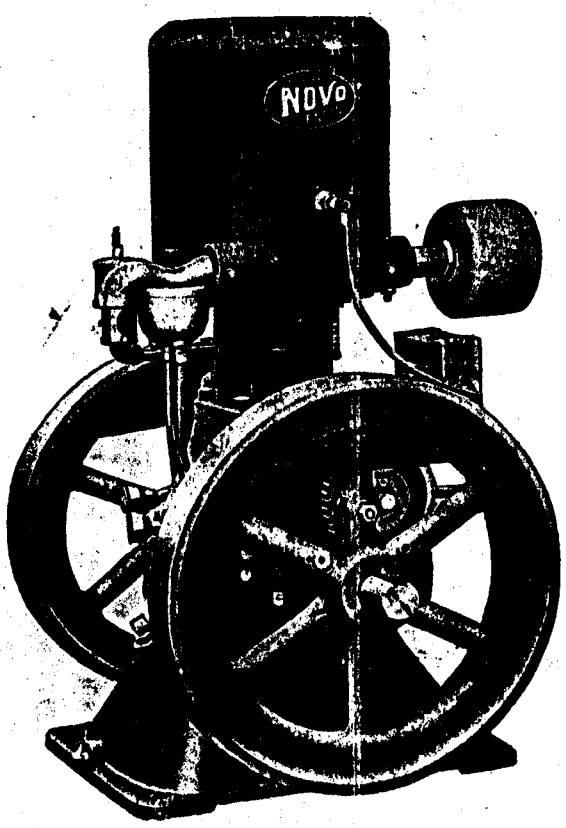
NOVO POWER

Operating Instructions

for

MODEL S ENGINES



Novo Single Cylinder Engine

NOVO ENGINE CO.

LANSING — MICHIGAN

U. S. A.

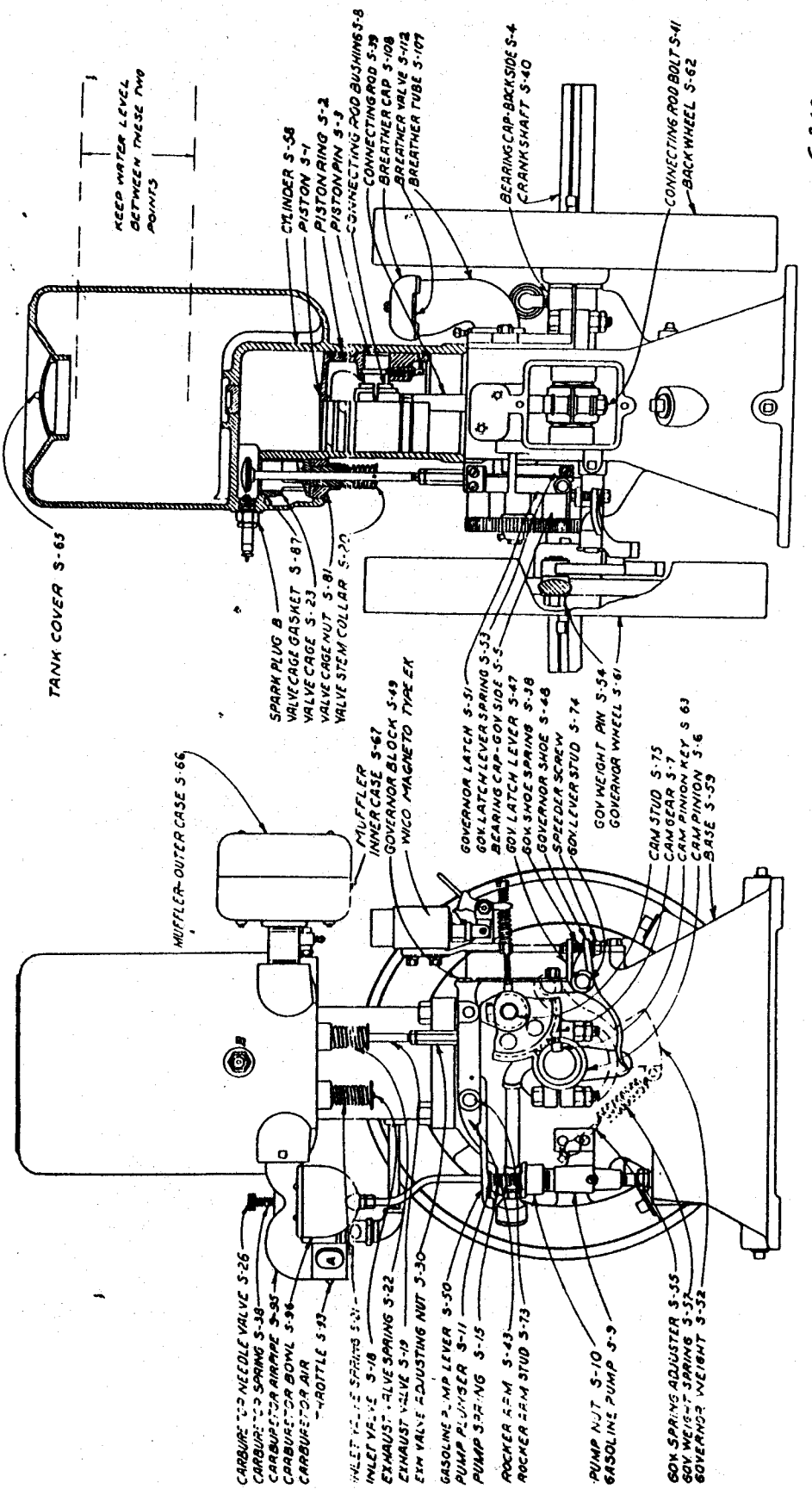


Fig. C348—Sectional View Model S Single Cylinder Engine

Introduction

To get the best service from your Novo Engine, please read over carefully the following instructions for installing and operating your engine.

Cleanliness is important to the life of anything mechanical. It is important for the proper working and long life of your engine. The better care you give it, the longer it will last and the more efficient service you will receive.

If there is anything that isn't perfectly clear or if at any time you have trouble with your engine that you cannot straighten out, we will help you all we can.

Every Novo Engine is inspected, tested and all adjustments carefully made before it leaves our factory.

We would suggest that you do not attempt to change any adjustments on the engine until after you have become thoroughly familiar with it. The less tampering done with the Novo Engine the better it will operate.

Do not destroy or mislay this book. It is valuable for future reference.

The Novo Engine Company reserves the right to change or revise its standard in the case of any feature of its products, with the idea of improving it, and the right to change, improve, increase, or decrease its standard of equipment from time to time, as in the manufacturer's judgment may be necessary or advisable, and in the case of such changes of standards neither the manufacturer nor the seller shall be obliged to make corresponding changes, improvements, additions, or eliminations to engines or outfits previously sold or shipped.

Principles of Operation

The Model S Novo Engine (Single cylinder) is of the upright, four cycle type. That means four strokes or two complete revolutions are required to perform the cycle, which consists of the following:

1. **SUCTION STROKE**—The piston moves downward and draws through the carburetor and inlet valve a charge of air and fuel mixture into the cylinder. At the end of the stroke the inlet valve closes.
2. **COMPRESSION**—On its upward movement the piston compresses the air and fuel mixture and when the piston reaches the end of the stroke, the compressed charge is ignited by means of an electric spark.
3. **EXPLOSION OR POWER STROKE**—The combustion of the compressed gases drives the piston downward with great force and this force acting on the connecting rod, crankshaft and fly wheels, furnishes the motive power.
4. **EXHAUST OR DISCHARGE STROKE**—At the end of the power stroke the exhaust valve opens and allows the burned gases to escape. This is aided by the upward movement of the piston, which pushes them out of the cylinder, thus preparing for the new cycle, which begins by the suction stroke of the piston, drawing in a charge, compressing, exploding, and discharging again as described before.

When the engine attains the rated speed at which it is set, the governor will come into action. **The hit and miss type of governor** controls the speed by omitting the number of explosions that are more than the necessary number to keep the engine at proper speed. This is accomplished by keeping the exhaust valve open until the engine again attains its rated speed. The hit and miss governor is standard equipment.

The **throttling type of governor** controls the speed by changing the quantity of mixture introduced into the cylinder, by means of a throttle valve placed in the carburetor and operated by the governor. By either method the engine is kept at its rated speed.

Installing the Engine

It is advisable to set the engine, if possible, in a place where you have both light and room to clean and to oil it.

If the engine is placed inside of a building, the exhaust gases should be conducted outside the building, using as short and as straight an exhaust pipe as possible. If the exhaust pipe is over four feet long it should be enlarged one size, if over ten feet long it should be enlarged two sizes, etc.

Magneto ignition is standard equipment on all Model S Engines.

Before putting the spark plug into the cylinder, see that the points are set 1-32 of an inch apart, or the thickness of a dime. The correct distance between the points of the spark plug is important, especially when magneto is used. For the older models equipped with battery and spark coil ignition, see that the box of batteries and coil is kept in a dry place, covered and away from heat and dampness. Be certain the binding post nuts are kept tight and that all the terminals are scraped clean before connections are made.

TO START THE ENGINE

First: Oil the engine (see Oiling). Turn up the small lever on top of cylinder oiler.

Second: Screw spark plug in cylinder and connect magneto wire to plug. (For battery ignition see wiring diagram, page 7, Fig. 17.) Turn engine over against compression. Raise inlet valve S18, Fig. C348 (one nearest to the carburetor) slightly by hand, at the same time turn engine over until keyway in the crankshaft is one spoke past lower dead center.

Third: Pump up the gasoline to carburetor, S95 and 96, Figure C348, until overflow level is reached, operating the pump lever, S50, Fig. C348, by hand. If the lever does not operate free turn engine over until the rocker arm, S43, is down.

Fourth: Turn the gasoline needle valve, S26, Fig. 19, from "off" position until open 1½ to 2 turns. This is the usual position for starting, more may be necessary in cold weather. (Close switch if battery ignition.)

Fifth: The air opening "A" must be partly closed by the air throttle, S93, Fig. C348. In cold weather it will be necessary to close air intake completely in order to give the engine plenty of fuel. Apply starting crank and turn rapidly in the direction indicated by the arrow on the fly wheel, until the engine starts. Then immediately open air inlet part way until the engine gets warmed up. Open wide after the engine gets warm. After opening the air inlet part way, shut off needle valve to about ¾ of one turn open. This will be about the running position of the needle valve. The adjustment, however, varies somewhat, but if the operator will bear in mind the following, the correct position can be obtained: When the carburetor is feeding too much fuel the exhaust from the muffler, Fig. 20, will be black smoke, if the carburetor is not feeding sufficient fuel the engine will backfire through the carburetor opening "A", Fig. C348.

TO STOP THE ENGINE

First: Close the fuel needle valve, Fig. 19. (Open switch if battery ignition.)

Second: Turn off the cylinder oiler, Fig. 20.

Third: Clean the engine of all grease and dirt.

OILING

Good gas engine oil must be used. This is a pure mineral oil and will effect the proper oiling and cooling. **Do not try to use steam engine cylinder oil, as it will cause trouble.** It contains too heavy mineral oil mixtures, which will clog and gum up the cylinder and piston.

See that all grease cups are filled with grease and put a few drops of oil in the oil holes of the cam stud, rocker arm, governor latch lever, governor shoe and governor weight, also on valve stems. Keep the cylinder oiler filled and adjusted to feed as follows:

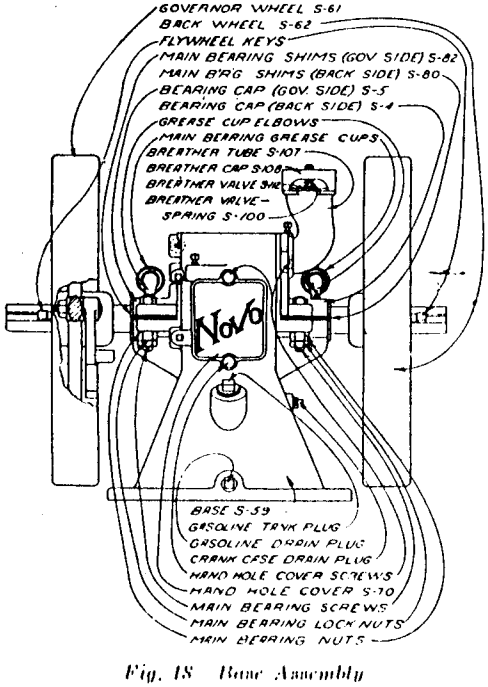


Fig. 18 Base Assembly

For 1½, 2 and 3 H.P. engines use six to seven drops of oil per minute.

For 4 and 6 H.P. engines use seven to eight drops of oil per minute.

For 8 and 10 H.P. engines use eight to ten drops of oil per minute.

When the engine is new it is well to use more oil than stated above for the first few days.

Always be sure that the cylinder oiler is turned on and working properly. If in cold weather the oil becomes too thick to flow freely thin it with a little kerosene and adjust oiler to feed as before.

Before starting an engine for the first time, or after it has been lying idle for a considerable length of time **it is very important** that one of the handhole covers on the crankcase be removed, and the crankcase **filled with enough gas engine oil so that the nuts of the connecting rod will just dip into it on the downward stroke.** To add more is wasteful. Oil from the cylinder will keep up this supply, but it is necessary that it should be frequently inspected and if too thin, or dirty, this oil should be entirely removed and fresh oil substituted.

It may be necessary, especially after the engine has stood for some time without running, to use kerosene in the cylinder and on the valve stems to cut out the old gummy oil and get them in working order. Use plenty of it and follow immediately with cylinder oil. Repeat if necessary.

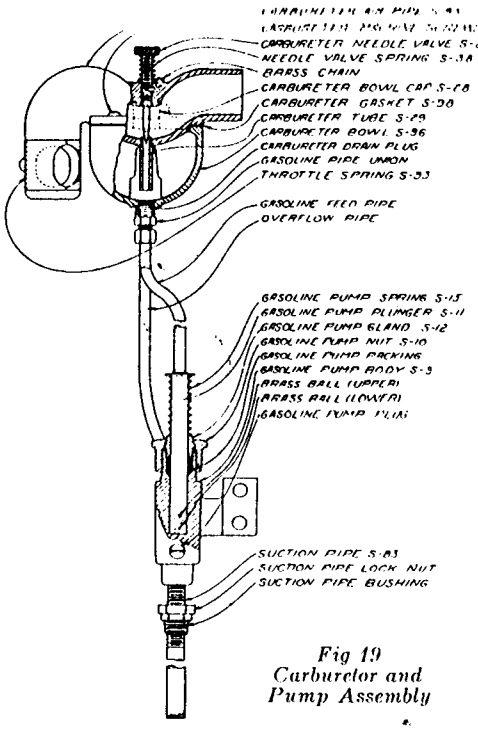


Fig 19
Carburetor and Pump Assembly

CARBURETOR AND FUEL SUPPLY

The function of the carburetor is the vaporizing of the fuel (gasoline or kerosene) and mixing it with air, before it enters the cylinder.

The fuel tank is in the engine base S-59, Fig. 18, from which the fuel is pumped up to the carburetor by the fuel pump S-9, Fig. 19, and kept at constant level, the overflow returning to the tank through an overflow pipe provided for that purpose.

The air enters the carburetor at "A", Fig. C348, and picks up the fuel from the carburetor tube; this mixture is carried into the cylinder past the inlet valve during each suction stroke. The amount of fuel necessary to form a perfect mixture with the air is regulated by the needle valve S-26, Fig. 19.

The fuel pump is packed with a specially prepared asbestos packing to insure constant delivery of fuel to the carburetor. A good substitute for the asbestos packing is common candle wicking well covered with either ordinary yellow laundry soap or graphite and oil.

Should the pump fail to start readily, **prime it.** This is done by pouring fuel into the carburetor, while operating the pump by hand. Sometimes after an engine has stood for a period without being run, the ball check valves of the pump will stick and prevent its operation. As a rule if the pump is jarred a trifle they will loosen, if not the pump should be removed and thoroughly cleaned.

The pump nut S-10, Fig. 19, should be screwed tight enough against the gland and packing to prevent leakage, but at the same time should not bind the plunger and prevent the spring S-15, Fig. 19, returning the plunger to its upper position in place for the next stroke of the pump lever.

COOLING

The heat generated by the explosions in the cylinder would soon burn off the lubricating oil if some means were not provided to keep the temperature down to a certain point.

This is accomplished by means of the open jacket of water surrounding the cylinder, Fig. 20, which keeps the temperature from getting above the boiling point.

The water in the jacket should be renewed as it boils away, but need not be replaced with cold water when it gets hot. A little oil on top of the water will prevent its boiling over.

Do not try to keep the jacket too full; three inches from the top is about right.

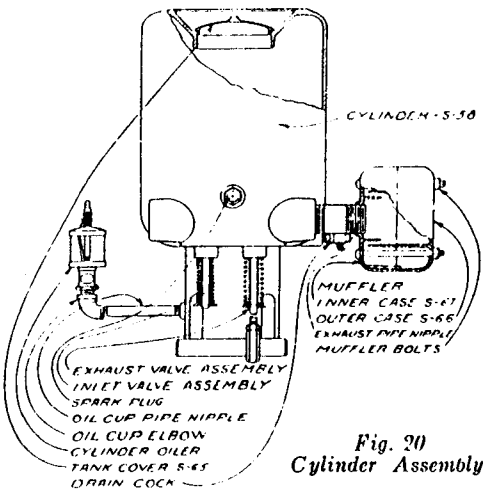


Fig. 20
Cylinder Assembly

Always Give Model and Serial Number of Engine and Outfit when Ordering Repairs.

Ignition

GENERAL INSTRUCTIONS FOR CARE OF WICO TYPE EK MAGNETO

This type is standard equipment on all model "S" single cylinder engines. These instructions state briefly how to take care of the Type EK magneto. If unusual circumstances arise reference should be made to the EK Instruction Book, which gives complete detailed information about the Type EK magneto. This Instruction Book will be furnished upon request.

1. **OILING.** Oil the magneto every working day with the same oil that is required for the engine cylinder. Special oil is not required. There is little danger from excessive oiling.
2. **CLEANING.** A magneto used constantly in the open will in time become coated with dirt and grease. This condition will cause no decrease of spark strength. If, however, the working parts are kept clean the life of the magneto will be prolonged. Occasionally remove the front cover of the magneto, and also the moving parts, to clean around the breaker points with a clean rag and small hardwood stock. Keep the points of contact between the armature and cores clean by wiping with a clean rag.
3. **MAGNETS.** Do not remove the magnets. It is unlikely the magnets will ever need recharging unless they are removed from the machine.

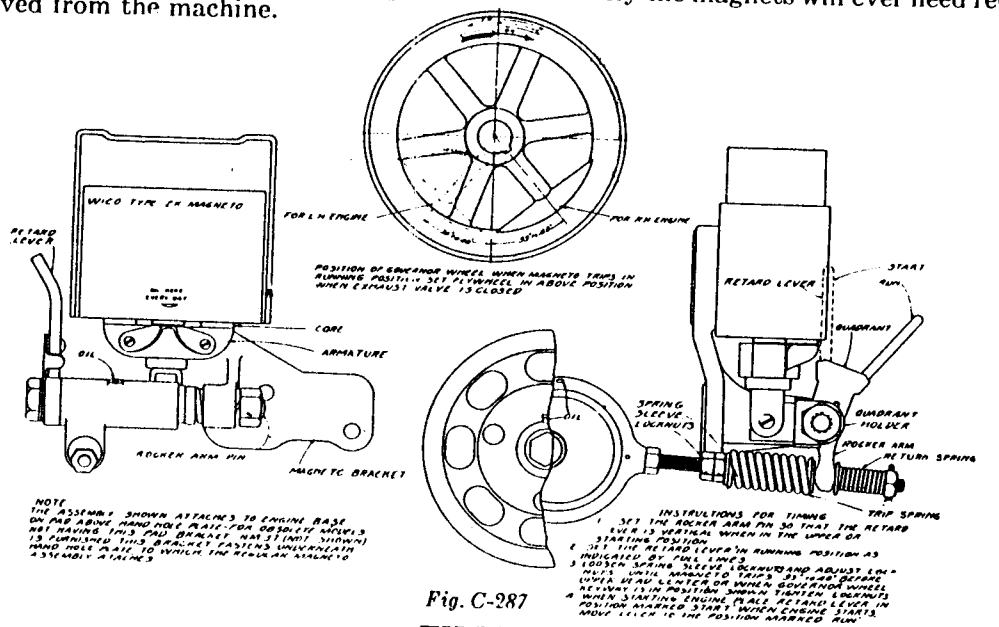


Fig. C-287

TIMING

Refer to paragraph headed "Instructions for Removing and Replacing Cam Gear," and make certain the cam gear is in correct position with relation to keyway and engine crankshaft.

Figure C-287 shows complete details relative to assembly and timing of magneto trip.

1. First turn the fly wheel in running direction until the compression stroke or where the exhaust valve is closed, to the position as indicated in Figure C-287. This is the firing point, or position the spark takes place.
2. Place rocker arm pin or shaft so that the retard lever, as indicated in Figure C-287, is in a vertical position when in the upper or starting position. (Rocker arm shaft can be moved by loosening nut holding shaft to magneto bracket.) Next tighten shaft in position.
3. Set retard lever in running position or farthest from the magneto.
4. Loosen spring sleeve lock nuts and adjust nuts until the magneto trips or until the armature snaps from cores. The engine being in firing position, as indicated by fly wheel, Figure C-287, the spring sleeve lock nuts can be tightened in position.
5. When starting engine place retard lever in vertical position as marked "Start" in Figure C-287, and when engine starts move lever to the position marked "Run."

The magneto is actuated by an eccentric and ring. The eccentric being a part of the cam sleeve. The armature of the magneto is held against the cores by the return spring and by the magnetic attraction of the cores. The spark is produced by pulling the armature about 3/32 of an inch away from the cores. This is done by the trip spring which bears against the end of the rocker arm and is compressed as the eccentric turns until the spring sleeve inside the trip spring bottoms against the ends of the rocker arm, and instantly breaks the magnetic contact between the cores and the armature, which is then snapped away from the cores by a compressed strip spring. As the eccentric continues to revolve the pressure of the strip spring is released and the return spring draws the armature back in position to the cores again.

The Wico magneto is guaranteed by the magneto manufacturers for all time against defects in material or workmanship.

BATTERY IGNITION SYSTEM 1½ to 10 H.P. Inclusive

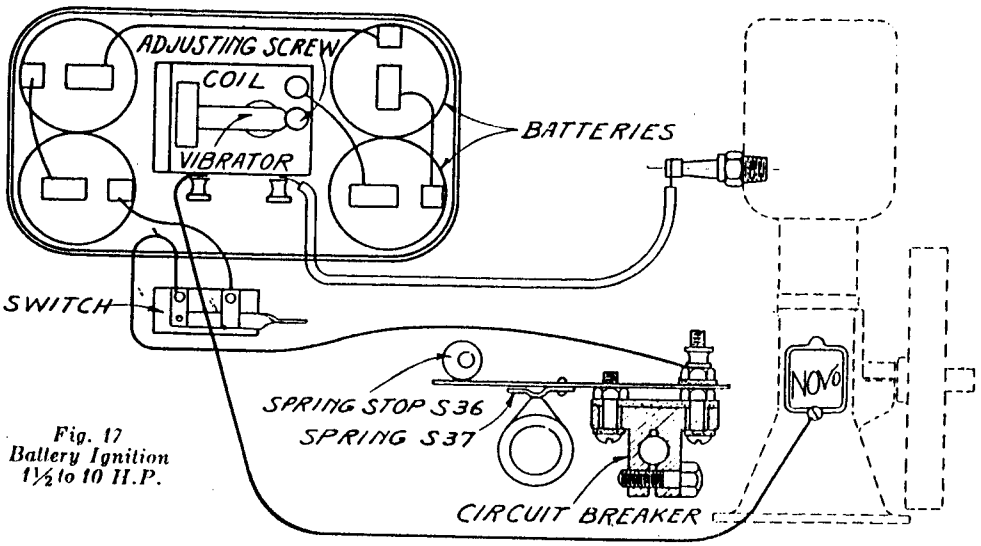


Fig. 17
Battery Ignition
1½ to 10 H.P.

The battery box with spark coil, batteries and connecting wires to engine are connected as shown in Figure 17. One of the two small wires leading from battery box connects to the crew in the head of one of the cap screws holding handhole plate to engine base (on 1½ H.P. screw is in head of one cap screw bolting cylinder to base). The other small wire connects to binding post on circuit breaker. The large wire leads directly from spark coil to spark plug in cylinder.

The spring S37 and screws which hold it in position are insulated so that they make no electrical connection with any other part of the engine except when the small firing cam on sleeve of cam assembled with large gear comes in contact. With switch closed, circuit is completed and spark is caused to jump across the points of the spark plug screwed into combustion chamber and thus ignites the compressed charge of gas in cylinder.

The spring stop "G", Fig. 4, mounted on the rocker arm allows the spring "D" to raise so no contact is made with the cam "E", except when the latch "F" unhooks and the exhaust valve is allowed to close and a new charge drawn into the cylinder.

In this way there is minimum wear on the cam, and the battery is not used unnecessarily.

The spring and firing cam should come in contact at the point when throw of crank shaft is 15 degrees ahead of its highest point or upper dead center. Keyway in crank shaft (governor side) will be within 15 degrees of lower dead center, as shown in Figure 4. For left hand (anti-clockwise) rotating engine, looking at governor side of fly wheel, keyway in crank shaft will be 15 degrees to the left of lower dead center.

To test this, close the switch and turn the engine slowly to the right (for L.H. engines turn opposite direction) until the coil in the battery box starts to buzz. This position is the ignition point and the keyway on the crank shaft should be in position as shown in Figure 4. The keyway in the shaft is opposite the throw of the shaft so that the position of the crank may be ascertained from the keyway.

If out of adjustment, loosen the nut which holds the spring "D" and shift the spring endwise on the screws until the right adjustment is obtained.

The circuit breaker should remain in contact until the crank has passed some distance over the center. The length of this contact can be adjusted by turning the spring stop S36, Figure 17. Too short a contact will cause the engine to miss explosions. (See instructions for installing and adjusting Circuit Breaker Spring, Figure 4.)

INSTALLING AND ADJUSTING CIRCUIT BREAKER SPRING

Put contact spring on circuit breaker clip "A", Fig. 4. See that contact hump on spring is over the center of cam shaft "H". Hook governor latch "F" under governor block "B", holding rocker arm in highest position. Tighten circuit breaker clip "A" on pin by screwing "C" so that contact hump on spring "D" clears contact cam "E" by at least the thickness of a dime. Now turn engine over until governor latch "F" releases rocker arm and lets it come to its lowest position. Keep turning engine until contact point on cam "E" comes in contact with hump on spring. Slide spring back or forward until contact occurs between 15 and 20 degrees ahead of upper dead center. The position is at upper dead center when keyway in shaft is at the bottom. It may be necessary to adjust eccentric fibre stop "G" until the points stay in contact about one-half the distance between two spokes. More contact than this will exhaust your batteries.

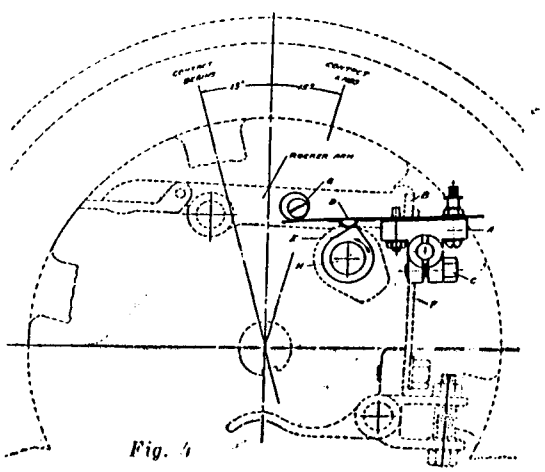


Fig. 4

GOVERNOR—1½ to 10 H.P.

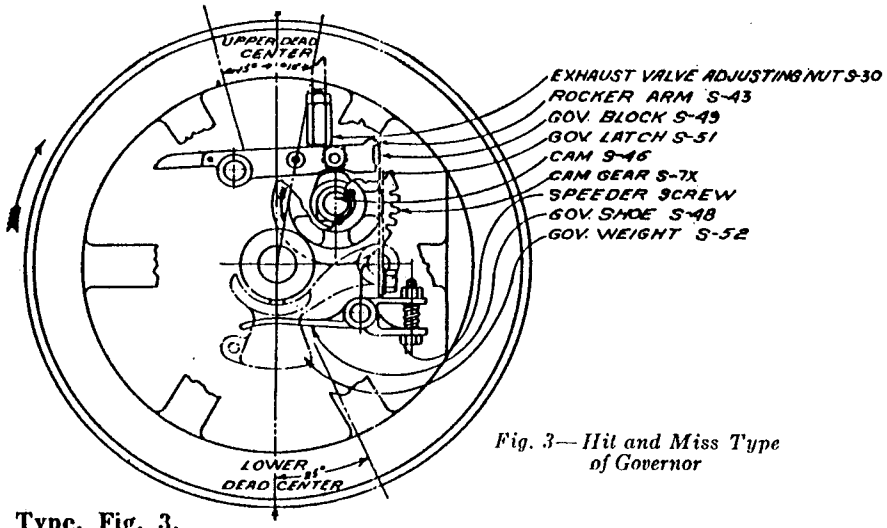


Fig. 3—Hit and Miss Type of Governor

Hit and Miss Type, Fig. 3.

The Novo Hit and Miss Governor is of the centrifugal type. The revolutions of the governor wheel tend to throw the governor weight S52 out from the hub of the fly wheel, causing it to come in contact with the governor shoe S48 and press it down. This pushes the governor latch S51 forward until it catches under the governor block S49 on the end of the rocker arm S43 when the cam has raised the rocker arm to its highest position. This holds open the exhause valve and cuts out the fuel and spark for a few revolutions until the speed decreases slightly, when the latch unhooks again, admitting fuel just often enough to maintain the desired speed.

To change the speed of the Novo Engine, with this type of governor, loosen the speeder screw nut, tighten the speeder screw to increase the speed and loosen it to decrease the speed. Then tighten the speeder screw nut again. The speed should be adjusted only when the engine is running with no load. The speed can be changed only to a limited extent. A variation of the tension in the governor spring on the fly wheel is sometimes necessary to get uniform movement at very high or very low speed.

The high position of the rocker arm should allow the governor latch 1/32-inch clearance, or the thickness of a dime, under the governor block. The governor latch is adjustable endwise for wear.

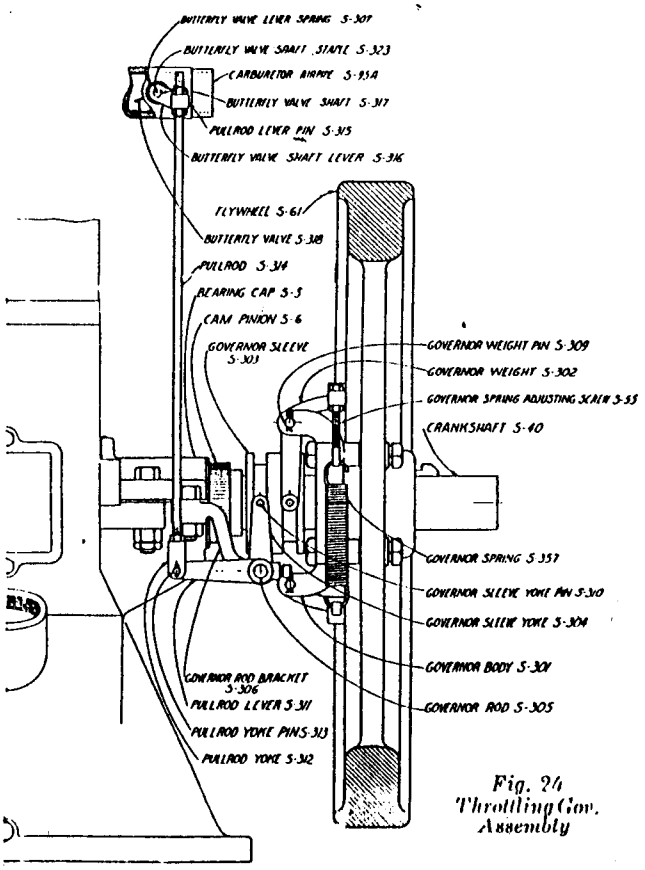


Fig. 24 Throttling Gov. Assembly

Throttling Type Governor, Fig. 24.

The governor body S301 is bolted to the fly wheel. The governor weights S309, which are counter-balanced by adjustable springs S-357, engage a sliding sleeve S303 on the crankshaft, which through proper connections acts on the butterfly valve S-318 placed in the carburetor air pipe.

The revolutions of the governor wheel throw the fly balls of the governor weight out, which action pulls the governor sleeve towards the fly wheel. This pulls the governor sleeve yoke along, and this being pinned to the governor rod lifts the pull-rod, which partially closes the butterfly valve in the carburetor air pipe, thus changing the quantity of fuel and air mixture to the cylinder.

To change the speed of the throttle governed engine the tension of the governor weight springs have to be changed by shortening or lengthening the spring adjusting screws S-55, thus varying the tension on the springs. If the governor springs adjusting screws are shortened the tension increases, which will cause the engine to speed up. The opposite adjustment will reduce the speed. This of course can only be accomplished when the engine is not running. Extreme care should be used so that both governor springs are adjusted with equal tension.

INSTRUCTIONS FOR SETTING EXHAUST VALVE 1½ H.P. to 10 H.P.

When it becomes necessary to readjust the exhaust valve setting on a Novo Model S single cylinder engine it can be accomplished from the following directions:

For right hand engines turn engine fly wheel (governor side) in running direction (clockwise) past the compression stroke until the keyway in the crankshaft is within 25 degrees of upper dead center as shown in Figure 14. To determine this angle closely, bear in mind, that the keyway is cut in the center line of the fly wheel spoke and that the spokes are 60 degrees apart. Place the keyway in such a position that the second spoke

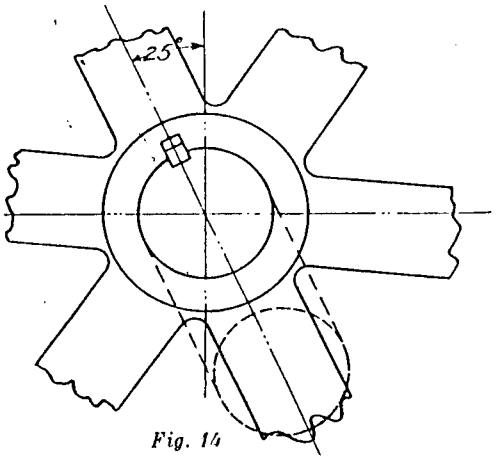


Fig. 14

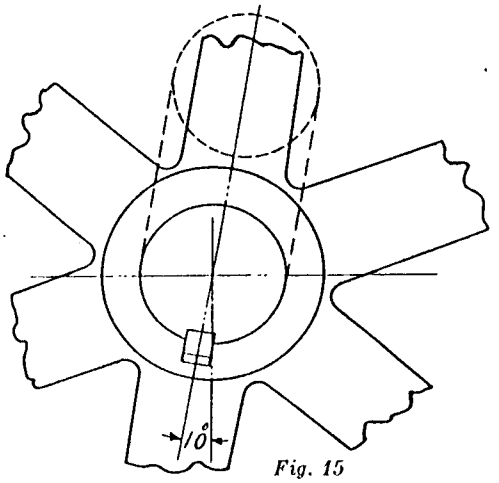


Fig. 15

from the keyway is slightly below the horizontal position. Next loosen the adjusting nut on the exhaust valve stem and either screw up or down as the case may be until the adjusting nut lightly engages the rocker arm. This will be the correct opening position of the exhaust valve in relation to keyway in the crankshaft, and the adjusting nut should then be securely locked in place. Test this after locking adjusting nut, by turning fly wheel back and turning over again slowly, noting exact point where exhaust valve is raised from its seat. If not correct reset adjusting nut and repeat above test. It is much more important that the opening point be set correctly than the valve closing point.

By rotating the fly wheel in the running direction (clockwise) you will note the valve rises to the extreme height of the cam lift then recedes until the position of the keyway in the crankshaft is 10 degrees past lower dead center as shown in Figure 15. This is the correct closing position of the exhaust valve. At this position the exhaust valve nut should disengage from the rocker arm and the rocker arm will travel on downward to the extreme lower point of the cam, permitting a clearance of from 1/32 to 1/16 of an inch between the rocker arm and the exhaust valve adjusting nut. If the above adjustment is not obtained check over valve setting and refer to the instructions under heading "Removing and Replacing Cam Gear."

For left hand engines—running direction (anti-clockwise), the instructions should be followed in a manner exactly opposite as given for right hand (clockwise) engines.

INSTRUCTIONS FOR REMOVING AND REPLACING CAM GEAR, 1½ TO 10 H.P.

If for any reason you have to remove the cam gear or are installing new gear, the following instructions will enable operator to place gear in proper position with relation to keyway in crankshaft.

For right hand engines—turn the fly wheel in running direction (clockwise); at the same time hold the governor latch in against governor button until rocker arm is held at its highest position by the governor latch. Draw fly wheel key (governor side) and pull fly wheel off far enough to permit the removal of cam gear. Replace key by hand so as to turn engine. Next turn engine in running direction until keyway is at left, midway between the upper and lower dead centers, as shown in Figure 16.

Now place the cam gear on the camshaft, so that the cam is in a horizontal position, with the high point of the

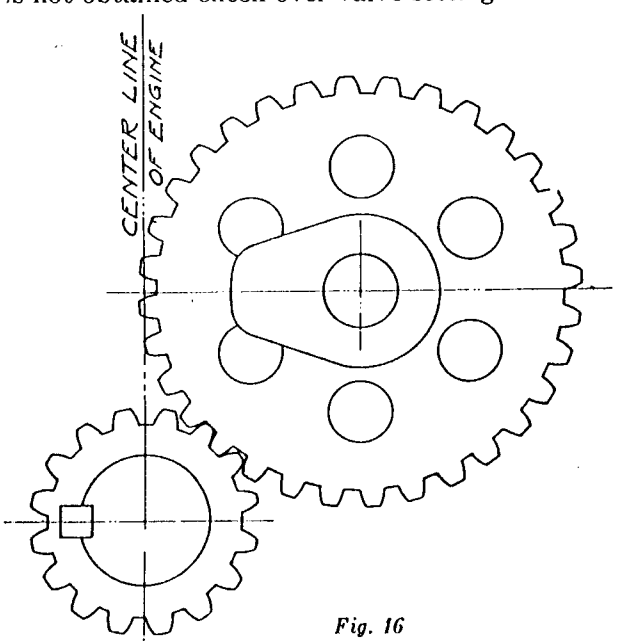


Fig. 16

cam towards the center line of this engine as shown in Figure 16. This will bring the cam gear in correct position within one tooth.

Then check the setting of the exhaust valve correctly according to the instructions for setting exhaust valve to ascertain whether the cam is set right or not.

If exhaust valve opens too early and closes too early the cam gear must be set back opposite to running direction one tooth. If the exhaust valve opens too late and closes too late the gear must be set ahead in running direction one tooth. When changing gears remember that cam revolves in the opposite direction to fly wheel.

For left hand engines, turn fly wheel in running direction (anti-clockwise) until keyway in crankshaft is exactly in the opposite position to that shown in Figure 16. Cam gear to be placed in same position as shown in Figure 16.

After setting the exhaust check the spark timing to see that ignition is correctly timed. Refer to pages 6 and 7 for ignition instructions.

INSTRUCTIONS FOR INSTALLING OR RESETTING ROTATING TYPE OF MAGNETO

Magneto outfits of this type are a separate assembly consisting of magneto, gears, gear guard assembled on a bracket. This complete assembly bolts on the exhaust side of the engine base on a special pad provided for this purpose.

To accommodate the application of this type of magneto equipment on engines already in the field, brackets are provided which bolt on underneath the hand hole cover plate on the exhaust side of the engine base.

Special studs are furnished which permit the removal of hand hole cover plate without disturbing the magneto assembly.

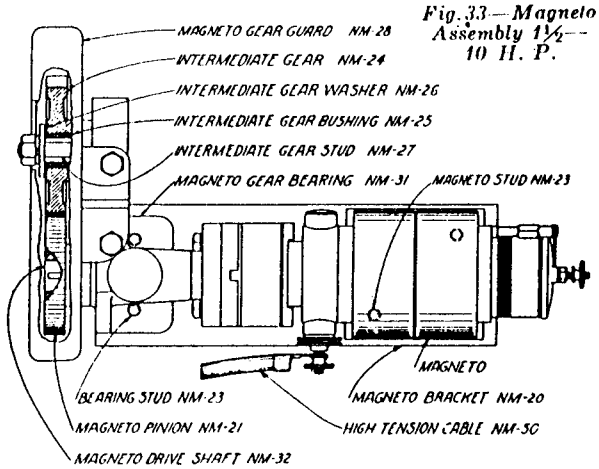


Fig. 33—Magneto Assembly 1½—10 H. P.

When assembled on the engine, the magneto pinion is driven by an intermediate gear in mesh with the cam gear. To time the magneto in proper relation to the firing position of the engines, carry out the following instructions:

For right hand engines, turn engine in running direction until the keyway in crankshaft (Governor side) is within 15 degrees of the lower dead center as shown in Figure 4, page 7. For left hand engines the keyway in crankshaft, for firing position, will be 15 degrees to the left of lower dead center. Next loosen nut which holds the intermediate gear in place on magneto bracket and remove gear. Now remove the magneto breaker box cover on opposite end of magneto from magneto gear and rotate magneto in running direction. This will be exactly opposite the running direction of the engine, until the breaker points "C", Fig. 638, are just beginning to separate. This will be the sparking position of the magneto. Hold magneto in this position and put intermediate gear back in place, meshing with cam gear on engine and pinion on magneto. Screw nut up on intermediate gear shaft securely against washer, holding intermediate gear bushing.

After the foregoing adjustments have been carried out it is well to check same over to see that everything is O.K. before attempting to start engine. If the adjustment obtained is not exact and the movement of the magneto gear, necessary for an exact setting, is less than that obtained by moving one full tooth, a fraction of this can be obtained by loosening the four screws holding magneto gear to hub on magneto shaft and moving magneto gear slightly to right or left on hub. Extreme care should be taken to see that the teeth of the gears do not bottom (mesh too deep) as this would throw a pressure against the magneto bearings and injure them and would also tend to make a noisy operating set of gears.

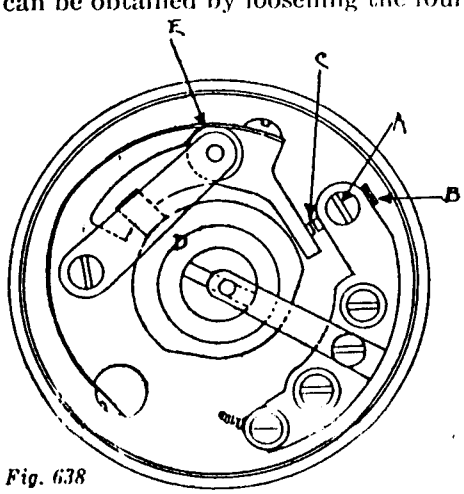


Fig. 638

To time a magneto with impulse starter, bring engine in firing position, take off the circuit breaker cover, loosen the three small cap screws on the impulse starter coupling and turn the coupling opposite to the running direction of the engine, see that the breaker points "C" (Fig. No. 638) just separate. This will be the sparking position of the magneto. Tighten the cap screws and replace the breaker cover.

Some types of couplings used are adjustable by large nut on coupling shaft. To adjust this type turn the prong of the lock-washer from the large nut on the drive shaft and release the nut. This enables you to turn the collar opposite the running direction of the engine and remove the breaker box cover. Watch till the points **just begin to separate**. This will be the sparking position of the magneto. Then put the cover back, tighten the large nut and lap one of the prongs of the lock-washer over one flap of the nut, thus locking it.

INSTRUCTIONS FOR OPERATING NOVO KEROSENE ENGINES

The general rules pertaining to the operation and care of Novo gasoline engines, as heretofore described, apply to the Novo kerosene engines also, **except the starting.** To start a kerosene engine carry out the following instructions:

First. Fill the fuel tank in the engine base with kerosene. Fill the hopper with water. Care should be taken that the **water valve** which supplies water from the hopper to the carburetor **is closed.** Place the spark plug in position and connect the magneto wire (for battery connections and instructions see Fig. 17, page 7). Pump up enough kerosene to fill the feed pipe, then drain the carburetor bowl, by opening the drain cock to overflow pipe, and be sure to shut the cock when the bowl is drained.

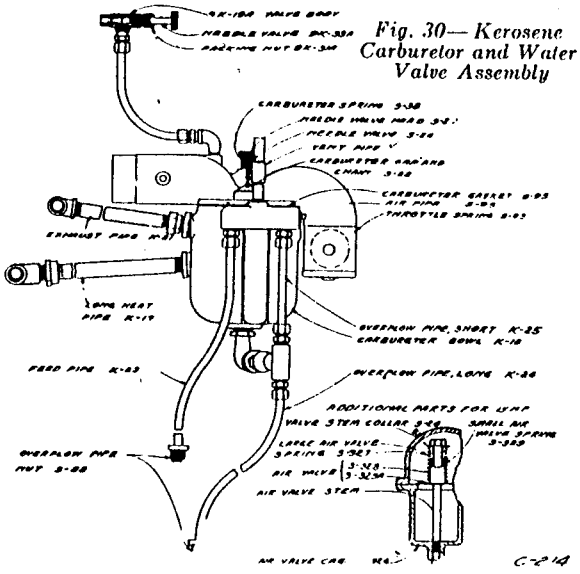


Fig. 30— Kerosene Carburetor and Water Valve Assembly

Second. Fill the carburetor bowl with gasoline to the overflow.

Third. Open the needle valve 1½ to 2 turns.

Fourth. Close the air throttle S-93, Fig. 30, partly, close the battery switch, if battery ignition, and crank the engine. Leave the air throttle partly closed until the carburetor bowl is heated enough to vaporize the kerosene properly. It is also advisable to load up the engine quickly to help the heating of the fuel as rapidly as possible. The correct opening of the air throttle is subject to various conditions and has to be determined by actual experience of the operator.

In moderate weather one bowl of gasoline, as a rule, is sufficient to heat up the carburetor to such a temperature that the engine will automatically continue to run on kerosene, as the pump delivers the kerosene to the bowl while the gasoline is being used up. It may smoke some, until thoroughly heated.

If the engine stops, especially in cold weather, do not try to start it until the carburetor bowl is drained of kerosene and filled with gasoline, otherwise the spark plug will become coated with kerosene and the engine will not start, until spark plug is cleaned.

When the engine is loaded heavily sharp knocks will occur at each explosion. To remedy this, open the water valve and let just enough water run through to deaden the sound. When engine runs on light load or empty, no water is necessary. Care should be taken **that the water valve is closed when the engine is stopped. In freezing weather drain the water valve.**

GAS MIXER

If desired to operate the Novo Engine on natural or artificial gas, a special gas mixer is furnished. The gas mixer, as shown in Fig. 31, consists of a gas mixer cover SG-1, a gas mixer body SG-2 equipped with **a** leather faced gas mixer valve SG-3, valve stem SG-4 and spring SG-5. This gas mixer is also equipped with a graduated index cock to regulate the amount of gas needed. A gasometer can also be supplied extra at an additional cost. This is placed between the gas main and the index cock, and gives a sufficient volume of gas at all times from which to draw and eliminates fluctuation common to gas lines and permits a better control of the gas.

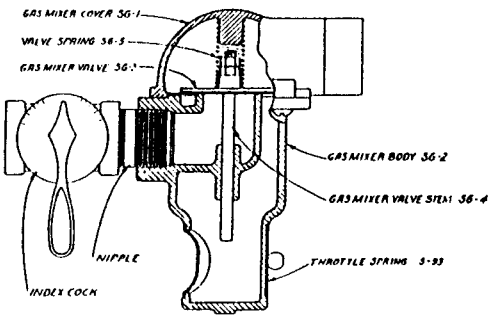


Fig. 31

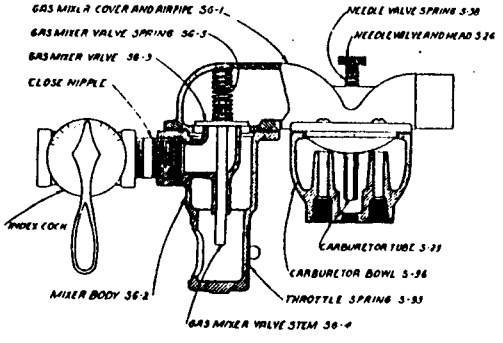


Fig. 32

COMBINATION GAS MIXER AND GASOLINE CARBURETOR

When a Novo Engine is to be operated on gas or gasoline according to fuel supply on hand, a combination of gas mixer and gasoline carburetor can be furnished as shown in Fig. 32. It consists of a complete gasoline carburetor combined with a gas mixer and index cock forming one solid unit and can be attached to any Novo Engine. Each part of the unit is used independently according to the fuel available. Keep in mind that only one fuel at a time can be used.

Refer to page 12 for operating instructions.

TO OPERATE NOVO ENGINES EQUIPPED WITH GAS MIXERS OR COMBINATION GAS MIXERS AND GASOLINE CARBURETORS

With the exception of the starting, follow the general rules governing gasoline engines for the operation of gas engines. When starting the engine it should be placed in running order. Oiler turned on, switch in, if battery ignition, and everything prepared so that when operator is ready to crank the engine the gas can be turned on and engine started immediately. Operators, as a rule, are inclined to force too much gas through the carburetor by opening cock too wide, thereby causing engine to start hard and perhaps making it necessary for operator to shut off gas and crank engine over a number of times to clean out excess gas before attempting to start again. A fixed opening cannot be given as the pressure and the quality of the gas varies in different localities, therefore, individual operators will have to determine the correct opening by noting carefully the general operation of the engine. When starting, the actual setting of the gas cock will have to be obtained by a try-out. Open cock to first or second graduation and then start. If engine does not take hold, the cock should be opened a trifle wider, and so on until correct opening is obtained. Thereafter correct setting can be made at once. If the engine appears lagging or laboring heavily without load, it is a sign of too much gas. Turn off the graduated stop cock slowly until the engine picks up and appears to be running easily. If a popping noise or explosion, called backfire, occurs in the carburetor, it is a sign that the engine is not getting enough gas and the operator should open the cock a trifle to that point at which the engine appears to be working at its best.

ADJUSTMENTS

Bearings. The crankshaft and connecting rod bearings are provided with **liners or shims,** which can be removed or replaced to take up the wear of the bearings. Always use enough liners to keep the bolts drawn tight, but do not get them too tight so that the bearing might run hot. **Examine the connecting rod often. Do not let it run loose. A loose connecting rod gives a knock at every revolution,** and if not remedied at once may cause serious trouble. The main crank bearing will seldom need adjusting.

Gasoline. The amount of gasoline cannot be accurately adjusted until the engine has been run a few minutes to get thoroughly warmed up. Then close the gasoline needle valve S-26 as much as possible without reducing the power; too little gasoline will cause sharp, weak explosions and backfiring in the carburetor. Occasionally an engine will make a very loud report while running. This is caused by the gasoline valve being out of adjustment and also indicates lack of gasoline. See that the gasoline pump is pumping enough. Clean out carburetor, then adjust the gasoline needle valve. Too much gasoline will make the exhaust black and smoky, while a blue, smoky appearance to the exhaust indicates too much cylinder oil and should not be confused with gasoline smoke. Water in the gasoline will collect in the bottom of the tank and carburetor and should be drained off from time to time. When water is in the gasoline the engine will not run.

Kerosene. The method of adjusting the amount of kerosene needed for the economic operation of the engine is similar to that of gasoline. If the mixture is lean, that is if the amount of kerosene is not enough, the engine will backfire; if the mixture is too rich, the exhaust will be heavy, blue gray smoke. It may also be an indication of too much lubricating oil. To ascertain the real cause, turn the needle valve down a little and observe the results. If the engine is hot, it will start on kerosene, but as a general rule drain the kerosene from the carburetor and fill the bowl with gasoline. When the gasoline is used up, the engine is usually warm enough to continue its operation on kerosene, which the pump has pumped into the bowl while it was running on gasoline. (See instructions for operating kerosene engines on page 11.)

Spark Coil. The rapid breakings of the circuit by the vibrator of the spark coil in the battery box, causes the sparks to jump across the points of the spark plug in the combustion chamber. This vibrator **must work properly** to make the engine run.

To test the coil and plug, unscrew the spark plug from the cylinder, connect the wire to it and lay the threaded end of it on some part of the engine. Close the switch and turn the wheels until cam "E" touches the spring "D" (see Fig. 4, page 7).

If the vibrator screw is adjusted properly, it should give a steady buzz and a bright blue spark between the points of the spark plug. This does not prove that a spark takes place in the combustion chamber under compression, for weak batteries will sometimes show a spark outside but not inside under compression. If the coil buzzes and you get no spark, the trouble is in the plug. Clean it thoroughly and try it again. When the vibrator of the coil as adjusted properly, it will start instantly and show no spark at the vibrator points underneath the adjusting screw.

The points of the spark plug must be $\frac{1}{32}$ of an inch apart (the thickness of a dime).

Too heavy a battery current or too close an adjustment will sometimes burn the points at the vibrator so the adjusting screw will need to be removed and the points smoothed up with emery cloth or fine file.

Magneto. Printed instructions for the proper care of the magnetos accompany each magneto equipment sent out. Apart from instructions regarding installation and timing, which were given on pages 6 and 10 of this instruction book, **do not tamper with the magneto.**

Cylinder Oiler. To adjust the cylinder oiler, turn the feed lever up and unscrew the round knurled nut until the oil drops six to ten drops per minute, depending on size of engine (see Oiling, page 4), then tighten the flat lock nut to hold it in position. Turn off the oil by turning the feed lever down.

Removing Carbon from Engine. There are several ways to remove carbon from engine. The best way is to remove the cylinder from the engine and scrape out the carbon with a scraper and then clean the exposed surfaces thoroughly with kerosene.

To remove cylinder from base: First loosen the set screw that holds carburetor in cylinder. Then draw carburetor from cylinder. Loosen four bolts that hold cylinder to base and cylinder may then be lifted from engine and carbon scraped out.

Another method is burning out with oxygen. The two following ways are common practice to prevent carbon formation. The first way is to pour in the spark plug hole a cupful of kerosene when the engine is hot, and after standing a while, start the engine and the carbon will be softened and removed to a certain extent. The second way is to inject steam in through the air hole "A" (Fig. C348) of the carburetor. Do not use too much steam, as the steam may condense and water formed will get into the spark plug, thus stopping the engine.

Grinding Valves. When you find the engine compression is not up to the standard remove the valves and cages and grind them. Valve grinding compound can be purchased at any local hardware or garage. A good composition to use is No. 90 emery thoroughly mixed with plenty of lubricating oil. Clean valves thoroughly before putting back in the cylinder, as emery will harm the engine. See that valve cage nut is tightened thoroughly before starting the engine, then retighten after engine has been warmed up.

Before laying the engine away for a length of time, it is a good plan to remove all excess oil and grease and leave on just enough to keep the engine from rusting.

When overhauling an engine replace and adjust everything strictly according to instructions. See that all bearings are properly adjusted, drawn tight, but not too tight to cause overheating. It is a good plan to run the engine after overhauling on a short test run and when the engine warms up enough then finally tighten the bearings.

DON'TS

Don't lay this book away to be read when you get in trouble; study carefully and learn to avoid trouble.

Don't run your engine without good **gas engine oil**, both in the cylinder oiler and in the crank pit.

Don't try to start on a cold morning without turning on plenty of gasoline and shutting off the air tight.

Don't forget, if you have a good spark, good compression and get gasoline into your engine it cannot fail to go.

Don't try to adjust a new engine. It has been tested and adjusted by an expert. Get it thoroughly oiled up, follow directions and you will have no trouble.

Don't imagine there is "something wrong on the inside" if your engine fails to run. Nine chances out of ten it is some little thing right before your eyes that is causing your troubles.

Don't think the engine overheats when the water boils. Keep cylinder well covered with water and it is safe.

Don't forget that ninety per cent of all engine troubles are carburetor and ignition troubles, weak batteries, loose wires, dirty spark plugs, dirt or water in the gasoline, etc.

COMMON GAS ENGINE TROUBLES

In the following paragraphs are grouped the more common causes of trouble to be encountered in the operation of a 4 cycle type of internal combustion engine. Study carefully, it will help in the general operation of an engine, and particularly if you are not getting proper results from your engine. Review the various instructions on preceding pages relative to operating and adjusting the engine. Be certain every adjustment is correct.

No. 1 DIFFICULT STARTING

A. Lack of Fuel—Caused from carburetor needle valve being closed, fuel tank empty, carburetor or feed pipe clogged, fuel pump out of order, air leak in fuel suction line. When starting, open carburetor needle valve twice as much as for running.

B. No Spark at Plug—Poor contact at wire terminals, wires broken, spark plug points too close or too far apart (should be about 1/32 of an inch or the thickness of a dime), spark plug dirty or porcelain broken and short circuits. For complete magneto instructions refer to magneto instruction book. If battery ignition, trouble may be caused from switch not closed, poor contact at switch, cells run down and weak, battery box improperly wired or coil out of adjustment.

C. Very cold weather may make an engine hard to start. Use plenty of gasoline (high test) when starting, and be sure the ignition is correct.

D. Water will sometimes accumulate in the fuel tank, or carburetor. Drain water off at plug provided for the purpose.

E. Be certain that all adjustments of the engine are correct. An engine properly adjusted with gasoline and a good spark will start.

No. 2 LACK OF POWER

A. Carburetor not properly adjusted. (See also paragraph "Lack of Fuel.")
B. Engine mechanism, spark or valve timing out of adjustment. (See various instructions relative to adjusting engine.)
C. Overheating, causing friction of moving parts, may be caused by lack of cooling water, insufficient lubrication, lubricating oil of an improper grade.
D. Leaks from compression chamber due to valves not seating, piston rings covered with carbon and stick in ring grooves. Cylinder and piston not properly lubricated.
E. Exhaust pipe too long or too many turns. If over 4 feet long enlarge one size, if over 10 feet enlarge two sizes. If two or more elbows are used enlarge pipe one size after each elbow.
F. Lack of power is sometimes wrongly applied when an engine is overloaded. Check up the power requirements carefully.

No. 3 ENGINE POUNDS

A. If pounding occurs at every revolution, look for a loose bearing either of the connecting rod or crankshaft, also a loose fly wheel key.
B. If pounding occurs at each explosion, the spark may be set too early.
C. If pounding occurs at each explosion only after engine has run for awhile, see if it is not due to lack of cylinder oil or water. Carbon in cylinder head or on piston will sometimes get hot and ignite the fuel charge too early.
D. An engine will pound when operated on kerosene. By admitting a small amount of water to combustion chamber with fuel charge, the pounding will cease. A water valve is provided for the purpose and just enough water to eliminate the pound is sufficient.

No. 4 POOR SPEED REGULATION

A. Defective ignition. (See paragraph "B" of "Difficult Starting.")
B. Governor out of adjustment due to lost motion in governor parts, governor latch and block with too much or not enough end clearance. (See instructions for Governor Adjustment.) Moving parts gummed with thick oil or new paint and binding. Insufficient lubrication of moving parts.
C. Weak fuel mixture will be indicated by popping noise at air intake of carburetor, particularly when starting engine. Open needle valve until this is overcome, then readjust carburetor after engine is thoroughly warmed up.

No. 5 EXCESSIVE FUEL CONSUMPTION

A. Leak in fuel tank or in connections from tank to carburetor.
B. Carburetor not adjusted properly.
C. Weak spark at plug.
D. Valves and spark out of time.
E. Any moving parts of engine heating and binding.

No. 6 ENGINE OVERHEATS

A. Caused by spark being set too late. Exhaust valve opening too late or closing too early.
B. Lack of cylinder oil or water.
C. Wrong carburetor adjustment, allowing too much fuel to enter combustion chamber.

NO. 7 ENGINE STOPS SUDDENLY

A. Fuel tank empty.
B. Dirt has clogged pump, carburetor or suction line.
C. Battery wire broken or jarred loose.
D. Spark coil vibrator sticks or needs adjusting.
E. Dirty spark plug.

No. 8 SMOKE AT THE EXHAUST

A. Black smoke indicates too much fuel.
B. Blue smoke indicates too much cylinder oil.

THE NOVO STANDARDS

The NOVO Model S Engine, the operating instructions of which are covered in this book, stands as a lasting tribute to the manufacturing principles followed by the Company which built it. The Model S Engine was the pioneer in the stationary engine field. Many of these engines, built one or more decades ago, are still in active service....changing hands many times....operating under various and sundry conditions and working in a great many cases with practically no care or service. There are cases of Model S Engines a quarter of a century old, sold in 1910, still rendering active duty.

REFINEMENTS HAVE FOLLOWED. Engine Design has changed, refinements have been made, new developments have been incorporated into NOVO Engines....but still that fundamental principle of building the product to last far beyond normal expectancy has carried on through to the present, up-to-the-minute, trim, smooth operating powerful engines and construction and industrial equipment.

The NOVO line of equipment includes--

Engines:	2 to 20 HP., one-, two- and four-cylinder.
Hoists:	500 to 15,000# capacity in one-, two- and three-drum sizes.
Pumps:	Dewatering, Pressure, and Sewage.
Light Plants:	1-1/2 to 7 KW.
Air Compressors:	For Diesel and Gas Engine starting.

NOTICE TO CUSTOMERS ORDERING REPAIR PARTS FOR ENGINES NUMBERED PREVIOUS TO 13,000

The parts listed in this book are intended primarily for engines numbered above 13,000. They may, however, be used to good advantage when ordering parts to be used on Models built previous to engine 13,000 if you will be careful to furnish the following information when ordering parts:

The serial number of the engine appearing on the brass name plate attached to the engine cylinder.

The horse power of the engine stamped on the name plate.

Name of part required.

When ordering the following parts: Cylinder, Piston, Piston Rings and Crankshaft, give the inside diameter of the engine cylinder. If ordering gears, give the number of teeth and state whether the flywheel rotates to the right or left looking at governor side.

NOTICE TO CUSTOMERS ORDERING REPAIRS EFFECTED BY A CHANGE IN DESIGN OF PARTS

Change in design affecting the replacement of valve cages. New style cages first used on the following engine:

8 H. P. engine number 57705. 10 H. P. engine number 46944.

If your engine is numbered previous to the above number and your repair order includes valve cages, do not overlook the necessity of furnishing the engine number with your order.

A change in design has been made on the 2 H. P. engine, first of the new design being numbered 73672. Cylinder bore changed from 3¾ to 4. When ordering cylinder, piston, piston rings, or piston pin be sure to furnish the serial number of your engine.

Change in design effecting piston pin lock screw on engines numbered 47571 to 59900, inclusive. When ordering piston pin set screw state the number of threads to the inch.

Change in design effecting the connecting rod bolts. When ordering connecting rod bolts and your engine is numbered previous to 47571 be sure to give the diameter of bolts and engine number.

Change in piston and rings effecting ring and ring groove from eccentric ring 1½ S2A to concentric ring NF2 first used on 1½ H. P. engine 95067.

Change in design effecting following parts, first used on 1½ H. P. engine No. 80573.

FROM OLD STYLE	TO NEW STYLE—NOT INTERCHANGEABLE	DIFFERENCE
1 S4 Bearing cap - back side	1½ S4 Bearing cap - back side	Change to same type as used on 2-10 H.P.
1 S5 Bearing cap - governor side	1½ S5 Bearing cap - governor side	Change to same type as used on 2-10 H.P.
1 S6X Cam pinion	1½ S6 Cam pinion	From 14 to 18 teeth
1 S7B Cam gear with 1 S46A	2 S7B Cam gear with 1½ S46	From 28 to 36 teet
1½ S30 Exhaust valve adjusting nut	1½ S30A Exhaust valve adjusting nut	From 3¼" to 2⅛" long
1 S43 Rocker arm	1 S43A Rocker arm	From 6 1/16" to 7⅛" long
1 S46A Cam for battery ignition	1½ S46 Cam for battery ignition	From 2⅜" to 2½" long
1 S48 Governor shoe	1½ S48A Governor shoe	From 6⅛" to 5½" long
2 S51 Governor latch	1½ S51 Governor latch	From 3 1/16" to 4⅞" long
1½ S59 Engine base	1½ S59A Engine base	Designed to use new style bearing, caps, gears and hand hole cover
1 S75 Cam shaft	1½ S75 Cam shaft	From 3⅝" to 3¾" long
1 S80 Main bearing liners, back side	1½ S80 & 80A Main bear. liners, back side	Same type as used on 2-10 H.P. engines
1 S82 Main bearing liners, governor side	1½ S82 & 82A Main bear. liners, gov. side	Same type as used on 2-10 H.P. engines
1½ S83 Gasoline pump suction pipe	1½ S83A Gasoline pump suction pipe	From 5¾" to 7" long

IGNITION CHANGE ON ALL SIZES FROM 1½ TO 10 H. P.

Changed from battery to magneto ignition as standard equipment January 1st, 1924, engine No. 85010. Obsoletes circuit breaker, battery box, coil, and cam for battery ignition replaced by cam with eccentric for EK Wico Magneto.

Change in design effecting cam for Wico Magneto from large to small eccentric, also effecting connecting parts and using parts NM52A, NM53A, NM54B, 1½NM55, 6NM55, NM58B, NM62A and S556B with cam with small eccentric, first used on 1½ H. P. engine No. 92634, 2 H. P. No. 92112, 3 H. P. No. 92580, 4 H. P. No. 93910, 6 H. P. No. 93248, 8 H. P. No. 93933, 10 H. P. No. 94048.

INSTRUCTIONS FOR ORDERING PARTS

Always give serial number of engine and outfit as it appears on the brass name plates.

Always specify type and model of both engine and outfit.

Always give symbol and name of each part.

All prices are F.O.B. Lansing, Michigan.

State whether shipments are to be forwarded parcel post, express, or freight.

Orders for parts should be written separately from correspondence pertaining to other matters. Be sure to write your name and complete address plainly.

Do not order by sets. State exactly how may pieces are required.

This Parts List supersedes all others of previous date. Prices are subject to change without notice.

Returned parts must be tagged showing shipper's name and address, and be accompanied by claim letter giving full details together with serial number of engine and outfit. In case of declined claims the inspected parts are subject to the shipper's orders for disposition and we cannot be held responsible for such parts for more than 30 days.

Claims for defective parts not of our manufacture must be made to their respective makers insofar as they are fully warranted by their manufacturers.

All claims must be made within 3 days after receipt of goods.