

INSTRUCTION BOOK

How to Care For and Operate

OTTAWA

LOG SAWS

1918-1919-1920 MODELS

ENGINES

KEROSENE - GASOLINE - GAS

BUZZ SAW RIGS

1919-1920 MODELS

This is a valuable book. Preserve it, and keep it always handy for reference. Apply the instructions in running the engine and get the best results.

OTTAWA MANUFACTURING COMPANY
OTTAWA, KANSAS

Special Instructions for Operating the Ottawa Log Saw

Read these instructions carefully before attempting to run your OTTAWA Log Saw. Read these two pages over several times so that you are thoroughly familiar with them, and also the accompanying instructions for the Webster Oscillating Magneto.

Before Starting the Engine.

1. It is impossible for the factory to file and set each saw blade properly for all kinds of wood. See that your saw blade is properly sharpened and set for the wood you intend to cut.
2. Suspend the slide arm on the Hook-up. (See accompanying photograph, page 4, for part LS34.) Attach the saw blade to the slide arm.
3. Place the Saw in cutting position on the log. The engine must be set a sufficient distance from the log, to allow the end of the slide arm to pass the log as the saw cuts through.
4. Hook the cant-hook on the under side of the log nearest the engine. Hook the chain in the end of the tightening screw. Place the cross-block on top of the skids and tighten the hand screw wheel sufficiently to hold the saw firmly in place. Tighten the hand screw wheel as often as necessary to prevent the saw from shifting from its original position on the log while running.
5. Set the clutch adjusting-nut on the engine crank shaft so that the clutch will pull the saw easily without slipping. Never get the clutch so tight that it will not slip if the saw should pinch or stick in the log while cutting. If the saw is stuck and the clutch is too tight to slip while running, it is almost sure to cause damage to the saw rig.
6. Put gasoline in the fuel tank, gas engine cylinder oil in the lubricator and hard oil in the three hard oil cups on the crank shaft bearings. See that all of the working parts of the engine and saw equipment are well oiled. Too much oil is better than too little.
7. Put HOT water in the water hopper of the engine. By using HOT water to warm up the engine it will start easily on the low grade of gasoline that every one is now obliged to use.

How to Start the Engine.

1. Be sure that you have followed the foregoing instructions.
2. Open the throttle of the gasoline mixer $\frac{1}{2}$ to $\frac{3}{4}$ of a turn.
3. Move the spark lever "J" on the magneto toward the engine fly wheel. (See magneto instructions.)
4. Place the starting crank on the shaft of the engine and crank the fly wheels over rapidly. While cranking, close the opening of the gasoline mixer with your hand until the engine takes its first charge of fuel and starts. Then remove the starting crank, and your hand from the mixer.
5. Move the spark lever on the magneto back toward the head of the engine as far as possible. (See magneto instructions attached.)
6. Turn on the cylinder lubricator. From 15 to 20 drops of oil per minute should be fed into the cylinder.
7. If the engine exhausts black smoke after it is started, close the throttle on the gasoline mixer slightly.

NOTE—Should the engine exhaust one or more charges of black smoke and then stop, too much gasoline will be the cause. Turn down the throttle on the gasoline mixer slightly and start the engine as before.

After the Engine Is Started.

1. Turn the tightening screw wheel down tight to hold the cant-hook firmly in the log and the rig in its place.
2. Raise the slide arm off the hook-up and place the saw on the log so that the saw blade will run in line or parallel with the engine skids.
3. As the saw cuts deeper into the log, drive one or more wedges into the cut to prevent it pinching or binding the saw.
4. Should the saw blade become pinched or stuck in the log while sawing, stop the engine until the difficulty is overcome.
5. When the cut is made, raise the saw and latch the slide arm on the hook-up. Move the rig over on the log for another cut and start as before.

NOTE—All OTTAWA Engines are properly adjusted and thoroughly tested and every saw rig is actually tested at sawing in our log yard near the factory before shipping. Keep all of the nuts tight and do not allow any one to change the adjustment of your engine.

How to Adjust Log Saw and Buzz Saw Rig Mixer.

The gasoline mixer is of the gravity feed type. As the fuel passes into the mixer it is mixed with air and forms the explosive gas.

In starting the engine you open the fuel throttle valve and hold your left hand over the mixer, partly closing the air intake when cranking. Should the engine have a tendency to slow down when it is cold, place your hand around the mixer opening for a few seconds. After engine is started, close the fuel throttle valve entirely by turning to right and slowly open it, a very little at a time, until point is reached where the engine will run with the least number of explosions in a minute and without black smoke coming from the exhaust or a popping sound from the mixer. Black smoke, smelling strong of gasoline, coming from the exhaust indicates you are using too much fuel. A popping sound at mixer is caused by not enough fuel.

When engine is running on load, the suction of piston is greater than when it is running empty, and you should turn down fuel some. Use the least amount of fuel the engine will run on and pull the load; it will save fuel and engine will run better.

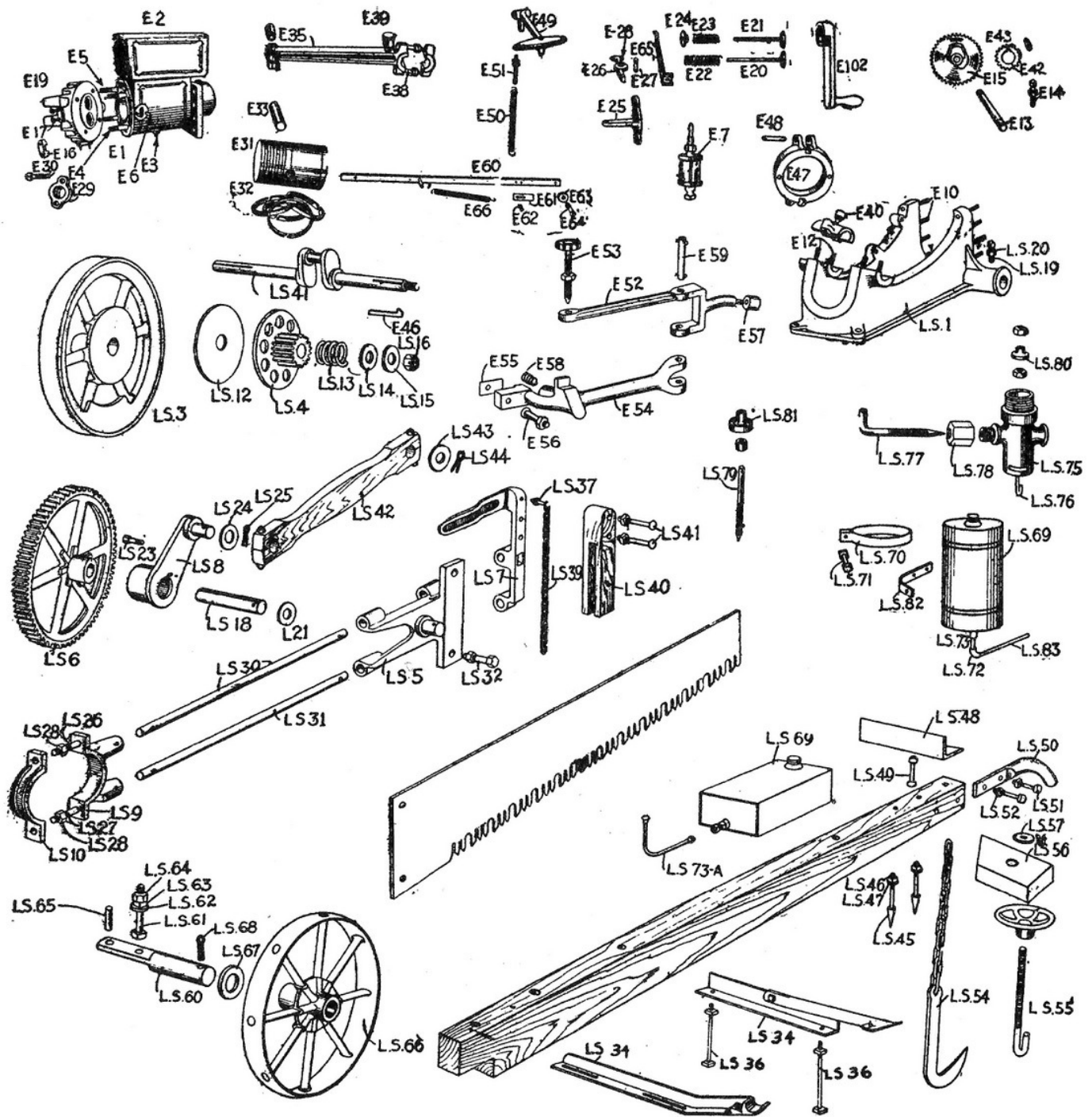
When engine is running without a load it should make an explosion and the fly wheels make a number of revolutions before another explosion is made. When the engine is running on full load the explosions will be made more frequent.

If Your Saw Cuts Too Slowly.

1. Your engine is using too much fuel. Turn down fuel throttle and your engine should run much faster, thus sawing faster.
2. Your engine is running too slowly. The OTTAWA Log Saw engine must run at 625 to 690 r. p. m. or it is not giving the proper results.
3. Governor springs too loose. Tighten them according to instructions given on page 20 of this book.
4. Speeder screw turned down. Loosen lock nut, turn up speeder screw and tighten lock nut. Your engine should then run faster.
5. Magneto lever J pushed back toward fly wheel. This lever must be pushed back toward engine head or you will have no power.
6. Your saw blade is dull.
7. Your saw blade teeth need setting. (Send for our setting block and tools.)
8. The raker teeth on saw blade are too long. (Should be shortened by filing.)
9. Using too much fuel.

If You Are Unable to Start Your Engine, or It Is Hard to Start.

1. Be sure there is plenty of fuel in the tank.
2. See that the fuel flows to the mixer.
Dirt sometimes gets into the fuel pipes and collects under check valve or fuel valve. Cock magneto, if engine is equipped with a magneto, so no spark will be made. Hold your hand over mixer and draw in fuel charge by turning fly wheel as in starting. If you cannot see any fuel in mixer, then you may be pretty certain something is wrong with fuel system. Disconnect pipes and clean all connections, valves and valve seats.
3. Too much fuel.
It is a common mistake to flood the cylinder with fuel in starting, which makes starting hard. It takes very little fuel to start an engine when it is warm or in warm weather. An engine can be choked down entirely by too much fuel, just as easily as by not giving it enough.
4. Too little fuel.
If engine is not getting enough fuel it will pop and back-fire at mixer. Back-firing at mixer is not always caused by insufficient fuel. It may be caused by poor ignition, valves not seating properly, or water in cylinder. Cylinder head packing may have given out, admitting water to cylinder. If you discover a packing leak, replace packing and follow instructions for putting on packing closely as given on page 19 of this book.
5. Weak spark. See magneto instructions enclosed.
6. Piston dry, on account of too much fuel.
7. Side rod stuck—rusty or painted.
8. Governor sticking.
9. Movable electrode sticking, not oiled.



No.	Name	Price
L.S.— 1	Base with caps and bearings...	\$30.00
L.S.— 2	Fly wheel on magneto side....	16.80
L.S.— 3	Fly wheel on saw blade side..	19.00
L.S.— 4	Small gear and clutch plate...	6.00
L.S.— 5	Cross head.....	8.00
L.S.— 6	Large gear.....	17.00
L.S.— 7	End strap complete.....	6.00
L.S.— 8	Eccentric craak	8.50
L.S.— 9	Rear eccentric strap.....	4.00
L.S.— 10	Front eccentric strap.....	4.00
L.S.— 11	Log hook haad wheel.....	1.40
L.S.— 12	Clutch f.bre washer (large)....	.75
L.S.— 13	Clutch spring.....	.50
L.S.— 14	Clutch fibre washer (small)...	.40
L.S.— 15	Clutch iron washer.....	.45
L.S.— 16	Clutch nut.....	.26
L.S.— 17	Cotter key for clutch nut.....	.10
L.S.— 18	Large gear shaft.....	2.50
L.S.— 19	Large gear shaft set screw....	.30
L.S.— 20	Large gear shaft lock nut for set screw.....	.10

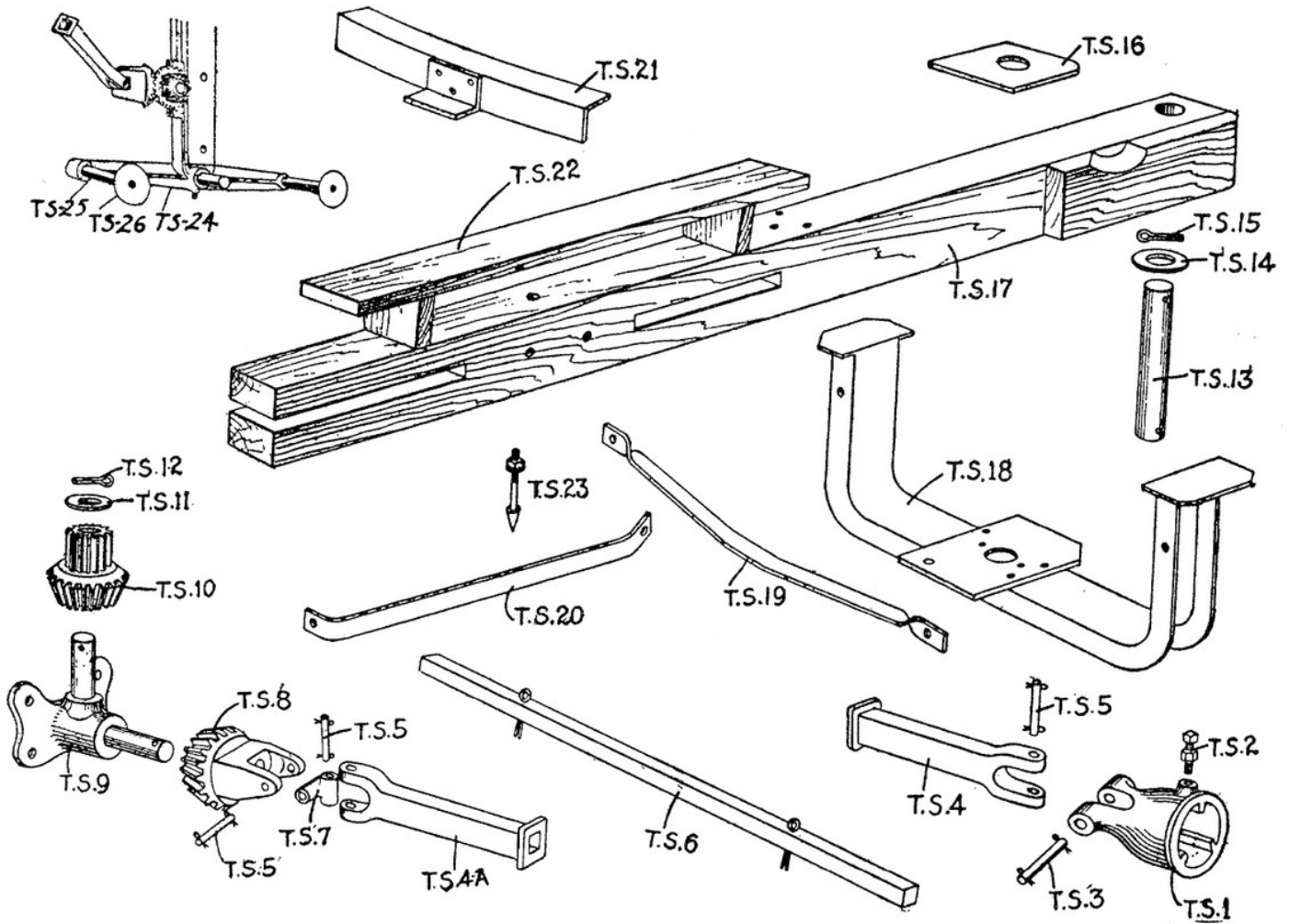
No.	Name	Price
L.S.— 21	Large gear shaft washer.....	.10
L.S.— 22	Large gear shaft cotter key....	.05
L.S.— 23	Eccentric crank cap screws, ea.	.30
L.S.— 24	Eccentric crank washer.....	.15
L.S.— 25	Eccentric crank cotter key....	.05
L.S.— 26	Eccentric strap stud (upper)..	.40
L.S.— 27	Eccentric strap stud (lower)...	.40
L.S.— 28	Eccentric strap stud nut (upper) .....	.15
L.S.— 29	Eccentric strap stud nut (lower) .....	.15
L.S.— 30	Parallel rod (upper).....	2.40
L.S.— 31	Parallel rod (lower).....	2.40
L.S.— 32	Cross head bolt nut and washer (upper).....	.30
L.S.— 33	Cross head bolt nut and washer (lower).....	.30
L.S.— 34	Hook up (used before August 1, 1919)	1.20
L.S.— 34A	Hook up (used after August 1, 1919)	1.60
L.S.— 35	Hook up brace.....	Discontinued

No.	Name.	Price.	No.	Name.	Price.
L.S.— 36	Hook up bolt and nut (each) .....	.40	E.— 7	Cyl. lub. complete.....	3.20
L.S.— 37	Hook up brace bolt and nut (upper).....	Discontinued	E.— 7A	Lub. glass, large.....	.90
L.S.— 38	Hook up brace bolt and nut (lower or skid).....	Discontinued	E.— 7B	Lub. glass, small.....	.40
L.S.— 39	Hook up chain.....	.60	E.— 10	Cylinder to base stud and nut.	.30
L.S.— 40	Saw guide.....	.45	E.— 12	Main bearing stud and nut...	.30
L.S.— 41	Saw guide bolts and nuts (2) ..	.35	E.— 13	Cam gear pin.....	1.20
L.S.— 42	Pitman rod—oak.....	.70	E.— 14	Cam gear pin set screw and nut	.30
L.S.— 43	Pitman cross head washer.....	.15	E.— 15	Cam gear	9.00
L.S.— 44	Pitman cross head cotter key..	.05	E.— 16	Side bar bearing cap.....	.40
L.S.— 45	Log spike.....	.75	E.— 17	Side bar cap stud and nut....	.30
L.S.— 46	Log spike nut.....	.10	E.— 19	Cylinder head—only.....	9.00
L.S.— 47	Log spike washer.....	.05	E.— 19A	Cylinder head—complete.....	19.00
L.S.— 48	Front axle brace.....	.80	E.— 20	Exhaust valve	2.60
L.S.— 49	Front axle brace bolts and nuts .....	.30	E.— 24	Intake valve spring washer....	.20
L.S.— 50	Handle on end of skid.....	.50	E.— 22	Exhaust valve spring.....	.0
L.S.— 51	Handle bolt.....	.20	E.— 23	Intake valve spring.....	.60
L.S.— 52	Handle nut.....	.05	E.— 24	Intake valve spring washer....	.20
L.S.— 53	Handle washer.....	.05	E.— 25	Exhaust lever bracket.....	1.70
L.S.— 54	Log hook and chain.....	3.50	E.— 26	Exhaust lever.....	.90
L.S.— 55	Threaded hook.....	2.20	E.— 27	Exhaust lever pin.....	.20
L.S.— 56	Log hook block.....	.20	E.— 28	Exhaust lever set screw and nut	.20
L.S.— 57	Log hook hand wheel washer...	.05	E.— 31	Piston	9.20
L.S.— 58	Axle	6.50	E.— 32	Piston rings, each.....	1.80
L.S.— 59	Axle skid bolt, nut and washer	.25	E.— 33	Piston pin.....	2.20
L.S.— 60	Axle Stub	2.80	E.— 34	Piston set screw and nut.....	.30
L.S.— 61	Axle stub bolt.....	.50	E.— 35	Connecting rod and cap.....	10.50
L.S.— 62	Axle stub bolt washer.....	.10	E.— 36	Piston pin brass bushing....	3.20
L.S.— 63	Axle stub bolt lock nut.....	.15	E.— 38	Connecting rod cap stud and nut .....	.20
L.S.— 64	Axle stub bolt nut.....	.15	E.— 39	Connecting rod grease cup....	.50
L.S.— 65	Axle stub bolt pin.....	.60	E.— 40	Main bearing grease cup.....	.50
L.S.— 66	Road wheel left or right.....	5.25	E.— 41	Crank shaft.....	15.00
L.S.— 67	Road wheel washer.....	.30	E.— 42	Crank shaft gear.....	6.50
L.S.— 68	Road wheel cotter key.....	.15	E.— 43	Crank shaft gear key.....	.40
L.S.— 69	Fuel tank.....	3.50	E.— 44	Governor collar.....	1.80
L.S.— 70	Fuel tank bands.....	.50	E.— 46	Fly wheel key.....	.60
L.S.— 71	Fuel tank bands, screws and nuts .....	.10	E.— 47	Governor frame	2.40
L.S.— 72	Fuel stub elbow.....	.25	E.— 48	Governor weight pin.....	.30
L.S.— 73	Fuel pipe, short.....	.30	E.— 49	Governor weight.....	.50
L.S.— 73A	Fuel pipe, copper.....	.80	E.— 50	Governor weight spring, each..	.20
L.S.— 74	Fuel mixer complete.....	10.50	E.— 51	Tension bolt and nut.....	.20
L.S.— 75	Fuel mixer body.....	5.80	E.— 52	Speeder lever.....	3.20
L.S.— 76	Fuel mixer priming rod.....	.90	E.— 53	Speeder lever adjusting screw and nut.....	.60
L.S.— 77	Fuel throttle.....	1.40	E.— 54	Detent lever with tips.....	1.80
L.S.— 78	Fuel throttle stuffing nut....	1.10	E.— 55	Detent lever tip.....	.40
L.S.— 79	Needle valve, complete with fly and nuts	5.00	E.— 56	Detent tip screw and nut.....	.20
L.S.— 80	Needle valve washers, pr.....	.60	E.— 57	Detent lever roller.....	.25
L.S.— 81	Needle valve guide.....	2.50	E.— 58	Detent lever spring.....	.36
L.S.— 82	Tank supports, each.....	.50	E.— 59	Detent lever pin.....	.40
L.S.— 83	Fuel pipe, long.....	.60	E.— 60	Side bar only.....	3.60
E.— 1	Cylinder and hopper.....	24.00	E.— 61	Side bar detent plate.....	.30
E.— 3	Drain plug .....	.20	E.— 62	Detent plate screw and nut....	.10
E.— 4	Head stud and nut, long.....	.40	E.— 63	Cam roller.....	1.10
E.— 5	Head stud and nut, short....	.40	E.— 64	Cam roller stud bolt.....	.20
E.— 6	Igniter stud and nut.....	.40	E.— 66	Side bar spring.....	.50
			E.— 102	Starting crank.....	1.80
			E.— 105	Asbestos packing for cylinder head .....	.50
			E.— 106	Igniter packing.....	.20

When Ordering Parts, Accessories or Supplies.

- 1st. Always give the NUMBER and NAME of the part.
 - 2nd. The ENGINE NUMBER, which will be found on the end of the crankshaft and on name plate. If you do not know the HORSE-POWER and NUMBER of your engine, return the old parts, charges prepaid. If you do not give us complete information, it will be necessary for us to write you, which will mean a delay in filling your order.
 - 3rd. In case you are not the original purchaser, please give us name and address of original purchaser.
 - 4th. Send draft, check, postal or express order, or stamps for the full amount of the order, adding sufficient amount for postage, if parts are to go by parcel post. Unless sufficient amount is paid for parcel post, the parts will be sent out, express collect. If over payment is made, we will refund difference.
 - 5th. If any part of your engine is not listed, return old part or send full description, so we may not be delayed in correctly filling your order.
- We will not ship repairs unless full payment accompanies order.

The Ottawa Manufacturing Co.,
Ottawa, Kansas.



Directions for Setting Up Tree Saw.

Take out the large cotter key holding master gear on the master shaft of engine. Slide the large gear off shaft and along with it will come the saw blade, rods, etc. Do not remove blade. Then place large gear over shaft that is held in end of Tree Saw Frame.

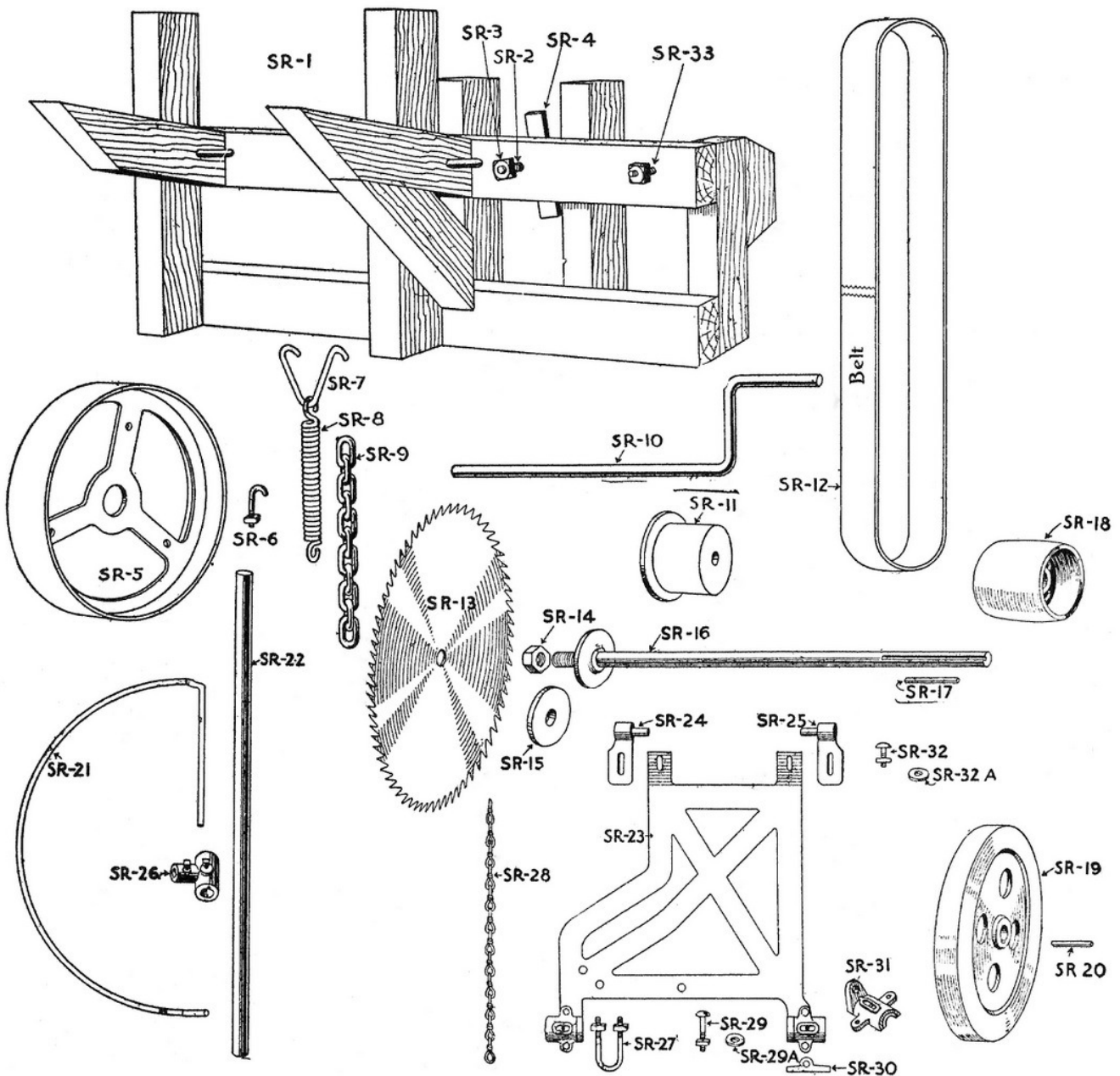
If you wish to cut trees off level with the ground, turn gears and saw frame over. Take off Saw Support (TS 22). If you wish to saw trees off above the ground, leaving a stump, then let the gear and blade remain on the top, allowing the saw blade to rest on the Saw Support (TS 22).

When one cut through a tree is about finished, stop engine and take out blade. Then drive in wedges and fall tree in the desired direction. It is a good plan to drive wedges in the tree while cut is being made, as it will prevent the saw from pinching and make cutting easier.

When ready to set for next cut, place saw frame against tree and fasten securely by tightening hand wheels. Then place engine and connect by the tumbling rod.

CAUTION: Be sure rod fits into each tumbling rod casting as far as possible and that set screw holding tumbling rod on engine end is fastened securely.

No.	Name	Price
T.S.— 1	Friction Gear Casting.....	\$3.50
T.S.— 2	Friction Gear Set Screw and Nut .....	.15
T.S.— 3	Friction Gear Coupling Pin and Cotter Keys.....	.45
T.S.— 4	Tumbling Rod Casting— Engine End	3.25
T.S.— 4A	Tumbling Rod Casting— Saw End	3.25
T.S.— 5	Tumbling Rod Pin and cotter keys each.....	.40
T.S.— 6	Tumbling Rod	1.85
T.S.— 7	Universal Joint Coupling..	1.40
T.S.— 8	Single Pinion	4.75
T.S.— 9	Pinion Rack	5.00
T.S.—10	Double Pinion	4.50
T.S.—11	Double Pinion Washer.....	.15
T.S.—12	Double Pinion Cotter Key ..	.15
T.S.—13	Master Gear Pin.....	2.25
T.S.—14	Master Gear Pin Washer..	.15
T.S.—15	Master Gear Pin Cotter Key .....	.15
T.S.—21	Parallel Rod Support.....	1.75
T.S.—22	Saw Support (complete)....	2.25
T.S.—23	Log Spike (each).....	1.85
T.S.—24	Tree Saw Frame (end).....	17.50
T.S.—25	Tree Saw Frame pipe stand (each)	1.10
T.S.—26	Tree Saw Frame stand base (each)	2.00



No.	Name	Selling Price
S.R.— 1	Buck, complete	\$5.00
S.R.— 2	Buck Bolt .....	.20
S.R.— 3	Buck Bolt Nut.....	.10
S.R.— 4	Buck Bolt Strap.....	.30
S.R.— 5	Large Pulley	12.80
S.R.— 6	Large Pulley Hook Bolt and Nut (each).....	.60
S.R.— 7	Hopper Spring Hook.....	1.40
S.R.— 8	Tension Spring	2.50
S.R.— 9	Tension Spring Chain.....	.85
S.R.—10	Idler Pulley Rod.....	1.70
S.R.—11	Idler Pulley	7.25
S.R.—12	Belt with Lacing.....	5.85
S.R.—13	Saw Blade 1-inch Arbor hole	5.10
S.R.—14	Mandrel Nut .....	.60
S.R.—15	Mandrel Loose Washer.....	.70
S.R.—16	Mandrel with Tight Washer	5.00
S.R.—17	Pulley Key .....	.60
S.R.—18	Mandrel Pulley	6.65
S.R.—19	Balance Wheel	8.60

No.	Name	Selling Price
S.R.—20	Balance Wheel Key.....	.35
S.R.—21	Saw Guard	1.30
S.R.—22	Pipe Handle .....	.70
S.R.—23	Main Frame with Bearing Caps	13.50
S.R.—24	L. H. Main Frame Hinge .....	.80
S.R.—25	R. H. Main Frame Hinge .....	.80
S.R.—26	Front Shield Support.....	.75
S.R.—27	Handle U Bolt with Nuts .....	.40
S.R.—28	Hook Down Chain.....	.45
S.R.—29	Tension and Hook Down Chain Bolt and Nut.....	.30
S.R.—29A	Tension and Hook Down Chain Washer .....	.10
S.R.—30	Main Bearing Liners.....	.15
S.R.—31	Main Bearing Cap without Babbitt .....	.70
S.R.—32	Main Frame Hinge Bolt and Nut .....	.25
S.R.—32A	Main Frame Hinge Bolt Washer .....	.10
S.R.—33	Hook Down Chain Bolt and Nut .....	.30

Instructions for Assembling and Operating Branch Saw and Buzz Saw.

(1) Uncrate the branch saw, and lay all parts on the ground so you can select them as mentioned.

(2) On the small end of the large main frame two small castings or hinges (Parts SR24 and 25 Main Frame Hinges) are bolted on. Take these off. Fit them into the ears behind the main bearings on the engine base.

(3) Bolt the main frame (SR23) securely to these hinges that you have just fastened on the base.

(4) You will find among the parts a large spring (SR8) or two short ones, as either may be used. On one end of the spring there is a short chain. This chain and spring bolts in a hole in the center of the large end of the main frame and just underneath the saw mandrel.

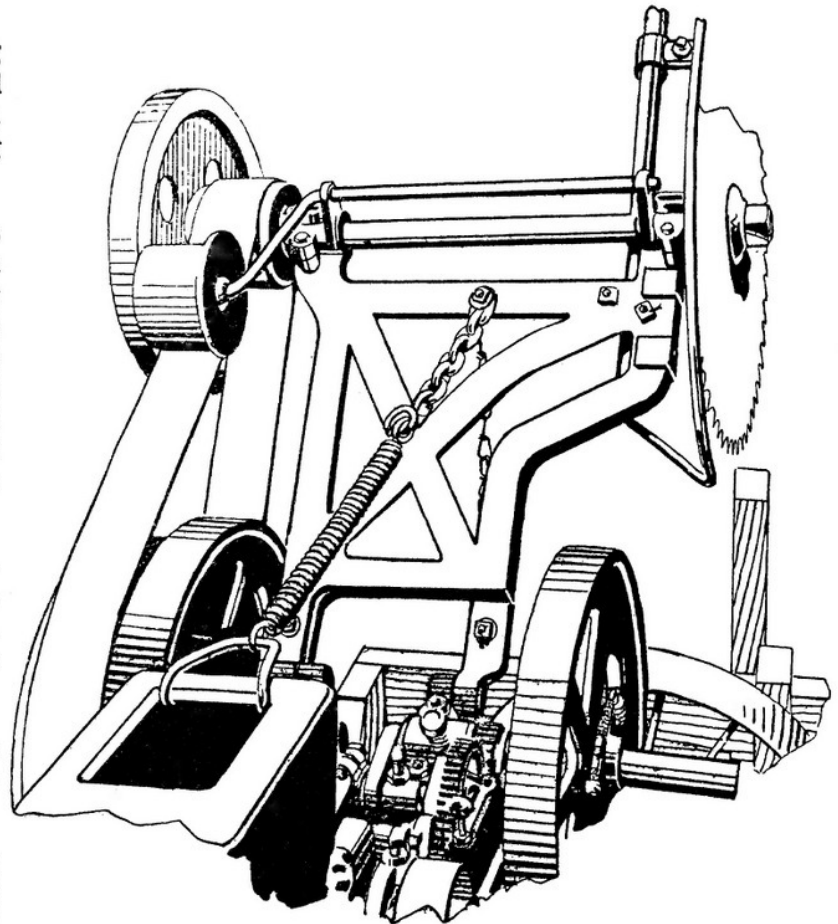
(5) Then take the hopper spring hook (SR7) and place the wide end over the edge of the water hopper. The loose end of the large spring hooks in the loop of this hook.

(6) The notches on the hinges and main frame are arranged so you can place the main frame in perfect line with the large pulley that fits on the engine fly wheel. Be sure the alignment of the main frame is correct so that the belt will not rub on the engine fly wheel and the idler pulley will not rub on the balance wheel.

(7) The main frame is now suspended at an angle of about 45 degrees by the tension of the spring. Now place the circular saw blade on the mandrel.

(8) Next, fasten the pipe handle to the main frame in the hole provided near the saw blade.

(9) Then you will find a piece of bent round iron. One end of this iron piece fits into the end of the pipe handle nearest the engine. It is then adjusted to run around the top of the saw and form a guard. The other end is fastened by a set screw in the small "T" shaped casting on the handle end of the pipe.



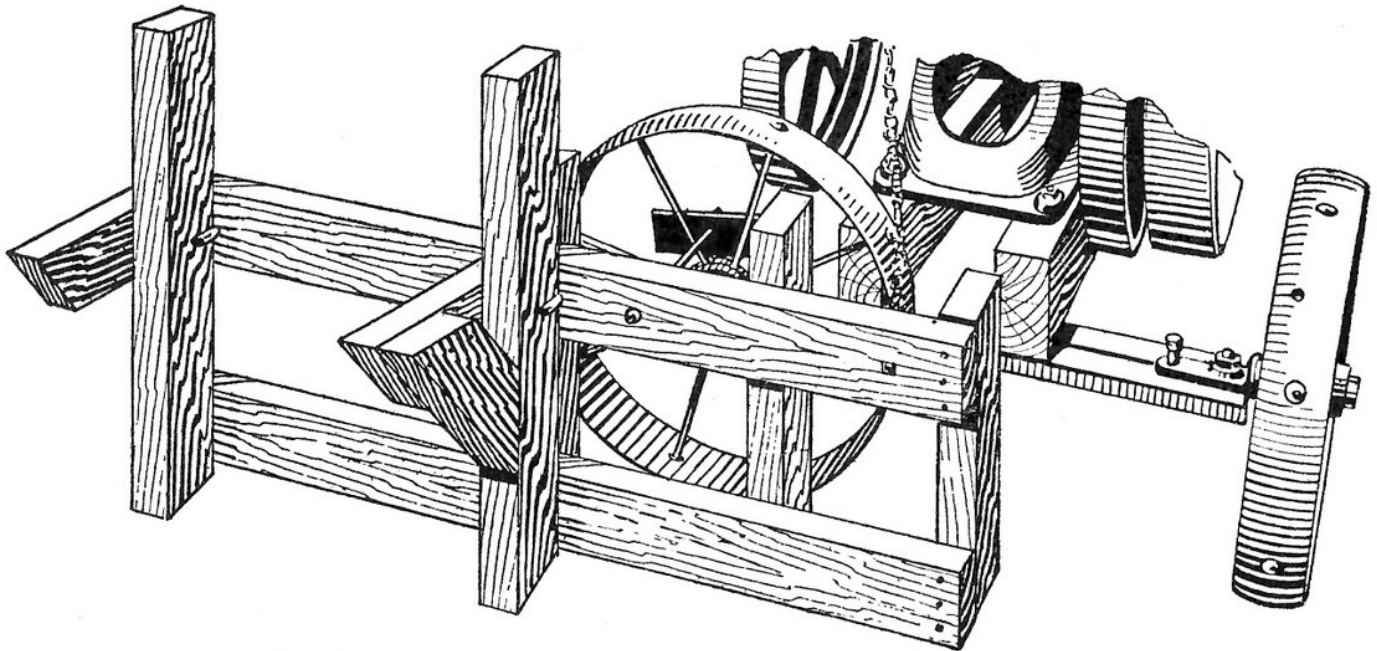
A top view showing every part of Branch Saw in proper place. Note spring and heavy chain. Also belt tightener.

(10) Take the light chain (SR28) which is about 26 inches long and bolt one end to the cross piece on buck. The other end bolts on the main frame at the same place as the support chain (SR9) bolts on. The function of the small chain is to keep the spring from pulling the entire saw back on the engine.

(11) Do not saw unless the small hook-up chain is attached.

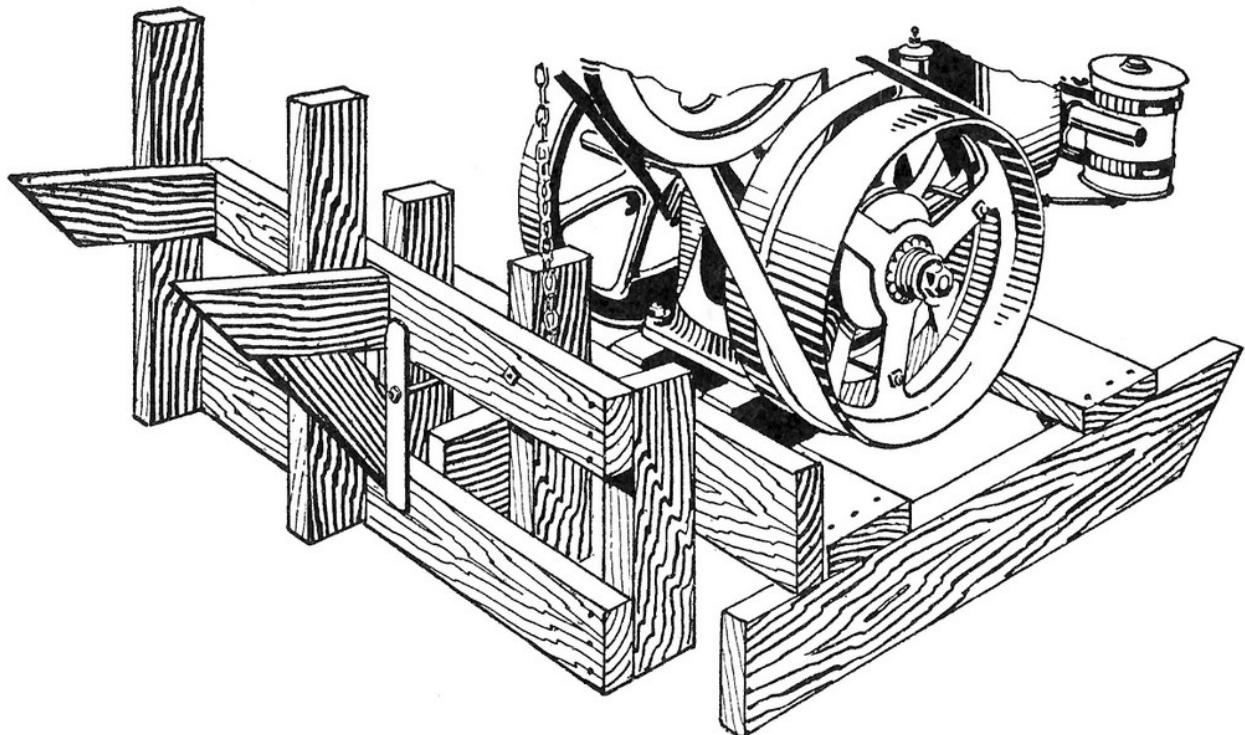
(12) Set the saw buck so that the two sharp pointed 2x4's point away from the rear of the log saw or engine. You will find a hole in the upper horizontal 2x4. If a

log saw, turn the left wheel of the rig at right angles to the log saw skid. You will find a piece of strap iron with a hole in the center. This acts as an anchor behind two of the spokes in the wheel. The long bolt goes through the hole in the saw buck and the strap iron. This holds the left side of the saw buck steady.

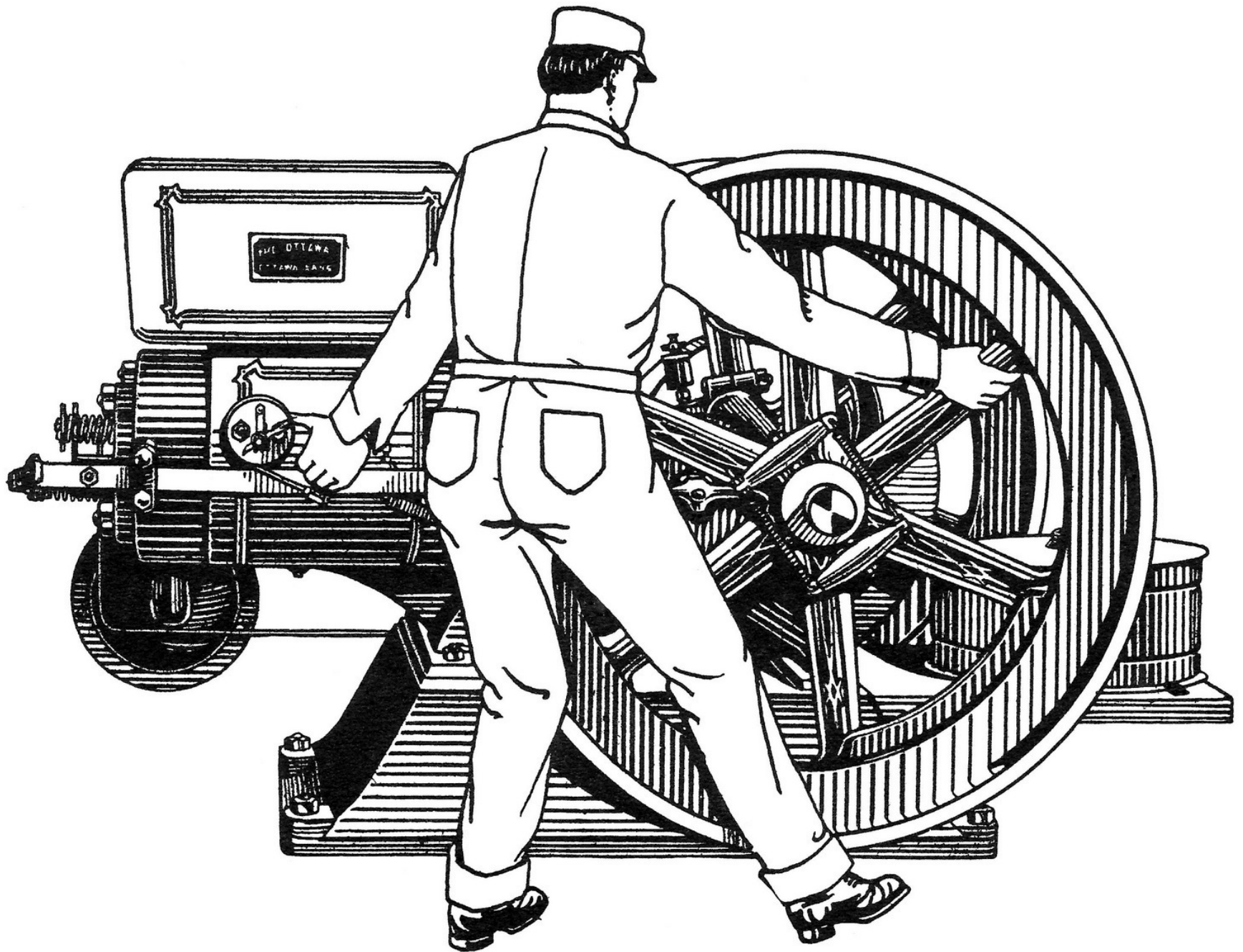


This shows the proper method of attaching the saw buck to the wheel mounted Log Saw. Note one wheel is turned.

(13) Nail the little block of wood you will find to the end of the right skid of the log saw, or the skid nearest the pulley. This little block must be used or your buck will tend to move as the saw is pushed down on a log, greatly reducing the results to be obtained while sawing.



This shows the proper method of mounting the Buzz Saw engine on sleds and how to attach the buck.



STARTING THE ENGINE.

It may be necessary to pull the fly-wheel back against compression three or four times before snapping magneto.

STARTING THE ENGINE.

How to Prepare Engine for Starting.

Clean off any dirt that may have collected on piston or other working parts in shipment Kerosene is good for the purpose.

Oil all working parts thoroughly, including valve stems, side rod, igniter and governor parts. If your engine is equipped with Magneto, oil Magneto shaft and spring rollers. (See page—.) Use a thin oil for oiling magneto. Do not use ordinary engine oil.

Fill grease cup on connecting rod with hard oil and screw down slightly to force oil to crank. The oil cups on main bearings are to be filled with hard oil, the same as cup on connecting rod.

Fill fuel tank with kind of fuel you are going to use, being sure there is no dirt in fuel.

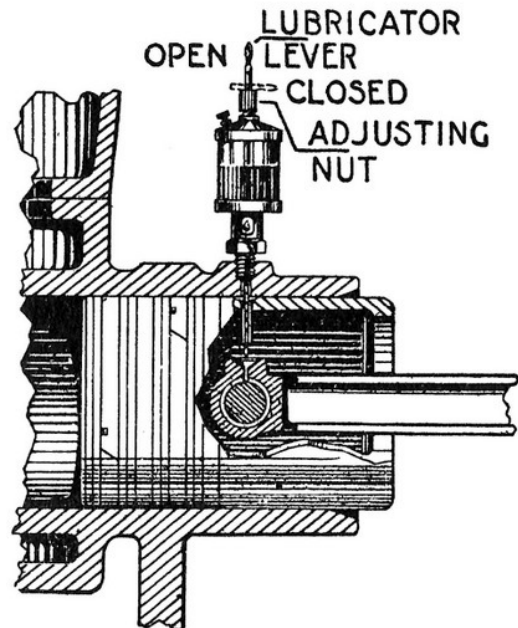
Fill hopper with clear water to within 2 or 3 inches of top.

Fill cylinder lubricator with oil. Turn on oil by raising lever on top of lubricator. Adjust lubricator so oil flows freely. To increase flow of oil, turn adjusting nut to left. To decrease flow of oil, turn nut to right.

Use only a good grade of oil—high heat test—made especially for gas engines. Never use steam engine oil. Be sure to use heavy oil with Kero-Eng.

Ordinarily it is best to set lubricator as follows:

H. P.	On full load	On light load
2 to 3	15 drops per minute	5 drops per minute
4 to 8	20 drops per minute	10 drops per minute
10 to 12	30 drops per minute	15 drops per minute
16 to 22	40 drops per minute	20 drops per minute



Cut No. 1.

Starting Cranks.

Starting cranks are furnished with engines from 2 H-P to 7 H-P only. No starting cranks are furnished with engines of 8 H-P and larger, as they are most too large to crank readily. Start the larger engines on compression without cranking.

How to Start Kerosene Engine Equipped With Magneto Without Cranking.

1. Prepare engine as directed above.
2. Close valves on mixer: Fuel throttle valve, water valve, fuel drain valve.
3. Fill fuel reservoir with gasoline.
4. Open hot air by-pass.
5. If your engine is cold, open pet cock on end of pump barrel and keep engine running by refilling reservoir with gasoline until engine is very hot. Then close pet cock so that kerosene may be pumped into reservoir.
6. Move timing lever J (Cut 6, Page 22) forward towards fly wheel; this retards spark for starting.
7. Hold intake valve in with left hand to release compression. With the right hand turn fly wheels over from cylinder until Magneto trips, then stop.

8. Pour about 2 tablespoonfuls of gasoline in opening of mixer, as priming charge, if engine is cold. If engine is hot, less fuel is required to start—about a teaspoonful. In case Magneto is equipped with priming cup, prime engine by pouring fuel charge through this cup. A squirt can filled with gasoline is handy to use in priming engine.

9. Hold left hand over mixer—do not close opening entirely—and turn fly wheels over from you about $\frac{5}{8}$ of a turn, or until the crank shaft is in forward position, just below dead center. This draws the fuel charge into the cylinder. When priming engine through cup, it is not necessary to hold hand over mixer opening.

10. Cock Magneto with starting lever A as in Cut 6, Page 22.

11. Open fuel throttle valve about $\frac{3}{4}$ of a turn on 2 H-P engine and from 1 to 2 turns on the larger engines.

12. Grasp spoke of fly wheel at top with right hand and put your foot on the spoke at bottom. (See picture on page 10.) Pull back with your right hand and push with your foot, turning the wheel back toward cylinder quickly, forcing piston against compression as hard as you can. Release hold of fly wheel with hand and foot and trip Magneto, when engine should start. CAUTION: Do not trip Magneto until you are clear of wheel.

Should engine fail to start, it will probably be due to your not having quite the right mixture. Cock the magneto with starting lever (see Cut 6, Page 22), close fuel throttle valve and pull fly wheels back, forcing piston against compression as hard as you can, instantly pressing in intake valve with left hand to release compression. This will blow old charge of fuel out of cylinder. Repeat operation several times, until you are sure you have all of the fuel out of cylinder.

After cleaning cylinder of gasoline, start over again, as directed before. When engine starts, pull back timing lever and readjust throttle.

CAUTION: Do not turn on any water until engine begins to pound. Then feed water very gradually.

How to Start Kerosene Engine Equipped With Magneto by Cranking.

1. Prepare engine as directed on page 11.

2. Close all valves on mixer: Fuel throttle valve, water valve and fuel drain valve. See Cut 2 Page 15.

3. Fill fuel reservoir of Kerosene Mixer with gasoline.

4. If your engine is cold, open pet cock on end of pump barrel and keep engine running by refilling reservoir with gasoline until engine is very hot. Then close pet cock so kerosene may be pumped into reservoir.

5. Open hot air by-pass.

6. Move timing lever J (Cut 2, Page 22) to the right. This retards the spark for starting.

7. Pour about 2 tablespoonfuls of gasoline in opening of mixer as priming charge if engine is cold. If engine is hot, less fuel is required to start—about a teaspoonful or less. In case Magneto is equipped with priming cup, prime engine by pouring in fuel charge through this cup.

8. Open fuel throttle valve about $\frac{3}{4}$ of a turn on 2 H-P engine and from 1 to 2 turns on larger engines.

9. Place starting crank on crank shaft and turn fly wheels over rapidly five or six times until momentum is gained. Partly close air intake opening with left hand until engine starts. When engine starts, pull back timing lever J on Magneto and readjust fuel valve with air damper open.

CAUTION: Do not turn on any water until engine begins to pound. Then feed water very gradually.

How to Stop Kerosene Engine.

1. Close water valve by turning to right as far as it will go.
2. Close fuel valve by turning to right as far as it will go.
3. Turn down lever on top of lubricator, shutting off oil.
4. Open fuel drain valve to drain fuel reservoir.
5. Turn fly wheel until exhaust valve closes.

In cold weather, be sure to remove drain plug underneath cylinder and drain out^e all water. Be sure to do this, as even a slight frost may crack the cylinder or cylinder head.

When you shut down for a few minutes at any time and start up again, when engine is hot, you can start on kerosene direct without using any gasoline, and it will not be necessary to drain fuel reservoir in stopping. Be careful not to flood engine in starting up while hot.

Customer should inspect bearings, and if any are hot, repair them at once by loosening the nuts holding the bearings.^e

The Kerosene Mixer.

The kerosene mixer on kerosene engines is of our own special design. The kerosene is supplied to the fuel reservoir by means of a pump (Automatic Fuel Control). Open the pet cock on end of pump—no fuel will be raised from tank to reservoir.

When the pet cock is closed, the fuel starts to flow into reservoir from fuel tank, where it is held until needed. If more fuel is drawn up to fuel reservoir than is used by engine, it overflows back to fuel tank through the reservoir drain pipe.

The fuel is drawn into fuel mixer from reservoir as needed. By having the fuel close to the mixer, each fuel charge is always the same without it being necessary to readjust the fuel throttle as the fuel supply in the tank runs low.

The heater drum of the Kerosene Mixer consists of a cast shell, containing an inside heater, similar to the boiler of a steam engine. The hot exhaust gas from the engine passes out around the heater, and when the hot air by-pass is closed, fresh warm air is drawn into the mixer through the heater and added to the fuel mixture.

The sound of the exhaust is muffled in passing through the heater drum, and no other muffler is required or furnished on kerosene engines.

In starting the engine you close the fuel drain valve to prevent fuel from running out of reservoir; fill reservoir with gasoline to use in getting the engine heated up.

NOTE—If the pump forces too much fuel into reservoir, and the reservoir overflows, then move the pump finger on side bar back $\frac{1}{8}$ or $\frac{1}{4}$ of an inch. This shortens the plunger stroke and less fuel is pumped.

How to Get Best Results From Kerosene.

Any engine will use less fuel after it gets warmed up, because the fuel is more easily vaporized. Bear this in mind, and after starting your engine, gradually close the fuel throttle valve, until the engine runs with the least number of explosions in a minute, and without black smoke coming from exhaust, or a popping sound at mixer.

Black smoke from exhaust is caused by too much fuel and popping at mixer is caused by not enough fuel.

As soon as you have your engine started and fuel throttle valve properly set, you may begin at your work and run on load. When the engine has been running a few minutes, close hot air by-pass, which conducts the warm air to mixer from heater drum.

After the engine has been working a while, with the by-pass closed, and becomes hot, you may notice a slight knock or thump in the cylinder at each explosion, which is characteristic of all kerosene engines. To overcome this, open water valve a little at a time until knocking has nearly stopped.

Very little water is needed. Be careful not to use too much water. You cannot entirely overcome the knock. A little knock indicates good power, and too much water will cause loss of power.

If you use too much fuel, your engine may not knock, but will lack power. Sometimes in a new or cold engine the piston may be loose, causing fuel to run into crank case when engine does not smoke—that is, you may not notice it and engine will not knock. Watch this and cut down fuel used.

Should you fail to get engine hot, it will flood and lose power.

When the engine gets thoroughly warmed up—especially in warm weather—the by-pass may be opened, air being admitted directly to the mixer, the same as when using gasoline for fuel.

N. B.—By-pass should be open when engine is pulling or it won't develop H-P.

How to Start Gasoline Engine Equipped With Magneto Without Cranking.

1. Prepare engine as directed on page 11.
2. Hold intake valve in with left hand or open priming cup to release compression. With right hand turn fly wheels over from cylinder until Magneto trips, then stop.
3. Move timing lever J on Magneto (Cut 6, Page 22) forward towards fly wheel; this retards spark for starting.
4. Pour about 2 tablespoonfuls of gasoline in opening of mixer as priming charge if engine is cold. If engine is hot, less fuel is required to start—about a teaspoonful. In case Magneto is equipped with priming cup, prime engine by pouring fuel charge through this cup. A squirt can filled with gasoline is handy to use in priming engine.
5. Hold left hand over mixer opening—do not close opening entirely—and turn fly wheels away from you about $\frac{5}{8}$ of a turn, or until the crank is in forward position, just below dead center. This draws the fuel charge into the cylinder. When priming engine through cup, it is not necessary to hold hand over mixer opening.
6. Open fuel throttle about $\frac{3}{4}$ of a turn on 2 H-P engine and from 1 to 2 turns on larger engines.
7. Cock Magneto with starting lever A as in Cut 6, Page 22.
8. Grasp spoke of fly wheel at top with right hand and put your foot on bottom spoke. (See picture on page 10.) Pull back with your right hand and push with your foot, turning the wheel back toward cylinder quickly, forcing piston against compression as hard as you can. Release hold on fly wheel with hand and foot and trip magneto with starting lever, when engine should start. CAUTION: Do not trip magneto until you are clear of wheel.
9. As soon as engine starts, pull back timing lever on Magneto and readjust fuel valve.

Should engine fail to start, it will probably be due to your not having quite the right mixture. Cock magneto. Close fuel throttle valve and pull fly wheels back, forcing piston against compression as hard as you can; instantly press in intake valve with left hand to release compression. This will blow old fuel charge out of cylinder. Repeat

operation to make sure you have all the fuel out of cylinder.
After cleaning cylinder, start over again as directed before.

How to Start Gasoline Engine Equipped With Magneto by Cranking.

1. Prepare engine according to directions on page 11.
2. Push timing lever J on Magneto (Cut 6, Page 22) forward toward fly wheel. This retards the spark.
3. Pour about 2 tablespoonfuls of gasoline in opening of mixer as priming charge if engine is cold. If engine is hot, less fuel is required to start—about a teaspoonful.
4. Open fuel throttle valve $\frac{3}{4}$ of a turn on 2 H-P engine and from 1 to 2 turns on larger engines.
5. Place starting crank on crank shaft. Push detent blade in behind catch on side rod and hold it there; when detent blade is "hooked up," exhaust valve is held open and compression is released. Turn fly wheels around rapidly to the right several times, until momentum is gained, release detent blade and continue cranking until engine starts.

When engine starts, pull back timer lever on Magneto, open air damper and readjust fuel valve.

How to Stop Gasoline Engine.

1. Shut off gasoline by closing fuel valve.
2. Shut off the oil by turning down lever on top of lubricator.
3. In cold weather drain the water from the cylinder and head, by removing plug under cylinder. Be sure to do this, as even a slight frost may crack cylinder or head by freezing water.
4. Turn fly wheel back until exhaust valve closes. This prevents corroding of valve seats and injury to cylinder.

How to Adjust Gasoline Mixer.

The gasoline mixer is of the suction feed type, gasoline being drawn from the fuel tank by the suction of the piston. As the fuel passes into the mixer it is mixed with air and forms the explosive gas.

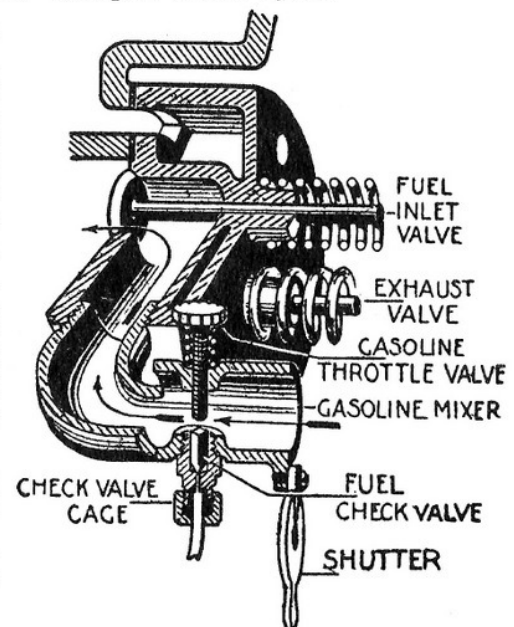
In starting the engine you open the fuel throttle valve and hold your left hand over mixer, partly closing the air intake, or close the air damper and turn the fly wheel over from cylinder—to the right—which draws the gasoline into the cylinder through the mixer and the engine is primed. If you close the air damper in starting, it should be opened as soon as the engine makes an explosion or two, but should the engine have a tendency to slow down when it is cold, the air damper may be partly closed. When the engine is warm you should be able to run with air damper wide open.

After opening the air damper, close the fuel throttle valve entirely by turning to right and slowly open it, very little at a time, until point is reached where the engine will run with least number of explosions in a minute and without black smoke coming in from the exhaust or a popping sound from the mixer. Black smoke, smelling strong of gasoline, coming from the exhaust indicates you are using too much fuel. A popping sound at mixer is caused by not enough fuel.

When engine is running on load, the suction of piston is greater than when it is running empty, and you can cut down fuel some. Use the least amount of fuel the engine will run on and pull the load; it will save fuel and engine will run better.

When engine is running without a load it should make an explosion and the fly wheels make a number of revolutions before another explosion is made. When the engine is running on full load the explosions will be made more frequent.

The engine, being of the four-cycle type, as ex-



Cut No. 2.

plained on pages 18 and 19, an explosion will not occur under any condition more frequent than every other revolution of the fly wheels.

If it is ever necessary to take the mixer apart, be very careful that you do not lose the check valve out of cage, and that all fuel connections are tight. All connections must be air-tight or engine will not get fuel regularly.

Starting in Cold Weather.

All engines are harder to start in cold weather because the fuel does not vaporize as readily as in warm weather. You can overcome the difficulty by putting some hot water in the hopper, which will warm the cylinder up to a point where the fuel will be readily vaporized. (Be careful not to use the water too hot if the engine is very cold, as the sudden change might crack the cylinder.) It will also be necessary to open the fuel valve wider in cold weather.

On a cold day, before starting, work the intake and exhaust valves with your hands to see that they are not stuck with frost.

If the valves should be stuck, the engine will be hard to start, and when you turn the fly wheels over, something may break.

GENERAL ENGINE INSTRUCTIONS.

Using Gasoline in Kerosene Engines.

The kerosene engines will burn gasoline as readily as kerosene without any change in equipment. You simply put gasoline in fuel tank and adjust the fuel throttle and air damper same as on regular gasoline engine.

It is not necessary to open water valve, as no water is required when burning gasoline. Be sure to keep by-pass open all the time when using gasoline.

When Water Boils in Hopper.

When the engine gets warm enough to boil water in the hopper it will run all the better, because the fuel vaporizes more readily when the engine gets warm, and it will use less fuel.

Boiling water in the hopper is just like boiling water in a tea kettle—as long as you keep the bottom of the kettle covered it will not be injured. So it is with the engine—keep the cylinder covered with water and no matter how hard the water boils, it will not injure the engine. Never let the water in hopper get below top of cylinder.

The cylinder is kept sufficiently cool by the water circulating around it and the heat passing off in the form of steam.

If you should ever let the water all boil away, do not fill the hopper while engine is hot. The sudden cooling might crack the cylinder.

Boiling water in the hopper may also be caused by any of the following:

Too much fuel. Piston dry. Water in fuel.

Side rod sticking—painted. Ignitor pin in side rod loose.

Exhaust valve partly open when engine explodes.

Ignitor moving, electrode sticking and slow acting.

Fuel lines stopped up.

If Engine Dies Down After Starting.

1. See that there is fuel in tank.
2. Air valve spring may be too weak.

Pull back on spring while engine is running, so as to put more tension on it. If engine runs better when spring is held back, remove spring and stretch it a little to make it stronger, or better still, get a new spring.

3. Magneto not working properly (see Page —; also special instructions).
4. Spark out of time. See page 18, "When the spark takes place."
5. Valves might be sticking. See that valves are working properly.
6. Too much fuel.

If You Are Unable to Start Your Engine, or It Is Hard to Start.

1. Be sure there is plenty of fuel in the tank.
2. See that the fuel flows to the mixer.

Dirt sometimes gets into the fuel pipes and collects under check valve or fuel valve. Cock Magneto so that no spark will be made. Hold your hand over mixer and draw in fuel charge by turning fly wheel as in starting. If you cannot see any fuel in mixer, then you may be pretty certain something is wrong with fuel system. Disconnect pipes and clean all connections, valves and valve seats.

3. Too much fuel.

It is a common mistake to flood the cylinder with fuel in starting, which makes starting hard. It takes very little fuel to start an engine when it is warm, as fuel vaporizes much easier when it is warm or in warm weather. See pages 6 and 10. An engine can be choked down entirely by too much fuel, just as easily as by not giving it enough.

4. Too little fuel.

If engine is not getting enough fuel it will pop and back-fire at mixer. Back-firing at mixer is not always caused by insufficient fuel. It may be caused by poor ignition, valves not seating properly, or water in cylinder. Cylinder head packing may have given out, admitting water to cylinder. If you discover a packing leak, see page 20 how to replace packing, and follow instructions for putting on packing closely.

5. Weak spark. (See special Magneto instructions attached.)
6. Piston dry on account of too much fuel.
7. Side rod stuck—rusty or painted.
8. Governor sticking.
9. Movable electrode sticking—not oiled.

If Engine Lacks Power.

1. Spark Regulation.

See that the timing lever "J" on Magneto is pulled back in running position.

2. Ignition. No spark or spark not timed properly.

Make sure that igniter trips when the word "Spark" on rim of fly wheel is even with top of side bar.

3. Poor fuel mixture.

Lack of power may be traced to a poor fuel charge. To have a fuel charge that is quickly ignited and will burn up completely, the fuel and air must be mixed in right

proportions. If the fuel charge is not properly mixed, it makes a slow burning mixture, causing back firing at the mixer and not giving force enough to bring the engine up to speed, so the governor cuts out; another charge of fuel is admitted which is fired too soon by the previous slow-burning charge and naturally escapes through the mixer. Try regulating fuel valve and be sure fuel pipe connections are tight; also that fuel pipes are not clogged up, or something may have lodged under valves, preventing them from seating properly.

4. Too large a pulley.

Many customers order too large a pulley on engine, then run engine too slow.

5. By-pass closed or damper closed after engine is hot.

6. Customer using poor oil or oil not heavy enough for kerosene. To make sure you are right, always use OTTAWA Special Lubricating Oil.

7. Atmospheric conditions vary.

As the conditions of the atmosphere change there is no certain point at which the fuel throttle valve may be set; however, if you will closely watch the action of the engine and adjust the fuel valve at a point where the engine runs regularly and without black smoke coming from the exhaust, you will have no difficulty along this line.

8. Water in fuel.

Water in fuel will cause loss of power. Test the fuel for water.

9. Exhaust valve not opening at right time.

Make certain exhaust valve is closing a little below inner dead center. See below.

10. Valves not seating.

If the valves are not seating properly, compression will escape, resulting in loss of power. Regrind the valves. See page 19, also page 17.

11. Piston ring stuck in grooves.

If piston rings are badly worn or stuck in grooves, compression will escape around piston, causing loss of power. Piston should be drawn and carbon removed. See page 20 on Piston and Rings.

12. Feeding too much water with kerosene mixture.

If you are using kerosene for fuel, be sure you have the water valve adjusted properly. Too much water makes a poor mixture, which burns slowly, resulting in late combustion, which, besides causing loss of power and leaving excessive carbon deposits in cylinder, heats the engine up to such an extent that pounding results, commonly called pre-ignition. This pounding can always be mostly overcome by feeding right amount of water to mixer. Pre-ignition will be indicated by a thumping sound in cylinder and is caused by carbon deposits being formed in cylinder which hold heat enough to fire the charge ahead of electric spark.

When the Spark Should Take Place.

To get full power from the engine, the spark should take place when the piston reaches the end of the compression stroke or when the piston is in the cylinder as far as it will go, the valves being closed.

Because of the momentum of the fly wheels, the spark is timed so it takes place when crank is a little below inner dead center. See cut 10, page 25, showing position of crank when spark takes place.

In order to easily tell when spark should take place to give best results, the word "Spark" is stamped on rim of fly wheel. NOTE: SOME ENGINES HAVE 3 CENTER PUNCH MARKS IN PLACE OF WORD "SPARK." The spark should take place in the cylinder when the word "spark" is opposite top of side bar and valves are closed. Turn the fly wheels around slowly to the right and stop the instant the magneto clicks. If the word "spark" on rim of fly wheel is directly opposite top of side bar, then the spark takes place at the right time in the cylinder. If the word "spark" is below top of side bar, when igniter snaps, the spark takes place too early. If the word "spark" is above top of side bar, then the spark takes place too late.

How to Adjust Detent Lever.

When the exhaust valve is held wide open by cam or large gear, and the detent blade is pushed in behind detent plate on side bar, there should be a space about the thickness of a dime between the blade and plate, to allow detent lever to release bar when governor acts.

To adjust the side bar plate, loosen the two set screws which hold it to side bar and set it so you have the correct space between the blade (Parts 55 and 61 on Page 21) and side bar plate, to allow detent lever to release bar when governor acts.

Both the detent plate and detent blade are made of hardened steel and should wear a long time. If they ever wear until they will not hold properly, they may easily be removed and ground off square again.

Power Force and Compression.

When the fuel is taken into the mixer it is mixed with air and vaporized. That is, it is changed into gas. This gas is taken into the cylinder, compressed by the piston and by means of the electric spark is burned, or as is generally termed, "exploded." The fuel, unless mixed with air, is not explosive. The fuel, being highly compressed, burns very quickly, creating a high degree of heat, and it is the expansion of heat against the piston which causes the engine to run and to develop power.

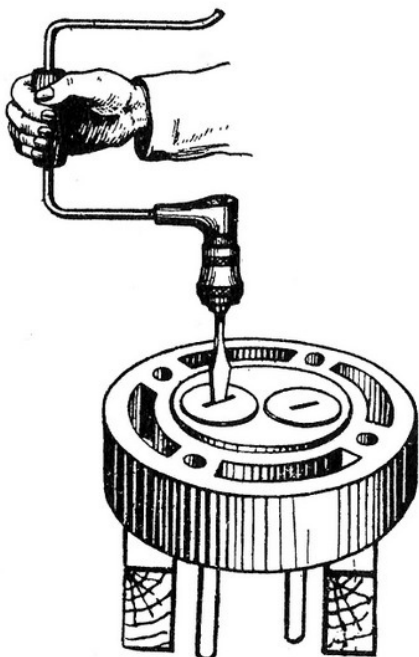
To compress the gas and hold the force of the expanded gas, it is necessary that the piston fits the cylinder closely, and that the valves seat tight. Each piston is fitted with sufficient number of rings that spring out and press against the wall of the cylinder to prevent escape of gas or loss of compression. Loss of compression means loss of power. A leak in compression around piston will be noticed by a hissing sound when closed by a spring.

Valves—Their Operation.

The intake valve is automatic, being opened by the suction of the piston and closed by a spring. A valve lock on side bar holds valve closed when exhaust valve is open, to prevent waste of fuel. The valve lock should press against washer on intake valve when exhaust valve is held full open. No valve lock is necessary on small engines.

The exhaust valve is opened by exhaust lever, which is operated by the side bar and engine is running.

How to Grind the Valves.



Cut No. 3.

Both intake and exhaust valves should seat tight or the engine will lose compression, resulting in loss of power, and fuel will be wasted. When a valve leaks, remove cylinder head and take off valve springs, then make a fine paste of emery dust and oil or use a regular valve grinding paste, which may be had at almost any automobile garage or hardware store. Put some of the paste on valve and seat and with screw driver (see Cut 3) turn the valve first one way, then the other, with a light pressure, occasionally raising the valve so the paste will get under it. Continue grinding with oscillating movement only until valve and seat show a bright streak all the way around.

After grinding valves, wash off the emery very carefully with gasoline, so none of it will get into the cylinder. Before replacing spring, see that there is no dirt under valve. Be sure that you have the heavy spring on exhaust valve and the light spring on intake valve.

Packing the Cylinder Head.

Scrape all old packing from both cylinder and cylinder head. The packing surface must be perfectly clean or you will not get a tight joint. Take a piece of asbestos packing, which you can get at your hardware store or

at an automobile garage, and cut out a new packing. If you prefer, we can send you a packing already cut. To cut out packing, lay the asbestos on cylinder head and lightly tap it with a hammer around edge of head and water jacket. After cutting out packing, soak it in linseed oil, or regular cylinder oil will do, if you don't have any linseed oil. After placing packing on cylinder, push the head in close to the cylinder and screw on nuts by hand. Then with a wrench tighten each nut a half turn at a time until they are all perfectly tight. Do not screw one nut down perfectly tight at a time, as this will cause an uneven joint and packing will not hold. When you start the engine up and it has been running a few minutes, getting warmed up, tighten all the nuts again and you will have a tight joint.

If you make a new packing from sheet of asbestos, be sure to cut openings so water will circulate from cylinder through cylinder head and around valves; if you fail to cut opening to allow water circulation, the head will get too hot and might be ruined.

Piston and Rings.

It being the purpose of the rings to hold compression, they must fit free in grooves of piston. If too much fuel is used or too much oil, or oil of poor quality, excess carbon will form on piston, causing rings to stick in grooves. When the rings stick or become set in grooves they cannot spring out against cylinder wall, and your engine will leak compression.

If the rings should stick in grooves, but are not stuck too tight, you may be able to loosen them by opening the cylinder lubricator wide and pouring some kerosene through it while the engine is running. After doing this you should immediately oil piston thoroughly, as the kerosene will wash all the oil from cylinder.

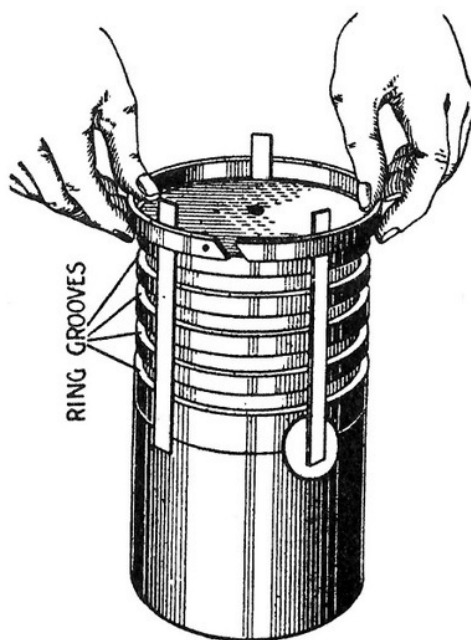
Should the rings become too badly set with carbon, it will be necessary to take the piston out of cylinder and clean the carbon off. To loosen rings, soak piston in kerosene and work them in and out in grooves with your hands.

To draw the piston, remove the connecting rod cap when piston may be pulled out. The rings may be removed from the piston by working several strips of thin metal under them. See Cut 4. Pieces of old hack saw blades are good for the purpose. Begin by inserting a strip under end of ring and working it around. After taking the rings out, clean them off thoroughly; also clean out grooves and clean the carbon from end of piston.

The rings may be easily put back on piston by using the metal strips. Care should be taken to put each ring back in groove from which it was removed.

The Governor.

The governor controls the speed of the engine and is of the fly ball type. When the speed of the engine slackens, the weights in fly wheel are drawn together by the governor springs, which allows the detent lever to release the side bar. When the side bar is released, the exhaust valve closes and a charge of fuel is drawn into the cylinder and fired by magneto. As the engine gains speed, the governor weights fly apart and cause the detent to hook up on the side



Cut No. 4.

bar, again holding the exhaust valve open. When the exhaust valve is held open, no fuel will be used.

Keep the side bar guides well oiled, also all governor parts, and see to it that they work freely at all times.

To increase the speed of the engine, tighten the governor springs; to reduce the speed, loosen the springs.

Always keep the governor springs set so engine runs up to normal speed to get full power.

Clean off all paint; clean springs of paint, too.

Bearings.

The main bearing and center crank bearing are die babbited from a special high grade babbitt and if kept tight and well oiled there is very little wear on them.

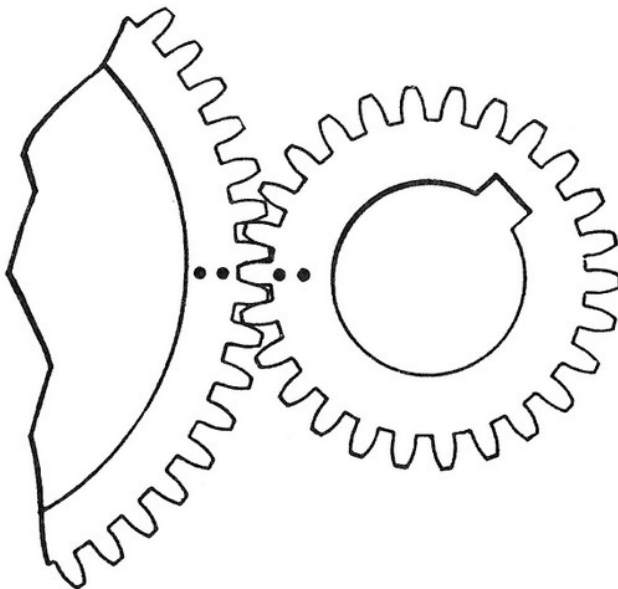
To tell if main bearings are too loose, put a pry under fly wheels and raise wheel up while holding hand on bearing cap and hub of wheel and you can detect any lost motion.

Provision for any wear is made by fitting the bearings with liners. To take up wear, remove cap and take out a liner on each side of bearing. The shaft should fit snug, but must work freely and not bind. Care should be used in taking up bearing wear not to get them too tight. Thinner liners may be used if necessary.

After tightening cap and before starting engine, turn fly wheels around by hand to see that shaft does not bind. If the shaft binds in bearings, they are likely to overheat.

Piston pin bearing is fitted with a slotted bronze bushing and wear may be taken up by means of adjusting screw on under side of connecting rod. Bushing can be removed without getting new rod.

The engine should never be allowed to run with dry or loose bearings. If it does, bearings may be ruined or it may be the cause of something breaking. Oil main bearings frequently and screw down oil cup on rod.



Cut No. 5.

How to Put on Gears.

The gears are marked with punch marks, as in Cut 5. If it is ever necessary to take off either gear at any time, be sure in putting it back that these punch marks come together.

One tooth out of the way will make quite a difference in running of engine, as the cam on large gear controls the time of spark and the opening and closing of valves, all of which must work in perfect harmony.

Engine Speed and Pulleys.

Each engine, when it leaves the factory, is set to run at speed it tested to do best work, and in order that you get full power you should have pulleys of proper size to permit engine to run at normal speed. This speed is stamped on name plate. If the

machine you are operating with engine runs at a very high speed, it is better to put a smaller pulley on the machine or line shaft where possible, rather than to increase the size of the pulley on the engine. You can increase the speed of the engine a little, if necessary, without injury to engine.

When you cut down the speed of the engine, you cut down your power at the same time. The speed may be changed easily and quickly by the speed regulator, while the engine is running.

To figure the correct size of pulleys, when you have the size of pulley and speed of the machine you are going to run: Multiply the speed of the machine you are going to

run with the engine by the diameter (in inches) of the pulley of the same machine, or line shaft, and divide the product by the normal speed of the engine. The quotient will be the diameter of the pulley, in inches, needed for the engine. If you want to figure the correct size of pulley to get on a machine or line shaft, multiply the normal speed of the engine by the diameter, in inches, of the regular pulley, and divide the product of this multiplication by the speed of the machine or line shaft.

To Tell How Fast Engine Is Running.

You can easily tell how fast your engine is running by counting the number of times the cam on large gear wheel touches the roller on side bar and multiplying the count by two, as the large gear has just twice as many teeth as the smaller gear, and the fly wheel will go around twice while the large gear goes around once.

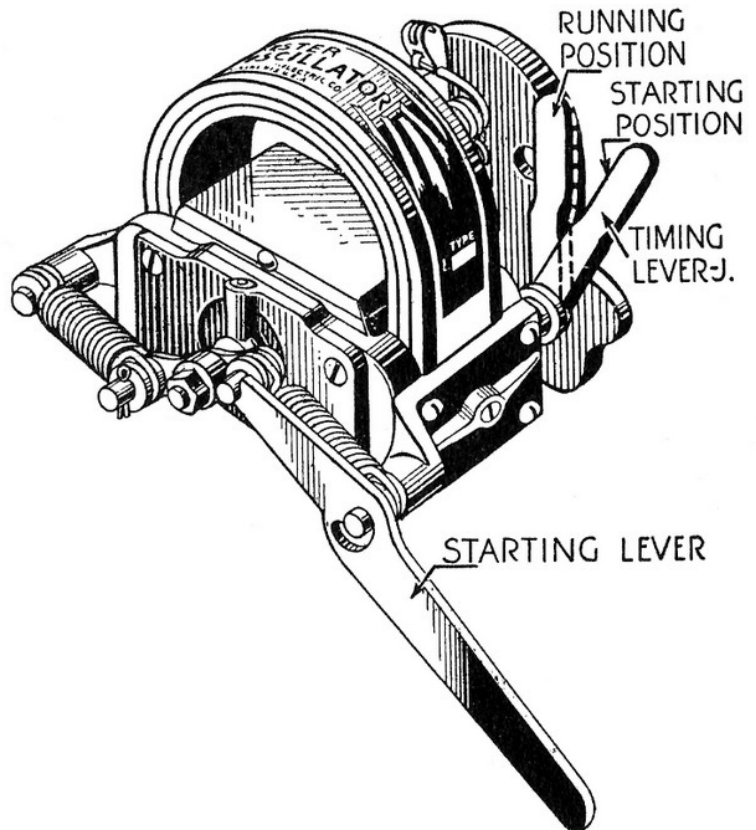
The Oscillating Magneto.

To test the igniter, when engine is equipped with a Magneto, remove Magneto and igniter block from engine without detaching Magneto from block. Trip Magneto with starting lever, as in starting engine. If you do not get a good spark at igniter points, there may be a short circuit, insulation on stationary electrode may be dirty or broken, or adjustments may be wrong. See special Magneto instructions sent with this book.

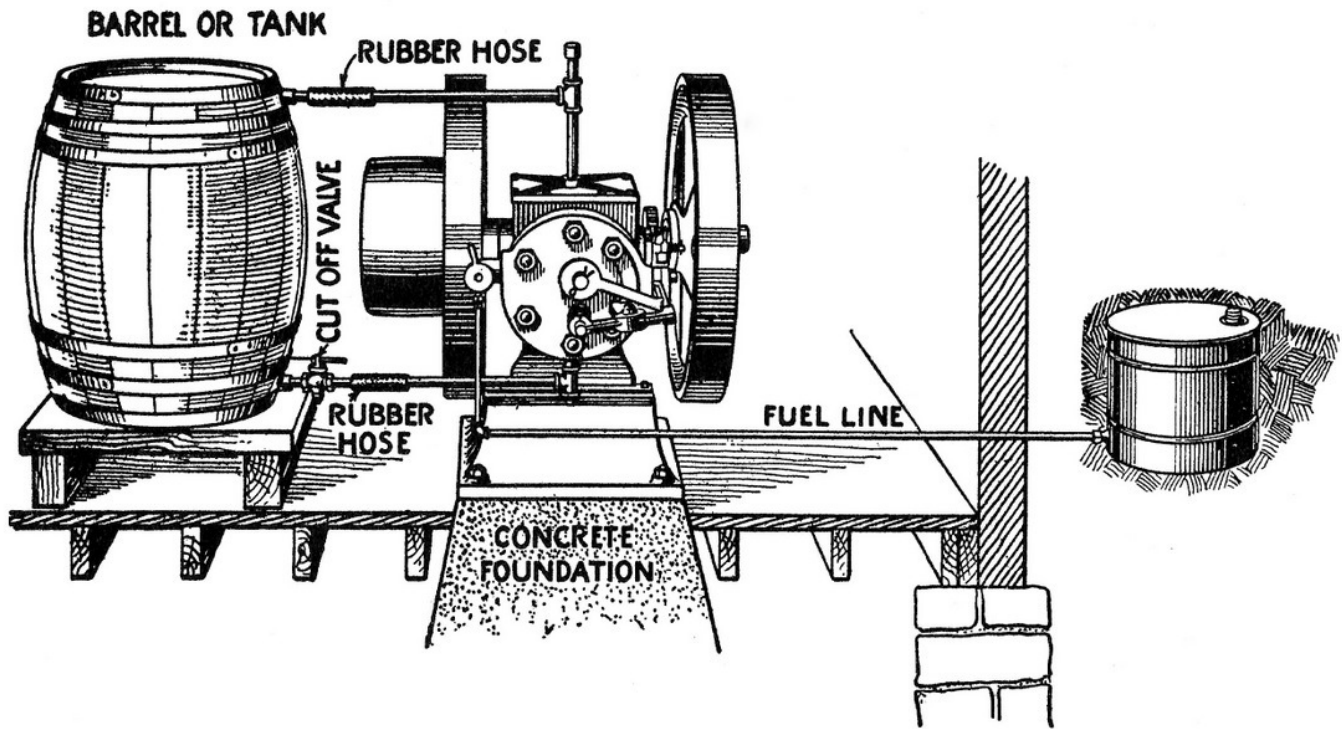
In starting, timing lever J is moved to the right, which retards the spark. When engine is running, timing lever is moved to left.

If you want to run your engine with batteries, loosen lock nut P (see special instructions) and tighten set screw E until igniter points are separated thickness of a postal card, then tighten lock nut.

Connect up a set of batteries, attach wire from coil to terminal on igniter and the other wire to bracket bolt under Magneto. Do not take off Magneto.



Cut No. 6.



Cut No. 7.

When an engine is used for inside work or for long runs it is sometimes desirable to have a larger water supply in order to avoid putting water in hopper as often as may be required. In such cases we can furnish a plate to fit on top of cylinder in place of the hopper and a tank or barrel may be attached as shown in cut above. The pipe under cylinder should be fitted with a drain plug or drain cock so that the water can be drained from the cylinder in cold weather, or an anti-freeze solution should be used in water.

If running water is to be had, you can arrange to let the water drip into the hopper as fast as it evaporates, keeping the water at a level in the hopper, or nearly so, all the time. Another way is to lead the water in at bottom of cylinder, using a valve in pipe. With either arrangement an overflow pipe should be provided.

The fuel tank may be placed outside any reasonable distance from the engine; but it should be so placed that the top of the tank is on a level with the lower part of the fuel mixer.

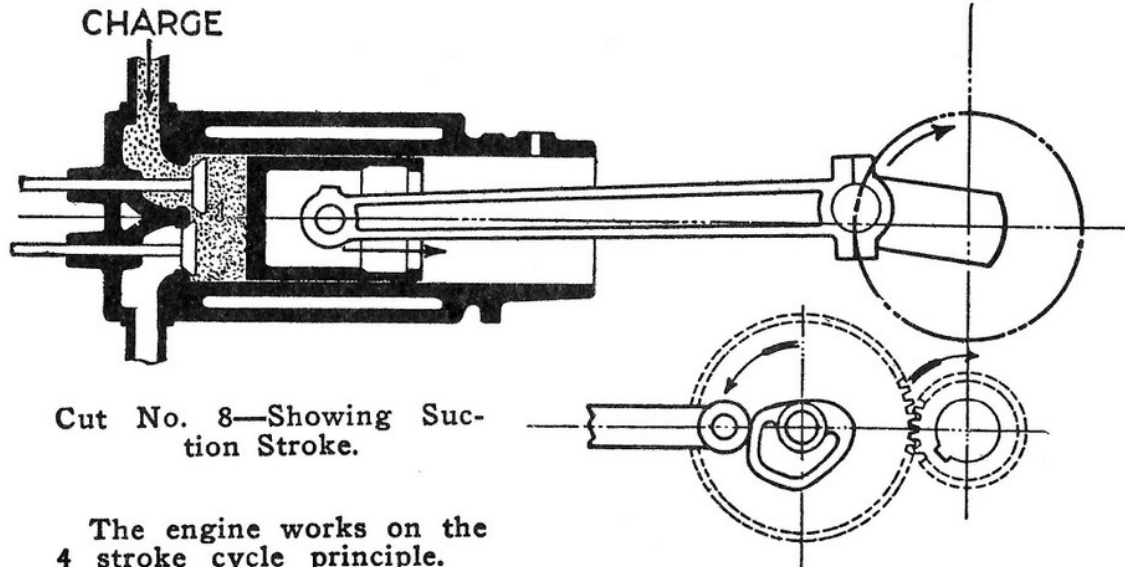
The Exhaust.

The exhaust pipe must be full size, and as free from turns as possible. If the pipe has to be very long, it is best to increase the size. Whenever possible, the exhaust pipe should run up through the roof. An inch air space should be allowed around pipe at joint where it goes through roof or wall, or a fireproof joint made. Never leave exhaust open so it will catch rain or snow. The water will run down and cause the exhaust valve to rust. Never connect the exhaust pipe to a flue or cistern. If you want to get rid of exhaust noise, you can do so by sinking a barrel into the ground, fill it with rock about the size of your fist, and lead the exhaust into the barrel near the bottom. Holes should be bored in bottom of barrel so water will seep out, and considerable space should be left around end of pipe in barrel.

Timing of Valves.

In some instances where engine is hard to start, or does not seem to give usual full power, it is due to valves not being properly timed. The intake valve being automatic, only the timing of exhaust valve need be watched. Examine timing of exhaust valve occasionally.

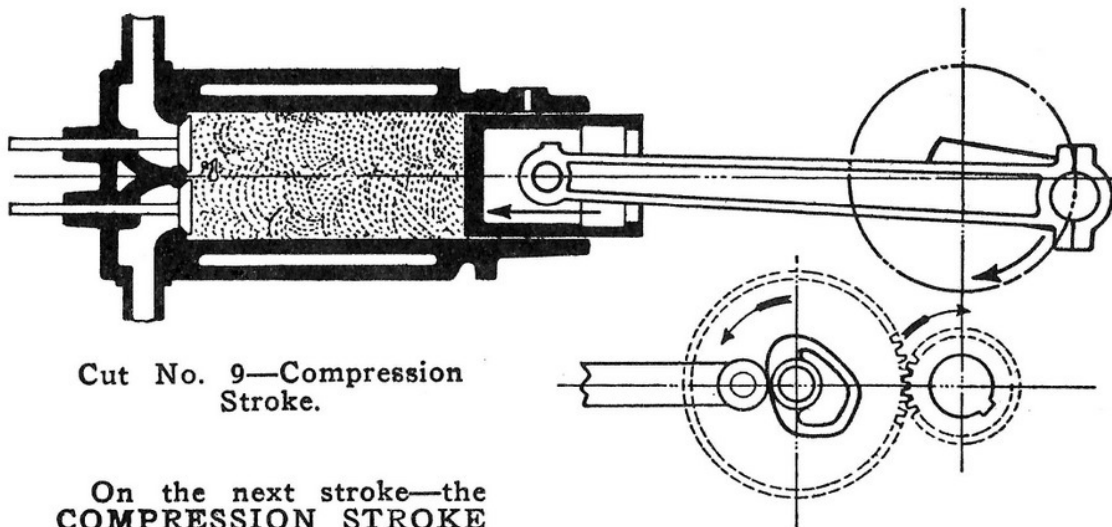
On the rim of Governor fly wheel you will find stamped the words



Cut No. 8—Showing Suction Stroke.

The engine works on the 4 stroke cycle principle.

This cut shows position of piston, crank and cam at beginning of **SUCTION STROKE**. Piston is moving out drawing in a charge of fuel and air. The intake valve opens by suction of piston. Exhaust valve remains closed on this stroke.



Cut No. 9—Compression Stroke.

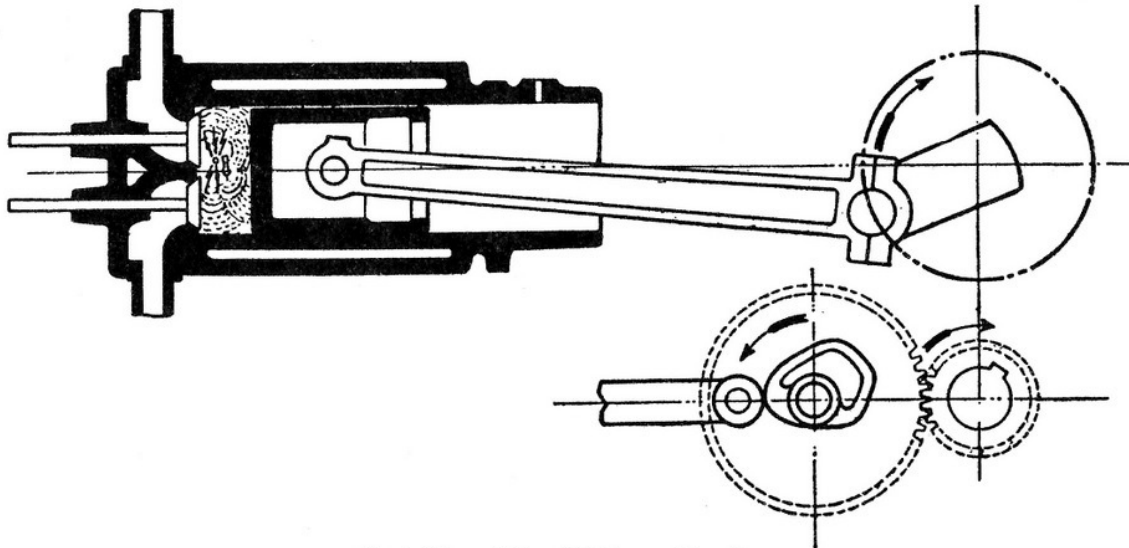
On the next stroke—the **COMPRESSION STROKE**—both valves remain closed and fuel and air are compressed by the return of the piston, forming the explosive mixture. This stroke begins when the crank is just under outer dead center. Cut shows position of cam, piston and crank at beginning of compression stroke.

“Exhaust Opens” and “Exhaust Closes,” in addition to the word “Spark.” To test timing of exhaust valve, simply turn fly wheel around

as in starting until the magneto trips, continue turning wheel until words "Exhaust Opens" are even with top of side bar, then see that exhaust valve is just beginning to open.

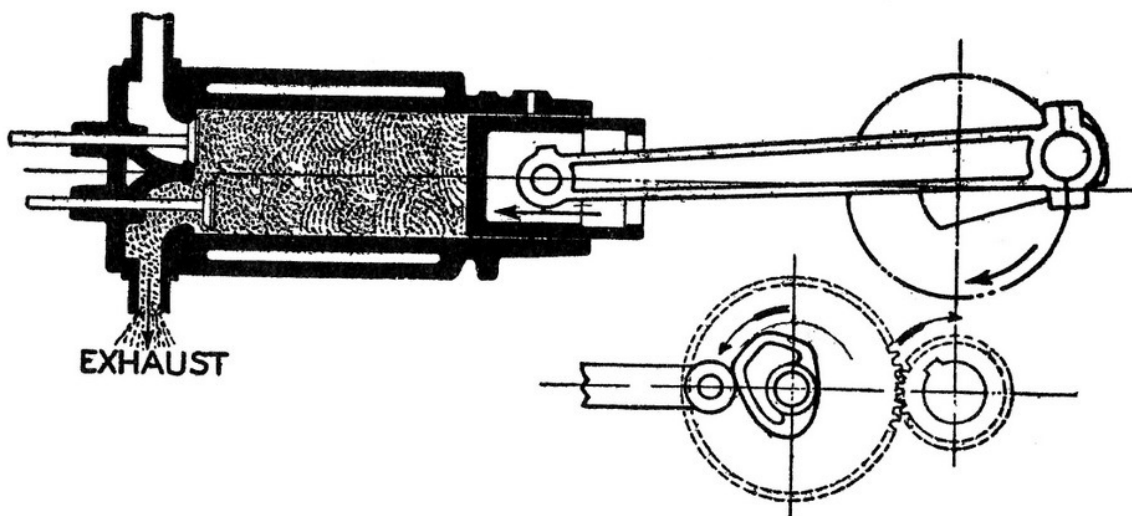
The time of opening and closing is controlled by adjusting screw on exhaust lever, see part No. 28, page 31.

If you find exhaust valve opening too early or too late, change adjustment of screw until valve is opening when words "Exhaust Opens" on rim of the governor fly wheel are even with top of side bar.



Cut No. 10—Firing Stroke.

Just before the crank reaches inner dead center, valves remaining closed, the fuel charge is ignited by the spark and the piston is forced out of cylinder. This is called the FIRING STROKE. Cut shows position of piston, cam and crank at beginning of this stroke. Arrows indicate direction of piston travel.



Cut No. 11—Exhaust Stroke.

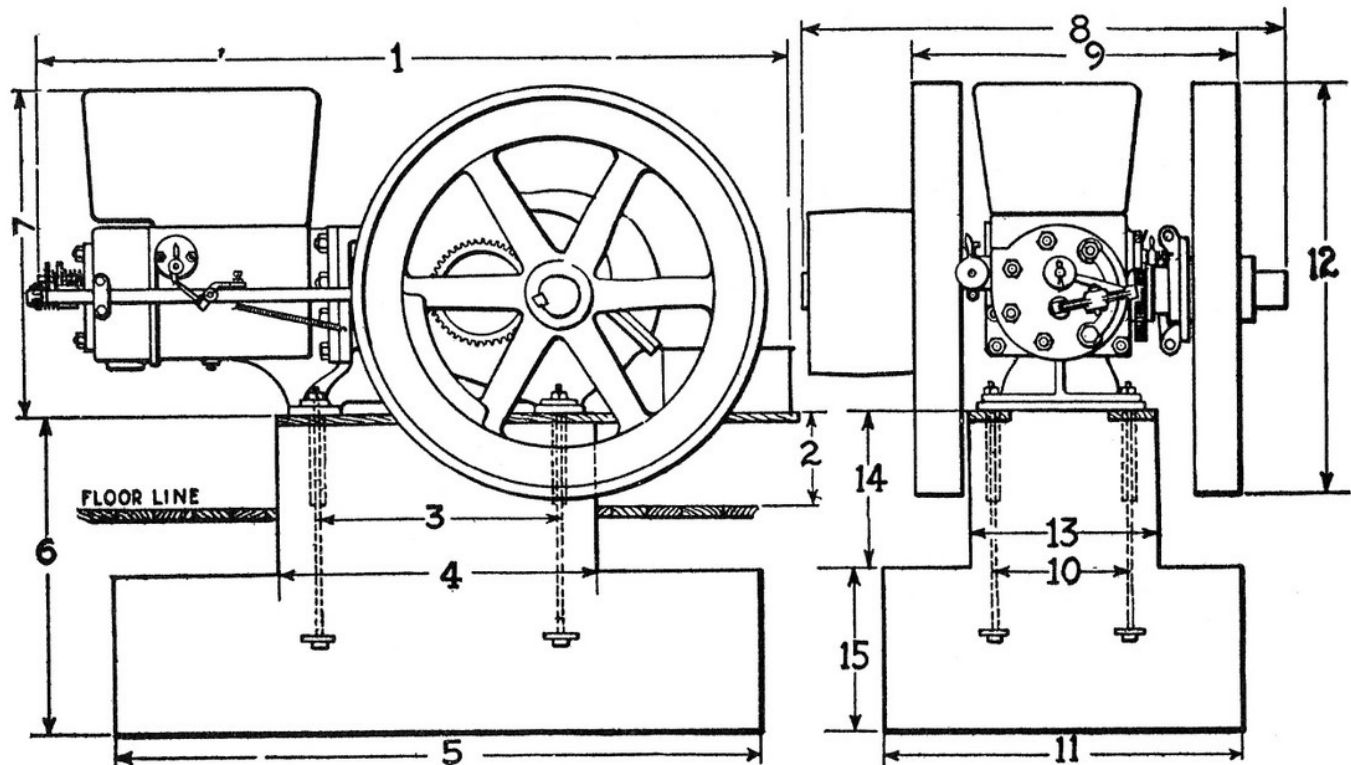
As the piston returns after charge is fired, the exhaust valve opens and the burned gases pass out. This is the fourth stroke or EXHAUST STROKE and completes the four cycles, during which the engine has drawn in, compressed, exploded and exhausted fuel, and the fly wheels have made 2 complete revolutions.

Installing and Erecting.

Unless otherwise ordered, all engines are shipped complete—self-contained and mounted on wood skids. When an engine is ordered with extra iron sub-base it is also shipped complete and self-contained.

If you use your engine for outside work, bolt the skids or iron sub-base to a couple of timbers, placing one timber under either end cross-wise. This will prevent engine from settling into the ground and serve as a foundation. It will pay you well to protect your engine from the weather, even if it is used out of doors.

If your engine is to be used for inside work, it should be firmly bolted to a good, solid foundation or floor and located in a light place.



Foundation Plan for Engine Without Iron Sub-Base.

Dimensions Given in Inches

Size Engine	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1½.....	38	4	13	14	38	14	15 ³ / ₄	23	16	6 ¹ / ₈	18	15 ³ / ₄	8	7	7
2½.....	40 ³ / ₄	5	16 ⁷ / ₈	18	44	18	18	26 ⁷ / ₈	17 ⁵ / ₈	7 ³ / ₈	22	20	9	9	9
3.....	43 ³ / ₄	6	19 ¹ / ₄	20	46	20	18 ¹ / ₂	27	18 ¹ / ₂	8	24	21 ³ / ₄	8 ¹ / ₂	10	10
4.....	51	6 ¹ / ₂	15 ⁷ / ₈	22	48	20	20 ¹ / ₈	35 ¹ / ₄	20 ³ / ₈	9 ¹ / ₈	26	23 ³ / ₄	12	10	10
5.....	61	7	24 ³ / ₄	27	52	22	24	35 ⁵ / ₈	21 ³ / ₈	9	28	28	12	11	11
7.....	61	7 ¹ / ₂	23	25	56	26	26 ¹ / ₄	31 ³ / ₄	21 ⁷ / ₈	9 ⁷ / ₈	32	30 ¹ / ₄	13	14	12
8.....	70	7	27 ³ / ₈	30	58	28	26 ¹ / ₂	36 ¹ / ₂	22 ¹ / ₂	9 ³ / ₄	34	32 ¹ / ₄	13	16	12
10.....	64 ³ / ₄	7	20 ¹ / ₄	27 ¹ / ₂	60	30	28	41 ³ / ₈	24 ⁷ / ₈	13 ³ / ₄	36	32 ³ / ₄	17	17	13
12.....	74 ³ / ₂	8	31 ¹ / ₄	43	68	32	31 ⁷ / ₈	45	26 ³ / ₈	12 ¹ / ₈	38	39 ¹ / ₂	15	18	14
16.....	80 ³ / ₄	8	37 ³ / ₄	45	84	40	39 ³ / ₄	48 ¹ / ₂	30	15 ¹ / ₈	40	44 ¹ / ₄	18 ¹ / ₂	26	14
22.....	92 ¹ / ₂	12	42 ³ / ₈	51	90	48	42 ³ / ₈	51 ¹ / ₄	35	17	42	50	20	30	18

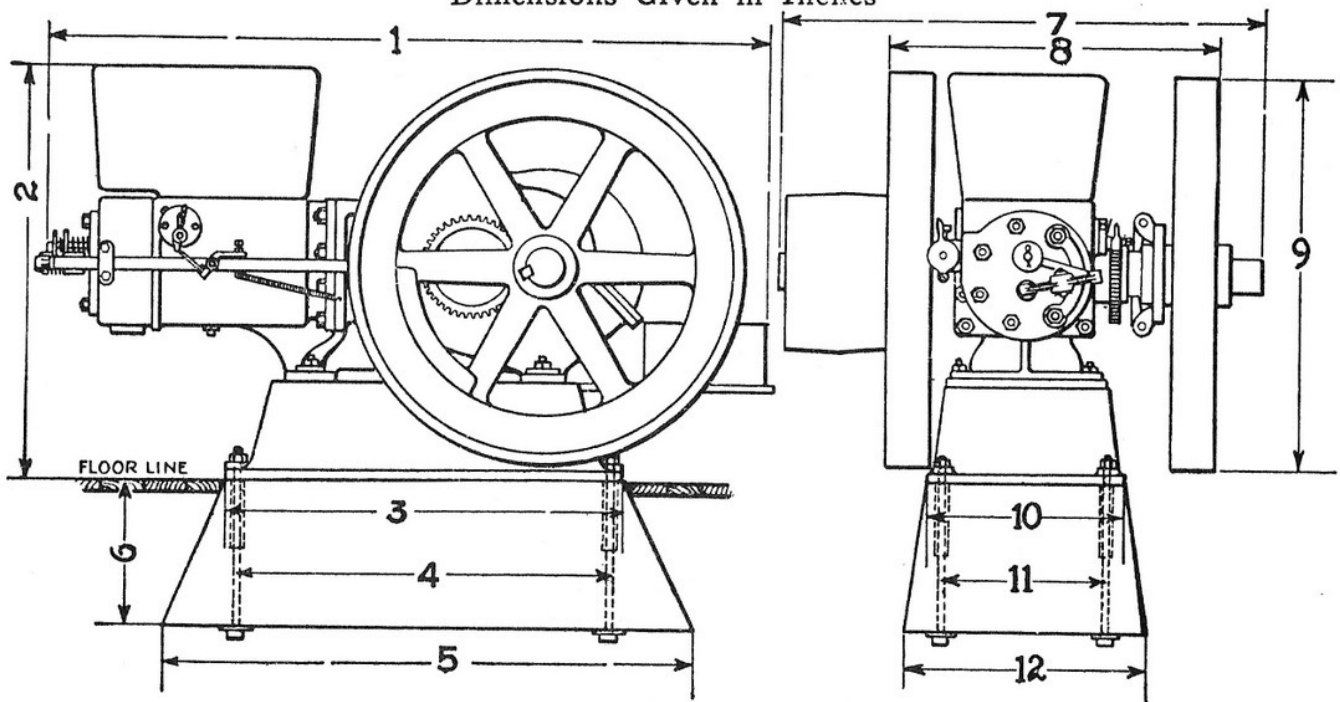
Allow plenty of space around the engine so you will have room to work.

In building a permanent foundation for your engine you can use either concrete, brick or stone. Cut No. 15 with table gives dimensions for making foundation for engine without extra iron sub-base, and Cut No. 16 with table gives dimensions for foundation for engine having the extra iron sub-base. The engine should not be set directly on foundation. Place a couple of planks (2x4 or 2x6) lengthwise on top of foundation and set the engine on them. The planks will act as a cushion.

The foundation bolts do not need to extend to the bottom of foundation. A piece of pipe or tubing a little larger inside than the bolts should be placed on each bolt as indicated by the dotted line in cuts. These pipes should come about 1/4 inch below the top of foundation. They are put in so bolts can be shifted to allow for any variation in bolt holes in engine bed or iron sub-base.

Foundation Plan for Engine With Iron Sub-Base.

Dimensions Given in Inches



Size of Engine	1	2	3	4	5	6	7	8	9	10	11	12
1½.....	38	18 ³ / ₄	17 ³ / ₄	16 ³ / ₈	38	14	24	15 ¹ / ₂	16	8 ¹ / ₂	7	18
2½.....	40 ³ / ₄	20 ⁷ / ₈	21 ³ / ₈	19 ⁷ / ₈	44	18	26 ⁷ / ₈	17 ⁵ / ₈	20	10 ³ / ₈	9 ¹ / ₄	22
3.....	43 ³ / ₄	22 ¹ / ₂	25	23 ³ / ₈	46	20	27	18 ¹ / ₂	21 ³ / ₄	10 ⁵ / ₈	9 ¹ / ₄	24
4.....	51	26 ⁵ / ₈	24 ¹ / ₈	22 ³ / ₄	48	24	35 ¹ / ₄	20 ³ / ₈	23 ³ / ₄	13 ¹ / ₂	11 ⁷ / ₈	26
5.....	61	30 ¹ / ₈	31 ¹ / ₂	29 ¹ / ₂	52	26	35 ⁵ / ₈	21 ³ / ₈	28	12 ¹ / ₄	10 ¹ / ₄	28
7.....	61	31 ³ / ₄	29 ¹ / ₄	27 ¹ / ₂	56	28	31 ³ / ₄	21 ⁷ / ₈	30 ¹ / ₄	13 ³ / ₈	11 ³ / ₈	32
8.....	70	32 ⁵ / ₈	34 ¹ / ₂	32 ³ / ₄	58	29	36 ¹ / ₂	22 ¹ / ₂	32 ¹ / ₂	13 ¹ / ₂	11 ³ / ₄	34
10.....	64 ³ / ₄	34 ¹ / ₈	28 ¹ / ₄	26 ⁷ / ₈	60	29	41 ³ / ₈	24 ⁷ / ₈	32 ³ / ₄	16 ³ / ₄	15 ¹ / ₄	36
12.....	74 ¹ / ₂	39 ¹ / ₈	39 ¹ / ₂	37 ⁵ / ₈	68	30	45	26 ³ / ₈	39 ¹ / ₂	16 ³ / ₈	14 ³ / ₈	38
16.....	80 ³ / ₄	47 ¹ / ₂	44 ³ / ₄	42 ⁷ / ₈	84	32	48 ¹ / ₂	30	44 ¹ / ₄	20 ¹ / ₂	18 ³ / ₈	40
22.....	92 ¹ / ₂	54 ⁵ / ₈	51	49	90	34	51 ¹ / ₄	35	50	22 ¹ / ₂	20 ¹ / ₂	42

Parts 54, 72, 79, 74 as shown here, discontinued. See new parts on opposite page.

Important General Information.

In order to get the best results with your engine it will be necessary for you to keep it in proper running condition and adjustment. Keep all bolts and nuts tight; all bearings properly adjusted and all working parts well oiled with good oil. Examine the connecting rod bearings and main bearings frequently. These bearings must be kept tight enough so there will not be any lost motion in them. (See page 21.) If you allow your engine to run with loose bearings it will not only be noisy but the crank shaft or some other part may break.

Be sure that all fuel pipes and connections are tight. A leak in fuel pipes is not only wasteful of fuel but very dangerous, and the engine will not get fuel regular.

The best way to do is to take a little time occasionally to go all over your engine when it is not in use and inspect the wiring to see that it is all right—all connections are tight. Examine the bearings to make sure they are tight. Look at the timing of the spark to see that the spark is made at the right time. As the igniter points wear a little it may be necessary to change timing of spark slightly.

Remember the old but true saying, "An ounce of prevention is worth a pound of cure." Follow instructions closely, which will help you in finding the information you want.

By all means keep your engine clean. Do not allow dirt or grit to accumulate on the bearings and working parts. Dirt and grit will cause them to cut out. Clean the engine off once in a while with kerosene and freshly oil it up. By keeping your engine clean and in good working order it will last much longer and will do best work for you. Besides you will save much time when you need your engine by having it always ready for work.

In running your engine keep these facts in mind: It is the fuel and air when mixed together in right proportions that forms the explosive gas; it is this gas when fired by the spark that makes the engine run. So if your engine is in correct adjustment, is getting the right mixture of fuel and air, you have a good spark at the igniter points; the spark is in time and the governor is working freely, it will run. Should anything go wrong look into these things first and make certain they are all right.

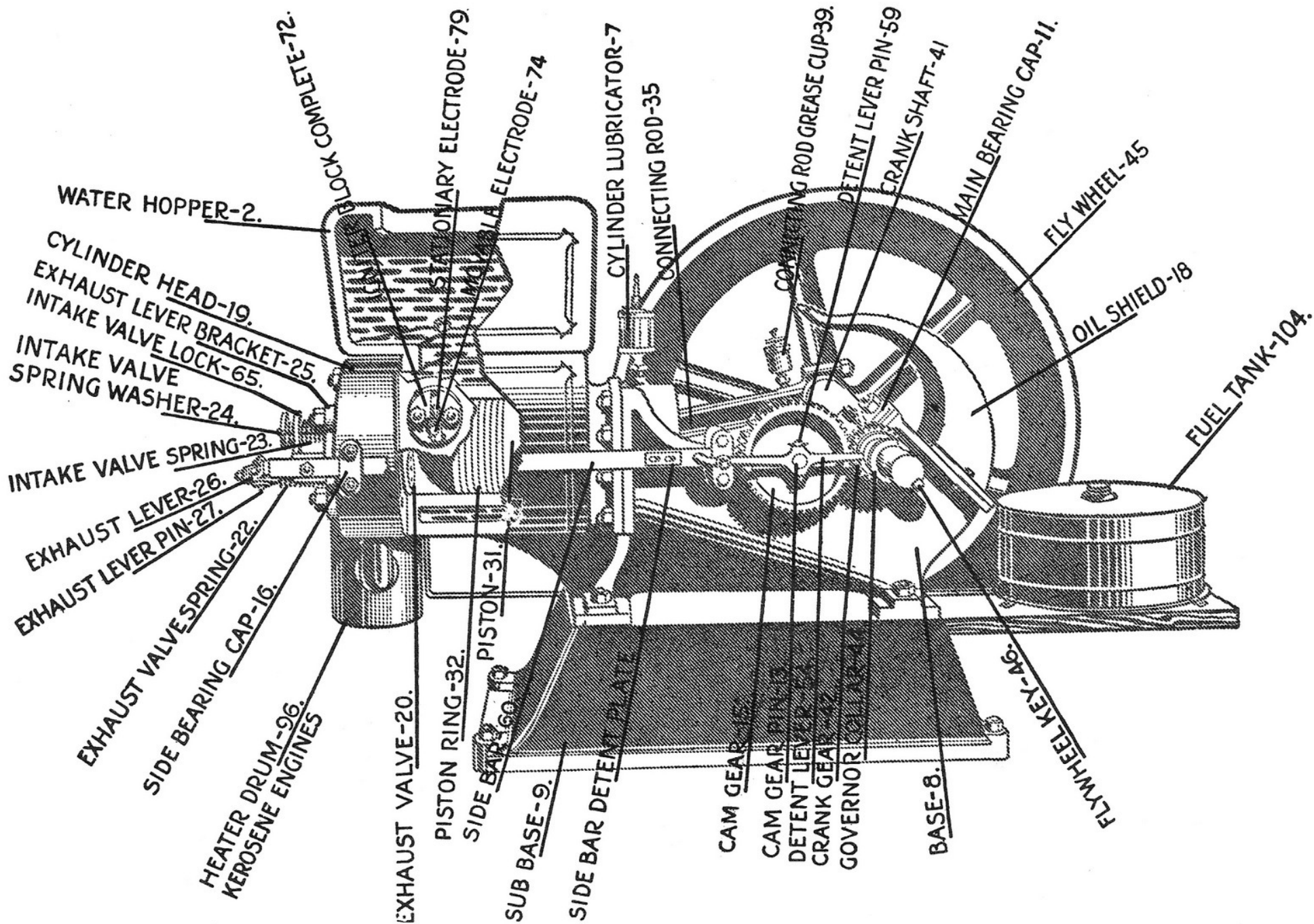
The guarantee made on your engine covers the replacement of parts that may break through actual defect in material, but does not cover replacement of parts that break in consequence of repairing or altering or which have been subject to misuse, negligence or accident. Any part that breaks through defect will be replaced free at the factory for a period of ten years, when such part is returned to the factory, carrying charges paid, for inspection.

The right is reserved to make any change in design of engine or to add any improvements that may be deemed an advantage.

In ordering any parts be sure to give the following: NUMBER OF PART, NAME OF PART—as given on page 29 of this book—NUMBER OF ENGINE and THE HORSEPOWER, stamped on name plate. If your engine should not have a name plate on it, you will find number of engine stamped on end of crank shaft.

Numbers and Names of Engine Parts

No.	Name of Part.	No.	Name of Part.
1	Cylinder and hopper	60	Side bar only
1	Cylinder	61	Side bar detent plate
2	Hopper	62	Detent screw and nut
3	Drain plug	63	Cam roller
4	Cylinder stud and nut, long	64	Cam roller stud bolt
5	Cylinder stud and nut, short	65	Intake valve lock
6	Ignition stud and nut	66	Side bar spring
7	Cylinder lubricator complete	67	Ignitor trip carrier
7A	Cylinder lubricator glass, large	68	Trip carrier spring
7B	Cylinder lubricator glass, small	69	Trip carrier pin
8	Engine base with bearings	70	Ignitor trip blade and nut
9	Sub base	71	Ignitor trip adjusting screw and nut
10	Cyl. to base stud and nut	72	Ignitor complete
12	Main bearing stud and nut	73	Ignitor body
13	Cam gear pin	74	Movable electrode with point
14	Cam gear pin set screw and lock nut	75	Movable electrode spring
15	Cam gear	76	Ignitor trip
16	Side bar bearing cap	77	Ignitor trip stop
17	Side bar cap stud and nut	78	Ignitor pin
18	Oil shield (cast iron)	79	Stationary electrode (Insulated)
19	Cylinder head (only)	80	Mica washers (set)
20	Exhaust valve		Nos. 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79 and 80 not used after Jan. 1, 1920.
21	Intake valve	81	Mixer top (only), kerosene
22	Exhaust valve spring	81A	Mixer top complete with valves, kerosene burner
23	Intake valve spring	82	Fuel throttle valve, kerosene
24	Intake valve spring washer	82A	Throttle valve spring
25	Exhaust lever bracket	82B	Throttle valve seat, kerosene
26	Exhaust lever	83	Drain valve spring
27	Exhaust lever pin	84	Drain valve
28	Exhaust lever set screw and nut	85	Reservoir cover
29	Cyl. head flange	86	Air damper
30	Cyl. head flange stud and nut	87	Water drip complete
31	Piston	88	Water drip valve stem
32	Piston ring	88A	Water drip valve spring
33	Piston pin	89	Air by-pass
34	Piston pin set screw and nut	96	Heater drum
35	Connecting rod and cap	97	Gasoline mixer with valve
36	Piston pin brass bushing	98	Check valve, gasoline
37	Cross head	99	Check valve ease
38	Connecting rod stud and nut	100	Fuel throttle valve, gasoline
39	Connecting rod grease cup	100A	Fuel throttle valve spring, gasoline
40	Main bearing grease cup	101	Muffler complete
41	Crank shaft	102	Starting crank
42	Crank shaft gear	104	Fuel tank
43	Crank shaft gear key	105	Asbestos packing for cylinder
44	Governor collar	106	Ignitor packing
45	Fly wheel	107	Pump barrel
46	Fly wheel key	108	Pump packing
47	Governor frame	109	Pump packing nut
48	Governor weight pin	110	Pump spring
49	Governor weight	111	Pump plunger
50	Governor weight spring, each	112	Pump finger
51	Tension bolt and nuts	113	Pump finger set screw
52	Speeder lever	114	Ball check casting
53	Speeder lever adjust. screw and nut	115	Small check ball
54	Detent lever with tips	117	Fuel line reducer
55	Detent lever tip	118	Large check ball
56	Detent tip screw and nut	118	Pet cock complete
57	Detent lever roller		
58	Detent lever spring		
59	Detent lever pin		



Parts 54, 72, 79, 74 as shown here discontinued. See new parts on opposite page.

