over All Height	74"
Clearance	14"

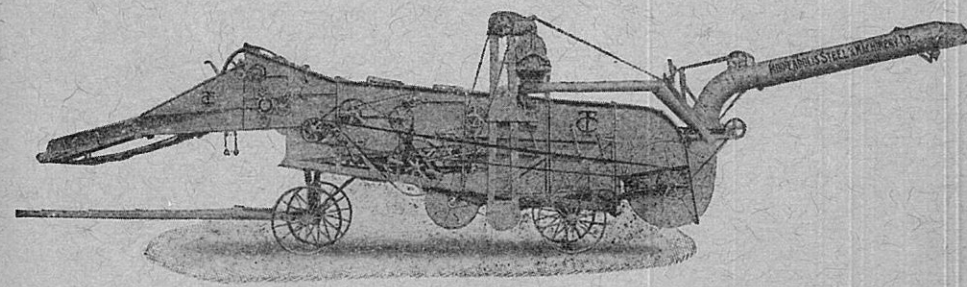
EQUIPMENT

Bosch High Tension Magneto with Impulse Starter and Adjustable Coupling.
Lubrication—Pressure Oil Gauge.
Air Cleaner.
Wheeler Schebler Carburetor.

TWIN CITY

21x36, 28x48 and 32x52

ALL-STEEL THRESHERS



Built for Lifetime Service

The all-steel construction defies the triple elements of poison rot from dust and moisture, warpage from exposure, and destruction by fire.

The unusual features of Twin City Threshers include: Extra large separating area; separate tailings cylinder (with delivery not back into the straw for a second separation, but direct to grain pan); adjustable sieves that handle all grains without

changing; cylinder and wind-stacker run on Hyatt Roller Bearings; all bearings are outside and may be oiled when the machine is in motion; simple to operate and care for; quick and easy of access. Full particulars will be sent upon request.

MANUFACTURED BY

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Minneapolis, Minn., U. S. A.