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INSTRUCTION BOOK

NUMBER 250

for

E. B. 12-20 MODEL AA TRACTOR

S. A. E. RATING

EMERSON-BRANTINGHAM IMPLEMENT CO.
INCORPORATED

GOOD FARM MACHINERY

Business Founded in 1852

ROCKFORD, ILL., U. S. A.

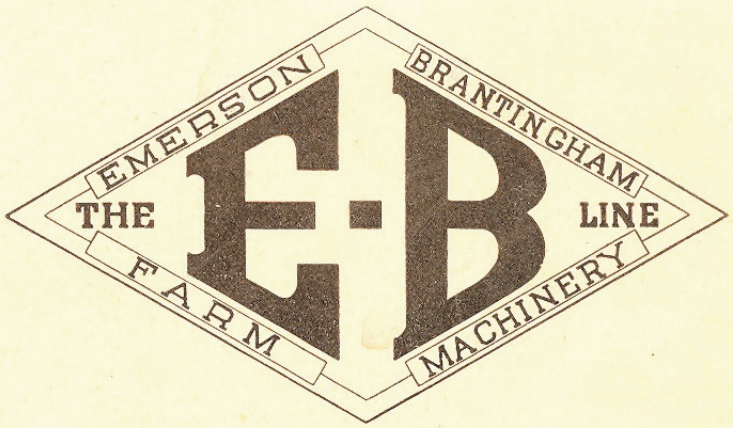
INSTRUCTIONS

for the

Care and Operation

of the

E-B 12-20 Model AA Tractor S. A. E. Rating



EMERSON-BRANTINGHAM IMPLEMENT CO., Inc.
ROCKFORD, ILLINOIS, U. S. A.

Introduction

IT is our desire to have every piece of "E-B" Machinery give satisfaction. The success of "E-B" Machinery, and also of our customers, depends largely on the customer and his method of handling a machine.

Anyone can run an E-B Tractor, and do a lot of work with it, who will exercise the same care, in proportion to the work done, that he does in running and caring for his automobile or stationary gas engine used for various work about the farm. Knowledge of the machine is necessary. Carefulness on the part of the operator is another necessity. But the use of good common sense and the careful study of the Instruction Book accompanying the tractor, in connection with the operation of a machine built as nearly automatic as engineering knowledge and experience can build it, will quickly convert the inexperienced operator into one of knowledge and judgment, thus making the operation of the tractor a pleasure and a success, rather than a trial and an expense.

It is with the purpose of imparting to our customers the proper kind of information leading to successful tractor operation that this book is written and distributed among you. We trust that with the aid of these instructions, every tractor owner will have confidence in his ability to obtain good results.

Each tractor leaves the factory thoroughly tested and ready to give the owner full value. Built as it is, of the very best of material, and by skilled workmen, little time is required to keep the tractor in perfect running condition. However, it is the duty of the operator to see that the tractor is not run entirely without care or attention.

We recommend systematic methods of care and operation. Make it a study, and establish a certain period each day for an inspection of the tractor. This inspection should be carried out faithfully and when adjustments are necessary they should be made then and there—not allowed to wait the operator's convenience. Avoid needless adjustments, for that has made many a well-running tractor give trouble.

It is to our interest, as well as your own, to have your tractor run successfully with a minimum amount of trouble, and this is more nearly possible when the operator has a good knowledge of its construction, adjustment, operation and care.

General Operation of Tractor

PREPARING TRACTOR FOR WORK

No one should attempt the operation of a new machine which he has never seen before without first looking it over carefully and becoming familiar with the various mechanisms and functions of its different parts.

It is assumed that the dealer, through whom the tractor has been purchased, will be able to give the purchaser such information as will be required by the beginner. Experience in actual work will give the operator opportunity to observe, and if he studies the Instruction Book, he will soon become thoroughly familiar with the operation and care of the machine.

When the tractor is shipped, all water and fuel is drained out and the drain cocks are left open. Raise the hood over the engine and close all drain cocks. Fill the radiator up to filler cap with pure water. Screw the filler cap back in place, turning it down tight.

See that the globe valves below the fuel tanks are closed; then fill the fuel tanks. Be sure to strain the fuel. A fine gauze strainer is the best to use, as it insures the removal of all dirt.

Look at the oil gauge on the left hand side of the engine. If the gauge does not show the reservoir to be full, obtain some good gas engine oil, and pour enough into the engine to raise the oil level slightly above the center of the glass in the oil gauge when the tractor is on level ground.

Consult the "Oil and Grease Chart" on page 10 to locate all grease cups and other places requiring oil or grease and see that they are well supplied.

After the tractor has been carefully oiled and greased, and all parts inspected, the engine may be started and the tractor put to work.

Avoid loading the tractor heavily the first few days it is operated. As a new ship must "find itself" and an automobile must be driven slowly the first few hundreds of miles, so must a tractor be broken in gradually, if it is to be broken in well, and thereby fitted for future years of successful work. **Do not, under any circumstances, load a tractor to its limit or allow it to receive any undue jar or strain until, through actual use, it has, like the ship, "found itself."**

HOW TO START ENGINE

Open the globe valve at the gasoline tank. The carburetor will quickly fill with gasoline.

Flood the Carburetor by raising the float valve stem, located directly above the union that connects the fuel line to the carburetor. Hold the stem up until gasoline squirts out of the small hole on the side of the valve.

Set the Magneto Lever on the steering post, at a point where the arms on each side of the magneto breaker box extend diagonally across the face of the magneto, and the short-circuiting spring all but touches the short circuiting screw beneath the breaker box. (See Fig. 2). Note the position of the spark lever on the steering post and let that be a guide to future settings.

Trip the ratchet catch lock on impulse starter located on the back of the magneto, above the coupling.

Set the Throttle Lever on the steering post at about the middle of the quadrant.

If the gasoline used is low test, it will be well to pour a little of it into each cylinder through the priming cups on the right of the engine.

See that the Clutch is Disengaged and that the gear shift lever is in neutral position. (See Fig. 4).

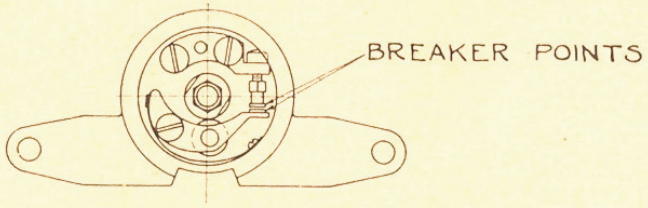
Crank the Engine by pushing the crank in until the jaws are engaged and pull up on the crank, giving it a quick turn past center.

CAUTION: Always lift up on the crank—never push down—and stand clear of the starting crank at all times.

Give the crank a quick turn, one-quarter distance around. The quicker the crank is turned the easier the engine will start.

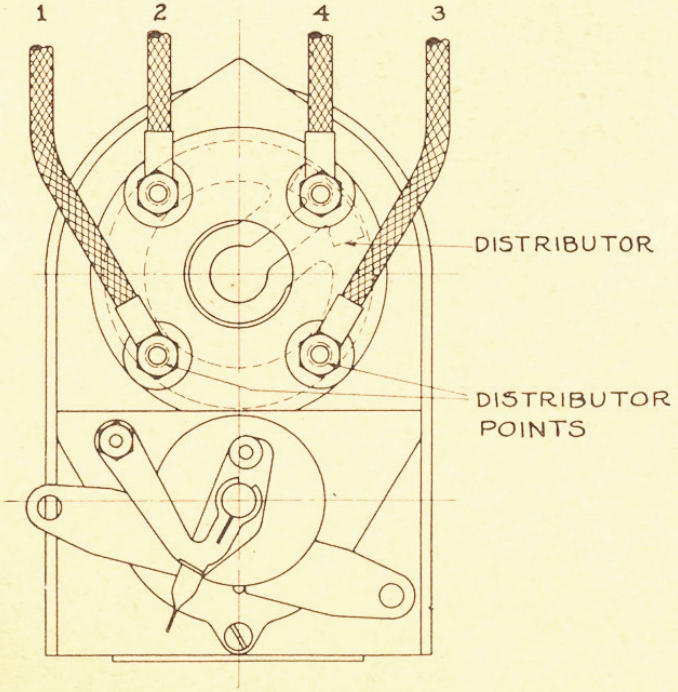
TO PUT TRACTOR IN MOTION

Shift gears to high, low or reverse, as required, (See Fig. 4), and with the foot, release the catch holding the foot pedal and allow it to work back toward you gradually until the clutch is engaged. The tractor will then be in motion. To stop the tractor, push the foot pedal forward. This releases the clutch and applies the brake in the same operation. The pedal is locked forward by a ratchet, all being operated by the foot.



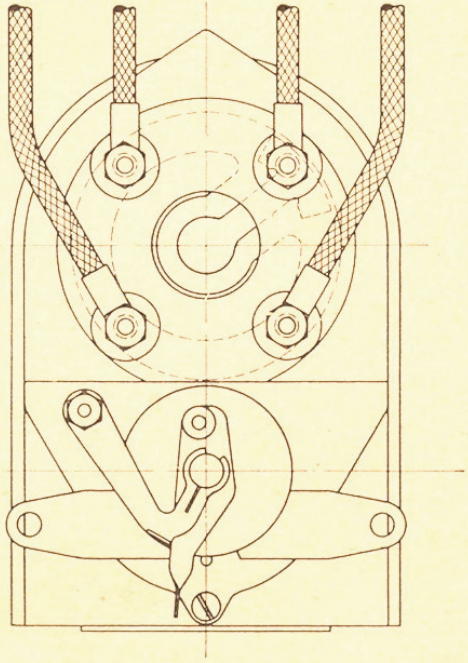
BREAKER BOX WITH CAP REMOVED

HIGH TENSION CABLES LEADING TO SPARK PLUGS



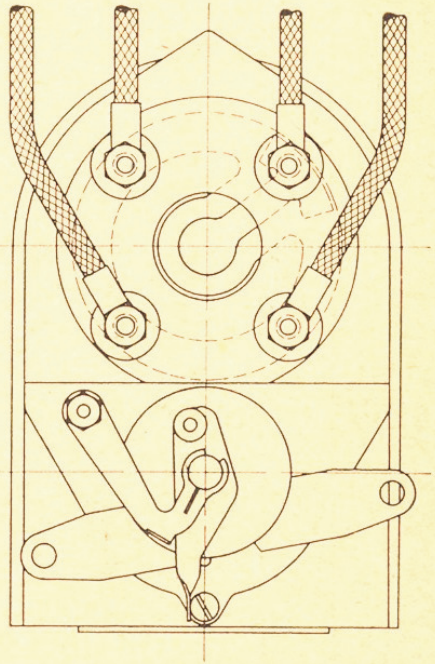
FULL ADVANCE.
SHOWS CORRECT POSITION
FOR FULL LOAD.

Fig. 1



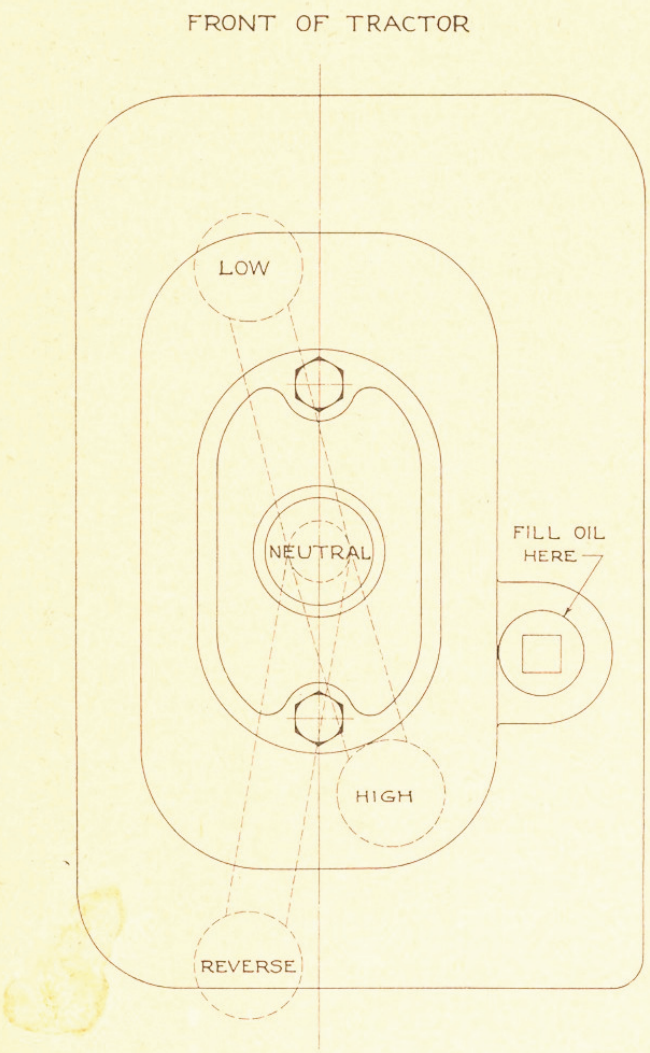
RETARDED.
SHOWS CORRECT POSITION
FOR STARTING.

Fig. 2



SHORT CIRCUITED.
SHOWS POSITION FOR
STOPPING MOTOR.

Fig. 3



GEAR SHIFT POSITIONS Fig. 4

When releasing the clutch and the tractor comes to a stop, bring the gear shifting lever to neutral position before removing the foot from the pedal. If the lever is not in neutral, the tractor will be started if the clutch is allowed to engage. For description of clutch, see "Care of Cone Clutch," on page 27.

Before attempting to shift gears be sure that the clutch is clear out. If the gears do not slide into place easily, never attempt to force them. By engaging the clutch just a little, the gears can be rotated very slowly until the gear teeth are in position to slide into mesh, and will slide without forcing.

TO STOP THE ENGINE

Push the spark lever forward until the short circuiting spring touches the screw and short circuits the magneto. The engine will then stop. (See Fig. 3).

USE OF SPARK ADVANCE

All governor throttled engines are intended to run at a given speed under all loads. The governor will regulate that speed. The spark advance can therefore be set at a point best suited to the speed of the engine under load, which on this engine is 900 R. P. M. The proper amount of spark advance has been determined and the magneto is so set as to take care of that advance and no more. Therefore, when the engine is first put under load, advance the spark fully and leave it fully advanced as long as the engine is under load. Under a very heavy load, the speed of the engine may decrease regardless of governor action, but the correct advance of the spark will not be affected by a decrease of from 200 to 300 R. P. M. and retarding the spark will not improve the action of the engine to any great extent.

If, however, the engine is running idle and is throttled down, or if it is loaded down to a very low speed, then a retarded spark will help to obtain a smooth running engine. If the engine is run at normal speed with the spark retarded, there will be a loss of power and the engine will get much hotter.

GENERAL LUBRICATION OF TRACTOR

On page 10 you will find a chart showing each part of the tractor requiring oil or grease, and the kind of oil to use.

Study that chart until you know every place requiring oil or grease, and where to find it on the tractor. Then see that all parts to be lubricated are properly taken care of in that respect as long as the tractor is in your care.

It is poor judgment to use any oil other than the best for the purpose that you can procure. Do not always judge oil by the price, nor try to economize by using a certain oil just because it is cheap. A great deal of a tractor owner's troubles can be traced directly to the use of oils and greases unsuited to the conditions under which they must work. Suitable oils can be ob-

tained, and, in the long run, will invariably be much cheaper.

The importance of good, clean lubrication cannot be over-estimated. Because we realize what good lubrication means, we feel that this item in the care and operation of the tractor cannot be dwelt on at too great length, nor be too emphatically expressed.

The oil and grease for the tractor, can and must, be kept clean. Store the oil in a sheltered place where flying dust will not settle all over the container and mix with the oil when it is drawn out for the tractor.

Dust and grit must not be allowed to get into the crank case of the engine or other working parts of the tractor. Use a clean pail for transferring the oil from the container to the tractor, and do not carry the oil in an open pail across a field or anywhere in the open when wind is blowing dust about. Use a covered pail or a can with a stopper. Steel drums with faucets, being dust, water, and sun, proof, make good storage tanks for engine oil.

Exercise the same care in handling the cup grease. Keep the container free from dirt and when filling a grease cup, clean all the dust off of it before putting in fresh grease.

Transmission oil can be stored in steel drums the same as engine oil, and the same care in handling should be exercised.

ENGINE LUBRICATION

The entire engine is automatically lubricated. The splash system is employed, the oil being forced to the connecting rod splash compartments by a pump, from the oil reservoir, which holds a surplus.

The connecting rod splash compartments referred to above are made in the form of troughs, placed under each connecting rod.

Each connecting rod carries an oil splasher, and these splashers dipping into the oil form a spray which reaches every working part within the engine.

The splashers on the connecting rods are so shaped as to scoop into the oil and throw it, rather than to simply strike the oil. These splashers must be attached to the bolts on the left of the bearing (viewing the tractor from the rear), in such a manner as to scoop under the surface of the oil in the splash compartment when the engine is turned in the direction in which it runs. See that these splashers scoop into the oil, and that they do not get bent in such a manner as to simply strike the oil, as in this case, they will quickly throw all of the oil out of the splash compartment, and thereby impair the engine's lubrication.

The gears which drive the cam shaft, the magneto, the water pump and the fan, receive a constant stream of oil. The surplus oil from all parts drains back into the oil reservoir, where it is received again by the pump.

USE CLEAN OIL

To get satisfactory service from a tractor, it is absolutely essential that the oil in the engine be at all times clean. Look at it; feel it, and if it is black and gritty, or if it shows that there is kerosene mixed with it, drain it out, wash the engine, and put in fresh oil.

The oil containers must be kept clean, and care must be exercised in transferring the oil to the engine. Even then, as the oil is worn out and fried away in a hot engine, the residue of the oil is constantly being washed back into the crank case, and if allowed to accumulate for any great length of time, will make the oil in the engine a better cutting compound than a lubricant, and will cut with telling effect on all of the bearing surfaces in the engine. In addition, it causes undue carbon deposits to accumulate on the pistons, combustion chamber walls, spark plugs and valves.

When the oil shows the first signs of grit, or of having kerosene mixed with it, prepare to wash the engine. If the oil is closely watched, it will not be necessary to drain any great quantity of oil when washing the engine, as it can be arranged to have only a little over an inch of oil in the oil gauge when the washing is to take place.

Before washing the engine, pour a half pint of kerosene into each cylinder through the spark plug holes, and allow the engine to stand two or three hours, or over night. The kerosene has a tendency to loosen up the carbon deposits on the pistons, combustion chamber walls, and the valves. Kerosene if used in this way from the very beginning will keep the engine clean, but will not help to any extent after carbon has been allowed to accumulate. After time has been allowed for this process, the engine should be

turned over a few revolutions to be sure that the kerosene is all out of the cylinders. Drain all of the oil out of the oil casing through the plug in the bottom, and wipe the oil from the splash compartments with a cloth. **Do not use waste inside of the engine housing.** Using a large syringe, or a small can, if a syringe is not obtainable, and kerosene, wash the interior of the engine housing, the splash compartments, the oil casing, and all working parts thoroughly, and wipe them dry with a clean cloth. Be sure that the opening to the oil gauge is not plugged up. There is also a small vent in the top of the oil gauge. If this is allowed to become clogged, the gauge will show oil when there is really none in the reservoir. Replace the plug in the bottom of the oil casing.

Be sure the oil pump is working. (See "Oil Pressure Gauge.") To test the oil pump when the engine is running, remove the compression coupling on the end of the copper tube that leads to the pressure gauge and if the pump is working, oil will squirt out through the side where the pipe was attached to the pump. Pour a little good, clean lubricating oil into each cylinder and bearing to facilitate starting and to guard against the possible scoring of some of the parts by running without sufficient lubrication.

It is necessary, when advising how often to change oil, to rely somewhat on the operator's judgment. **Do not think your engine is being lubricated properly because there is a sufficient quantity of "oil."** The oil may appear all right when looking at it through the oil gauge, after having been used for some time, but on getting your fingers into it, you may find it in a dirty, gritty or thin condition, and when this is the case, do not merely put in more clean oil—drain the old out and renew, as in putting in clean oil under these conditions, you are not remedying your trouble. With proper carburetor adjustment, good oil and good compression, it should not be necessary to change the oil more than once every thirty hours. On the other hand, if the carburetor is not adjusted right, or you have poor oil, or low compression is present, it will be necessary to change oil oftener than every thirty hours, so if on examination, the oil is found thinned down or dirty and requires frequent cleaning, it is necessary to correct the cause before you can get the proper number of hours' run on a given amount of oil.

CAUTION: Keep plenty of oil in the reservoir at all times. Do not allow the oil level to reach a point lower than one inch from the bottom of the glass in the oil gauge when the tractor is on level ground. This is the danger line.

THE OIL GAUGE

The Oil Gauge is a glass located on the side of the oil casing, on the left side of the engine. It screws into the lowest point in the reservoir, and the oil finds its own level in the glass. This shows the exact level of oil in the reservoir at all times.

OIL PRESSURE GAUGE

This gauge is placed on the dash in the lower left hand corner and indicates the number of pounds pressure the oil pump is exerting. The amount of pressure indicated by the pressure gauge varies with the speed of the engine and the temperature of the oil. When the engine is warm and supplied with good clean oil, the pressure on the gauge should be from one and one-half to four pounds when the engine is running at normal speed. Practically all engine lubricating oils become less viscous from use even under normal conditions. Do not continue to run the engine, if, as a result of low viscosity or thin oil, no pressure is indicated on the gauge when the engine is running at normal speed. Cold oil will show higher pressure than hot oil, and therefore indications should be observed when the engine has been thoroughly warmed up and the oil is hot.

THE OIL PUMP

The oil pump is a unit in itself, contained within the crank case, and held to the left, or valve side of the engine by cap screws from the outer side of the crank case.

The pump is of the plunger type. The plunger is hardened steel and is ground to a close fit. A spring holds the upper end of the plunger (E) against an eccentric on the cam shaft, and when the engine is running, the plunger works up and down in the sleeve of the pump bushing.

In attaching this pump to the engine housing, a gasket of tarred roofing paper is used to prevent oil leakage. The check valves are both located in the pump bushing, the plunger being solid, and the oil is forced out through a passage in the

body of the pump, through a check valve (F) and into a pipe (H) which leads to both ends of the engine. At each place where this pipe intersects a splash compartment, a small hole (L) is drilled in the under side of the pipe. Thus the oil is forced directly from the pump to the splash compartments. The pump bushing is cast to this pipe at almost its middle point, and the oil inlet (G) to the pipe is drilled in the course of machining the pump bushing. Thus it will be readily seen that the pipe is not removable from the pump.

ENGINE OIL

When buying Engine Oil, do not always take the dealer's word as to the suitability of a certain oil, nor place an order with any oil salesman who may happen along simply because he thinks his oil is best. Both the dealer and the salesman may be honest in their convictions, but not be reliably informed.

A number of reliable oil companies are selling oils expressly for use in tractors, and publish recommendations for each make and type of tractor. It is, therefore, safer to buy a well known oil **prepared by a well known reliable company,** than to choose at random from a number of oils which are not well known.

Our engineers have made an exhaustive study of engine oils, making physical tests their basis of judging an oil. These tests place us in a position to advise our tractor users intelligently regarding the suitability of most brands of oils, and if you will write the Emerson-Brantingham Company, Tractor Works, Minneapolis, Minnesota, for recommendations, stating the name of the company with whom you prefer to deal, they will be gladly given.

If you buy an oil from a reputable oil company represented to you as having the proper requirements, the Service Department will be

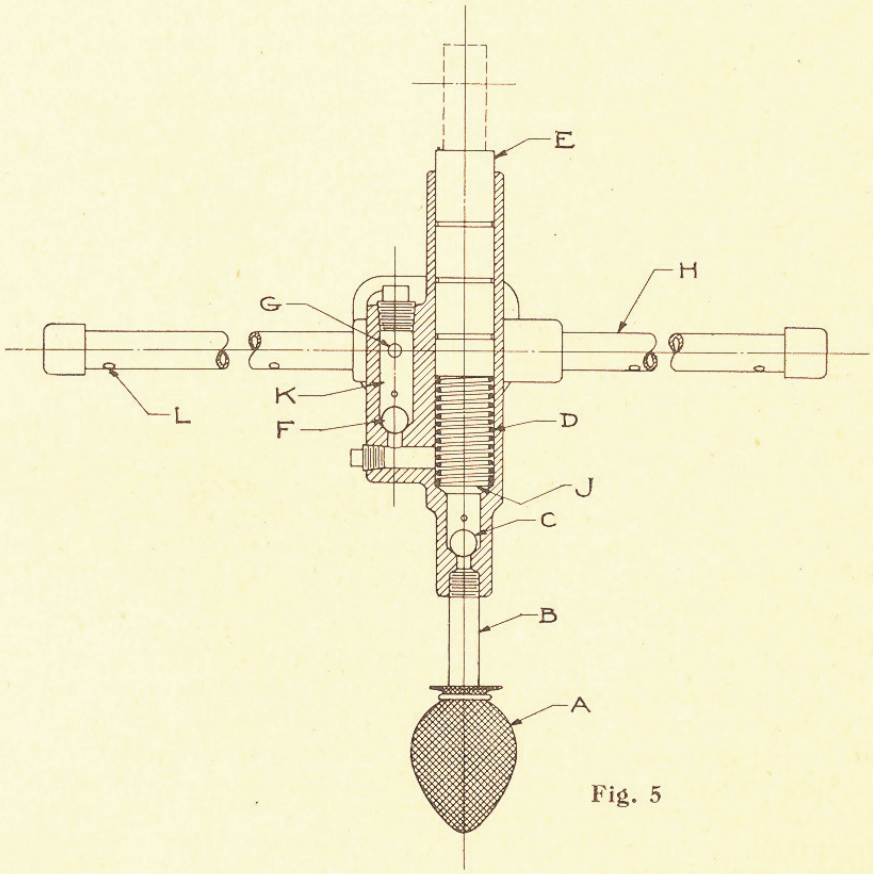
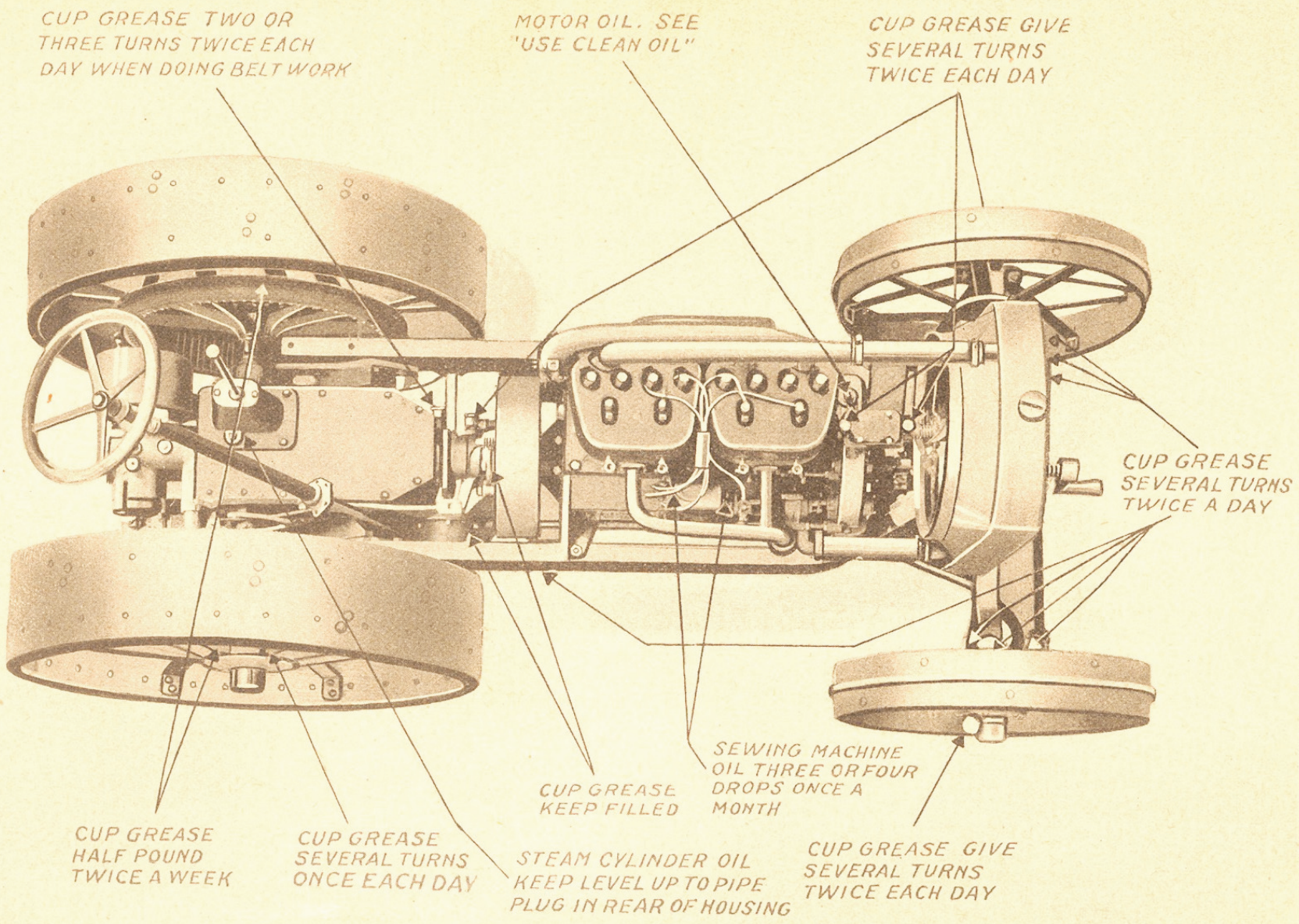


Fig. 5

THE OIL PUMP


CUP GREASE TWO OR THREE TURNS TWICE EACH DAY WHEN DOING BELT WORK
MOTOR OIL. SEE "USE CLEAN OIL"
CUP GREASE GIVE SEVERAL TURNS TWICE EACH DAY
CUP GREASE SEVERAL TURNS TWICE A DAY
SEWING MACHINE OIL THREE OR FOUR DROPS ONCE A MONTH
CUP GREASE KEEP FILLED
CUP GREASE HALF POUND TWICE A WEEK
CUP GREASE SEVERAL TURNS ONCE EACH DAY
STEAM CYLINDER OIL KEEP LEVEL UP TO PIPE PLUG IN REAR OF HOUSING
CUP GREASE GIVE SEVERAL TURNS TWICE EACH DAY

glad to investigate it for you upon receipt of an eight-ounce sample, bearing your own name, the name of the oil, and the name of the company putting it out.

Always have plenty of good, clean oil in the reservoir. Watch the oil gauge and never let the oil level get lower than one inch from the bottom of the glass.

PISTONS AND CYLINDERS

The friction contact between the pistons and cylinders forms the most important bearing surface in the whole engine. It is of the greatest importance that only the best oil for the purpose be used there, and that neither too much nor too little be used. The oiling system, when properly adjusted, supplies equal lubrication to all portions of these bearing surfaces. **Keep the oil clean.** See **"Use Clean Oil,"**

In order to keep the cylinders in the best working condition, they should be thoroughly flushed through the priming cups or spark plug holes with kerosene at least once a week. The kerosene cuts any gummy deposits and cleans the cylinders, pistons and valves, causing the piston rings to spring tightly against the cylinder walls, thereby improving compression and preventing over-heating. **The operator should begin this flushing early, however, as after a time, the carbon hardens so that it can only be removed by taking out and scraping the pistons, piston rings and combustion chambers.** See **"Use Clean Oil"**

Before starting the engine, after flushing with kerosene, always pour a little cylinder oil through the priming cups so that the cylinder walls will not be damaged from lack of oil.

MAGNETO LUBRICATION

About once a month the magneto bearings should be oiled, using a good grade of light oil. One oil hole will be found on top of the distributor housing, which oils both the distributor bearing and the front main bearing. The other oil hole will be found on the rear bearing cap.

Put only three or four drops of light oil in each oil hole once a month. A good sewing machine oil is very satisfactory. Do not use engine oil.

Aside from this, the circuit breaker housing should be removed and all oil wiped out of it, especially around the platinum points, and one drop of oil should be put on the bearing in the roller on the contact arm. Make sure that the contact or platinum points are clean, and that no oil has lodged on them. Oil on the contact points is an insulation and will cause hard starting and probable missing at low speed. It will also burn pits in the platinum, making it necessary to dress them down often.

CAUTION: Do not use too much oil. The amount should not exceed three or four drops. Too much oil in the magneto is just as bad as not enough.

FAN SHAFT LUBRICATION

Turn the grease cups on the fan shaft four or five turns twice each day. This shaft runs at high speed and must be well lubricated.

CLUTCH LUBRICATION

The transmission clutch is a metal wheel with a bevel rim covered with a friction lagging. The bevel of the clutch cone fits perfectly into an internal bevel surface in the fly wheel of the engine and is held against this friction surface by four steel springs. When the clutch is released and the engine is running, the clutch is stationary. The tension of these springs as well as the weight of the clutch is then taken by a radial and thrust bearing within the clutch, and an equal load is also placed, under these conditions, on the ball thrust bearing in the trunnion ring. These parts should be well lubricated. This is especially true of the trunnion ring. The grease cup on the trunnion ring should be screwed down daily.

TRUNNION RING LUBRICATION

The clutch coupling (AA-470-T) which transmits the power from the clutch to the drive shaft of the transmission has four keyways cut on the inner side and is designed to slide on the AA-647-T splined sleeve for drive shaft, when the clutch is released and allowed to engage. Beside the necessity of this coupling sliding backward and forward on the AA-647-T drive shaft sleeve it is forced to perform somewhat the same duty as a universal joint and on this account the splines on the AA-647-T drive shaft

sleeves and the keyways in the AA-470-T clutch coupling must be well lubricated. These parts receive their lubrication from a grease cup on the AA-468-T trunnion ring. **Give this grease cup several turns twice each day.**

The ball thrust bearing in the trunnion ring also receives its lubrication from this grease cup, but as the grease for the splined sleeve must first pass the ball thrust bearing, it is seen that by taking care of the lubrication of the splined sleeve, the trunnion ring bearing AA-612-T is also properly lubricated.

THE TRANSMISSION

The transmission is a two-speed type, strongly constructed and automatically lubricated. It is built to stand the strain and abuse that it naturally will receive, but as the life of a machine depends upon the care it receives, this transmission will require care just the same as any other part of the machine.

The lubrication of the gears and bearings in the transmission is the most important item of care in connection with this part of the machine. The entire transmission and differential is enclosed in one case, frame and housing combined. It is an oil-tight, dust-tight case. The oil to use in this case is a heavy steam cylinder oil.

The transmission gears and all bearings are automatically lubricated as long as sufficient oil is in the transmission case. A pipe plug is placed in the rear end of the transmission case so that the level of the oil can be determined. Good heavy steam cylinder oil should be added whenever necessary to maintain the oil level to this point. A large grease cup is provided for additional lubrication of the front drive shaft bearing and this should be given several turns twice each day when doing belt work.

The Belt Pulley Gears are located in a compartment at the rear of the Transmission, and require separate lubrication. Keep this compartment two thirds filled with semi-fluid transmission grease. This can be done by removing the $\frac{3}{4}$″ pipe plug just in front of the tool box. Care should be taken that no dirt is allowed to get in the compartment while filling.

If, for any reason, it becomes necessary to remove the gear shifting mechanism, proceed as follows: First—Engage the shift lever with the high speed pinion and shift same in mesh. While the high speed pinion is engaged with the high speed gear, remove the cover plate No. AA-305-T, which will allow the shift lever to be removed. Next remove the cap screws which hold bracket No. AA-303-T in place. After this is done, the bracket may be removed by tipping toward the steering post.

When replacing this mechanism, care should be taken that the high speed pinion is in proper mesh with the high speed gear and that the low speed pinion is out of mesh. Have a space of 3-16″ between the face of the low speed pinion and the face of the low speed gear. Great care should be exercised in doing this, as it is necessary that the shifting yokes are in proper position and engage the gears correctly. After installing, it is advisable to engage the clutch and crank the engine over by hand, thereby assuring you that it is correctly assembled. **Try each gear** before starting the tractor under its own power.

The belt pulley gear shift is provided so that when not using the pulley, the operator can shift the gears out of mesh. The pulley running idle, requires a certain amount of power and by keeping it out of gear when not in use, relieves the belt pulley gears and roller bearings of unnecessary use.

To shift the belt pulley out of gear, proceed as follows: Remove the retaining pin (No. AA-341-T) in the belt pulley shaft end plate (No. AA-359-T) on the right hand side of the transmission. Then turn the lock collar (No. AA-360-T) a quarter turn, having the drilled hole in the square headed end of lock collar parallel to the hole in the end plate (No. AA-359-T). When the lock collar (AA-360-T) is in this position, push the belt pulley to the right until the inside hole in the lock collar lines up with the hole in the end plate. Insert retaining pin and cotter keys as found in the beginning. When this is completed, the belt pulley gears will be out of mesh. To get the belt pulley gears in mesh again, reverse this operation.

By removing the plates holding the bearings in place, the roller bearings in the transmission become easily accessible, and the rollers can be pulled out and examined.

If clean oil is put into the transmission, it will remain clean. It is advisable, however, to clean out all oil about once a year and put in fresh oil.

The Transmission Brake is so constructed as to be integral with the transmission and is applied when the clutch pedal is pushed down. It consists of a metal wheel assembled on the rear end of the transmission counter shaft. A metal band lined with a friction lagging is contracted against the outer surface of the wheel, thus stopping the tractor. When the clutch pedal is locked down, the brake remains on, so that in stopping on a steep grade, the tractor will not tend to start itself moving. Always see that the brake contracts properly when clutch pedal is pushed clear down.

There are two adjusting nuts provided for taking up the wear in the friction lagging of the brake band. These should be so adjusted that the brake will take effect only when the clutch pedal is pressed clear down, as it is necessary that the clutch, which is controlled by the same foot pedal, should release before the brake is applied. Otherwise you will encounter trouble in shifting gears on account of inability to entirely disengage the clutch because of the brake taking effect too quickly and thereby limiting the movement of the clutch pedal.

THE DIFFERENTIAL

One case is used to house the transmission and differential so that all parts may be run in oil, well protected, and that rigid construction may be used. Compactness and few parts go a long way toward making a tractor simple, durable and accessible.

The differential forms the hub of the large bevel gear, and consists of three small bevel pinions running between two bevel gears. The differential shaft is of the spline type of shafting, having four keys a part of the shaft, and is in two pieces, one piece extending into the differential from either side, and both held in place by keyways in the bevel gears, and by retaining sleeves fitting against shoulders on the shaft. A cut steel case hardened master pinion, having four keyways, slips over the outer end of each differential shaft, which has four keys milled out of the shaft itself. These pinions are held on by retaining washers and nuts.

The differential runs in the same bath of oil that lubricates the transmission, so that replenishing the oil for one, takes care of both. Ample provision is made for the oil within the case to reach all parts of the differential.

The transmission and differential case has a large removable cover. When this cover is removed, all parts within the case are easily accessible.

DRIVE WHEELS

The rear wheel hub is of semi-steel and of ample size. The machine cut master gears bolt directly to the hubs of the drive wheels and as the rear axle turns in bearings in the transmission housing, perfect alignment of the master pinions and gears is assured at all times. Sixteen flat $\frac{1}{4}''$ steel spokes are riveted to the hub and rim, thereby providing great strength for transmission of power to the rim. The master gears and pinions are entirely enclosed in dust and dirt-proof housings. **By removing the pipe plugs in the rear wheel hubs, hard oil can easily be put in for lubrication.** This should be done once a week. Care should be taken that all dirt around the plugs be removed before taking them out, so that no dust or dirt can get into the housings.

The rear axle is carried on Heavy Duty Hyatt Roller Bearings. Midway between the outer and inner spokes a bolt extends through the left drive wheel hub and the rear axle, thus making the rear axle turn with the left drive wheel hub.

In turning with a tractor, it is necessary for one drive wheel to travel faster than the other. This action is taken are of by the differential gears, which divide the power equally between the drive wheels regardless of their respective speeds. As the left drive wheel and the rear axle turn at the same speed at all times, when the tractor is turned it is readily seen that the rear axle must revolve to some extent within the hub of the right drive wheel and must be lubricated. A large grease cup is placed on the hub of the right drive wheel to provide for this lubrication. Give this cup several turns twice each day.

THE FRONT AXLE AND STEERING MECHANISM

The front axle is of very rugged steel construction and is pivoted to the center of the front girt. Two radius rods extend to the rear of the girt and are attached to the pivot bar bracket, thereby keeping the tractor frame level regardless of the position of the front axle.

The steering worm and gears are totally enclosed in a dust-proof housing and a $\frac{1}{4}$" pipe plug is provided for putting hard oil in the housing. This housing should be kept filled with a good grade of cup grease, which will insure proper lubrication and long life of the gears.

The tractor is steered by an arrangement of knuckles somewhat similar to those used to steer an automobile. Strong construction is used and all parts move freely, making the steering easy.

The connecting link between the two steering knuckles should be kept adjusted to allow both front wheels to run straight. If the wheels point in different directions, the tractor will be hard to steer, and will be working against itself. The result will be extra strain on the steering apparatus and loss of power. This adjustment should be checked up only when the tractor is set to run straight ahead.

FRONT WHEELS

The hubs of the front wheels each have one large grease cup. Fill these cups with cup grease or good graphite axle grease, and give them several turns twice each day.

When considering the lubrication of a tractor, remember—"Oil is cheaper than machinery." Use good oil and plenty of it. Keep all oil and grease clean. Lubricate the parts that are working together, but don't pour oil all over the outside of your machine.

GENERAL CARE OF TRACTOR

Spectacular stunts never made any money for a tractor owner. It is always the average amount of work done for each actual working day of the year, figured from the total year's work, that will determine the success of the tractor. Tests of power may show what a tractor can do, but it is the daily average over the entire working season that decides whether or not the tractor is a successful investment. From this we can conclude that the man who keeps his tractor in good running condition, and turns out his full day's work every working day, is the man who is going to make money with his tractor.

Every piece of machinery has certain bearing surfaces which must be lubricated. These must not only receive the right amount of oil, but also the right kind of oil. Poor oil or the wrong kind of oil is often nearly as bad as no oil. All bearing surfaces are provided with some method of lubrication. It is of the greatest importance that the operator know how each bearing is lubricated, what kind of lubrication is suitable, and how much lubrication that bearing needs. Failure to know this has ruined many expensive pieces of machinery.

Crank shaft bearings are subject to jars and heavy duty and must be kept tight or they will not only ruin the bearings, but will also pound the shaft out of round.

THE PRODUCER TYPE KEROSENE CARBURETOR

There are two essentials to the successful burning of any fuel, which must be taken care of by the engine's carburetion equipment.

First: Under all conditions, from the very slowest speed that the engine will run, to full load, the carburetor must be capable of such adjustment that it will automatically and constantly deliver to the engine the exact amount of fuel and air required by it at that instant.

Second: The fuel and air must be thoroughly mixed. When burning gasoline, this is a comparatively simple operation, as in the Producer Type Kerosene Carburetor, the fuel is drawn through a number of very small holes with such force that when gasoline is used, it is very satisfactorily atomized by this simple process. But to form a suitably combustible mixture from kerosene, it is necessary to first vaporize the fuel. This requires the application of heat. The heat is supplied by the exhaust of the engine, and its passage to either the pulverizer of the carburetor or to the rear muffler is controlled by a three-way cock in the exhaust manifold. When gasoline is to be used for fuel, none of the exhaust should be permitted to go through the carburetor. When it is desired to use kerosene, the tractor should be run on gasoline under load long enough to thoroughly warm the engine without any heat being deflected through the carburetor. Then the heat should **all** be deflected through the carburetor until the carburetor is thoroughly hot, at which time the gasoline may be turned off and kerosene turned on. It is necessary that the engine be warm before turning on to kerosene as even though the kerosene be properly vaporized in the carburetor, when it passes into the combustion chamber, if the combustion chamber is relatively cool, the kerosene gas will tend to

condense to some extent. To overcome this it is only necessary to have the combustion chamber as warm as the gas.

The fuel shut-off valves, the three-way exhaust cock, and the water needle valve are operated by hand wheels on the operator's platform. The right hand wheel operates the gasoline valve; the next to the left, the kerosene valve; the third, by pushing and pulling, instead of turning, operates the three-way exhaust cock; and the fourth controls the water, which under some conditions must be injected into the mixture in the carburetor.

It will not be necessary to use any water in the mixture until pre-ignition occurs, at which time the water needle should be turned on only enough to stop pre-ignition. Do not flood the mixture with water. Pre-ignition can be detected by a sharp metallic knock in a cylinder, caused by the mixture in the cylinder being ignited before the piston has reached the proper position for ignition to take place. If excessive carbon deposits are allowed to accumulate on the pistons and combustion chambers, pre-ignition will be much more noticeable, as carbon points protruding from the pistons and walls of the combustion chambers will become red hot and ignite the mixture before the spark occurs. The same is true of any spark plug having electrodes or other protruding metal parts which do not radiate their heat readily. When the tractor is shipped, it is equipped with spark plugs having no heavy metal projections, and as long as the engine is kept reasonably free from carbon, and these plugs are used, it is rarely necessary, except in very hot weather and on very heavy loads, to use water in the mixture.

When using kerosene, operate the engine the same as at any other time, excepting that the **carburetor and engine must be thoroughly heated before turning on to kerosene, and as long as kerosene is used, the three-way exhaust cock must be at all times turned so that all of the heat of the exhaust will pass through the carburetor.** As kerosene is a more sensitive fuel than gasoline, it is very essential that the carburetor be accurately adjusted for this fuel. See "Carburetor Adjustment." Use only what fuel is necessary, and when necessary use enough water to prevent pre-ignition. As the water used in the carburetor is taken from the cooling system on the tractor, enough to refill it should be poured into the radiator. Always keep the water in the radiator well up toward the filler pipe.

Excessive carbon deposits are not due to the fuel, but to the lubricating oil. Sooty deposits will occur in the cylinders when kerosene is used, and will also occur when gasoline is used, but the use at all times of good clean lubricating oil and the frequent and regular flushing of the cylinders with kerosene will keep them clean and free from carbon deposits. See **"Use CleanOil."**

The use of kerosene does not have any injurious effect on the engine, but in order to burn it with the greatest amount of success, the engine must be kept in good condition, and the proper kind of lubricating oil must be used.

We have touched a number of times on this subject of "Good Clean Engine Oil." That very fact should emphasize the importance of that point, but lest you should at any time be tempted to "run it another day," we want to say, and it is an absolute fact—**you can do that engine more harm in one day by running it with dirty or thin lubricating oil, than it should receive in an ordinary season's hard work. Look at it; feel it; and if it is worn and full of sediment and grit, or if it shows that there is kerosene mixed with it, clean the engine and put in fresh oil. It will pay. When the carburetor is properly adjusted, no kerosene will be found in the crank case.** (See "Carburetor Adjustment."

While it is necessary to heat the fuel in order to vaporize it and make it more volatile, heating of the fuel has but little tendency to heat the engine. The engine naturally runs hotter with kerosene as fuel, but since the vapor passing into the manifold mixes with cold air, the mixture goes into the cylinders comparatively cool, and therefore has little to do with heating the engine.

With the proper adjustment of the carburetor the use of good, clean lubricating oil, keeping the engine free from carbon, having good compression, and a good spark, your success with kerosene is assured. There is no reason for not getting results if handled properly.

CARBURETOR ADJUSTMENT

As stated before, perfect carburetion consists in supplying the engine at all times with the exact amounts of fuel and air required at that instant, and the thorough mixing of these elements.

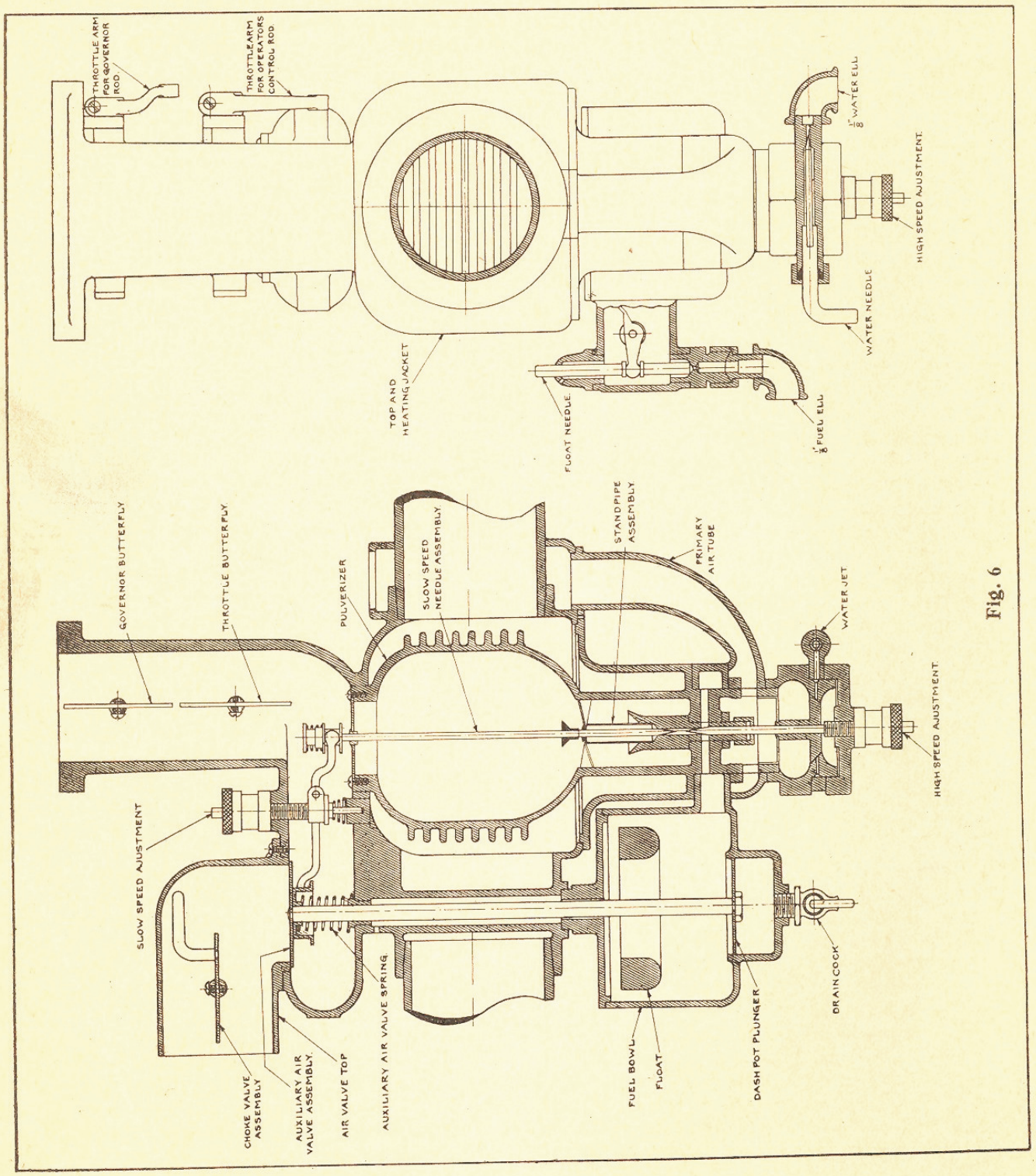

THROTTLE ARM FOR GOVERNOR ROD
THROTTLE ARM FOR OPERATORS CONTROL ROD
TOP AND HEATING JACKET
FLOAT NEEDLE
1/8" FUEL ELL
1/8" WATER ELL
WATER NEEDLE
HIGH SPEED ADJUSTMENT
GOVERNOR BUTTERFLY
THROTTLE BUTTERFLY
PULVERIZER
SLOW SPEED NEEDLE ASSEMBLY
STAND PIPE ASSEMBLY
PRIMARY AIR TUBE
WATER JET
HIGH SPEED ADJUSTMENT
SLOW SPEED ADJUSTMENT
CHOKE VALVE ASSEMBLY
AUXILIARY AIR VALVE ASSEMBLY
AIR VALVE TOP
AUXILIARY AIR VALVE SPRING
FUEL BOWL
FLOAT
DASH POT PLUNGER
DRAIN COCK

Fig. 6

These requirements are fully met in the Producer Type Kerosene Carburetor. There are two adjustments on this carburetor; one for full load, and the other for light loads, idling and slow engine speeds.

The full load adjustment is a fuel needle and is located on the extreme bottom of the carburetor. (See Fig. 6.)

The Slow Speed Adjustment, by regulating the lift of the slow speed needle, controls the amount of fuel the engine may have when not working to capacity, and is located on top of the heating jacket between the neck of the carburetor and the air valve top.

To adjust the carburetor, start the engine in the usual way. Have the three-way exhaust cock turned so that none of the heat of the exhaust will be permitted to go through the carburetor.

The Full Load adjustment may be accurately made by closing the full load or lower needle valve a notch at a time when the engine is under load. When the lower needle valve has been closed too much, the engine will back-fire through the carburetor or stop. When the needle valve has been closed enough to cause these symptoms, open the needle valve a notch at a time until the back-firing is overcome.

CAUTION: Give the engine only enough fuel through the lower needle valve to allow it to work under load without back-firing through the carburetor.

Never change the top adjustment, except when the engine is running idle and very slow. This adjustment raises and lowers the fulcrum point of a small walking beam. At one end, this walking beam carries a needle, the lower end of which obstructs the fuel passage directly above the seat of the full load needle valve. The other end of the walking beam is carried by the auxiliary air valve, so when the engine attains sufficient speed to suck the auxiliary air valve down, it thereby, through the walking beam, raises the slow speed needle automatically, and gives the engine the extra fuel required to make the larger volume of mixture. As the auxiliary air valve should start to open at about 300 R. P. M., the most accurate setting of the slow speed adjustment can be made while the engine is running idle, and at a speed considerably under 300 R. P. M.

CAUTION: When the engine is running idle and at its slowest speed, screw the top adjustment down (clockwise) a notch at a time, as far as possible without causing the engine to stop.

This will indicate that the engine is getting the proper amount of fuel, and if the engine and its lubricating oil are in running condition, it should fire on all four cylinders and run smoothly. When the butterfly valve is opened, the suction of the engine is applied to the auxiliary air valve, thus automatically opening the auxiliary air valve as the butterfly valve is opened. As the auxiliary air valve opens, allowing more air to the engine, it also raises the slow speed needle valve, and allows more fuel, until at full load, the auxiliary air valve is wide open and the slow speed needle is drawn up so far that it is entirely out of action. The full load adjustment then takes entire care of the fuel supply.

After these adjustments have been made, and the engine has been run on gasoline for a sufficient length of time to cause the cylinders to become warm, if you wish to burn kerosene, first throw all of the heat of the exhaust through the carburetor by pushing the L-819-T hand wheel for three-way exhaust cock rod clear in, and allow the engine to run under load until the carburetor is thoroughly hot. Then turn off the gasoline and turn on the kerosene by means of the Q-516-T hand wheels for valve rods on the operator's platform. It is not necessary to stop the tractor to make this change. After running under load for a few minutes, it will most likely be noticed that the carburetor is not adjusted correctly for this fuel. It is generally possible, after adjusting the carburetor properly for gasoline, to close each adjustment about two notches, after running under load a few minutes on kerosene. But as there is a very wide variation in the fuels used, the only rule that can be given is to go over the adjustments again exactly the same as you did for gasoline, closing each one as far as possible without making the engine back-fire or stop, as the case may be. Remember, the top adjustment has no effect when the engine is under load. It is the slow speed adjustment. The bottom needle valve must be so set that the engine gets the proper amount of fuel when under load.

After getting your carburetor adjusted properly for kerosene, and running the tractor all day, the next time you start the engine, when

cold, it will probably back-fire through the carburetor or stop, when you open the choke valve. From this it would appear that your adjustment is wrong, when in reality, it is because the engine and carburetor are cold. Do not immediately change your adjustment, but deflect heat of the exhaust through the carburetor until it is warmed up. Do this until you can open the choke valve without stopping the engine. The reason the engine backfires or stops is because cold gasoline in a cold carburetor does not flow through the needle valve opening as readily as hot kerosene through a hot carburetor, consequently when first starting a cold engine even on gasoline, it may be necessary to run it a short period with the choke valve closed and with the heat deflected through the carburetor. After running enough to properly heat the engine and carburetor for kerosene burning, you will find the adjustment correct, provided it was properly made in the first place. When running on kerosene, be sure the gasoline valve is shut off tight, to prevent the kerosene mixing with the gasoline in the tank and causing future trouble in starting.

The length of time that the engine must be run before turning on to kerosene will vary somewhat with the seasons. In ordinary summer weather, it is generally unnecessary to make any change in carburetor adjustment whatever, after the carburetor has once been adjusted for kerosene. Simply leave the heat turned through the carburetor and run on gasoline until the carburetor is thoroughly hot. In summer weather, the engine will then be warm enough to handle the kerosene and no change in carburetor adjustment will be necessary.

But for winter use of kerosene, it is advisable to run a longer period on gasoline, to insure the warming up of the engine, and to do this, it is sometimes necessary to turn the three-way exhaust cock so as to deflect the heat of the exhaust away from the carburetor for a short time, to allow the engine to run under load long enough to warm up. This may make it necessary to open the bottom needle valve a notch or two. But, in any event, never turn on to kerosene until the carburetor is also thoroughly hot. Be sure, after turning on to kerosene, that your carburetor is properly adjusted for that fuel.

Open the pet cocks on the bottom of the carburetor bowl at least twice each day. This will remove any water or foreign matter that may have collected in the carburetor bowl.

Before stopping an engine that is running on kerosene, always shut off the kerosene, turn on the gasoline, and deflect the exhaust to the rear muffler. The carburetor will then cool off before stopping, and will be filled with gasoline, making the starting easy.

LEAKY CARBURETOR

If the carburetor should begin to leak or overflow, it may be caused by dirt or paraffine collecting in the seat of the fuel shut-off valve in the carburetor bowl. All fuel contains some oil and paraffine, the amount depending upon the grade of the fuel. To stop a leak caused in this way, tap lightly on the stem of the float valve, which is located directly above where the fuel line connects to the carburetor. If dirt or paraffine has collected in this valve and is causing the leak, this tapping will dislodge it and allow the float to press the needle down tight in the seat.

If it should ever become necessary to remove any parts from the carburetor, first study Fig. No. 6 carefully. It will be noticed that in removing the bowl of the carburetor, the dash pot plunger must pass through the float. If the bowl must be removed, be very careful so as not to damage the float. The cover of the fuel bowl screws on. Note carefully the position of the water jet, and the primary air valve assembly.

When replacing the carburetor fuel bowl, care must be taken to have all parts of the union at the fuel outlet to the standpipe perfectly clean, or a leak will result at that point. Put a thin layer of soap on either side of this union to insure a gas tight joint and apply the retaining nut with the finished side toward the bowl of the carburetor.

THE CARBURETOR AIR CLEANER

The dust from a dry field going into the engine through the carburetor air valve plays an important part in the life of an engine. This dust, if allowed to get into the engine, will mix with the lubricating oil and cut with telling effect on the pistons, rings, cylinder walls,and all bearing surfaces in the engine.

The Air Cleaner connected to the air-intake valve of the carburetor receives the air before it reaches the carburetor and removes the dust. The dust is stored in a glass jar on the

bottom of the cleaner and only clean air passes into the carburetor.

There are no moving parts, no screens or sieves, no cloths to clean and no springs. All that is necessary in the way of care is to remove the jar from the bottom of the cleaner once each day and let the collected dust out. When replacing the jar, see that it screws up firmly and makes an air-tight joint.

SHIFTING GEARS

Shifting gears to high, low or reverse is an utter impossibility, except at the time when the required pinion and gear are in such positions that the teeth of one will slide between the teeth of the other. When in correct relation to each other, they will slide easily into mesh without forcing. **Do not under any circumstances attempt to shift gears until the clutch is entirely released and until the gears have stopped.** Such attempts will only result in damage to the transmission. If, on attempting to shift gears you find that they do not shift readily, engage the clutch just a little, or enough to turn the belt pulley an inch or less—not a hundred revolutions, as it may then stop in exactly the same position—and try again to engage the gears. The practice of careful shifting of gears will save time as well as the big item of saving the gears.

THE ENGINE

Our own engine, designed especially for this tractor, is of the most modern and improved heavy duty type.

Large water jackets completely surround the cylinder walls, combustion chambers and valves, insuring proper cooling. The perfect oiling system, the gear driven fan, the simple locking device for holding the valve caps tight, the large removable inspection plates, and the general accessibility of the engine throughout, make it possible for the few adjustments in connection with the care of the engine to be accomplished quickly and easily.

The engine is so thoroughly protected from dust and dirt and all parts are built with such an ample margin of safety, that it will, without abuse, stand up to the heavy duty required of it.

HOW TO TEST COMPRESSION

Loss of compression may be traced back to the following causes: Leaky valves, riding valves, leaking piston rings, or scored cylinders and pistons, lack of lubrication, and valve caps not tight on gaskets.

To test compression, have the priming cup closed on the cylinder to be tested, and open the cups on all other cylinders. Using the starting crank, turn the crank shaft until the piston in the cylinder to be tested comes up on the compression stroke. Work the piston up against compression several times. If compression is escaping, it will probably be impossible to rock the crank against compression more than once. If compression is right in this cylinder, the pressure should be springy and elastic and should turn the fly wheel back when released. The remedy for leaky compression may require some new piston rings, but in most cases, the leak is in the valves or valve caps. Always keep the valves ground to a perfect seat, and good gaskets under the valve caps.

HOW TO REMOVE A VALVE

Remove the No. L-425-T cover plates for valve spring housings. Pry up on the valve spring seat until the spring is compressed and raised sufficiently to permit the removal of the horseshoe washer holding the spring seat in place. When the horseshoe washer is removed, the spring and seat will drop down, leaving the valve stem free.

Loosen the yoke holding the valve cap in the top of the cylinder and take the yoke and cap out. The valve can then be removed through the opening made by removing the cap. Push up on the valve stem until the head of the valve comes through the opening, and the valve can be lifted out. Sometimes the valve stem gets burred slightly from the constant pounding on the horseshoe washer. If the lower end of the valve stem does not slip out easily through the valve guide, cut the high spots off the valve stem with fine emery cloth or a file.

VALVE CAP GASKETS

Each valve cap is held in place by a locking device consisting of a small retaining bar which seats at either end on a heavy boss in the top of the cylinder, and a cap screw which screws through the retaining bar and down on to the center of the valve cap. This cap must form an

absolutely gas tight joint or a loss of compression and pre-ignition will result. To hold compression at this point a copper covered asbestos gasket is placed under the valve cap. **When replacing the valve caps after an inspection of the valves, be very careful to wash the valve caps, their seats in the cylinders, and the gaskets, with gasoline, and wipe them absolutely clean.** If the gasket seems defective, replace it with a new one. Use judgment in tightening the valve caps. If the gaskets and the surfaces which rest against them are clean, it will not require any great pressure to make a gas tight joint, but if any particle of dirt is allowed to get under the valve cap, no amount of pressure will give the required results, and excessive pressure will only ruin the gasket.

The great strength of these parts is designed to withstand the pressure due to combustion within the cylinder—not to overcome the effects of a long wrench. After the engine has run a short time, go over the valve caps again, tightening them down firmly. It is a good plan to always keep an extra set of valve cap gaskets (No. L-409-T) on hand.

HOW TO TIME THE CAM SHAFT

The cams on the cam shaft are ground to such a shape that when the valves are properly spaced, and the cam shaft properly timed, each cam will hold its respective valve open during exactly the proper piston travel.

First, let us consider the proper spacing of the valves, as until this is done, it is impossible to check up the timing of the cam shaft with any degree of accuracy. You will notice, by referring to Fig. No. 8, that a little more than half of the circumference of each cam is perfectly round, having an equal radius.

To properly space a valve on this motor, have the valve lift resting on the round, or equal radius part of the cam, the point of the cam being down, and adjust the adjusting screw in the valve lift to a point where it is just possible to slip an average postal card between the top of the adjusting screw and the lower end of the valve stem. You must be exact about this spacing. The exact distance that you should have in this position between the adjusting screw and the valve stem is twenty-five one-thousandths of an inch, or a very small fraction less than 1-32 inch. Post cards are not all the same thickness, and to be sure that the post card which you are to use is of the proper thickness, cut it into ten pieces and measure the thickness of the ten spieces instead of one. These ten pieces should be just $\frac{1}{4}$ of an inch thick, or each piece equal to twenty-five one-thousandths of an inch. **Keep the valves spaced so that there is twenty-five one-thousandths of an inch space between the top of the adjusting screw in the valve lift, and the lower end of the valve stem, when the point of the cam which works that valve lift is pointing down. This will mean that the post card .025″ thick will be a close fit when placed between the valve stem and valve lift. Be sure the lock nuts are tight on the adjusting screws.**

When this has been done, turn the fly wheel until the mark, Ex. C. 1. & 4 on the fly wheel is on the valve side of the engine and in direct line with the pointer. The pointer or timing indicator is attached to the left side of the main frame and extends toward the flywheel on a level with the machine surface of the under side of engine housing. In timing the cam shaft or magneto or in checking up the timing, see that the pointer is in its correct position in relation to the machine surface of the engine housing.

Turn the cam shaft until the exhaust cam on No. 1 cylinder is pointing in, and has raised the valve lift enough to take up the twenty-five one-thousandths of an inch space between it and the valve stem. The valve lift should touch the stem, but not lift the valve. With the crank shaft and cam shaft in the positions given, fit the cam gear and bolt it tight to its hub on the cam shaft.

If any difficulty is experienced in getting the holes in the cam gear to match those in the shaft, remove the gear and revolve it one-fourth of a revolution. This will give a new combination of holes and a different relative position between the teeth of the crank shaft gear and the holes in the cam shaft gear. Any combination desired may be obtained by one of these four positions. If the holes do not match, never allow the cam shaft to be turned, even slightly, to overcome the trouble, as in that case a loss of power would surely result. Remove the gear and turn it one-fourth revolution as above stated.

The correct position of the crank shaft and piston, cam shaft and valve lift are shown in Fig. 8.

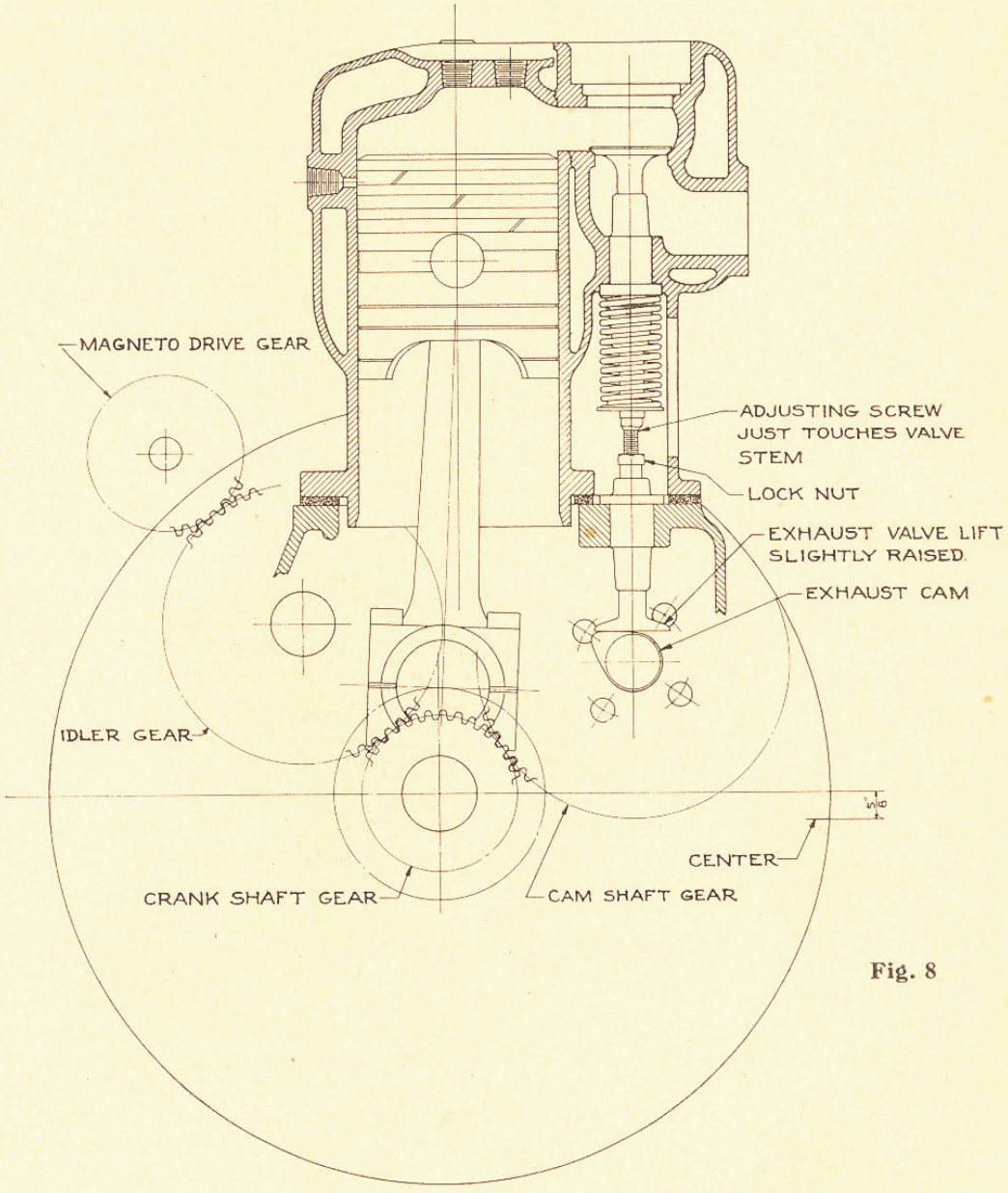


Fig. 8

SECTIONAL VIEW SHOWING TIMING AND CORRECT POSITION OF EXHAUST CAM AND VALVE LIFT

CAUTION: Always keep the valves properly spaced. The result will be more power and a better running engine.

HOW TO TIME MAGNETO

When the engine is running at normal speed and under full load, the spark should be advanced to the point where the best results are obtained. This point in our engine has been determined, and the setting of the magneto is arranged to have the spark occur at that point at full advance. Therefore, when setting the magneto, always set it at the full advance position. That will insure the spark occurring at the proper time when the tractor is pulling a load. Five and one-quarter inches before the center mark for cylinders Nos. 1 and 4 on the fly-wheel, is a center punch mark, indicating the firing point at extreme advance of spark.

Place this mark in a direct line with the pointer as described under "How to Time the Cam Shaft." At this point, either cylinder No. 1 or No. 4 will be in position to fire, this being indicated by both valves for that cylinder being closed, and the valve lifts free, thus showing that that piston is coming up on compression. If cylinder No. 4 is in position to fire, both valves being closed, turn the magneto in the direction it must run, until the brush on the distributor arm rubs on No. 3 brass segment and until, with the breaker box in position of full advance, the points in the breaker box are just separated. Brass segment No. 3 leads to Cylinder No. 4, on account of the firing order being 1-2-4-3 (See Fig. No. 1). Holding the magneto shaft in the above position, slip the magneto forward on the magneto stand, engaging the half of the coupling which is pinned to the magneto shaft with its mate on the drive shaft and bolt it firmly to the stand. See that the coupling lines up straight and does not bind.

When the magneto is set as above, the platinum points in the breaker box of the magneto should be just separated when the magneto is on full advance, as shown in Fig. 1. The slightest turn of the fly-wheel backward should close the gap between the points, and the slightest turn forward should cause them to open still more.

The proper opening for the points in the magneto is 1-64th inch at their greatest gap. These points will gradually wear off and require adjusting. See "Care of Magneto." If the points open too far, it appears that the magneto is not timed just right. Therefore, the gap between the points should be correct when checking up the timing as described above.

CARE OF MAGNETO

The platinum points of the magneto must be kept clean and flat, and must fit together over the entire surface. Clean these points off occasionally by scraping the surfaces with a knife blade, or with a platinum or manicure file. This must be done regularly. If the points are allowed to become pitted, they will deteriorate rapidly and the result will be hard starting, probable missing and unnecessary repair expense. Do not flush the breaker box with gasoline, as all gasoline contains some oil which will stick to the contact points and cause them to burn. Wipe the breaker box out at least once a week with a soft cloth. Be sure no particle of dirt gets between the contact points while doing this, as a perfect platinum contact is absolutely essential to obtaining a good spark.

There is but one adjustment on the Magneto. This adjustment is on the contact points in the breaker box. These points should separate 1-64th inch when the roller is on the highest point of the cam. One of these points is mounted on the end of a small screw and as the points wear down, they should be adjusted by means of this T-194 screw, so as to maintain the proper opening—1-64th inch when the roller is on the round part of the cam. You will find the tools for making this adjustment attached to the instruction book. The small wrench fits the screw, while the lock nut is operated by the screw driver. See that the lock nut is kept tight on this screw.

Remove the T-21 distributor block occasionally and wipe all carbon dust from the interior of the distributor housing.

Keep all connections tight and free from dirt and water.

The Model TK Magneto must be mounted on a brass base and only brass screws are permissible for use in attaching this magneto to an engine.

Never dismantle a magneto except as instructed above. If this should ever become necessary,

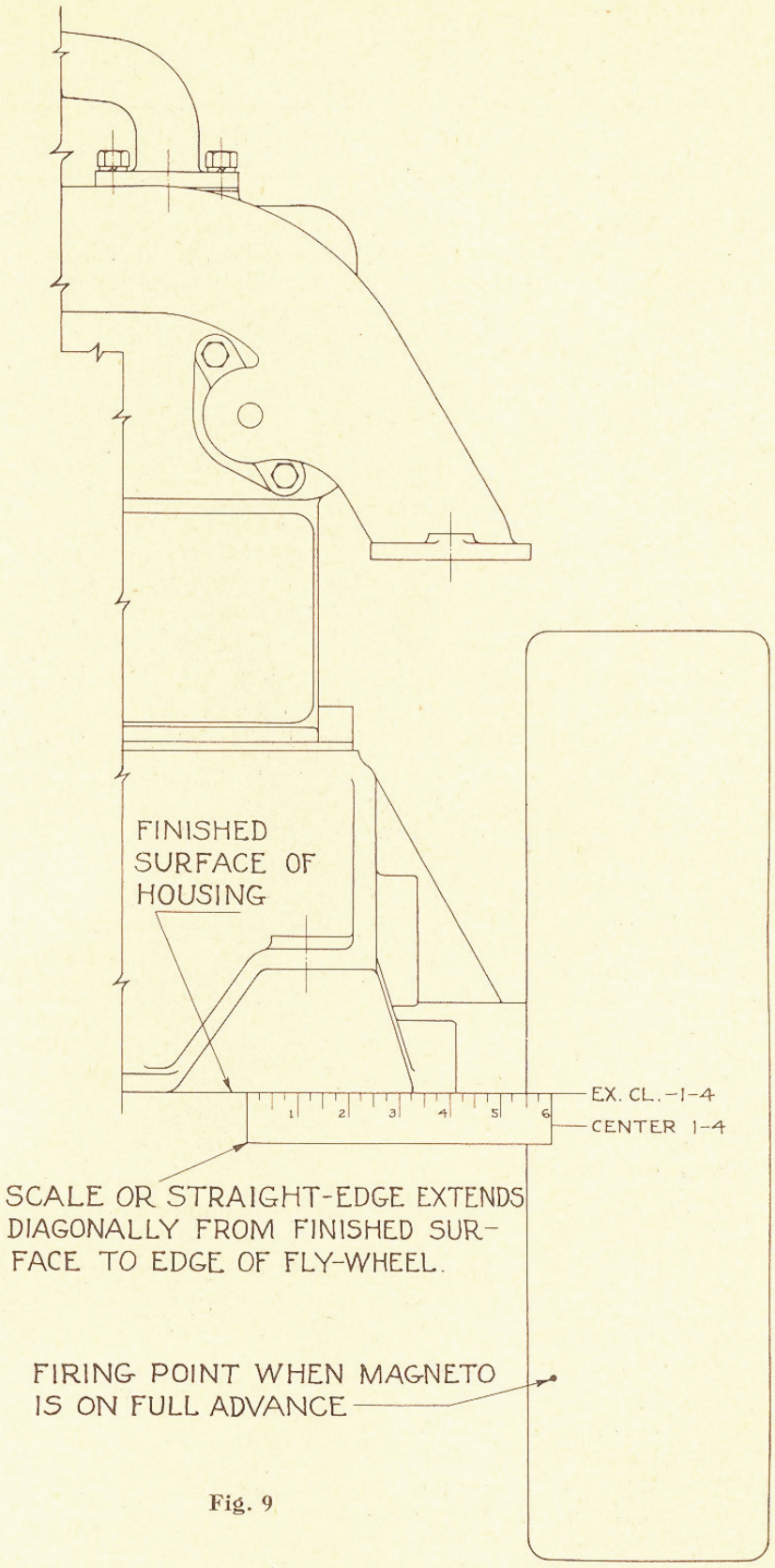


Fig. 9

VIEW SHOWING METHOD OF FINDING CORRECT POSITION OF FLY-WHEEL FOR TIMING VALVES AND MAGNETO.

it is work which only a magneto specialist, equipped with the necessary apparatus for recharging the magnets, can do properly. Thirty per cent of the efficiency of a magneto is instantly lost when the magnets are removed.

ENGINE BEARINGS

The bearings of the engine should always be kept in proper adjustment. Never allow a bearing to get so loose that it will knock. This condition can be prevented by testing them occasionally and making necessary adjustments.

Bearings have to be taken up at intervals varying with the work the tractor is doing and the care that is exercised in its lubrication. It is of such very great importance, however, that they always be tight and free from play, that they should be tested at regular intervals.

Only the right kind of oil should be used for lubricating the engine, and this oil **must be kept free from grit.** Examine the oil in the engine every day—get your fingers in it, and if, on examination, it does not compare closely with the new oil, clean the engine and put in fresh oil. If this precaution is taken, the bearings will not require adjustment more than once or twice a season. See "Use Clean Oil."

BEARING ADJUSTMENT

Connecting rod bearings are subject to more wear than any other bearing in the engine, consequently they will require adjusting more often than any other bearing. However, these bearings are amply wide and heavy to stand a great deal of running without much wear. We can set no definite periods for tightening bearings. They must be taken up as they require it. They will require more attention the first season the tractor is run than at any time thereafter.

Examine the connecting rod bearings often. This can easily be done by removing the inspection plates on the side of the engine, and with a bar two or three feet long, extending under the connecting rod, pry down, then release. Have the rod turned to the position nearest the inspection hole, and a little above the level of the opening. Have all priming cups open to relieve all pressure on the piston. If any lost motion can be detected, the bearing must be adjusted at once.

Do not adjust a bearing too tight. When all play has been taken up, the crank shaft should turn freely.

In adjusting a connecting rod bearing, it should rarely be necessary to remove more than one shim. However, if it should be necessary to remove more than one, always take one from each side of the bearing. Care must be taken to always keep as nearly the same number of shims as possible on either side of the bearing.

Draw the nuts up tight, and see that cotter keys are put in properly. See that the oil dippers are in their proper place as described under "Engine Lubrication."

Do not try to take up the main bearings without first removing the oil casing.

CAUTION: Examine the bearings often, and do not neglect to tighten a loose bearing as soon as detected.

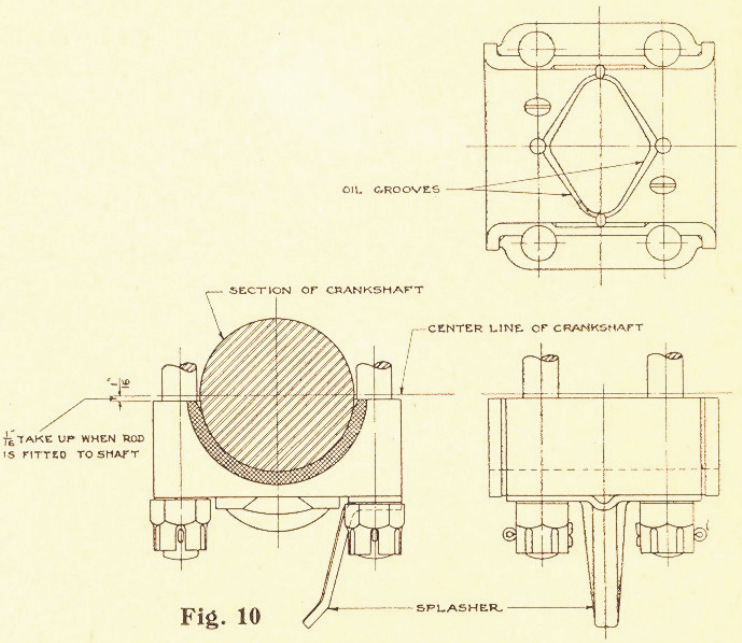


Fig. 10

FITTING CONNECTING ROD BEARINGS

When fitting the die cast bearings into a connecting rod, be sure to fit each new bearing carefully. Start the bearing into the rod, then tap the rod firmly on a block of wood until the bearing is in place.

Using a babbitt scraper, scrape the rough bearing smooth, and relieve both sides $\frac{3}{8}$ inch as shown in Fig. No. 10. The edges of the bearing must be scraped or filed until it will drop over the crank pin and not bind. Leave about 1-64th inch play at the end. Clean all oil off the crank pin and work the bearing around on it to reveal the high spots. If a very thin covering of lamp black mixed with oil is used on the crank pin, the high spots on the bearing will pick it up and show very plainly what parts of the bearing must be scraped.

Continue in the above manner until the bearing fits the shaft perfectly, which will be shown by the lamp black being distributed evenly over the bearing surface.

In order that the pistons may run freely, 1-16 inch side play at the wrist pin end of the connecting rod is provided. When the connecting rod and piston are put in place in the engine, the piston must run perfectly free and parallel with the cylinder walls, and the connecting rod must slide freely back and forth on the crank pin. If the connecting rod has been bent even slightly, the piston will be crowded over to one side of the cylinder while the connecting rod will be forced to the opposite side of the crank pin. If allowed to run in this condition, both the piston and the connecting rod would be damaged.

CAUTION: When replacing a piston and connecting rod in the engine, see that they line up perfectly with the cylinder walls and with the crank pin.

CRANK SHAFT BEARINGS

As is the case with the connecting rods, in order to fit properly, these bearings must first of all set into the engine base and cap absolutely firm and solid.

The bearings are not fastened in, except that the shims keep them from turning or getting out of place. When fitting a new die cast bearing in the engine base, relieve the bearing surface of each half for a distance of about $\frac{3}{8}$-inch on each side, the same as when fitting a connecting rod bearing. After releasing it down, smooth the surface with a babbitt scraper. Set it in place and fit that half first. Put a thin coating of lamp black and oil on the shaft and rotate the crank shaft on the bearings to find the high spots, and proceed to scrape the bearing to a fit, and until the shaft bears perfectly on all three of the main crank shaft bearings.

The other half should then be set into the cap first, then scraped and fitted.

If good clean oil is used in the engine, these bearings will require very little attention. Practically all the wear comes on the cap, so that after all the shims have been taken out, a new bearing in the cap will be all that will be necessary in most cases. In case the bearing in the engine housing must be replaced, it will be necessary to remove the crank shaft.

THE WATER PUMP

A very simply constructed and efficient water pump is provided and positively driven whenever the engine is running. There is nothing about the pump to give trouble and there is only one item of care—packing it occasionally to keep it from leaking. A brass gland extends into the body of the pump from each side, and behind these glands the packing is pressed against the shaft, making a water-tight connection, and forms practically the only friction surface.

Jewitt Ring Packing (AA-776-T), is excellent for packing this pump. It should be placed in behind the glands carefully and neatly, and the glands should be drawn up against the packing quite tight.

If a good graphite packing is used, the wear will be slight and repacking will not be necessary very often. When the pump begins to leak, and tightening of the glands will not stop it, the pump should be repacked. Remove the old packing, and when repacking the pump, do not fail to lap the joints of the packing.

GASKETS

Gaskets, made of a fire-proof material, are used to insure the manifolds against leakage around the intake and exhaust ports at the cylinders, and between the carburetor and manifold. **A leak through a gasket on the intake manifold, however small, will destroy the mixture and cause the engine to misfire, lose power, accumulate carbon, and run very poorly in general. A leaky gasket must be replaced at once.** We recommend that each tractor owner keep an assortment of gaskets on hand for

ergency use. They are inexpensive and in case of need, it is worth many times their cost to have them when they are wanted. But do not throw them into the tool box of the tractor where they will be bruised and broken. Hang them on the wall of some out building where your oil and other articles used with the tractor are stored, and where they will not be molested until needed. We would suggest that you keep a couple of L-621-T gaskets, which are used on both the exhaust and intake manifold; an L-626-T carburetor gasket; and a set of eight L-409-T valve cap gaskets.

Before putting on a new gasket, carefully remove every piece of the old one and scrape the metal parts clean. If a gasket in the intake manifold is disturbed, when replacing it, put a good coat of shellac on either side of the gasket and draw the manifold up tight.

For instructions in regard to the use and care of valve cap gaskets, see page No. 19.

GRINDING VALVES

To grind a valve into its seat, remove the valve spring and valve cap, and take the valve entirely out. Examine the valve seat in the cylinder and if in fair shape and the metal is not burned, it will not take long to reseat it. Place a light coil spring on the valve stem so that it tends to hold the valve up and off from its seat. (See Fig. No. 11.) Place a small amount of fine carborundum valve grinding paste, or a paste of fine emery and oil on the valve seat. By using a brace holding a screw driver bit, and placing the screw driver bit in the slot on the top of the valve, the valve may be revolved back and forth on the seat with very little effort. If the valve is ground steadily, revolving in one direction, and is not lifted from its seat, it will cut more on one side than on the other, and grooves will be cut into the valve and seat, which will spoil both. But by allowing the spring to lift the valve from its seat, and starting at a new point after each quarter revolution, the valve will be ground evenly all around. The best method of doing this is to turn about one quarter of a revolution, lift the valve from the seat, replace it and revolve another quarter of a revolution in the same direction. Again lift the valve and turn a half a revolution in the same direction without the valve touching.

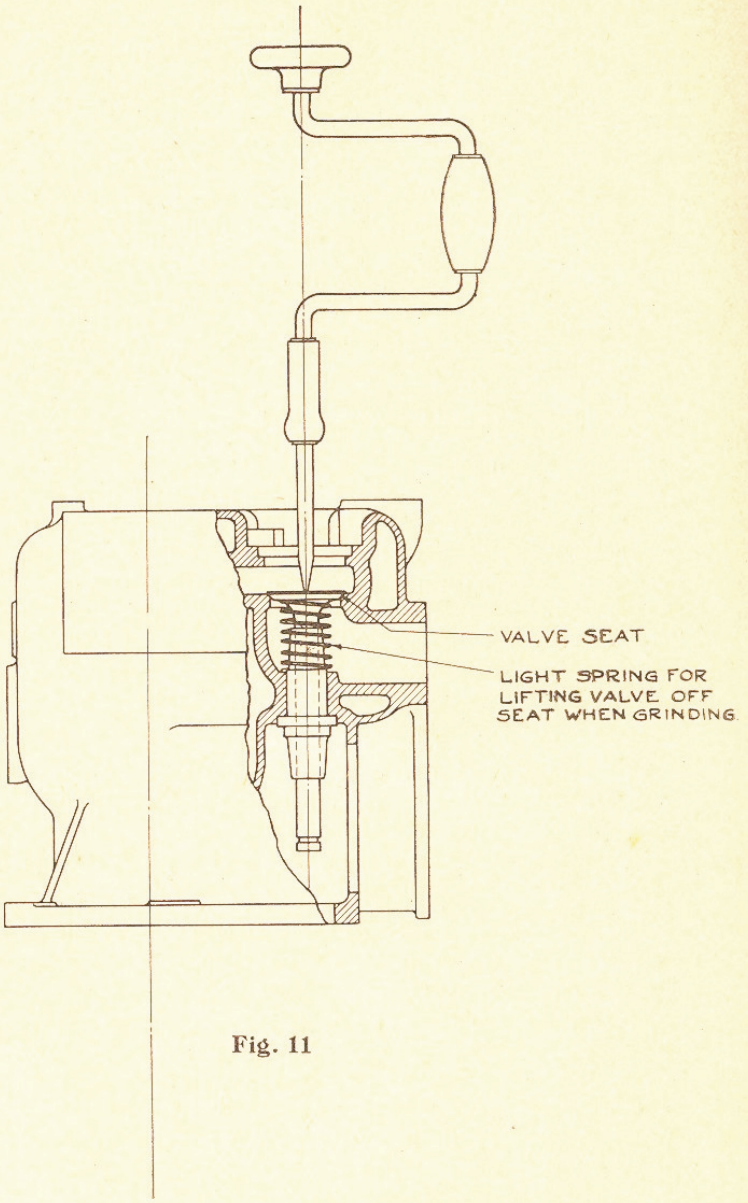


Fig. 11

Then reverse the direction with the valve touching the seat a quarter revolution at a time.

After grinding for a short while, remove the valve, and clean the valve and valve seat to see if they have been sufficiently ground. If it is ground sufficiently, the line of contact of the valve on its seat should have a bright silvery polish. If any discolored places remain, the valve must be ground more. To get the best surface on a valve seat, finish the grinding by making the turns very short and lifting the

valve frequently. When finished, clean every particle of grit from the valve, the valve seat, valve chamber, and valve guide, using care not to get any grit in the cylinder.

The exhaust valves should be ground in the above manner after each thirty days use of the tractor.

CARE OF THE CONE CLUTCH

IMPORTANT: Avoid releasing the clutch and locking the foot lever to hold for any length of time. It is much better to shift the gear shifting lever to neutral position and allow the clutch to engage. This practice will eliminate wear on the radial and thrust bearing in the clutch, and will also guard against the tractor being put in motion unexpectedly. The clutch rides on radial and thrust bearing, on the crank shaft. This is lubricated by grease in the center of the clutch spider. (See Oil Chart, page 10.) As, when the clutch is released, the crank shaft runs at a high speed in this bearing, it must be kept well greased.

The clutch lagging and the interior of the fly wheel sometimes accumulate a surplus of lubricants. This may cause the clutch to slip. To overcome this, wash these surfaces thoroughly with gasoline.

If trouble is experienced, due to a slipping clutch, and washing it with gasoline does not overcome the trouble, it will be necessary to increase the tension on the clutch springs. To do this, remove the cotter pins from the four studs that the clutch springs are placed on, and tighten each of the four nuts the same amount—only enough to secure the desired spring tension to keep the clutch from slipping. Then replace the cotter pins.

If the clutch lagging becomes worn or loose, it should be renewed. When fastening the lagging to the spider, put the rivets in with the heads next to the lagging, and countersink the holes in the lagging enough to permit the head of the rivet to work well down below the friction surface. The first points to be fastened down are the two ends. The lagging, as furnished by our repair depots, is cut to a length that will require a tight fit if both ends are brought together. Do not attempt to fit the lagging over the entire surface before fastening the ends, as after the ends are fastened, a block or board can be placed behind the spider, and the lagging can then be pounded on to it by sliding the spider back and pushing it up forcefully, so the lagging extending over the edge of the spider will be forced onto it. Countersink all the rivet holes, as suggested above.

THE GOVERNOR

Figure 12 shows our own make of governor. This governor automatically maintains the correct normal speed of the engine, which is 900 R. P. M. It is of the fly-ball type and is bolted directly to the cam shaft. The governor weights shown at "R" are of drop forged steel. These weights when moved push out stem "O" which actuates on governor arm "E," thereby controlling the throttle butterfly valve "A" through the reach rod "B." The speed adjusting screw is shown at "K." This adjustment is set at the factory for the maximum speed and should not be changed. Any operator who changes this speed thereby assumes responsibility for any trouble in connection with the engine. All parts of the governor are automatically lubricated from within the engine housing.

HOW TO TEST SPARK

If a cylinder is missing fire, and the trouble is thought to be in the ignition system, test the spark when the engine is running, by removing the high tension cable from each spark plug in turn, until the one that misses is located.

If the first spark plug you remove the cable from cuts out one of the explosions, you may know that that cylinder is not at fault. It will be the one on which the removal of the cable has no effect. Hold the terminal on the cable to the missing cylinder about 1/16-inch distant from the plug. If the spark jumps from the cable to the spark plug, it is seen at once that the trouble does not lie in the magneto or cable. Take out the spark plug and clean and adjust as described under heading "Spark Plugs."

If the trouble is found to be in the magneto, the platinum points are at fault in most cases. Keep these points clean, and adjusted so they will break apart squarely and return together freely, wipe all carbon dust and foreign matter

from the distributor housing and see that all connections are tight. See "Care of Magneto."

Do not attempt to make extensive repairs on a magneto. That is work only for a magneto specialist.

SPARK PLUGS

When leaving the factory, your engine was equipped with spark plugs, which experiments and long use have shown us will run cool and stand up under kerosene burning. Similar plugs can, in most cases, be obtained from your dealer, but as so much depends on the type of the spark plug used, we recommend that you always keep a couple of plugs of this brand on hand for emergency use. If this is done, you will not be compelled to use an unknown substitute.

It should seldom be necessary to clean a spark plug. If you encounter trouble of this kind, don't just clean the plug and try again. If the plug is cracked or otherwise short-circuited, replace it with a new one. But if it is not, you may rest assured that the trouble is somewhere else. **Find that trouble and remedy it.** By way of suggestions as to where this trouble may be found, we would advise first examining the lubricating oil. **If you have not washed the crank case out for a week and the oil is dirty, don't expect the spark plugs to stay clean.** If kerosene has worked down past the pistons and thinned the oil, your plugs will get dirty. In either case, the engine must be washed and cleaned (see "**Use Clean Oil**"), but in case kerosene is found in the crank case, when you start up with fresh, clean oil in the engine, adjust the carburetor, so the same trouble will not occur again. See "Carburetor Adjustment." If any difficulty is experienced in getting the carburetor adjusted, throttle the engine down slow, and squirt a little gasoline around the three gaskets of the intake manifold and around the valve caps. If there is a leak in a gasket, the gasoline will be drawn into the engine, making the mixture rich, and can be detected readily by the change in the action of the engine.

Remember, a carburetor cannot be correctly adjusted while there is any leak of air into the intake manifold above the carburetor; unless the carburetor is correctly adjusted, some kerosene is likely to find its way into the crank case; and one of the evil effects of these conditions is dirty spark plugs. Some other causes for dirty spark plugs might be poor and uneven compression (see "How to Test Compression,") or a missing spark (see "Care of the Magneto").

If you are taking the proper care of your engine, the spark plugs will burn clean. At any rate, they must be kept clean. When carbon or soot gathers on the points or porcelain, it causes a short-circuiting of the current and prevents proper ignition of the charge in the cylinder. If spark plugs become dirty, they should be cleaned by washing them in kerosene or gasoline and wiping them clean. The best results are obtained when the gap between the points is 1/64th inch.

To determine whether or not a plug is sparking properly, remove the plug and lay it on top of the cylinder in a manner to form a ground contact. The high tension cable must remain connected to the plug and must not touch the engine. Run the engine on three cylinders and watch for a spark between the points. If none occurs, the plug is probably cracked or short-circuited in some other way.

It should be remembered that electric current follows the course of least resistance. Carbon is a conductor of electricity. Therefore, when a plug gets a sufficient coating of carbon, there is a great temptation for the electric current to follow the carbon coating of the porcelain, and avoid jumping the open gap at the points of the plug.

Avoid the use of spark plugs having heavy points or any unnecessary metal projections, as a plug of this kind does not radiate its heat as readily, and is more likely to become overheated and cause pre-ignition and the consequent loss of power.

STRAINING FUEL

Occasionally, a tractor gets into the hands of an operator who does not, from the very beginning, fully realize the importance of straining the fuel going into the fuel tanks. Dirt, water, and lint, if allowed to get into the tank, can cause a lot of trouble, and are exceedingly hard to get out of the tank.

There is a small strainer just below the carburetor in the pipe line, so that none of the dirt

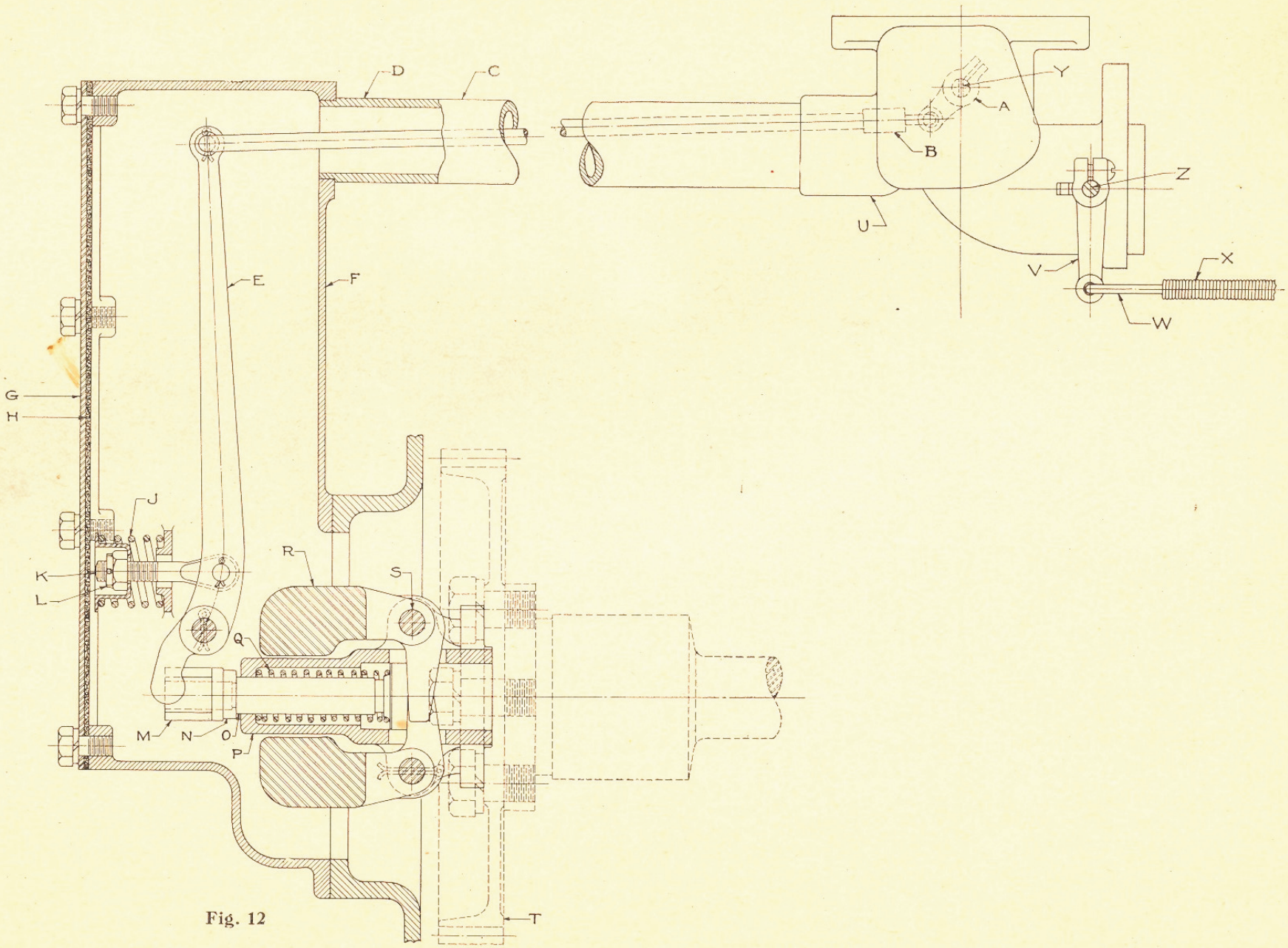


Fig. 12

THE GOVERNOR

or lint can get into the carburetor. This strainer acts in the capacity of a water trap as well as a strainer. The dirt, lint, and water will be caught at this place, and, provided there is enough of it, will retard the flow of fuel, and cause the supply of fuel in the float chamber to become low, resulting in a back-fire into the carburetor, and the probable stopping of the engine. It then becomes necessary to remove this strainer and clean the dirt and lint out. In case of water in the fuel open the small pet-cock in the strainer and drain the water out. Water and gasoline or kerosene will not mix. The water will always go to the bottom. But this takes time. Avoid this by straining the fuel when you put it into the tank.

All fuel contains a certain amount of foreign matter, depending, of course, on the grade and kind of fuel, so that if it is not strained when transferred to the engine fuel tank, it will in time cause trouble which can only be remedied by removing the fuel tanks, together with all pipe lines, and cleaning them out thoroughly.

IMPORTANT: On receipt of your tractor, provide yourself with a large funnel, equipped with a very fine copper gauze strainer. The mesh of the copper gauze should correspond to that used in the strainer valve in the pipe line. A piece, at least four inches in diameter to permit pouring the fuel into the tank more rapidly should be soldered into the funnel. Always take precaution to strain the fuel before using, thus avoiding much unnecessary trouble. In spite of everything, some water will get into the carburetor. Open the pet-cocks on the bottom of the bowl of the carburetor twice each day.

CARE OF RADIATOR

The flow of water through the cooling system should be free and easy with nothing to clog or retard the passages. Therefore, the most important item in the care of the radiator is to keep out all dirt, using only clean, pure water. There is a screen in the filler pipe which will stop foreign matter from entering. Do not throw this screen away because it becomes stopped with dirt. Clean the dirt out. Dirt gathering there is the best indication that the water is going into the radiator clean. Of course, if the water used is being dipped out of a ditch or slough, no doubt some mud and sediment will be dipped up at the same time. The screen will not stop all of that kind of dirt. Avoid the use of that kind of water as much as possible, as the sediment will settle on top of the core of the radiator and retard the circulation. If muddy water has been used for sometime, it will be well to remove the radiator and wash the entire cooling system. See "Care of Engine at End of Season."

An alkaline water will have practically no chemical effect on the radiator. However, we recommend the use of pure water, avoiding any of an alkaline nature.

The capacity of the cooling system is seven gallons.

OVERHAULING AND MAKING REPAIRS

Keep the tractor in good running condition always. How much better and more pleasant to operate a tractor that runs smoothly and develops its full power, than one that rattles and makes one think it about to break down and does not develop its full power.

The instructions on the previous pages for care of the tractor are intended to guard against things which will injure the tractor or cause any part of it to go wrong. It is daily care and necessary adjustment from time to time that prevent big repair jobs.

However, if the time comes when it is necessary to replace parts due to breakage or wear, look the work over and decide which will be the best method to go about putting in new parts. Save as much time as possible by removing just as few parts as the placing of the new parts will permit, but do the work well. **When a part is removed, put it back just as you found it. Leave nothing loose. Be thorough.** Parts taken off the machine should be kept together and not scattered all over where dirt and sand will get on them and perhaps some small piece will be lost. **Be sure to keep parts clean.**

Repairing is always done best when done systematically.

When a hard season's work is finished, a thorough overhauling of the tractor should be planned. Remove the fuel tanks, the drive wheel shields and the hood; then proceed to clean the tractor up. Wash the mud off with

water and cut the grease and dirt off with kerosene or gasoline. Get all parts clean so that when the housings are opened up, dirt and grit will not fall into them.

Go through the transmission. Remove all the old oil and wash the case out carefully with kerosene. It may be well to remove one of the roller bearings and examine it. There will probably be nothing to be done to the bearing except to clean it out and put on some fresh oil, for this bearing will run for years without wear if properly lubricated.

Examine the gears. The condition of the teeth will show what care you have taken in shifting of gears to different speeds. See that the bevel gears on the countershaft and differential shaft mesh properly. If these gears are not operating correctly, examine them closely to see which gear should be meshed deeper, or if both should be moved.

If the bevel pinion (No. AA-177-T) on the countershaft should be meshed deeper, it will be necessary to place a fiber or sheet metal washer of the required thickness between the ball thrust bearing (No. 4156-T) and the thrust bearing bushing (No. AA-234-T) (see Plate No. 12). Should the large bevel gear (No. AA-176-T) need to be meshed deeper, it is necessary to place a fiber or sheet metal washer of the required thickness between the ball thrust bearing (No. 4156-T) and the sleeve for differential thrust bearing (No.AA-382-T) (see Plate No. 11).

Do not leave the transmission case open after you have finished cleaning it out and making any adjustments that were necessary in order to put it in good condition. Put in fresh, clean steam cylinder oil and close the case tight. Do this to prevent dirt and grit or some small part of the machine, such as a nut or bolt, dropping into the case without your knowledge.

The engine is next. Drain out all of the oil and remove the oil casing. Wash the entire case out with kerosene. Test the compression. Remove one piston at a time until all four pistons have been out and the carbon scraped off of them. Put new rings on the pistons if the rings are black or worn. Just before putting a piston back, pour plenty of oil over it and see that oil is running through the hollow wrist pin. All piston rings must fit freely and the slots must not be all on one side of the piston.

Make perfect adjustments on the connecting rod bearings and tighten any of the main crank shaft bearings that may be loose. Replace the oil case and make sure that all screws holding it in place are tight. Pour in fresh, clean engine oil until the gauge shows the reservoir is full.

Grind the valves and check up all the timing.

Remove the clutch, wash and examine all of the parts. If any of the parts are badly worn, replace them with new ones.

Remove the fuel line from the fuel tanks to the carburetor and blow it out to remove all foreign matter.

During a general overhauling of this kind, make every little necessary adjustment as you go along. Replace broken or worn parts with new ones and be sure they are properly fitted.

We recommend that every tractor owner keep on hand a few small repairs for just such times as this: A set of piston rings, a pair of connecting rod bearings, two or three spark plugs (see "Spark Plugs,") an assortment of gaskets (see "Gaskets,") a box of assorted cotter keys, a few extra bolts, nuts and spring washers of different sizes, a D-109 fuel connection assembly, a 2494 $\frac{1}{4}$-inch ball and socket joint, a set of radiator hose connections, a small supply of AA-776-T Jewett Ring Packing, and such minor parts as may save any loss of time when urgently needed.

CARE OF TRACTOR AT END OF SEASON

Experience has shown that every engine must receive certain protection to withstand the cold and dampness if it is to remain idle during the winter. The cold air will cause moisture to condense on all parts of the tractor, inside and out. As most tractors remain idle for about four months in the winter, this moisture will cause the engine to rust badly if it is not protected. For this reason, see that your tractor receives the following protection when through with the year's work:

Run the tractor under cover to protect it from rain and snow. Be sure that all water has been drained from the cylinders, the water pump, the piping and connections, and the radiator. Shut off the fuel at the tanks and drain the carburetor.

Pour about a pint of heavy engine oil into each cylinder and turn the crank over until the oil has been spread over the walls of the cylinders and pistons, and between the valves and their seats. Be sure all priming cups are closed. Put thick oil on all exposed iron or steel parts, such as the gear shift lever, the governor parts, exposed surfaces of the crank shaft, etc.

After a season's work there is likely to be an accumulation of dirt, etc., in the radiator, from the water. If this is allowed to remain there through the winter, it is very likely to form a cement-like crust, which will retard, if not entirely stop the circulation of the water when the tractor is started in the spring. A good way to get this sediment out is to remove the radiator, turn it upside down, and connect a pressure line of either water, steam or compressed air to the pipe in the bottom of the radiator, leaving both openings in the top (the filler pipe and the inlet pipe from the engine) open, and allow the pressure used to flow through rapidly until the discharge from the radiator shows that it is clean.

Before starting the tractor in the spring, clean the heavy oil out of the cylinders and from all other parts with kerosene. Clean the engine and put in fresh oil, as suggested under "Use Clean Oil." Prime the cylinders with plenty of good engine oil before starting. See that the transmission is well supplied with a good grade of heavy steam cylinder oil.

HITCHING PLOWS TO TRACTOR

The principal point in hitching plows behind a tractor is to have the plow pull in a straight line with the tractor. Getting the plow to pull straight is a matter of adjusting the plow to run straight. Usually not enough attention is given to the condition of the plow and how it is lined up with the tractor. Plows are made to pull straight and not to point off to one side. A straight running plow, properly leveled, will pull a great deal easier and do better work than one not so adjusted.

STARTING ENGINE IN COLD WEATHER

Difficulty in starting the engine in cold weather is usually caused by the fuel and air not mixing readily at a low temperature. This is particularly true of a low grade of gasoline, such as is usually sold for tractor use. For starting the engine at temperatures below the freezing point, it is a good plan to have enough high test gasoline to use for priming purposes only, as naphtha and the lower grades of gasoline will not mix nor ignite readily at a low temperature.

Be sure the frost is removed from the water pump before trying to turn the engine.

Prime each cylinder with high test gasoline and pour a little into the carburetor through the primary air port, and allow it to stand a few minutes. Close the choke valve of the carburetor and crank the engine, turning the crank over very quickly to insure a good spark. As soon as the engine starts, open the choke valve.

At freezing temperatures, the lubricating oil congeals. **Never start the engine in cool weather without immediately making sure that the oil pump will do its work properly.** See instructions for testing the pump under the heading "Use clean Oil."

In case the pump should refuse to operate, draw out three or four quarts of lubricating oil from the crank case, and heat until quite hot. Divide one-half pint of this hot oil among the four cylinders, pouring it through the spark plug holes, and pour the remainder of the oil back into the motor. We are quite sure the results will be satisfactory.

Even when the weather is not so cold that the heating of the oil in the oil casing is necessary, pouring a little hot oil into each of the cylinders will be found to be a great help in starting a cold engine.

If the above method should fail, take out the spark plugs, clean them, and heat them until quite hot. When the engine is cold, prime quite freely, but when it is hot, be careful not to prime too much.

CARE OF COOLING SYSTEM IN COLD WEATHER

In the fall and spring of the year, the weather in most localities is very uncertain and subject to sudden frosts. If a tractor has not been drained of all water, the result may be burst cylinders, a broken water pump and a damaged radiator. Do not take any chances. It is surprising what a little bit of frost it takes to do a lot of damage.

Whenever there is any danger of frost, drain all water out of the tractor carefully before leaving it any great length of time.

THE TWO SPEEDS

The two-speed transmission is so constructed as to be durable and at the same time, consume the least amount of power in propelling the tractor. This is accomplished by the use of Roller Bearings throughout the transmission, and perfectly cut, perfectly hardened, smooth running gears.

A greal deal of the work done with a tractor is on rolling ground and in fields where the soil conditions vary greatly within the field itself. From light loam and level ground to gumbo spots and hills causes a continuous varying from light to heavy load.

The two-speed transmission, both speeds being direct, is made to take care of just such conditions as these, so that although the tractor is expected to run on direct high speed a large portion of the time, whenever a tough spot or a hill is encountered and the engine begins to labor, drop back into direct low. The low gear will allow the tractor to take full load through these bad places without straining or jerking anything. After this has been tried a few times, you will realize the value of the low gear and the strain it relieves the tractor of, in hard plowing or hauling.

Do not open the governor and speed the engine to increase tractor speed. Use judgment as to speed. It is bad judgment to run a tractor at a very high speed over rough roads.

BELT WORK

Twenty horse-power at the belt furnishes power enough for quite a variety of belt work. Most every kind of machine from ensilage cutter to fanning mill is made to run at a certain speed, determined by that speed at which it does the best work. Therefore, before belting up to a piece of machinery, figure the speed at which that machine will run with the engine running normally. The pulley on the machine may be too large or too small to get the required speed, and thus necessitate a change to accommodate the speed of the tractor pulley.

To find the speed of the machine to be driven, proceed as follows: Multiply the number of inches in the diameter of the pulley on the tractor by its number of revolutions per minute and divide the product by the number of inches in the diameter of the pulley on the machine to be driven. The quotient will be the number of revolutions the machine will be driven per minute.

Example: Suppose tractor is to drive a shredder which is equipped with a pulley 9 inches in diameter—

$$\frac{12\times900=1,200}{9}$$

This shredder will be driven 1,200 R. P. M.

To find what size pulley will give the required speed, proceed as follows:

Multiply the number of inches in the diameter of the pulley on the tractor by its number of revolutions per minute and divide the product by the number of revolutions per minute the pulley on the machine to be driven is required to run. The quotient will be the diameter in inches of the pulley that must be used to obtain that speed.

Example: Suppose the tractor is to drive the above shredder and that the speed of the shredder must be about 800 R. P. M.

$$\frac{12\times900}{800}=13\tfrac{1}{2}\text{ inches}$$

To drive the above shredder at a speed of 800 R. P. M. with this tractor, the shredder must be equipped with a drive pulley $13\frac{1}{2}$ inches in diameter.

DRAW BAR HORSE-POWER

Many tractor owners do not realize the real meaning of the term "Draw Bar Horse-Power." The rating given a tractor by the manufacturer states the horse-power the tractor will develop at the drawbar, when properly operated under average conditions. That horse-power will be developed on high or on low gear, although the load pulled or, we will say, the actual number of pounds draw bar pull, will not be the same.

A twelve horse-power tractor geared to travel at the rate of one and one-half miles per hour will, on ordinary footing, develop twelve horse-power at the draw bar, which means a pull of

a certain number of pounds. But change that speed to two and one-half miles per hour and the number of pounds draw bar pull will be greatly decreased, although the tractor still develops its twelve horse-power.

Any five thousand-pound tractor, traveling at 2.3 miles per hour up a 10 per cent grade requires 3.1 horse-power more than it takes on the level. In other words, the draw bar pull is reduced 3.1 horse-power. A 5 per cent grade would require just one-half the above, or 1.55 horse-power.

In the case of a tractor pulling loaded wagons, a different draw bar pull per ton will be required, depending on the condition of the road and whether the load is pulled on the level or up hill.

In the case of a tractor pulling plows, a different draw bar pull per plow will be required, depending on the condition of the soil.

In order that you may form some idea as to the difference all these conditions will make, we show below a table taken from some of the leading Farm Journals, showing the draw bar pull required for a load of one ton in a wagon and for one plow bottom in various soils.

DRAW BAR PULL REQUIRED FOR A LOAD OF ONE TON IN WAGON

	Good Road Lbs.	Gravel Lbs.	Sand Lbs.
On the level	125	250	625
Rise of 1 ft. in 100 ft.	145	290	725
Rise of 2 ft. in 100 ft.	165	330	825
Rise of 3 ft. in 100 ft.	185	370	925
Rise of 4 ft. in 100 ft.	205	410	1025
Rise of 5 ft. in 100 ft.	225	450	1125
Rise of 6 ft. in 100 ft.	245	490	1225

DRAW BAR PULL REQUIRED FOR ONE PLOW IN VARIOUS SOILS

A tractor traveling at 2.33 miles per hour will travel 204 feet in one minute. For plowing, the following table shows the time and distance required to plow one acre:

	12-in. Bottom			14-in. Bottom		
Depth	4 in. Lbs.	6 in. Lbs.	8 in. Lbs.	4 in. Lbs.	6 in. Lbs.	8 in. Lbs.
Sandy	144	216	288	168	252	336
Clover Sod	336	504	672	442	588	734
Clay	384	576	768	448	672	896
Virgin Sod	720	1080	1440	840	1260	1680
Gumbo	960	1440	1920	1120	1680	2240

	16-in. Bottom		
Depth	4 in. Lbs.	6 in. Lbs.	8 in. Lbs.
Sandy	192	288	384
Clover Sod	448	672	896
Clay	512	768	1024
Virgin Sod	960	1440	1920
Gumbo	1280	1920	2560

1—12-in. Plow traveling 43,560 ft. equals 1 acre.
2—12-in. Plows traveling 21,780 ft. equals 1 acre.
3—12-in. Plows traveling 14,520 ft. equals 1 acre.
4—12-in. Plows traveling 10,890 ft. equals 1 acre.
1—14-in. Plow traveling 37,400 ft. equals 1 acre.
2—14-in. Plows traveling 18,700 ft. equals 1 acre.
3—14-in. Plows traveling 12,466 ft. equals 1 acre.
4—14-in. Plows traveling 9,350 ft. equals 1 acre.
1—16-in. Plow traveling 32,700 ft. equals 1 acre.
2—16-in. Plows traveling 16,350 ft. equals 1 acre.
3—16-in. Plows traveling 10,900 ft. equals 1 acre.
4—16-in. Plows traveling 8,175 ft. equals 1 acre.
(The above also applies to tractor traveling 1.81 miles per hour.)

TRACTOR TRAVELING AT 2.33 MILES PER HOUR

1—12-in. Plow traveling 214 minutes equals 1 acre.
2—12-in. Plows traveling 107 minutes equals 1 acre.
3—12-in. Plows traveling 71⅓ minutes equals 1 acre.
4—12-in. Plows traveling 53½ minutes equals 1 acre.
1—14-in. Plow traveling 183 minutes equals 1 acre.
2—14-in. Plows traveling 91⅓ minutes equals 1 acre.
3—14-in. Plows traveling 61 minutes equals 1 acre.
4—14-in. Plows traveling 45¾ minutes equals 1 acre.
1—16-in. Plow traveling 160 minutes equals 1 acre.
2—16-in. Plows traveling 80 minutes equals 1 acre.
3—16-in. Plows traveling 53⅓ minutes equals 1 acre.
4—16-in. Plows traveling 40 minutes equals 1 acre.

TRACTOR TRAVELING 1.81 MILES PER HOUR

1—12-in. Plow traveling 273⅓ minutes equals 1 acre.
2—12-in. Plows traveling 137⅔ minutes equals 1 acre.
3—12-in. Plows traveling 91⅓ minutes equals 1 acre.
4—12-in. Plows traveling 68½ minutes equals 1 acre.
1—14-in. Plow traveling 234 minutes equals 1 acre.
2—14-in. Plows traveling 117⅓ minutes equals 1 acre.
3—14-in. Plows traveling 78¼ minutes equals 1 acre.
4—14-in. Plows traveling 58⅔ minutes equals 1 acre.
1—16-in. Plow traveling 224 minutes equals 1 acre.
2—16-in. Plows traveling 112 minutes equals 1 acre.
3—16-in. Plows traveling 74⅔ minutes equals 1 acre.
4—16-in. Plows traveling 56 minutes equals 1 acre.

The E-B 12-20 Tractor S. A. E. Rating will develop 12 horse-power at the draw bar when in good condition and properly operated on level ground sufficiently firm to give the tractor wheels a good footing. Twelve horse-power at 1.81 miles per hour means a draw bar pull of 2,490 pounds. Twelve horse-power at 2.33 miles per hour means a draw bar pull of 1,930 pounds.

A Few Hints

TRACTOR WILL NOT START

A. Gasoline not turned on.
Water in gasoline.
Gasoline line frozen or stopped up.
Poor gasoline.

B. No spark.
High tension cables not correctly connected.
Short circuit in magneto.
Open circuit in magneto.
Broken low tension connection.
Spark gap in spark plugs too great.
Water condensed on spark plug points.
Platinum points do not strike together and make a contact.
Platinum points do not separate far enough.
Carbon dust in distributor.

C. Magneto badly out of time.

D. Cam shaft badly out of time (only possible when removed and not put back correctly).

MISFIRING

A. Spark plug, porcelain insulation broken.
Spark plug points in contact.
Spark plug filled with carbon.
Spark plug points too far apart.

B. Low compression.
Leaky valves.
Valve riding.
Too much clearance between valve and lift.

C. Spark advanced too far or not far enough.

D. Cam shaft badly out of time.

E. Mixture too rich.

F. Mixture too lean.

ENGINE STARTS, RUNS A MINUTE, STOPS

Fuel pipes stopped, or only a little fuel in tank.
Carburetor needle valve not open enough.
Carburetor needle opened too much.
Water in gasoline.
Fuel air-bound in pipe.
Dirt in fuel. Remove strainer below carburetor and clean.
Cam shaft badly out of time (only possible when removed and not put back correctly).

LOSS OF POWER

A. Weak compression.
Riding valves.
Leaky valves.
Leaky piston rings.

B. Mixture too rich.
Carburetor needle valve adjusted wrong.

C. Engine out of time.
Cam shaft too late (only possible when removed and not put back correctly.)
Cam shaft too early (only possible when removed and not put back correctly).
Too much clearance between valves and lifts.
Spark too late or too early.
Engine gummed up from poor oil.
Insufficient lubrication
Bearing too tight.
Bearings cut by dirty oil.

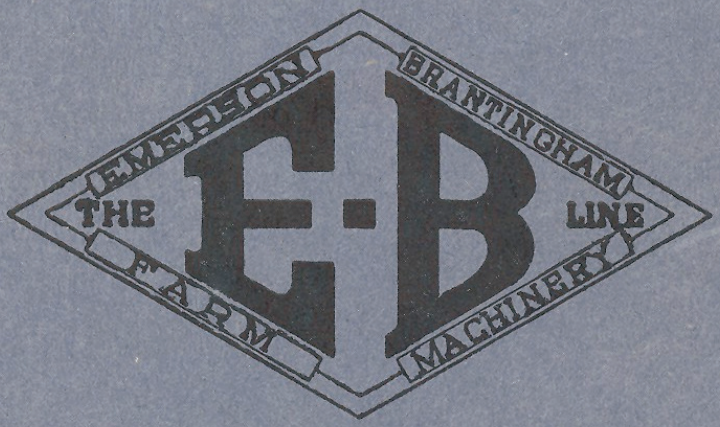
Form A 1518 6-25 2M Printed In U. S. A.

Repair Price List

NUMBER 310

for

E. B. 12-20 MODEL AA TRACTOR



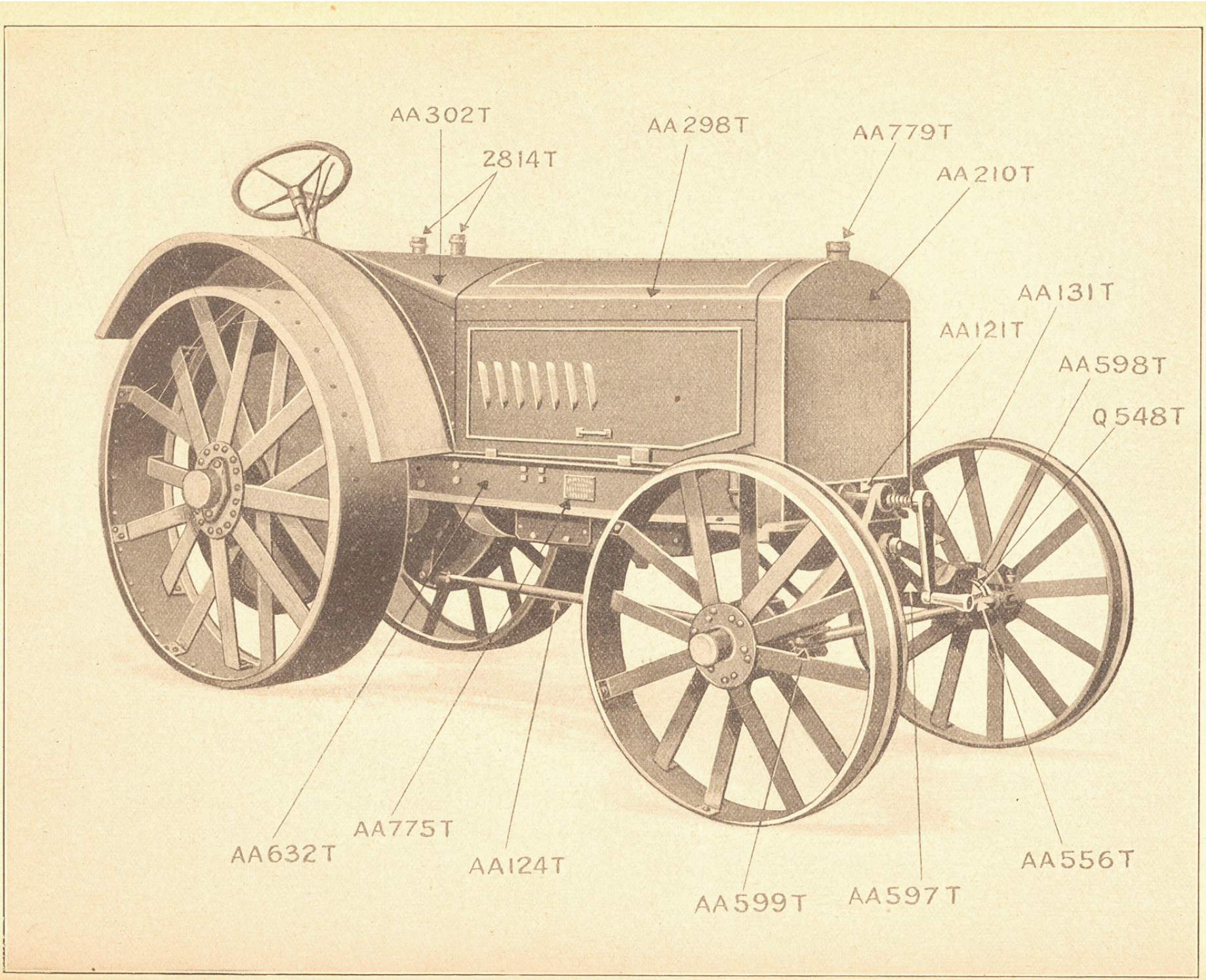
EMERSON-BRANTINGHAM IMPLEMENT CO.
INCORPORATED

GOOD FARM MACHINERY

Business Founded in 1852

ROCKFORD, ILL., U. S. A.

PLATES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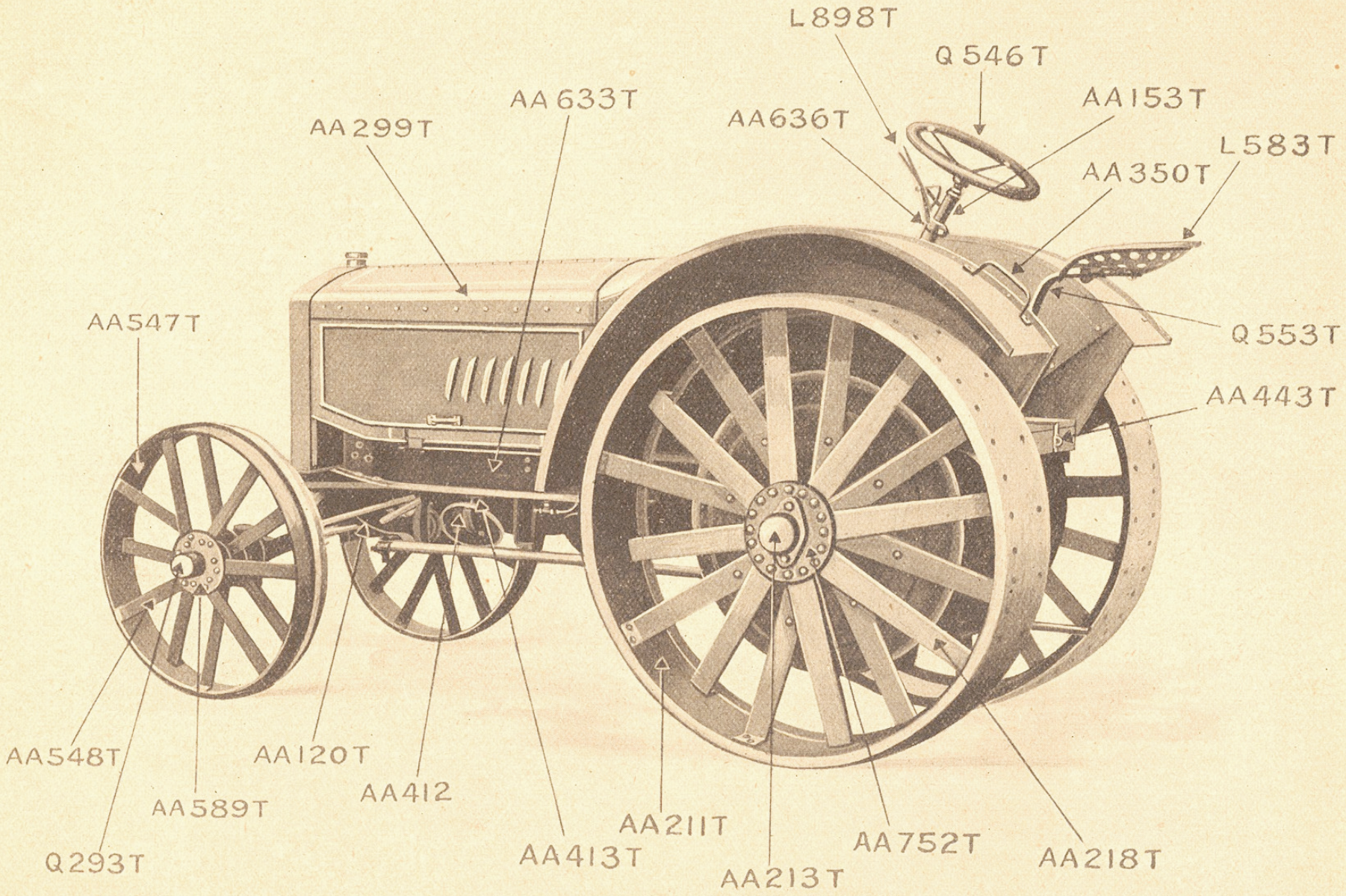
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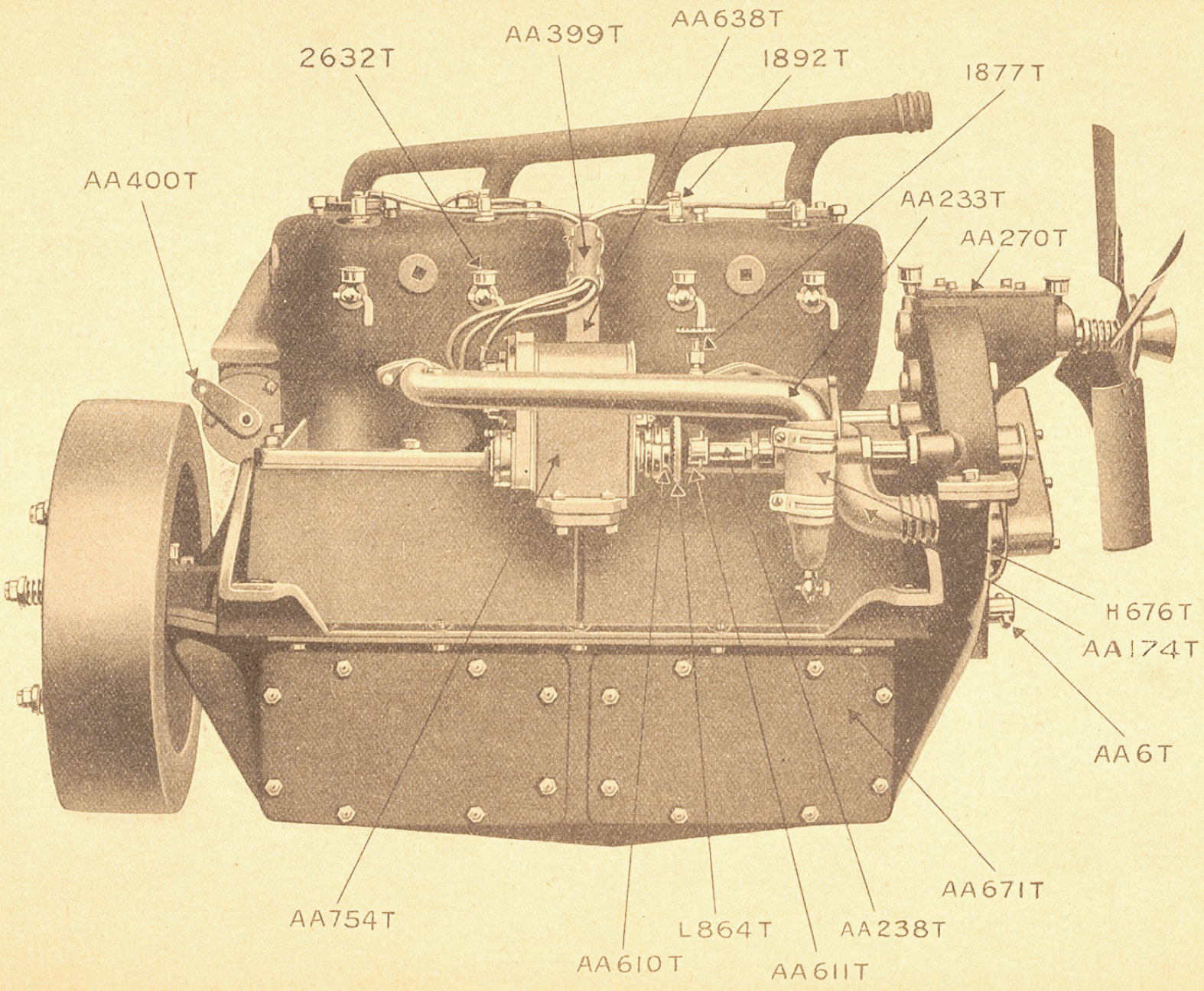
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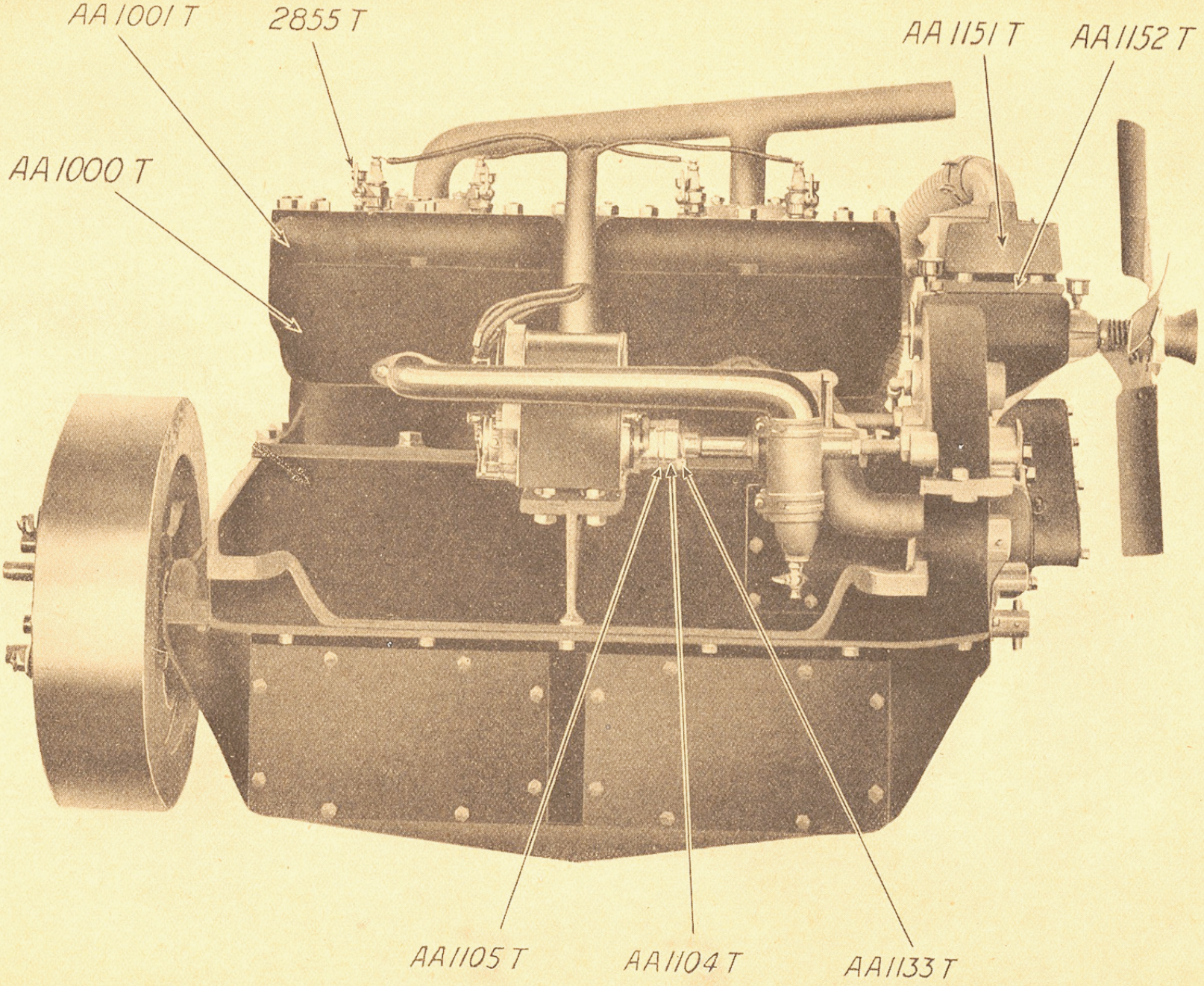
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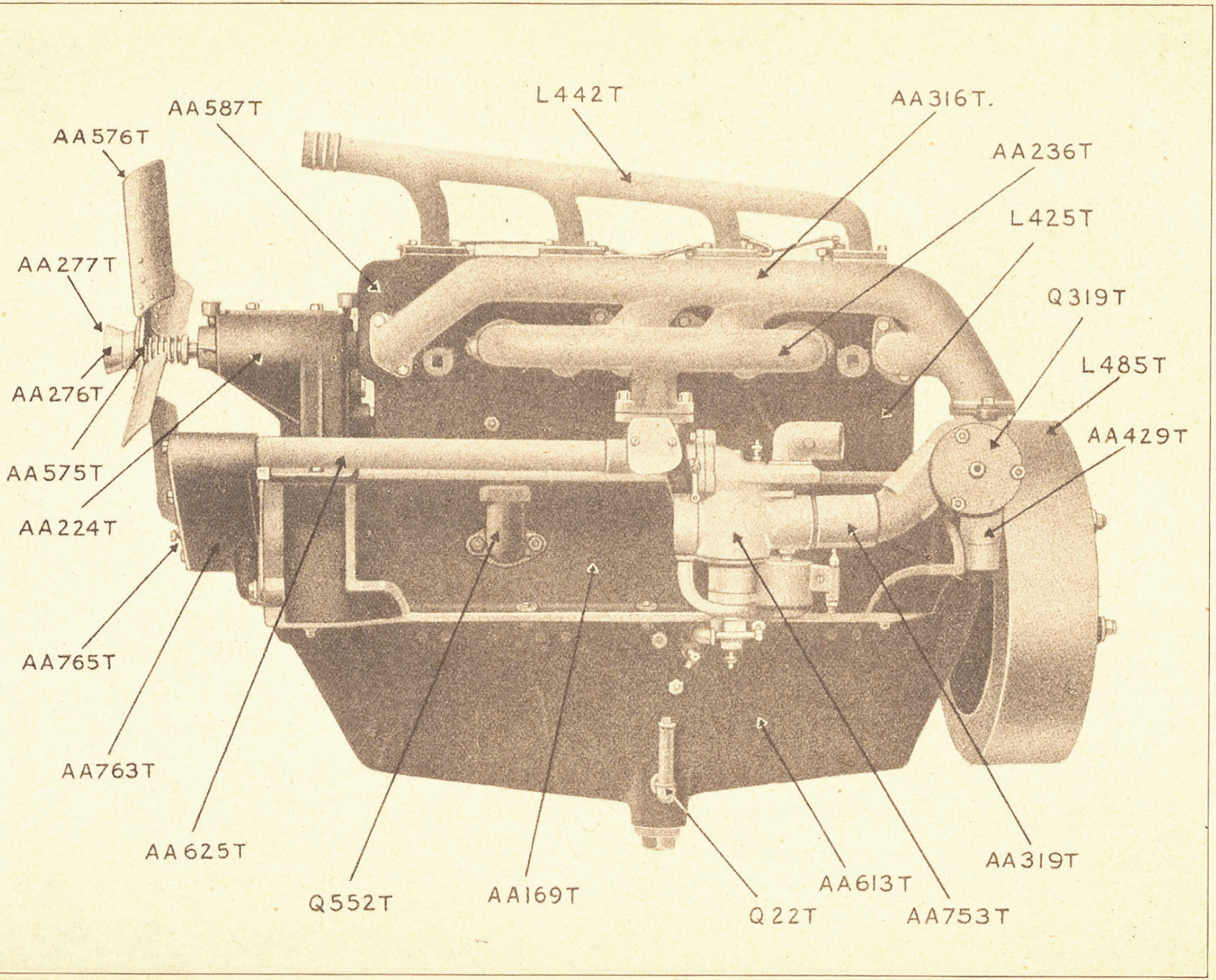
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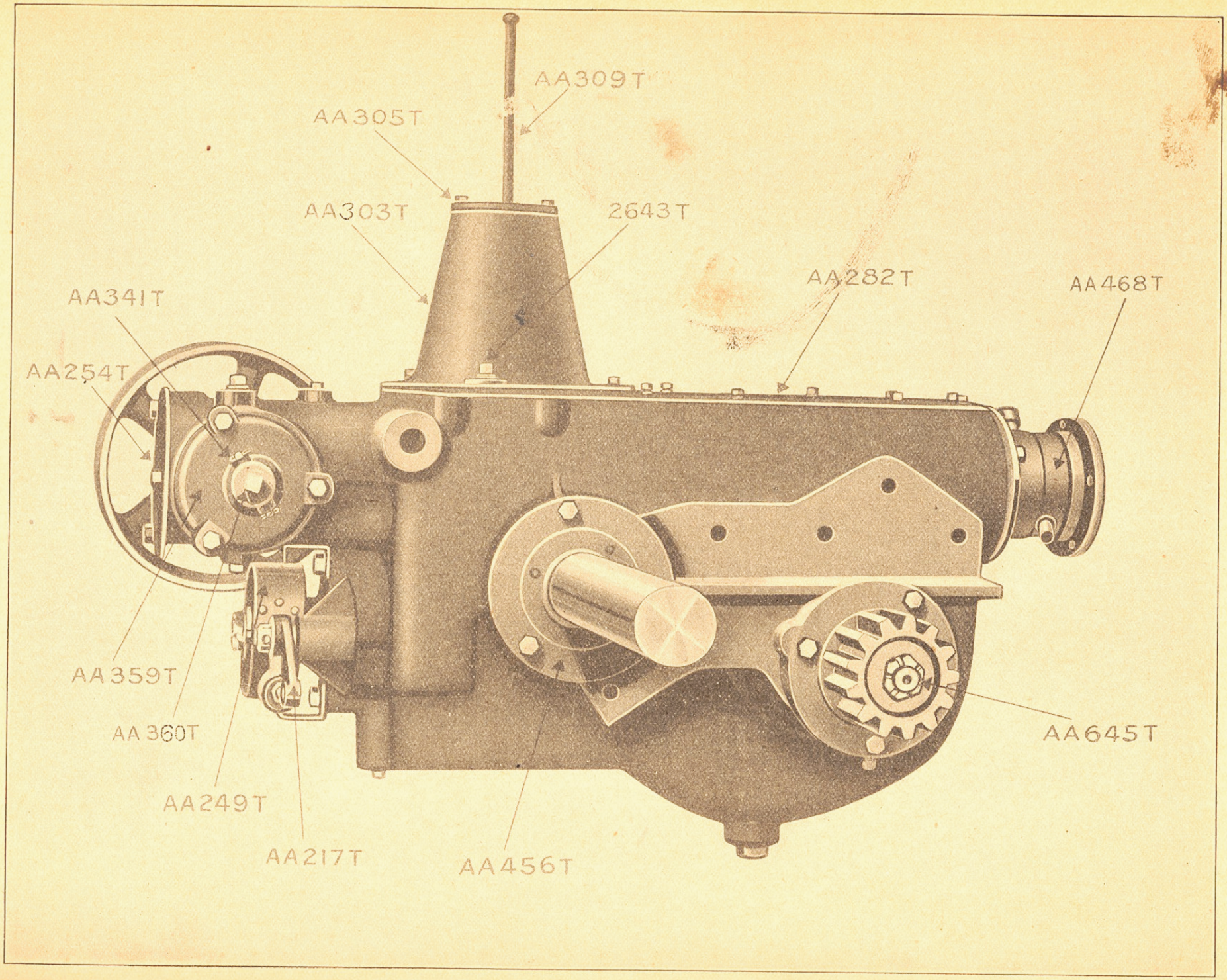
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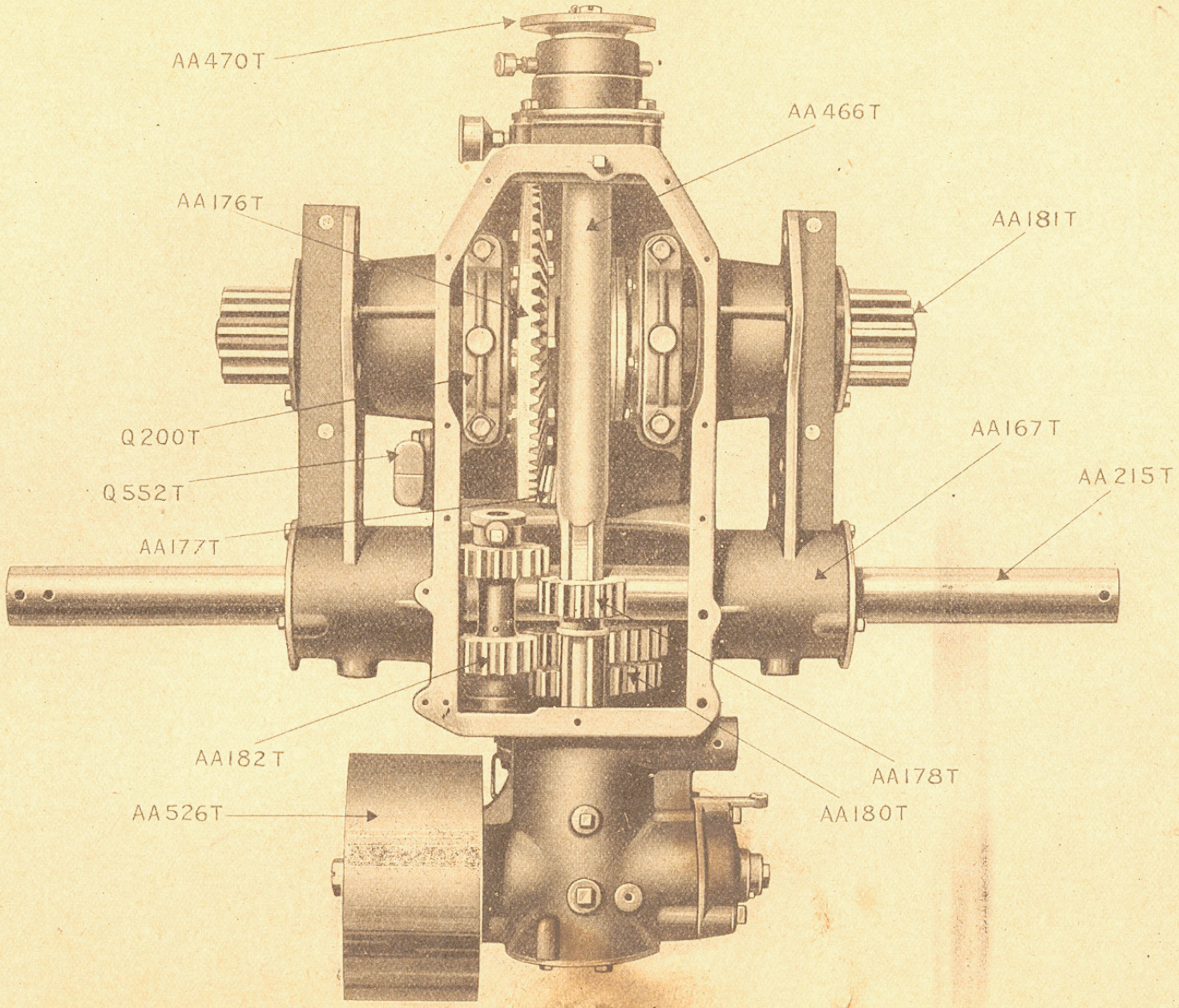
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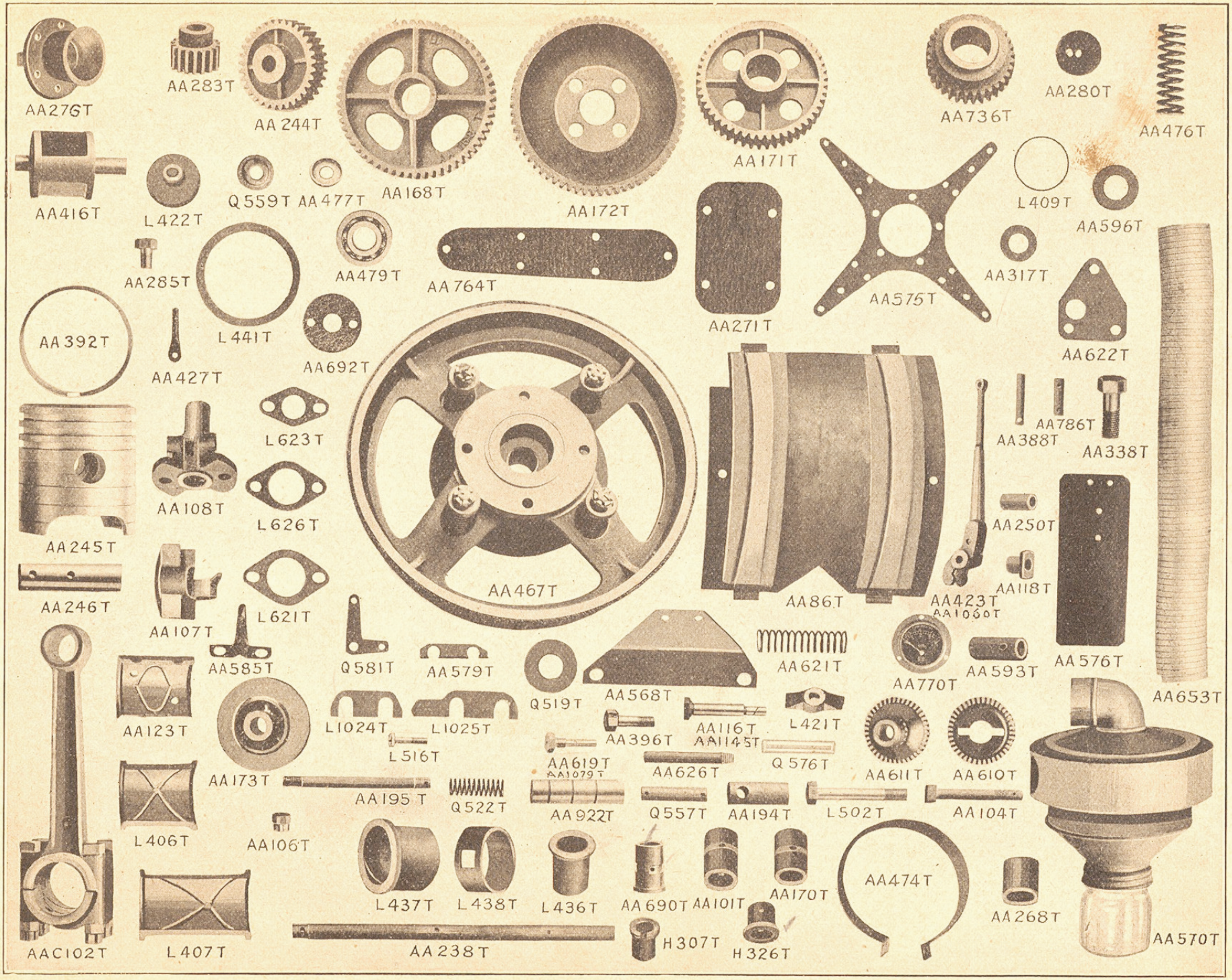
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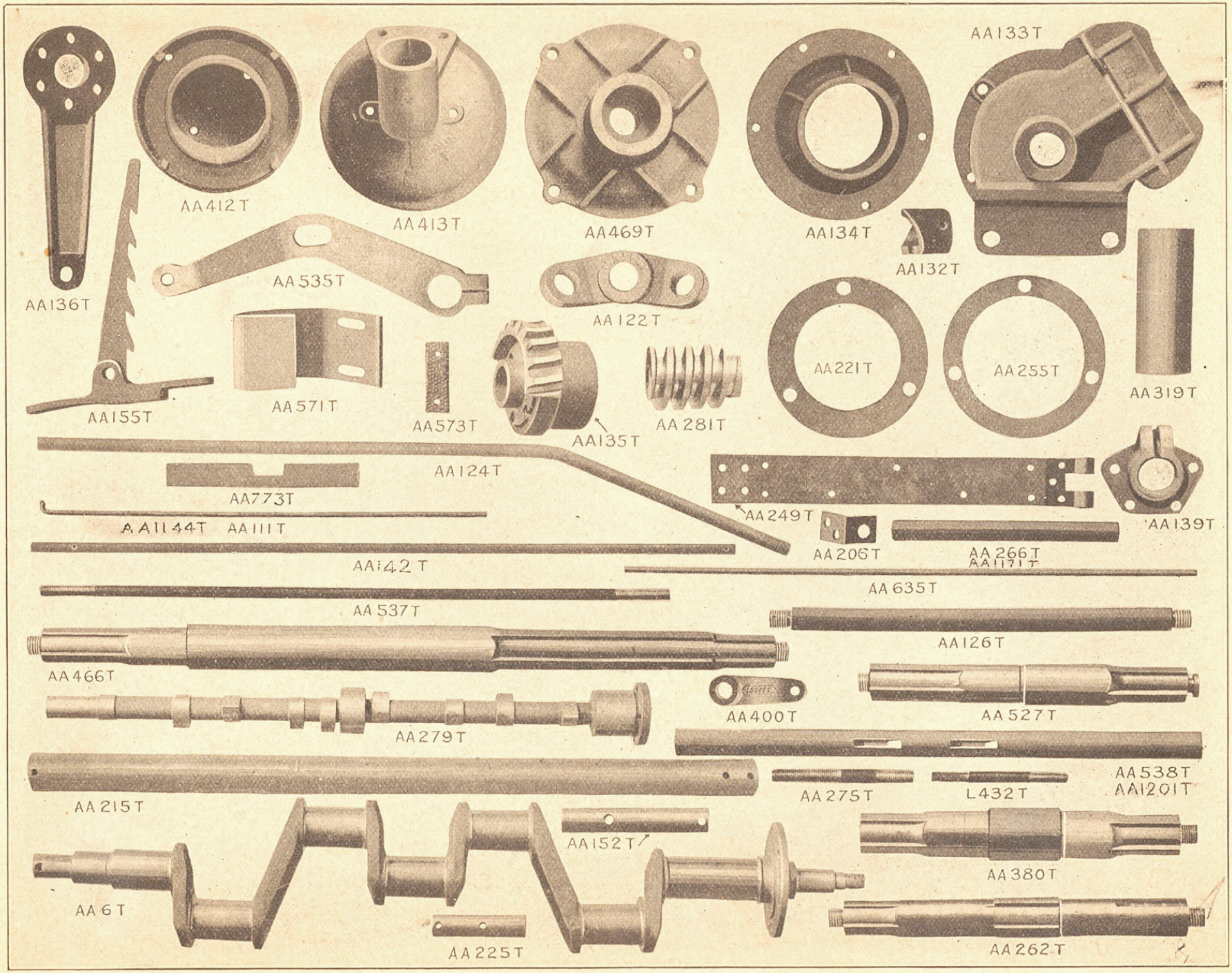
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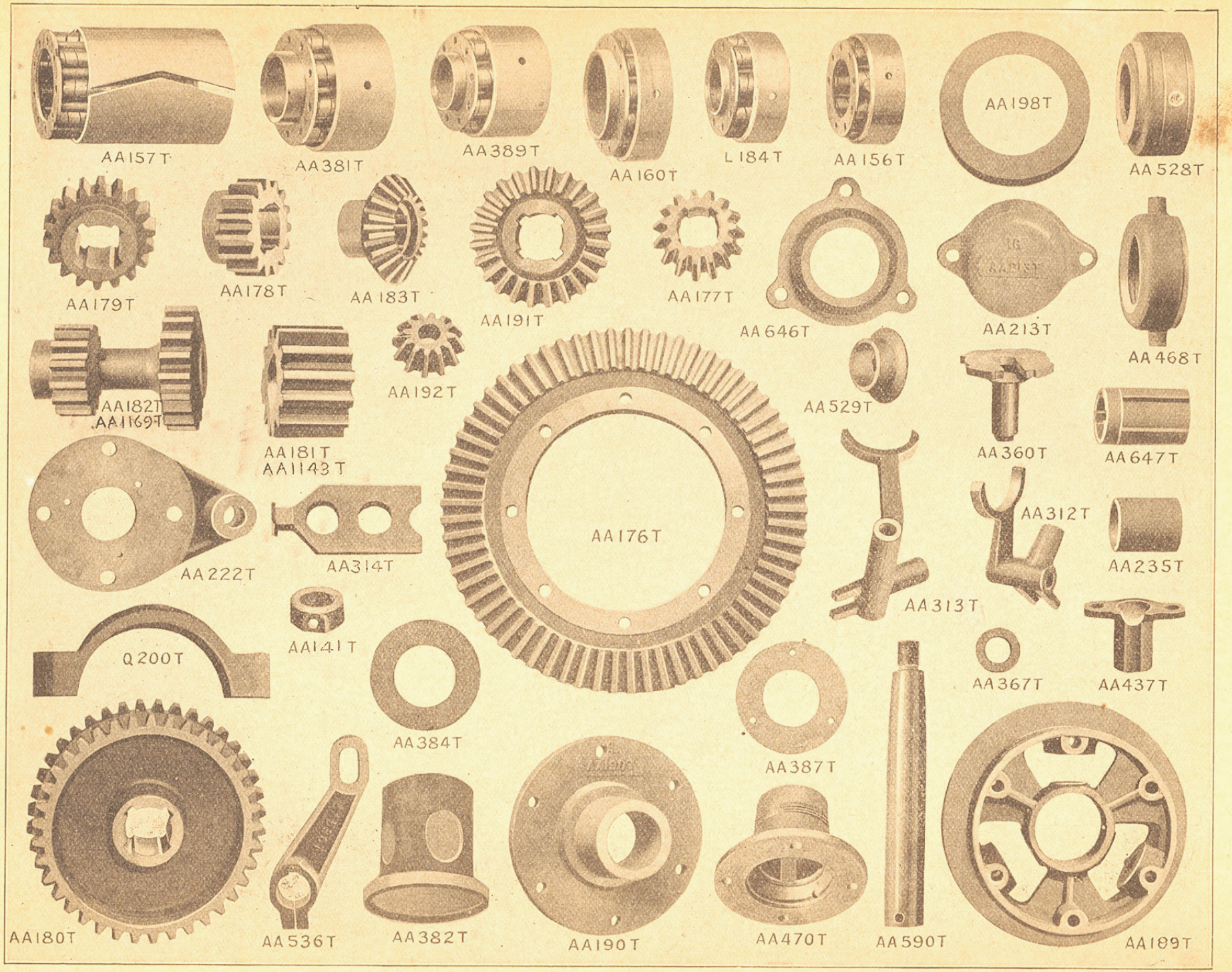
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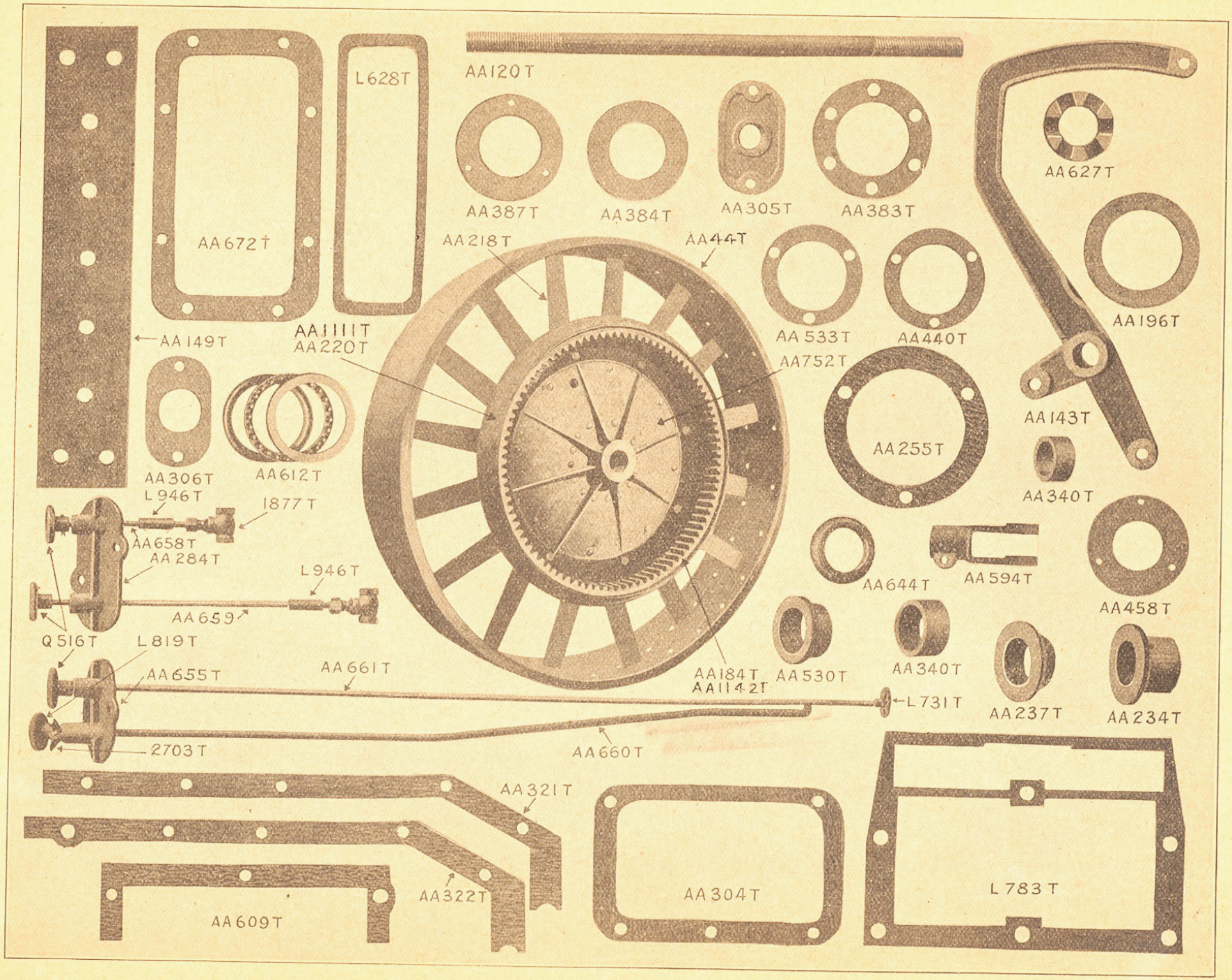
PLATE NO. 9

PLATE NO. 9



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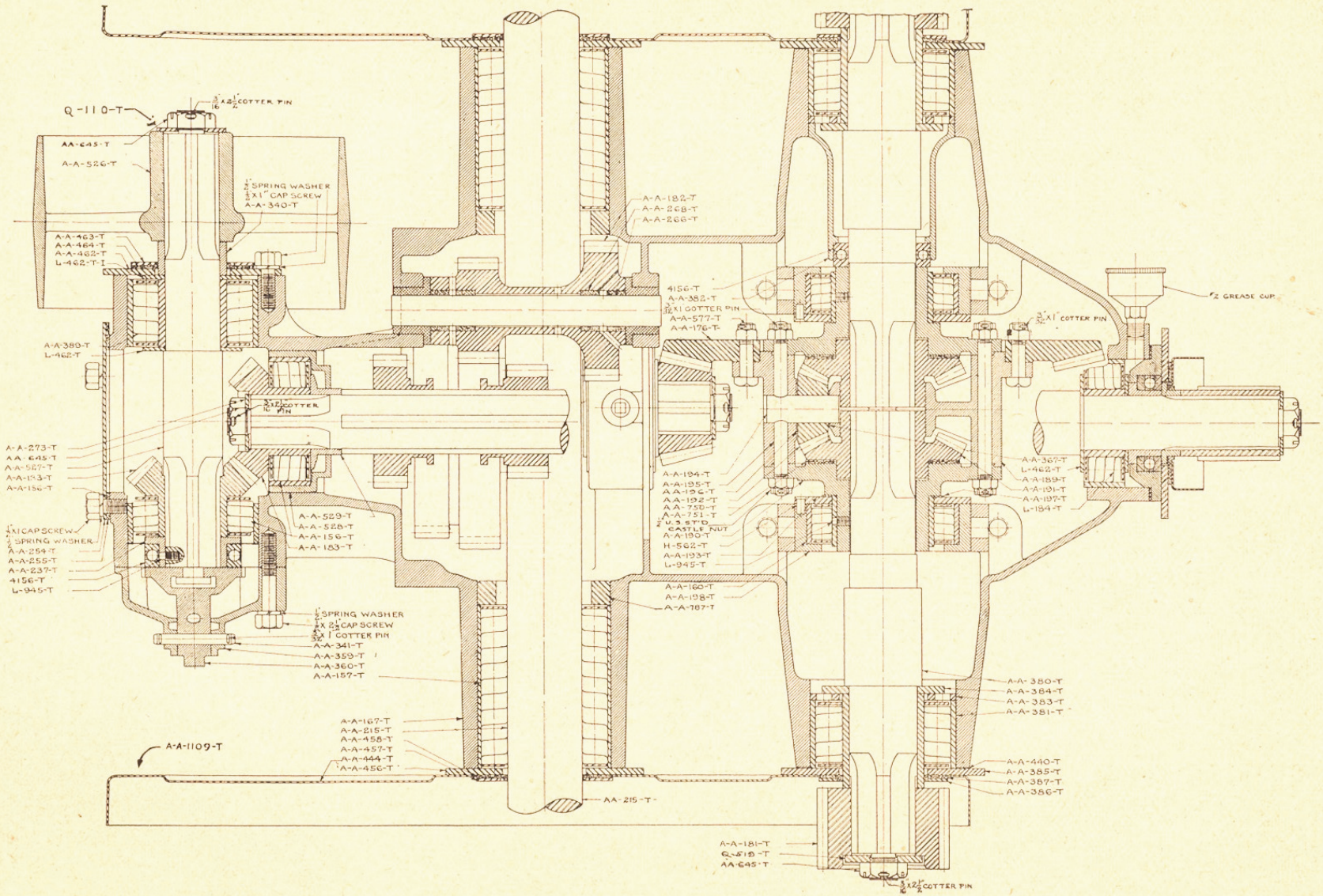
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A-A-526-T
SPRING WASHER
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L-462-T-1
A-A-380-T
L-462-T
A-A-273-T
AA-645-T
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A-A-156-T
CAP SCREW
SPRING WASHER
A-A-254-T
A-A-255-T
A-A-237-T
4156-T
L-945-T
A-A-529-T
A-A-528-T
A-A-156-T
A-A-183-T
SPRING WASHER
CAP SCREW
COTTER PIN
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GREASE CUP
COTTER PIN
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COTTER PIN

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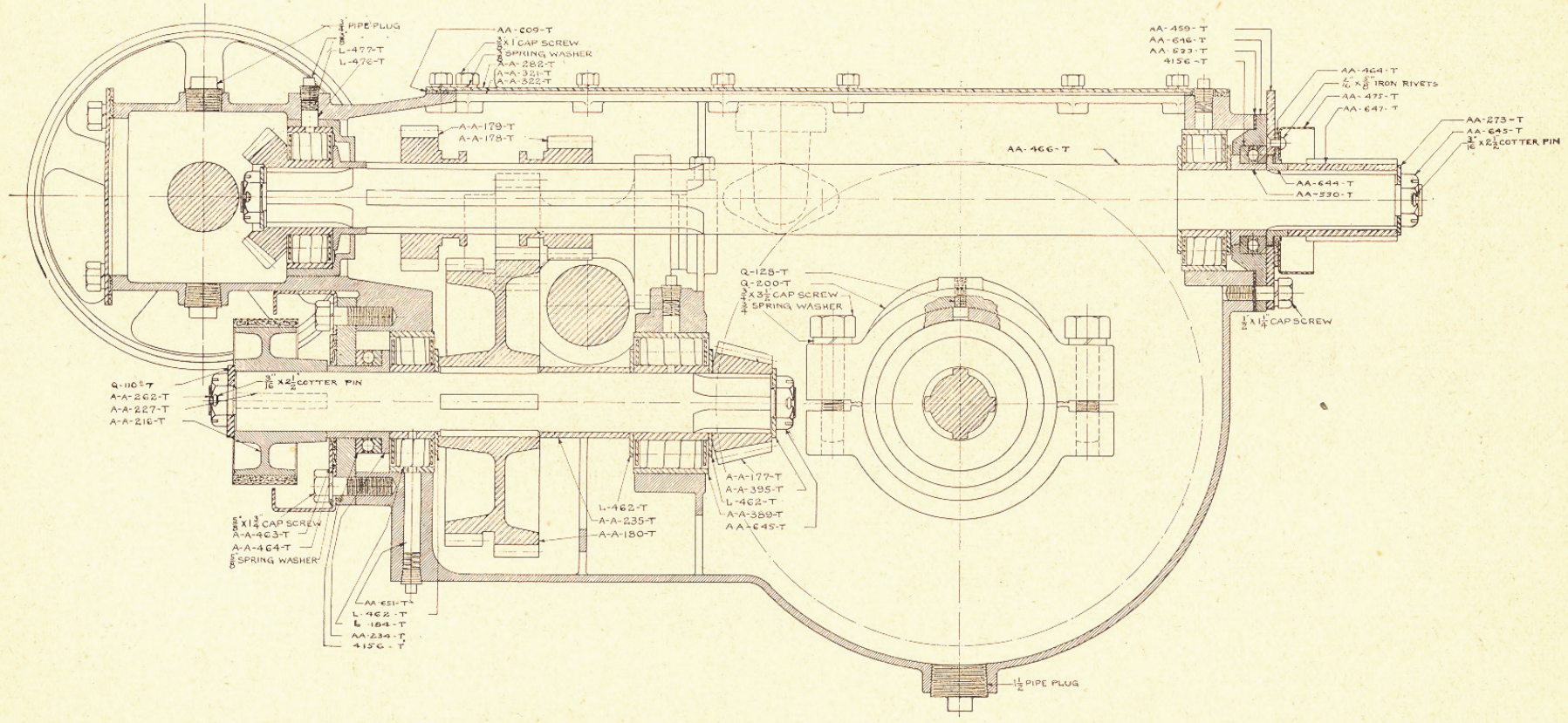
PIPE PLUG
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SPRING WASHER
A-A-282-T
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AA-459-T
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AA-633-T
4156-T
AA-464-T
IRON RIVETS
AA-475-T
AA-647-T
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COTTER PIN
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CAP SCREW
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PIPE PLUG

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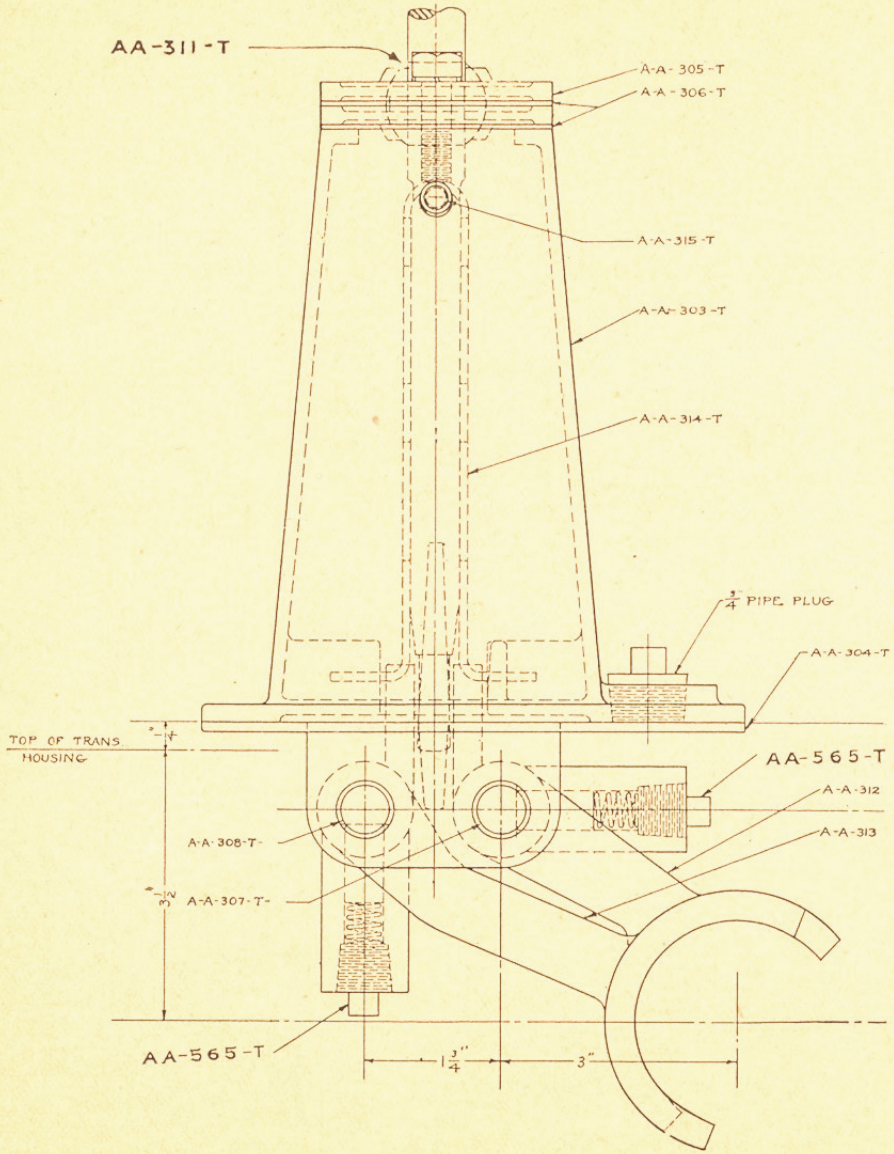
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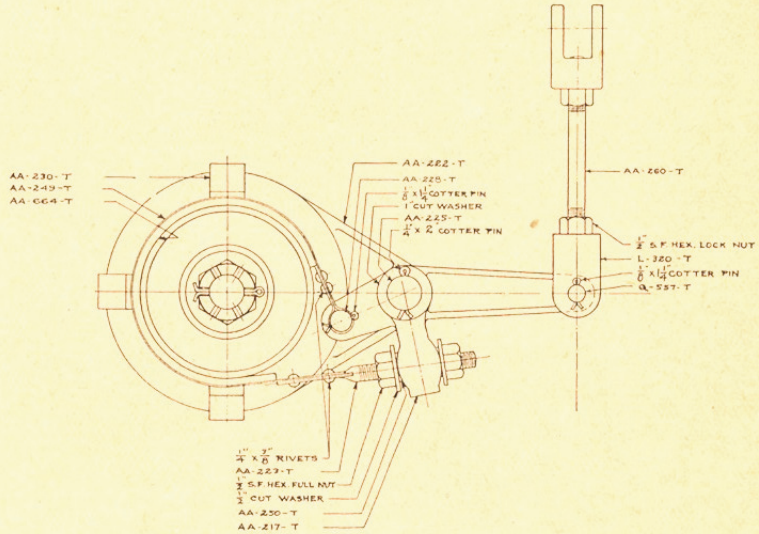
A-A-306-T
A-A-315-T
A-A-303-T
A-A-314-T
3/4 PIPE PLUG
A-A-304-T
TOP OF TRANS. HOUSING
AA-565-T
A-A-312
A-A-313
A-A-308-T
3 3/4"
A-A-307-T
AA-565-T
1 3/4"
3"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1/8 x 1 1/2 COTTER PIN
1" CUT WASHER
AA-225-T
1/4 x 2 COTTER PIN
AA-260-T
1" S.F. HEX. LOCK NUT
L-320-T
1/8 x 1 1/2 COTTER PIN
Q-587-T
1/4" x 3/8" RIVETS
AA-227-T
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1/2" CUT WASHER
AA-250-T
AA-217-T

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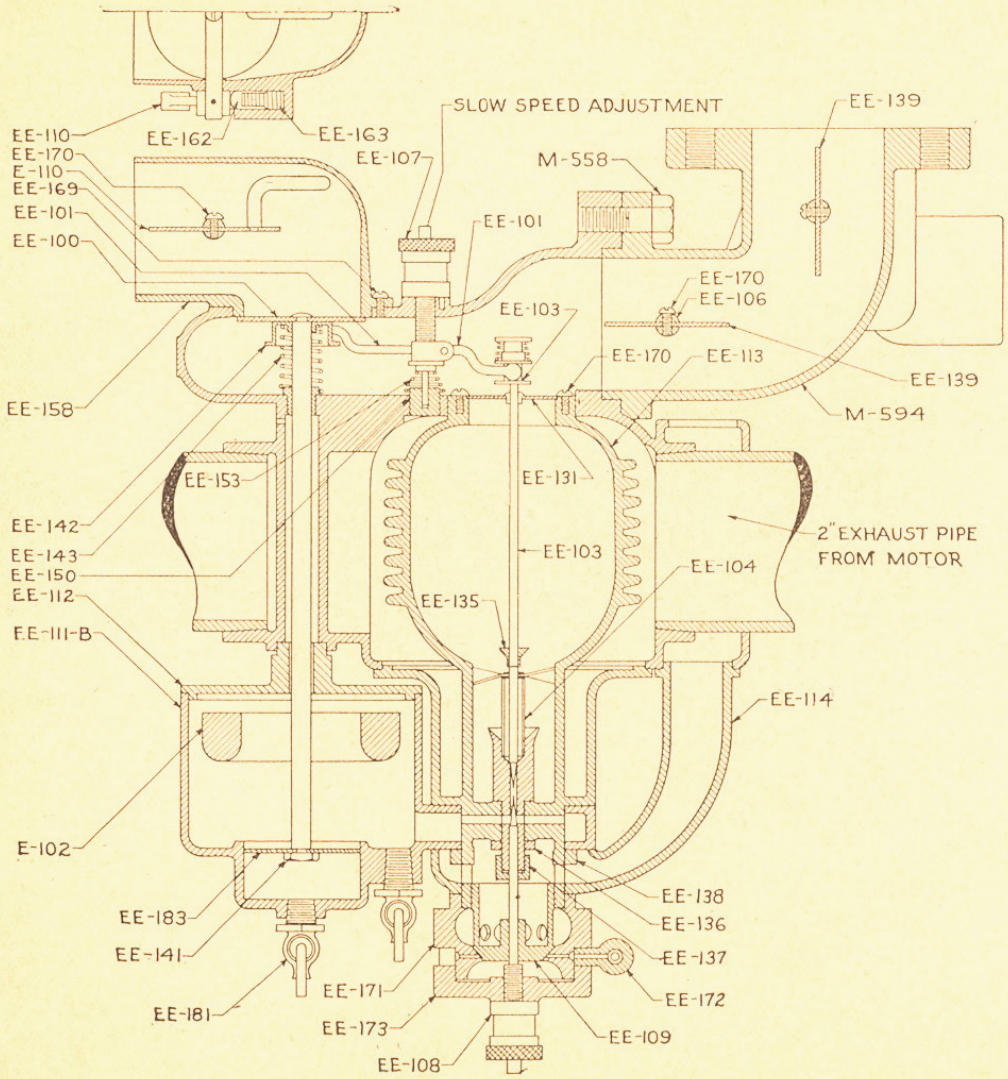
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EE-101
EE-100
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EE-163
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M-558
EE-101
EE-170
EE-106
EE-103
EE-170
EE-113
EE-139
M-594
EE-158
EE-153
EE-131
EE-142
EE-143
EE-150
EE-112
EE-103
2" EXHAUST PIPE
FROM MOTOR
EE-104
EE-135
EE-111-B
EE-114
E-102
EE-183
EE-141
EE-181
EE-171
EE-173
EE-108
EE-138
EE-136
EE-137
EE-172
EE-109

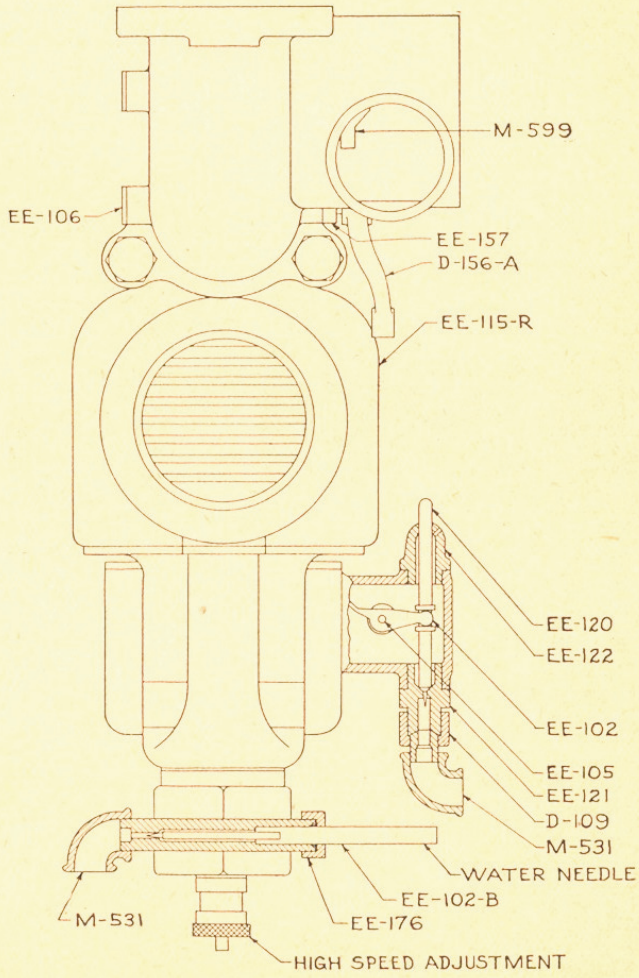
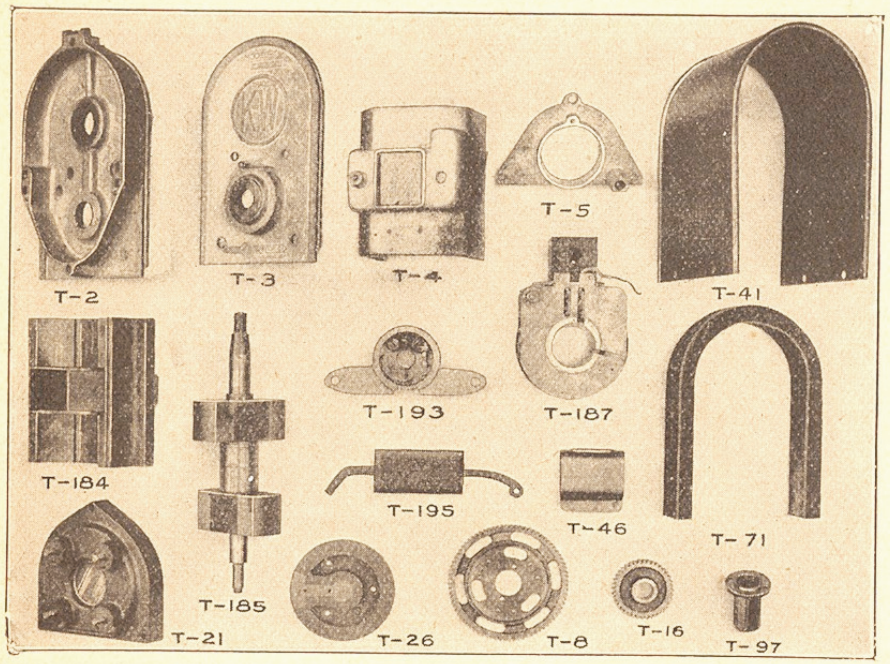

M-599
EE-106
EE-157
D-156-A
EE-115-R
EE-120
EE-122
EE-102
EE-105
EE-121
D-109
M-531
WATER NEEDLE
EE-102-B
EE-176
M-531
HIGH SPEED ADJUSTMENT

PLATE NO. 14


T-2
T-3
T-4
T-5
T-41
T-184
T-193
T-187
T-195
T-46
T-71
T-185
T-21
T-26
T-8
T-16
T-97

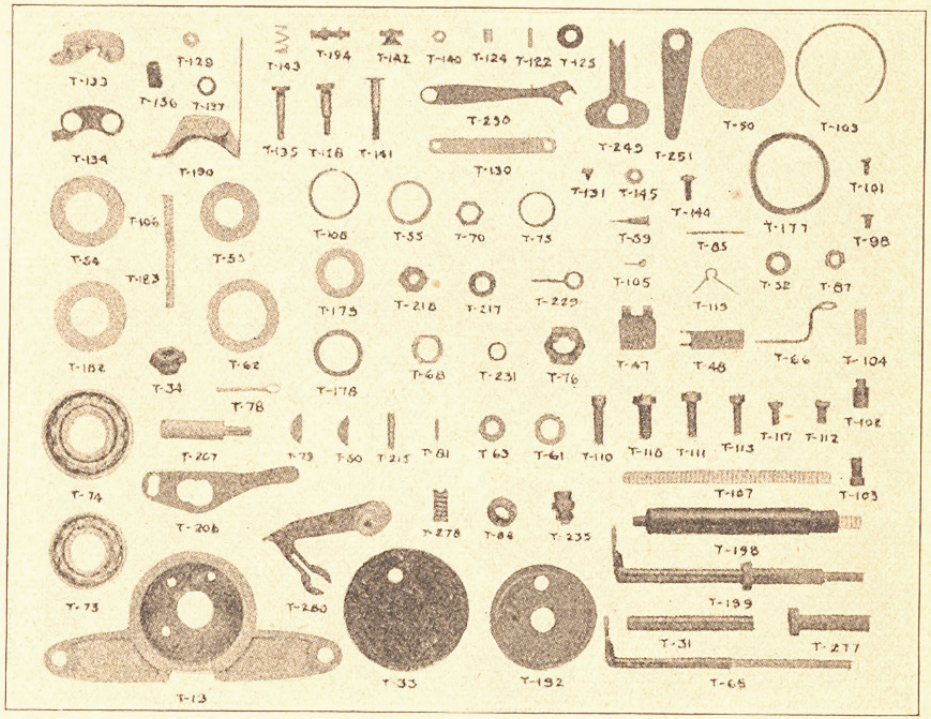
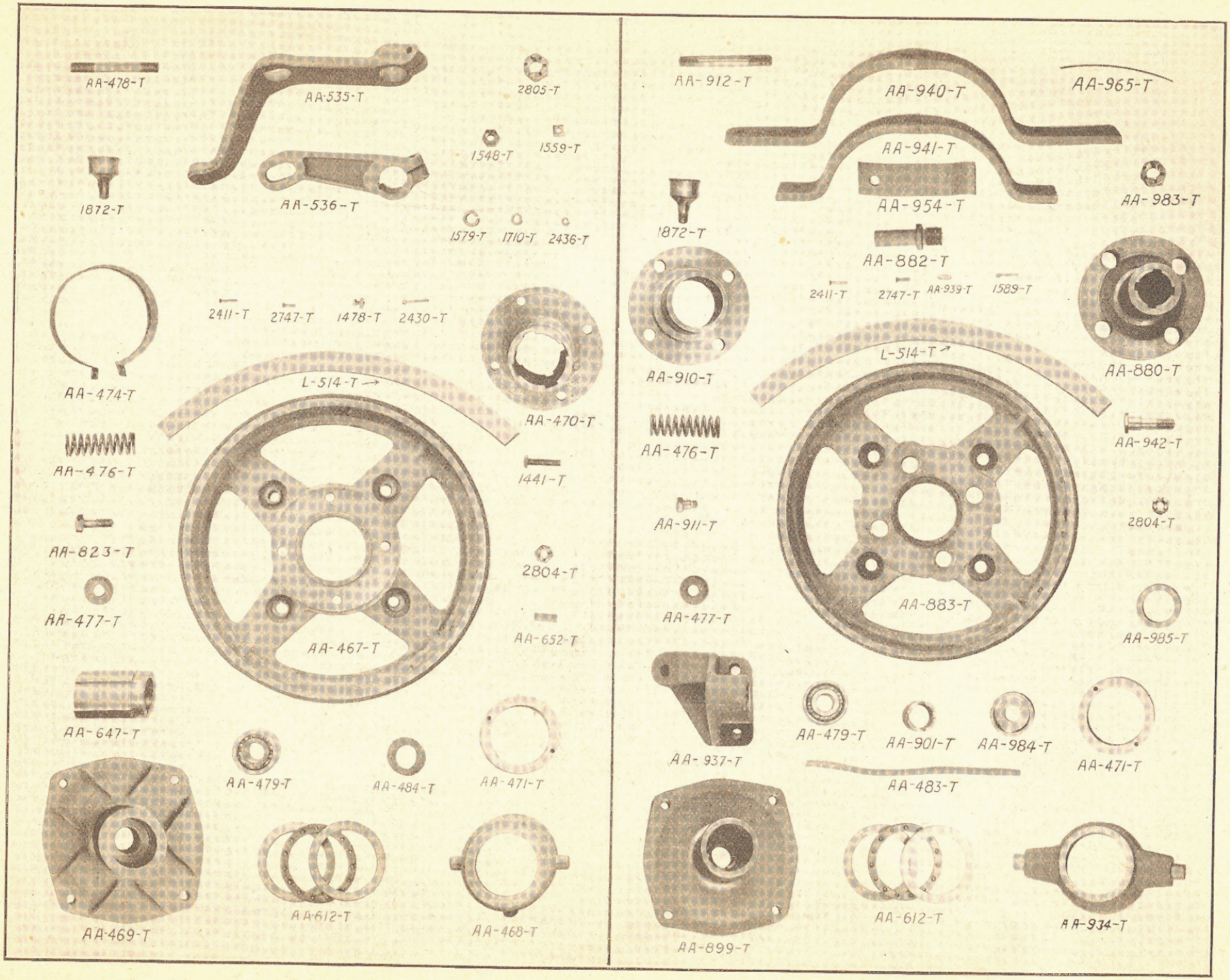

T-133
T-129
T-136
T-137
T-134
T-190
T-143
T-194
T-142
T-140
T-124
T-122
T-125
T-135
T-118
T-141
T-230
T-130
T-245
T-251
T-90
T-103
T-106
T-54
T-123
T-55
T-108
T-55
T-70
T-73
T-131
T-145
T-144
T-177
T-101
T-59
T-85
T-98
T-175
T-218
T-217
T-229
T-105
T-115
T-32
T-87
T-182
T-34
T-62
T-78
T-178
T-68
T-231
T-76
T-47
T-48
T-66
T-104
T-207
T-74
T-79
T-60
T-215
T-81
T-63
T-61
T-110
T-116
T-111
T-113
T-117
T-112
T-108
T-206
T-278
T-84
T-235
T-107
T-103
T-198
T-73
T-280
T-139
T-31
T-277
T-13
T-33
T-192
T-65

PLATE NO. 15


AA-478-T
AA-535-T
2805-T
1548-T
1559-T
1872-T
AA-536-T
1579-T
1710-T
2436-T
2411-T
2747-T
1478-T
2430-T
AA-474-T
L-514-T
AA-470-T
AA-476-T
1441-T
AA-823-T
2804-T
AA-477-T
AA-467-T
AA-652-T
AA-647-T
AA-479-T
AA-484-T
AA-471-T
AA-469-T
AA-612-T
AA-468-T
AA-912-T
AA-940-T
AA-965-T
AA-941-T
AA-954-T
AA-983-T
1872-T
AA-882-T
2411-T
2747-T
AA-939-T
1589-T
AA-910-T
AA-880-T
L-514-T
AA-476-T
AA-942-T
AA-911-T
2804-T
AA-883-T
AA-477-T
AA-985-T
AA-937-T
AA-479-T
AA-901-T
AA-984-T
AA-471-T
AA-483-T
AA-899-T
AA-612-T
AA-934-T

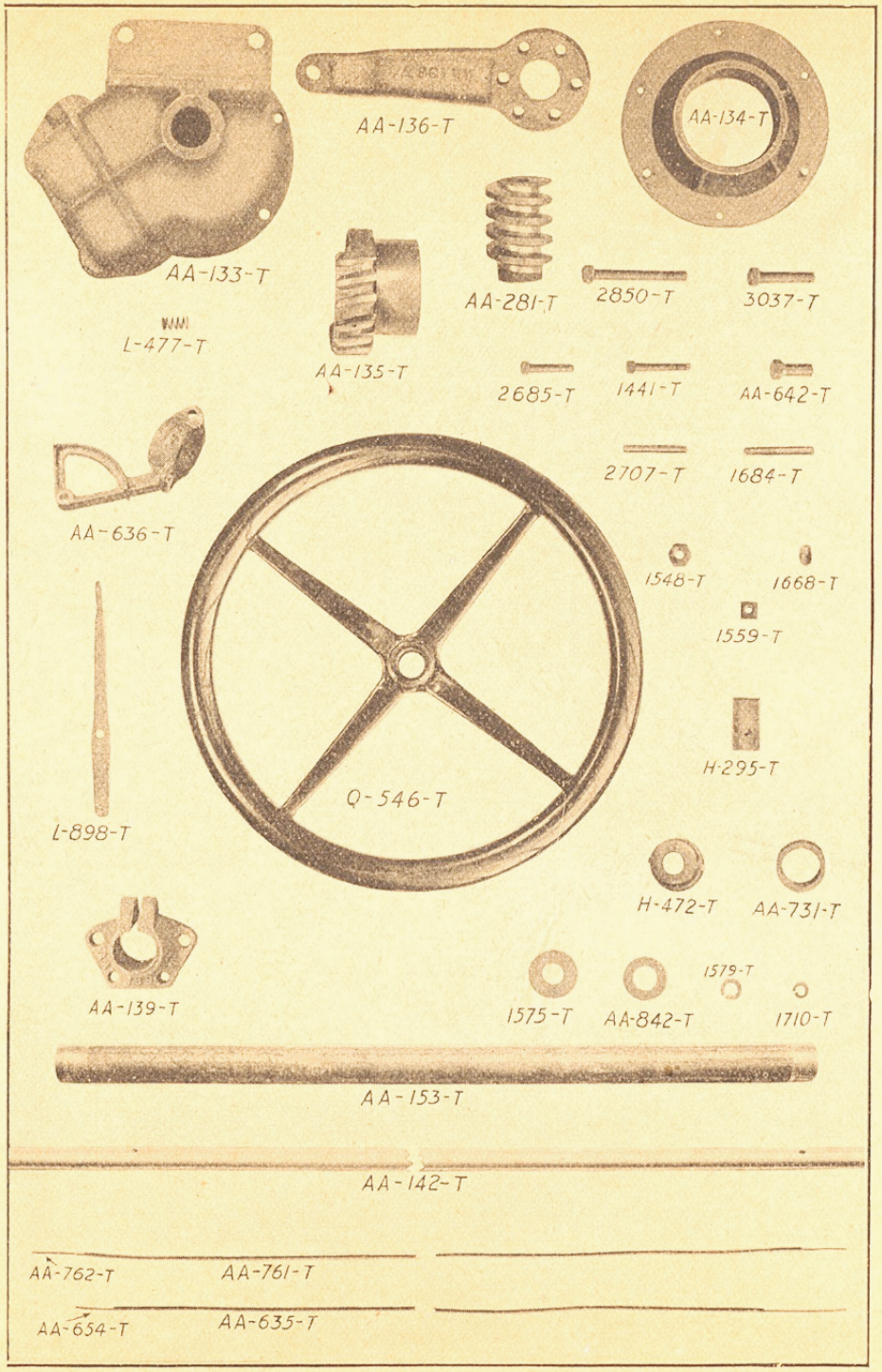

AA-136-T
AA-134-T
AA-133-T
L-477-T
AA-135-T
AA-281-T
2850-T
3037-T
2685-T
1441-T
AA-642-T
2707-T
1684-T
AA-636-T
1548-T
1668-T
1559-T
L-898-T
Q-546-T
H-295-T
H-472-T
AA-731-T
AA-139-T
1575-T
AA-842-T
1579-T
1710-T
AA-153-T
AA-142-T
AA-762-T
AA-761-T
AA-654-T
AA-635-T

PLATE NO. 17

PLATE NO. 17

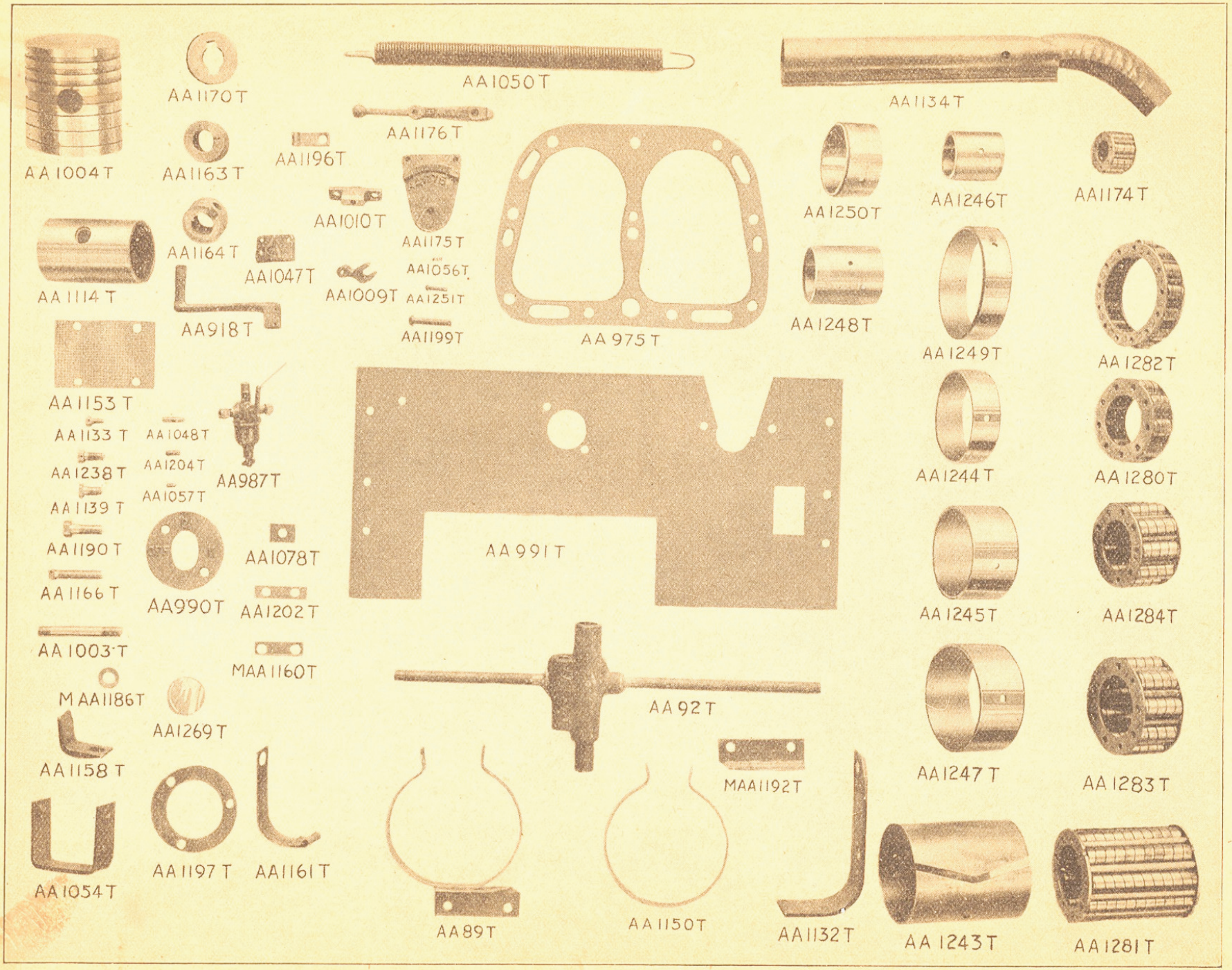


PLATE NO. 18

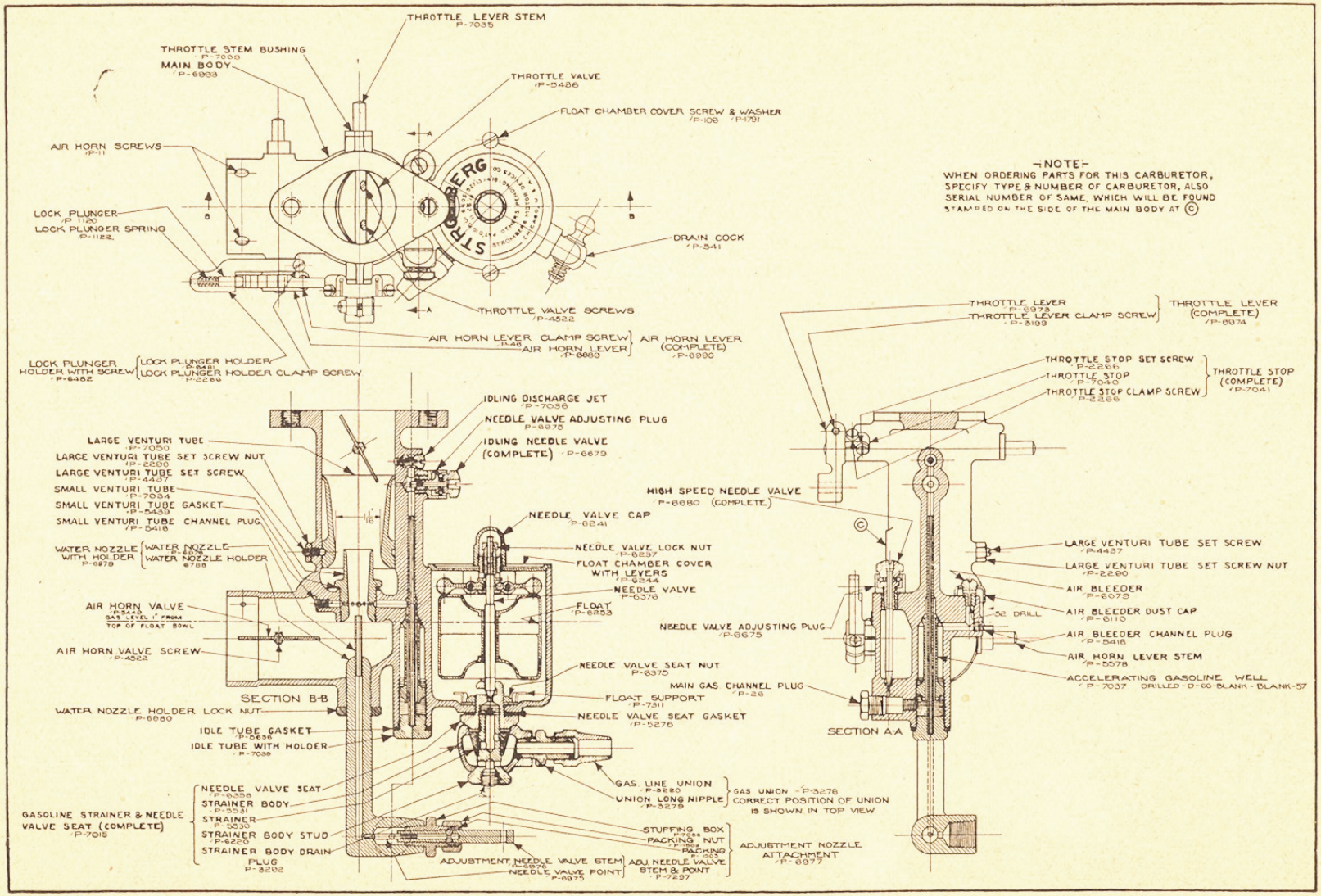

THROTTLE LEVER STEM P-7035
THROTTLE STEM BUSHING P-7008
MAIN BODY P-6003
THROTTLE VALVE P-5486
FLOAT CHAMBER COVER SCREW & WASHER P-108 P-1731
AIR HORN SCREWS P-11
LOCK PLUNGER P-1120
LOCK PLUNGER SPRING P-1122
DRAIN COCK P-341
THROTTLE VALVE SCREWS P-4522
AIR HORN LEVER CLAMP SCREW P-48
AIR HORN LEVER P-6089
AIR HORN LEVER (COMPLETE) P-6090
LOCK PLUNGER HOLDER WITH SCREW P-6482
LOCK PLUNGER HOLDER P-6481
LOCK PLUNGER HOLDER CLAMP SCREW P-2266
-NOTE-
WHEN ORDERING PARTS FOR THIS CARBURETOR, SPECIFY TYPE & NUMBER OF CARBURETOR, ALSO SERIAL NUMBER OF SAME, WHICH WILL BE FOUND STAMPED ON THE SIDE OF THE MAIN BODY AT ©
THROTTLE LEVER P-6078
THROTTLE LEVER CLAMP SCREW P-3199
THROTTLE LEVER (COMPLETE) P-6074
THROTTLE STOP SET SCREW P-2266
THROTTLE STOP P-7040
THROTTLE STOP CLAMP SCREW P-2266
THROTTLE STOP (COMPLETE) P-7041
IDLING DISCHARGE JET P-7096
NEEDLE VALVE ADJUSTING PLUG P-6675
IDLING NEEDLE VALVE (COMPLETE) P-6679
LARGE VENTURI TUBE P-7050
LARGE VENTURI TUBE SET SCREW NUT P-2290
LARGE VENTURI TUBE SET SCREW P-4437
SMALL VENTURI TUBE P-7084
SMALL VENTURI TUBE GASKET P-5459
SMALL VENTURI TUBE CHANNEL PLUG P-5418
WATER NOZZLE WITH HOLDER P-6979
WATER NOZZLE P-6978
WATER NOZZLE HOLDER P-6788
HIGH SPEED NEEDLE VALVE P-6680 (COMPLETE)
NEEDLE VALVE CAP P-6241
NEEDLE VALVE LOCK NUT P-6237
FLOAT CHAMBER COVER WITH LEVERS P-6244
NEEDLE VALVE P-6378
FLOAT P-6253
AIR HORN VALVE P-5422
GAS LEVEL 1" FROM TOP OF FLOAT BOWL
AIR HORN VALVE SCREW P-4522
NEEDLE VALVE ADJUSTING PLUG P-6675
LARGE VENTURI TUBE SET SCREW P-4437
LARGE VENTURI TUBE SET SCREW NUT P-2290
AIR BLEEDER P-6079
.52 DRILL
AIR BLEEDER DUST CAP P-6110
AIR BLEEDER CHANNEL PLUG P-5418
AIR HORN LEVER STEM P-6578
ACCELERATING GASOLINE WELL P-7037 DRILLED-0-60-BLANK-BLANK-57
NEEDLE VALVE SEAT NUT P-6375
MAIN GAS CHANNEL PLUG P-20
FLOAT SUPPORT P-7311
NEEDLE VALVE SEAT GASKET P-5276
SECTION B-B
SECTION A-A
WATER NOZZLE HOLDER LOCK NUT P-6080
IDLE TUBE GASKET P-5638
IDLE TUBE WITH HOLDER P-7038
GAS LINE UNION P-3220
UNION LONG NIPPLE P-5279
GAS UNION P-3278
CORRECT POSITION OF UNION IS SHOWN IN TOP VIEW
NEEDLE VALVE SEAT P-6356
STRAINER BODY P-5531
STRAINER P-5530
STRAINER BODY STUD P-6620
STRAINER BODY DRAIN PLUG P-3202
GASOLINE STRAINER & NEEDLE VALVE SEAT (COMPLETE) P-7015
STUFFING BOX P-7094
PACKING NUT P-7096
PACKING P-983
ADJUSTMENT NOZZLE ATTACHMENT P-6077
ADJUSTMENT NEEDLE VALVE STEM P-6676
NEEDLE VALVE POINT P-6675
ADJ. NEEDLE VALVE STEM & POINT P-7297

PLATE NO. 19