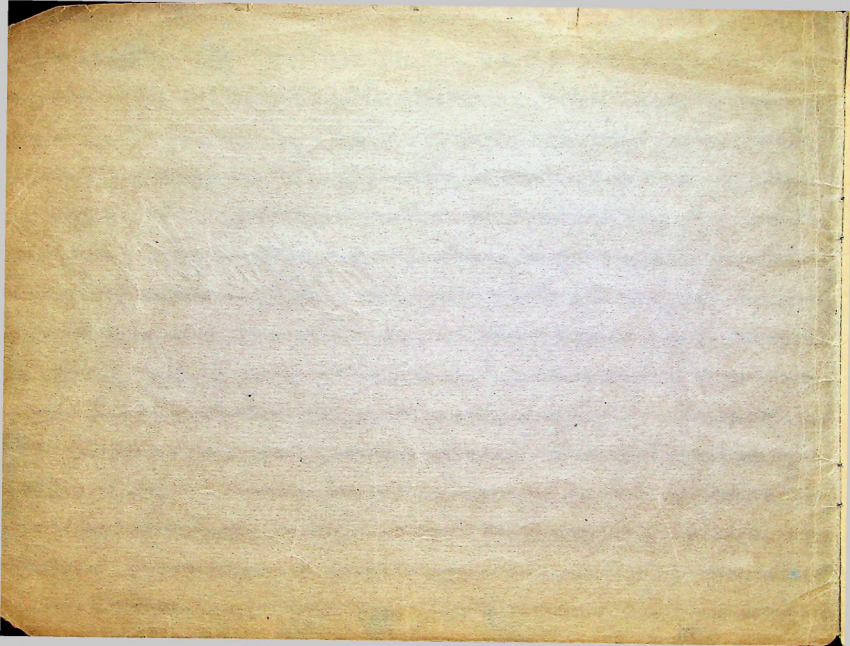


INSTRUCTIONS

FOR THE CARE AND OPERATION OF THE
STANLEY STEAM CAR WITH CONDENSER

Stanley

STEAM CAR



INSTRUCTIONS

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STANLEY STEAM CAR WITH CONDENSER

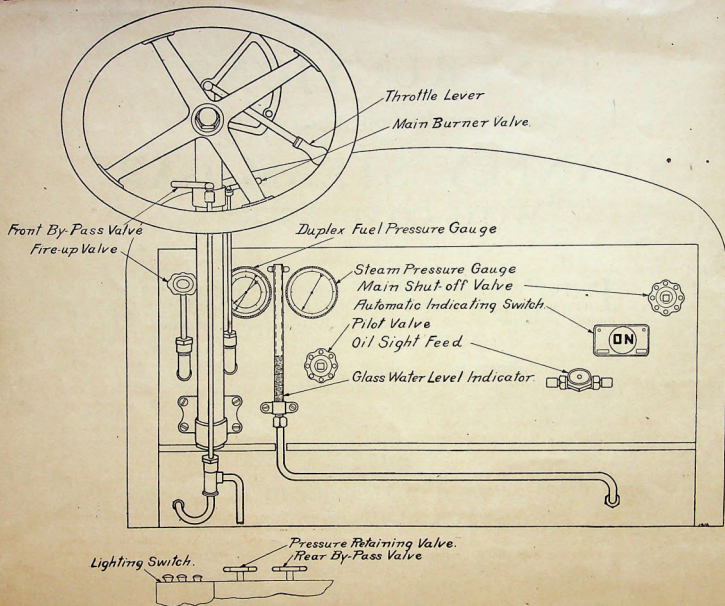
IN ordering parts for STANLEY CARS, be sure to give the number and name of the part wanted, as these numbers and names are listed in our Price List of Parts, a copy of which may be had on application.

Also, give the name of the model, the year of manufacture, and the number of the car as on the name plate on the cross-sill under the rear foot board.

1917

STANLEY STEAM MOTOR CARRIAGE CO.,
NEWTON, MASSACHUSETTS

1915-16 & 17



To Steam Up

Assuming that the boiler and tanks are empty set the emergency hand brake, open the throttle valve and engine drip valve. Connect a hose to the left blow off pipe using the hose coupling furnished with the car. Open the left blow off valve and turn on the water supply, filling the boiler until water will run out of the try cock at the bottom of the low water automatic valve in front of dash on the right. After shutting off the supply of water and the blow off valve, see that the water still runs out of the try cock, thus showing that the water is above this point. This is sufficient for steaming up, more does no harm but will require more time to raise steam. Take the filler cap off the radiator and fill the water tank through it.

If no pressure water supply is available use the hand water pump to fill the boiler after filling the water tank as directed in the article headed "The Water Pump and Tank."

Fill the main fuel tank with kerosene or gasoline. Fill the pilot fuel tank about three-quarters full of gasoline, and after screwing the filler cap down tight open the pilot air valve and pump in air until there is about thirty pounds pressure as indicated by the red hand on the duplex fuel pressure gauge. Be sure to close the air valve after pumping in air. Open the main air valve and pump in air until there is about seventy pounds pressure in the main pressure tanks as indicated by the black hand on the fuel pressure gauge, then close the air valve. Open the pressure retaining valve and operate the hand pump lever which will pump fuel into the main pressure tanks, until the gauge shows about one hundred sixty pounds, then close the pressure retaining valve.

Fill the cylinder oil tank with the proper cylinder oil.

If the car is in the usual condition it is only necessary to set the emergency hand brake, open the throttle valve and engine drip valve and to be sure that there is sufficient water in the boiler, and that the pressures are as described above.

Lift the left side of the hood and the smoke bonnet lid, open the Prest-O-Lite tank valve and light the acetylene torch with a match, placing the torch so that the flame strikes the pilot vaporizer.

After from fifteen to thirty seconds, or when the pilot vaporizer is sizzling hot, open pilot valve, light pilot by moving the

torch so that the flame will enter the peek hole; then move the torch back so that the flame will strike the upper part of the vaporizer for fifteen to thirty seconds longer, or until the main burner nozzles are sizzling hot.

Then close the Prest-O-Lite tank valve, open the fire-up valve and close it immediately—repeating this until the gas from the main nozzles is dry. Then leave the valve open for one or two minutes, close it, and open the main burner valve, closing it again immediately—repeating this until the gas from the main nozzles is dry. Then leave the valve open.

When the pressure on the main pressure tank falls below 100 lbs., it can be raised by pumping fuel with the hand fuel pump or by pumping air with the tire air pump. If what pumping is required for steaming up is done by pumping air, it will maintain about the right amount of air in the pressure tanks.

If the boiler is too full of water, open the blow-off valve and draw out some, opening the throttle valve at the same time so as to give vent to the boiler.

It is good practice to open the steam chest drip valve and open the throttle a little with the emergency brake set, while raising steam, and when the pressure reaches fifty lbs. to run the car back and forth on the floor a few times, and thus warm the engine and free the steam pipe, steam chest, and cylinders from water; to open each blow off valve a few seconds to clear out the connections; and to start as soon as there is sufficient steam pressure to drive the car.

When starting out on the road, open the main burner valve enough to give a good fire but not so much that the burner will whistle, also open the pressure retaining valve.

It is easily possible to steam up in ten to fifteen minutes, depending on the expertness of the operator, and this time may be utilized in doing things that should be done, such as oiling, filling oil tank, water tank, etc.

There should be no fire burning while filling the fuel tanks.

Operating

While running, the operator should see that the fuel pressure and the steam pressure are maintained, also that a proper water level in the boiler is maintained, as indicated by a medium height of water in the glass water level indicator. Remember

that when the water is low in the boiler it is high in the glass, and, *vice versa*, when it is high in the boiler it is low in the glass.

The hook-up pedal overlaps the reverse pedal. To hook up the engine, press on the reverse pedal only until the dog drops into the notch. To release, press on the hook-up pedal and when the foot is removed the spring should pull it into full forward gear. To reverse, press both pedals together as far as they will go before opening the throttle. After reversing, be sure that pedals come back into the full forward gear position before opening the throttle. Always start with engine in full forward gear, and hook up directly after starting. In full gear the engine cuts off at five-eighths stroke; therefore has no dead center. When hooked up, it cuts off at about one-quarter stroke; therefore is more economical and should be run hooked up all the time, except when a stop is imminent, as in congested traffic.

When stopping the car for any length of time, close the main burner and pressure retaining valves; in fact, it is well to close the main burner valve just before stopping, and when through with the car for the day close also the pilot valve. This will leave the car in normal condition for steaming up the next time.

The Burner

In a steam car the source of all power is the heat produced in the burner. Therefore, a good burner in perfect condition is the first essential, and to give good results it must have a supply of fuel flowing freely to it under the proper pressure.

If the main fire is not good, it indicates that either there is insufficient fuel pressure (the normal pressure for main burner fuel is 160 pounds), or some valve or automatic not open, or a clogging in the fuel line from the pressure tank to the burner. See that the small holes in the vaporizer nozzles are clean. If they are not, they can be cleaned by running a small wire through them, after taking out the vaporizer screw. Never use a reamer or broach for this purpose, as it is likely to enlarge the hole.

See that the main burner valve and the fuel shut-off valve are open. See that the steam pressure is not so high that the steam automatic is closed. (See Hydraulic Pressure article.)

See that the low water automatic is not hot. (See Low Water Automatic article.)

If there is a clogging in the fuel line, it should be easily located as follows: With all the fire out, take out the vaporizer screws, open the main burner valve, and see if there is a good flow of gas. If there is not, it indicates that the clogging is farther back. Then disconnect the copper tube from the vaporizer at the back of the burner, and try it there. And so on, disconnecting at each union, back in the line, to the main burner valve. When necessary to go back further, use the fuel shut-off valve.

To clean the vaporizer, take the cap off the end of the large tube and with pliers draw out the wire cable and clean it. While the cap is off, kerosene may be blown through the vaporizer by opening the main burner valve. This should be done with no fire burning. The vaporizer may be blown out with steam by connecting the siphon valve to it with a copper tube. If the vaporizing coil on top of the boiler clogs, it may be necessary to replace it.

To clean the fuel filter, do not attempt to take it apart on the car, but disconnect the copper tube unions and screw it off from the fuel shut-off valve. Put one square in a vise, and with a wrench on the other square, screw it apart. Clean the wire screens or replace with new.

If, when starting to steam up, the main burner valve is opened too quickly, the rush of kerosene may flood the burner, or if there is a slight leak in the main burner valve or in the vaporizer, the burner chamber may become filled with a mixture of air and gas so rich that it will not burn inside, but only where it oozes out to the air. The remedy in this case is to get some air into the burner. This can be done by using the air pump to force air in through the mixing tubes.

Sometimes, after stopping a car, or while coasting down a hill and the steam automatic valve closes, the pressure of the gas at the nozzles of the burner will be gradually reduced, so that the gas will ooze out at a very low velocity. Under these conditions the burner may light back with a slight explosion; that is, the gas will light at the nozzles; then when the automatic valve opens, the fire may continue to burn inside the burner and mixing tubes, with a roaring sound. If this is allowed to continue, it will ruin the burner, burning or melting the iron. To prevent this, when the roaring sound is heard, the main

burner valve should be closed for a few minutes, and then, when it is re-opened, the fire should light in the proper place on top of the burner casting.

Sometimes, when the burner lights back, it will do so with a light popping. The ordinary cause for this is that the two main burner nozzles are not flowing equally, one of them being partially or wholly clogged up. See that they are made to flow evenly.

If the burner lights back with a loud popping, and this takes place often, it would indicate that there was either a leak around the burner casing, a leak in the vaporizer or burner casting, or a leak of steam in the boiler or superheaters over the burner. See that there are no air leaks around the burner casing, that the asbestos between the casing and the boiler is airtight, that the peek hole cover is closed. If the popping continues, with full steam pressure on the boiler, take off the burner and examine the boiler. Then run the front wheels up against something immovable, and open the throttle valve so as to get a pressure of steam on the superheaters, and examine them. See that the burner casting is not cracked. If it is, it should be replaced. See that there is no leak between the burner casting and the sheet iron bottom which is crimped over the edge of the casting.

The size of the holes in the main burner nozzles should be as follows:

23 inches, No. 62 drill

26 inches, No. 60 drill

If they become larger, pean the end of the nozzle until the holes are too small; then ream them out to the right size. If they are too large it will increase the tendency of the burner to "whistle".

The Pilot Light

The hole in the pilot nozzle is the same size as in the main nozzle, but the pilot vaporizer screw has a wire in the end of it which goes through the hole and practically fills it. This wire is filed off slightly on one side to give sufficient opening so that the proper amount of gas will go to the pilot burner.

The pilot light should be as strong as it can be, and not raise steam while standing with full pressure on the fuel. The normal pressure for the pilot fuel is from twenty to thirty lbs.

It is good practice to take out the pilot screw and clean the wire before steaming up each time.

If the pilot gets weak, with a screwdriver turn the screw back and forth. This revolves the wire in the hole and cleans it. This is done with the pilot alone burning.

If the pilot light burns with a yellow, smoky flame, it indicates that it does not get air enough. If it burns with a very blue flame and "lifts" from the burner, it indicates that it gets too much air. The amount of air is regulated by the position of the nozzle in relation to the mixing tube. To give it more air, pull the nozzle farther out from the mixing tube. To give it less air, push it in. This can be done by bending the pilot vaporizer tube slightly. The pilot light should burn with a blue flame, slightly tinged with yellow, and should lay down close to the burner casting. The pilot should be adjusted when hot; that is, under road conditions. The pilot nozzle should point horizontal or slightly upward, never downward.

It is the custom of most Stanley car owners when using the car every day, to leave the pilot light burning over night.

To do this, see that the boiler is well filled with water, that there is no leak from it through the throttle or other connections, and no leak of gasoline anywhere, and that the main burner and pressure retaining valves are closed.

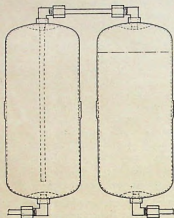
Under normal conditions, the pilot light should burn for from twelve to fifteen hours.

If the pilot light should go out, on the road, shut the main and pilot valves and run the car a short distance, to clear the burner from gas. Then lift the hood and smoke bonnet lid and relight it.

The Pilot Pressure Tank

Gasolene only should be used in the pilot tank.

Before filling the pilot tank, see that the main burner and pilot valves are closed and that no fire is burning. The tank should be filled only about three-quarters full so as to leave some space for air. After filling, pump in air until the red hand on the duplex fuel pressure gauge registers at least twenty lbs. The normal pressure for the pilot fuel is from twenty to thirty lbs.

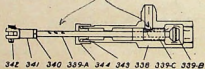


FROM AIR PUMP AND TO
PRESSURE GAUGE

FROM FUEL PUMP AND TO
BURNER

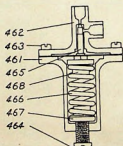
MAIN PRESSURE TANKS

*Three dots on stem
in line with opening
of valve sleeve*



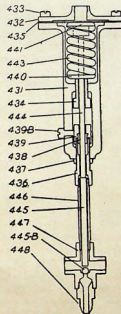
337

The Throttle Valve



460

Fuel,
The Gasolene Automatic
Relief.



430

The Steam Automatic

The Main Pressure Tanks

The purpose of the pressure tanks is to supply the burner with fuel under pressure, and avoid carrying a pressure on the larger quantity of fuel in the main tank.

While running, more fuel is pumped from the main tank to the pressure tanks by the power fuel pump than the burner requires, and the surplus escapes through the fuel automatic back to the main tank, thus maintaining a constant pressure on the fuel, as shown by the black hand on the duplex fuel pressure gauge.

A quantity of air is carried in the pressure tanks in order to maintain a pressure on the fuel while the car is standing. The amount of air required is a matter of volume rather than pressure.

Starting with the tanks empty, that is, full of air at atmospheric pressure, if air is pumped in until the gauge registers fifteen pounds, then kerosene pumped until the tank No. 2 is full of kerosene, the gauge will register about forty-five pounds. If enough, more kerosene is pumped to fill tank No. 1 half full, the gauge will register about one hundred and five pounds. Then the one and one half tanks of kerosene can be drawn out, or can be burned, before the gauge pressure will fall to fifteen pounds again, provided there is no leak, and no air is absorbed by the kerosene.

Kerosene in contact with air under pressure will absorb some of the air, and this should be replaced.

As suggested in the article "To Steam Up," if what pumping is required for steaming up is done by pumping in air, it will maintain about the right amount of air.

If the hand of the fuel pressure gauge vibrates while running, it indicates that there is little or no air in the pressure tanks.

The purpose of the pressure-retaining valve is to prevent any fuel from escaping, by leakage, through the fuel automatic, or check valves. It should be closed at all times except when running or pumping fuel by hand.

The Fuel Automatic Relief Valve

The purpose of this, commonly called the fuel automatic, is to maintain a constant pressure on the fuel.

The spring holds the valve closed until the pressure over-balances it, and opens the valve, allowing some fuel to pass from the pressure tanks back to the main tank. To carry higher fuel pressure screw the adjusting screw farther in. Lower pressure farther out.

If the fuel automatic does not shut tight there may be dirt or sediment on the seat. It can usually be cleaned out by backing out the adjusting screw so there is no tension on the spring, then working the hand fuel pump, leaving the pressure-retaining valve closed. If this is not effective, it should be taken apart, cleaned, and if necessary the valve ground in.

The Steam Automatic Valve

The purpose of this, commonly called the steam automatic, is to control the steam pressure in the boiler, by shutting off the supply of gas to the main burner when the pressure reaches the desired point. The spring holds the valve open until the steam pressure over-balances it and closes the valve, shutting off the gas to the main burner. When the steam pressure is reduced slightly the valve opens and the gas flowing to the main burner lights from the pilot light. To carry higher steam pressure, screw the adjusting screw farther in. Lower pressure, farther out.

To set the steam automatic valve loosen the lock nut and screw the body up until the valve closes, then turn it back three-quarters of a revolution and set the lock nut.

The stuffing-box nut should not be screwed down harder than necessary to prevent leakage, as it would increase the friction on the valve stem, and thus require more variation of steam pressure to operate it.

If water leaks through the adjusting screw, it indicates that the diaphragm is cracked and a new one needed.

The Boiler

If the fire is started when there is no water in the boiler, or the boiler is allowed to run dry with the fire burning, the boiler will become overheated, commonly called "burned out," and when cooled it will contract, and may leak around the tubes. This would not necessarily cause a permanent injury to the boiler, but might require re-expanding of the tubes. This is done by driving a taper expanding tool into the ends of the tubes, first dipping it in oil so it will come out easily.

To determine that there is water enough in the boiler to steam up safely, open the throttle to give vent to the boiler, and open the try-cock at the bottom of the low water automatic. If water flows out here it indicates that the water is above this point and that is sufficient. If there is any doubt always give the doubt full benefit and put some in. It is good practice to steam up with the boiler full and blow out some water after getting a little steam pressure.

To fill the boiler from town supply, connect a hose to blow-off pipe, using the hose coupling furnished with the car, and before turning on the water see that the blow-off valve is open. Open the throttle valve and steam chest drip valve, and let the boiler fill until it overflows and water runs out through the drip valve.

To pump water to the boiler by hand, see that there is water in the tank, open hand water pump valves, close front and rear by-pass valves, and operate the pump.

To avoid pumping fuel at the same time, close the fuel tank valve, but remember to open it again.

See that the hand water pump plunger is in as far as it will go when closing the hand water pump valves.

If, after using the car, it is left with plenty of water in the tank, when the boiler cools, the steam condensing will form a vacuum which will draw water from the tank until the boiler is full.

The elbows on the superheaters and main steam pipe are made on a taper and driven into boiler tubes. To remove them, pry under the elbow and hammer it at the same time, first one side and then the other, until they will loosen and come out.

Hydraulic Pressure

If the fire is started with the boiler full of water, with no vent, the heat will quickly expand the water, creating a hydraulic pressure that will close the steam automatic and perhaps lift the safety valve. Then if the throttle is opened, the pressure will instantly fall. In this case, open the blow-off valve and draw out about one-quarter of the water. This would be, in a

23 inch boiler, 15 quarts

26 inch boiler, 22 quarts

If the boiler is much more than three-quarters full when the throttle is opened, water or wet steam will go to the engine. This is called priming. When the boiler primes, if the throttle is opened wide the steam will rush out of the exhaust with a soft mushy sound, the engine will "pound" and seem to have but little power. When this occurs, open the by-pass valves and run the car slowly with the throttle open but a little, until enough water is used so that the boiler will not prime, or open the blow-off valve and draw out sufficient water.

To test the boiler under hydraulic or cold water pressure, fill it full of water, then pump water with the hand water pump until the steam gauge shows the desired pressure. Any boiler that has been used may "weep" a little around the tubes under a high cold-water pressure, and yet be perfectly tight under steam.

Blowing Off the Boiler

In order to prevent an accumulation in the boiler of sediment and scale from the water used, and graphite and oil from the engine lubricant, the boiler should be blown off once a week, if soft clear water is used. If the water used is hard, the boiler should be blown off every day. Even with this precaution the nipple where the feed water heater enters the boiler may become encrusted and in time become entirely closed. If the plug is taken out, this nipple can be easily drilled out.

After shutting the burner valves previous to blowing off, see that the fire is all out before opening the blow-off valve. Sometimes the flame in the pilot will burn some minutes after the valve is closed. It can be extinguished by blowing into the pilot mixing tube.

When blowing off open both blow-off valves. Do not continue until the pressure is reduced to zero, but close the valves as soon as the water is all out and the pressure has dropped about one hundred lbs. This is desirable in two ways: First, it leaves sufficient steam for running the car a short distance if desired; and, secondly, when this steam condenses it forms a small quantity of chemically pure water that falls to the bottom of the boiler and tends to re-dissolve any scale that has formed.

The Water Level Indicator

The purpose of this, commonly called the indicator, is to show the level of water in the boiler.

The three tube indicator body is made up of three tubes brazed together. The middle one forms a part of the water column, water is pumped through the left one, and the right one is the stand pipe connected to the glass. The stand pipe and glass connected together by a copper tube form a U tube, which is filled with water, so that when cold the stand pipe, copper tube, and about one inch of the lower part of the glass are completely full of water and contain no air.

While running, so long as the water level in the boiler is above the stand pipe, the water pumped through the indicator body keeps it comparatively cool. When the water level gets below the top of the stand pipe the heat will vaporize some of the water in the stand pipe, and cause the water to rise in the glass. As the water level gets lower, more will be vaporized, raising the water higher in the glass, thus indicating the water level through a range of about three inches.

Remember that when the water is high in the boiler, it is low in the glass, and, *vice versa*, when low in the boiler, it is high in the glass.

When the boiler is cold the indicator gives no indication. That is, the water will be low in the glass whether the boiler is full or empty.

Should some of the water evaporate out of the glass, more should be put in to replenish it.

To fill the indicator, take out the screw in the top of the stand pipe, and run water into the glass faster than it can run out through the stand pipe, until it is certain that all the air has been expelled. Then with water still running, put in the screw, leaving it loose until the water falls to about one inch from the bottom of the glass, then screw it down tight. This should be done when the boiler is cold.

A little absorbent cotton with a piece of wire screen over it is placed in the indicator glass bracket under the glass to retard the flow of water through it, and to prevent a sudden fluctuation which might throw some of the water out of the glass.

To test the indicator. With steam up and boiler well filled, open the try-cock until the water rises in the glass, then if cold water is poured on the stand pipe, the water should fall in the glass.

While the car is standing with steam up, the stand pipe may get hot and raise the water in the glass, but after starting it will fall so as to indicate the level of the water.

If the car is to be run in freezing weather, a mixture of glycerine or alcohol and water, one to one, may be used in the glass to prevent freezing.

If the connection between the bottom of the boiler and water column should get clogged, the water column might remain full of water, even though there was none in the boiler; this would cause the indicator to register falsely, would prevent the low water automatic from operating, and water would flow from the try-cock when opened. It is important, therefore, to see that this does not occur. The blow-off line on the right hand side is through this connection and blowing off the boiler tends to keep it clear.

The Low Water Automatic Valve

This is an expansion valve, and the purpose of it is to shut off the supply of gas to the main burner before the water in the boiler gets extremely low.

So long as the water level is above the point where it is connected with the water column (marked "Try-cock" in the cut), it will remain cool. When, however, the water level falls to this point, the expansion tube will fill with steam and the heat will expand the tube and close the valve, thus shutting off the supply of gas to the main burner.

Do not change the adjustment or attempt to set the Low Water Automatic Valve unless you are certain that you know how it should be done.

The Automatic By-Pass Valve

This is an expansion valve and its purpose is to open and close the by-pass, so as to maintain the proper water level in the boiler. It is placed on the left side of the boiler, and the front end of the expansion tube is connected to the bottom of the boiler and the rear end to the top of the boiler. When the water level is above it, the expansion tube fills with water and cools, thus opening the valve. When the water falls below it, it fills with steam, expands and shuts the valve. It should not be depended upon entirely to maintain water in the boiler, because if the water should get all out of the tank, or the

pumps should for any reason fail to work, it could not do so. (See Water Pump article.) If at any time the automatic by-pass valve should fail to work, operate the hand by-pass valves.

When the front one on the steering post is closed and the rear one open, the water from one pump should go to the boiler. When both are closed, the water from both pumps should go to the boiler. When the front one is open, no water will go to the boiler whether the rear one is closed or not, assuming that the automatic by-pass does not close. When the automatic by-pass valve is in proper condition, if both hand by-passes are open the automatic will control the water from one pump only. If the rear by-pass is closed, it will control the water from both pumps. Running on ordinary good roads one pump should supply enough water. But on hard roads and hills, also when stopping often, both should be used.

Boiler Check Valves

There are two check valves in the water feed line: one at the indicator, which we call the indicator check valve, to distinguish it from the other; and one close to the boiler, which we call the boiler check valve.

The latter has a stem in the bottom of it, which should be screwed up so as to lift the valve from the seat and thus make it inoperative. When it is desired to disconnect the indicator check valve with steam up, the stem can be screwed down so that the valve will hold the pressure.

If the indicator check valve leaks, steam or hot water from the boiler may come back through the by-pass valve, or to the water pumps, and heat them while the car is standing. When this occurs the check-valve should be replaced. It costs but a small sum.

The Throttle Valve

If the throttle valve leaks steam, take it off and grind the valve into the seat, or put on a new throttle valve. It may appear to leak on account of the lever not being properly adjusted. This can be adjusted by the distance rod parallel to the valve stem, by the jaw at the end of the valve stem, or by turning the sector at the top of the steering post. There should be some tension on the throttle valve stem when the lever is locked in the closed position.

There are three prick punch marks on the throttle valve stem which are in line with a port in the sleeve on the valve stem inside the body. These marks should be in line with the steam outlet of the throttle valve.

The Safety Valve

If the safety valve blows off and does not close readily, rap the end of the valve stem. If it continues to leak, take it off and clean it, and if necessary grind in the valve.

The Cylinder Oil Pump

This pumps oil from the cylinder oil tank through the oil sight feed on the dasher to the main steam pipe leading to the engine.

It is well to keep plenty of cylinder oil in the tank. If it is all pumped out, the oil pump may become air-bound, and this may make it necessary to loosen the suction check cap until oil flows out.

The amount of oil pumped can be varied by changing length of the stroke of the plunger. To pump more, set the adjusting nuts on the plunger farther on; to pump less, set them nearer the end of the plunger.

A gallon of cylinder-oil should be sufficient to run the car from three hundred to five hundred miles.

Cylinder Oil—Important

It is very important that only cylinder oil that is adapted to the condition should be used in Stanley cars.

The Harris Condenser Steam Cylinder Oil, made by the A. W. Harris Oil Co., Providence, R. I., is particularly suited for use in Stanley cars having condensers, and we would urge each owner of such a car to have this oil on hand at all times and use it exclusively.

Oiling

We recommend the use of the heavy Harris Superheat Steam Cylinder Oil in the engine case and for oiling all bearings in the car except those on the dynamo. We advise using it in all grease cups instead of grease.

If grease is used in cups, it should be very light graphite grease. Enough oil should be maintained in the engine and gear case so that it will be one-half to three-quarter inches

deep at the front end of the centre case. The oil should be thin enough so that it will splash well.

To thin heavy cylinder oil, add good machine oil. This will oil the working parts of the engine, differential, driving gears and inside rear axle bearing.

Once a week the outside rear axle bearings should be oiled through the cups on the housing over same.

Also the rear axle spring blocks through cups on the same, the bearing on the pump cross head and guide near the pumps, and also the pump drive crank.

To oil the latter jack up the rear right wheel, and take the plug out of the top of the housing of the crank just in front of the rear axle

Revolve the rear wheel until the crank comes around under the hole, then put about a tablespoonful of oil on the crank. The housing at the lower end of the steering column should be kept filled with oil.

The oil holes for the two bearings of the dynamo should be given a few drops of thin oil once a week. The left one is in the center of the iron casing and the right one on top of the projection on that end of the casing, and are closed by a ball and spring.

The Water Pumps and Tank

The power pumps, being driven from the rear axle, are running all the time that the car is running. When the by-pass valves are closed, the water is pumped to the boiler. When they are open, it returns to the tank.

If it appears that the boiler is not getting sufficient water, see that there is plenty of water in the tank.

With the rear wheels jacked up, the engine running and the by-pass valves closed, see that there is no excessive leak through the packing of the plungers, and no leak from any pipes or fittings in the water line from the pumps to the boiler.

To see if the pumps are working, slack up a union nut on water pump line near the pump, and if the pump is working water will spurt out with great force while the plunger is going in. If it does not, take out the check valves in the pump and clean the valves and seats.

To see that the by-pass valves shut tight, disconnect the copper tube leading from the by-pass valve to the tank and see that

water does not come through the valve. If the lever on the front by-pass valve stem strikes the steering post before the valve is shut, take off the lever and set it back one square on the stem.

If the pumps do not start working, see that the strainer in the water tank is not clogged. To do this, take out a screw cap in the bottom of the tank and let the water run out; then the strainer can be drawn out.

The water pumps are packed with hemp packing. The stuffing box nuts should not be screwed down any harder than necessary to prevent leakage.

If it should be necessary to pump water by hand, close the main burner valve and run some distance to reduce the steam pressure, open the hand pump valves, close the front and rear by-pass valves and close the fuel tank valve, so as to save pumping kerosene.

After pumping by hand, close hand water pump valves while the plunger is in as far as it will go.

As the hand water pump is seldom used it very likely will be full of air. To get the air out and get it primed with water, take out the stem of the front hand water pump valve, place a finger over the hole and draw back the plunger, lift the finger and push the plunger in, repeating until water comes.

To fill the water tank with the siphon, slip the siphon hose on to the hose nipple in front of the dash on the left side, drop the end of the hose into the water, taking care that it does not go to the bottom where it would draw in dirt or sediment, and open the siphon valve. To fill the water tank with a hose, take the cap off the radiator and fill through the opening until water runs out the overflow pipe on the tank. It is advisable to fill the tank before it is quite empty, and to let it overflow a short time to carry off what oil has accumulated in the tank.

The Main Fuel Tank and Pumps

If the power fuel pump gets air-bound, or the check valves do not operate, a few strokes of the hand pump will usually clear it out, as the hand pump forces through the power pump.

To pack the power fuel pump, first put in a thin leather washer, then three of the special packing rings which we supply for the purpose, and then another thin leather washer on top, and screw the stuffing-box nut only as tight as you can screw

it with your fingers. If this nut is screwed down too tight, it causes the plunger to cut out the packing. If the fuel pump is properly packed and the nut is not screwed down too tightly, it should not need repacking for a whole season.

In order that the hand pumps may work easily, the stuffing-box nuts should not be screwed down any harder than necessary to prevent leakage.

Kerosene, gasolene, or any mixture of the two may be used in the main fuel tank. Any time it is inconvenient to get kerosene, do not hesitate to put in gasolene.

The Rear Axle

To take off a rear wheel after removing the dust cap and the nuts that hold the wheel on the shaft, screw a wheel puller into the thread in the hub and screw the screw into the center, in against the end of the shaft, keeping a tension on the screw, strike the end of it sharply with a hammer until the wheel loosens, then it will come off easily.

To take out the bearing, screw off the round nut on the shaft, take out the clamping screw on the housing and screw out the slotted disk sleeve with a spanner wrench. The whole bearing will then slip off the shaft. To separate it, take out the locking screw and screw out the disk, which will allow the taper sleeve carrying cone and roller unit to come off. The cone and roller unit are pressed on to the taper sleeve. The cup is pressed into the slotted disk sleeve.

To adjust the bearing, screw the slotted disk sleeve into the housing as far as it will go, and set the round nut up so as to force the taper sleeve against the shoulder on the shaft; then back out the slotted disk sleeve until there is a tension on the bearing; then loosen it a little by screwing in the slotted disk sleeve.

To take out the rear axle only, take off the spring clip nuts, the perch rod bolts, the engine brace rod nuts and the four nuts on the engine frame rods at the back of the axle housing and disconnect the brake rods and wire on the dynamo; block up under the engine frame perch rods and brace rods so they will be supported when the axle is removed. If chain falls are available use them to raise the rear end of the car by hooking on to the chassis frame in front of the rear seat. If not, jack it up, putting the jacks under the side sills in front of the

rear axle, raising it high enough so that the wheels will roll out under the mud guards. The differential is held in position sideways by the pinions coming in contact with the bevel gears. It requires some knowledge and skill to assemble the rear axle and get the right adjustment in these parts.

The Front Axle and Steering Gear

The front wheel bearings should be adjusted so there is a slight motion to the wheel and kept packed with grease.

The ball and socket joints on the ends of the drag link should be packed with grease.

There are three adjustments to the steering gear. To take up on the end thrust bearings of the worm, screw down the large nut at the top of the housing, first loosening all parts that are clamped to the steering post, because the post tube turns with the nut. To bring the worm and gear nearer together, turn the eccentric bushing, the end of which comes through the side sill of the chassis frame and has two slots in it, first loosening the set screw with lock nut, which is just inside the sill and back of the center of the housing. To take up end thrust on the gear shaft, screw in on the screw with lock nut on the inside end of the housing opposite the end of the shaft. In making any of these adjustments great care should be taken not to get them too tight so as to make the parts bind or run hard.

Valves, Check Valves and Filters

In addition to the valves shown in the cut of the dash there will be found the following:

Under the front foot board and near the hand water pump are two valves called hand water pump valves. When it is desired to pump water to the boiler by hand these two valves should be open and both by-pass valves closed. They should be closed while the hand water pump plunger is in as far as it will go, and should remain closed at all times except when pumping water by hand.

Under the front seat on the right side of the car will be found two valves in line with the air pump nipple. The one leading from it to the pilot tank is called the pilot air valve, and should be closed at all times except when pumping air into the pilot tank. The other valve which is in the line leading from the

nipple to the main pressure tanks is called the main air valve. This should be closed at all times except when pumping air into the main pressure tank.

A third valve near the other two is a valve for drawing kerosene from the main pressure tank back into the main fuel tank and is called the main pressure draw-off valve. It should be closed at all times except when it is desired to allow some or all of the kerosene in the pressure tank to flow out into the main tank, as for instance when it is noticed that the black hand on the fuel pressure gauge vibrates while the car is running, indicating that there is little or no air in the main pressure tank. To make it easy to pump air in, this valve can be opened until a large portion of the kerosene has escaped and the pressure reduced; then the air can be pumped in easily.

There is a cock in the tube leading from the cylinder oil tank to the cylinder oil pump. This should be open at all times except when disconnecting the line to the pump. If this is closed at any time special care should be taken to remember and open it again before running the car, because if it is closed no cylinder oil can be pumped.

Under the rear foot boards and near the front seat is a valve in the line leading from the main fuel tank to the pump. This is called the fuel tank valve. This should be opened at all times except when it is desired to disconnect the tube from the pump, or anything done which will make it desirable to stop the flow of fuel from the tank to the pump, as for instance when it is desired to pump water to the boiler by hand. By shutting this valve pumping of fuel at the same time will be avoided.

Farther back in this line on the left side of the car will be found a check valve. This is the suction valve for the hand fuel pump. This pump delivers into the power fuel pump and the check valves on it act as delivery checks for the hand pump.

Just back of this check is a filter called the fuel suction line filter. If the hand fuel pump will not draw any fuel, see that there is plenty in the tank, and if there is, screw out the wing nut on the under side of the filter and remove the strainer and clean it.

The valve in front of the dash on the right at the bottom of the low water automatic is the valve called the try-cock.

The use of this is to determine whether the water level is above it.

In front of the boiler on each side are the blow-off valves. In blowing off the boiler they should both be opened.

Back of the boiler on the left hand side is a valve in the line leading to the siphon. This is called the siphon valve, and should be closed at all times except when filling the water tank with the siphon.

The fire-up valve as provided allows gasolene from the pilot tank to flow into the main burner vaporizer. It takes less heat to vaporize gasolene than it does kerosene, and when steaming up the car from cold, after the pilot has burned a short time this valve can be opened and the gasolene will vaporize and burn, thus heating the vaporizer so that when the main burner valve is open the kerosene will be vaporized; thus saving time in steaming up.

The course of the water and steam is as follows: From the water tank to the power pumps, from them to the indicator check valve. If the by-pass valves are open it will flow back to the water tank. If they are closed it will proceed from the indicator through the feed water heater and boiler check to the boiler, where it is made into steam. The steam passes through the throttle valve, down through the boiler, through the superheaters, up through the boiler again, through the main steam pipe to the engine, where it does its work. The exhaust steam from the engine passes through the feed water heater to the radiator, where a portion or all of it is condensed, and the water flows back to the water tank.

The course of the fuel is from the main fuel tank to the power fuel pump, from it to the pressure tank, and from there through the low water automatic valve, the vaporizing coil on top of the boiler, the main burner valve, steam automatic valve to the vaporizer where it is vaporized, and the vapor issues from the nozzles into the mixing tubes, drawing with it sufficient air for combustion. The mixture passes up through the small holes in the burner casting, where it burns.

The course of the cylinder oil is from the cylinder oil tank to the pump, and from there through the oil sight feed into the main steam pipe; thence it passes with the steam to the engine, lubricating the cylinders, pistons and slide valves.

The pilot fuel flows from the pilot tank through the pilot valve to the pilot vaporizer, into the pilot mixing tube, and up through the slots in the pilot casting, where it burns.

The Engine

The packing of piston rods and slide valve stem should be given attention about once a week. To get at them, take out the two screws in stuffing box case and remove it.

The stuffing-box nuts should not be screwed down any harder than necessary to prevent leakage. If they are properly packed and adjusted often, so as to keep the right tension on the packing, they may run a whole season without repacking. When the nuts are screwed down to the end of the thread, so that there is no more adjustment, some packing should be added. We use vulcabestine braided cord packing for this purpose.

The wrist pins which hold the cone ends of the connecting rod in the crosshead should only be tight enough to prevent a noticeable knock. When the lock nuts are set up it should be loose enough so that it can be revolved with the fingers.

The main bearing clamp and rear end of the connecting rods have shims, some of which can be removed to take up lost motion.

The crosshead slides have shims back of them. Great care should be taken in making any of these adjustments not to get them too tight. If they are too loose, little or no harm will result, but if too tight great damage may be done.

To take out the engine, take out the four screws that hold the flanged exhaust elbow on to the feed water heater and pull off the exhaust hose; disconnect the main steam pipe at the packed swivel joint and the reverse rods at the engine; take out the engine brace rods and remove the four nuts at the back of the rear axle housing which hold the engine; take off the nut at the top of the engine hanger strap and pull the strap off the stud and let the front end of the engine down; then pull it ahead until it clears the rear axle.

The engine should be set so that it is in line at right angles with the rear axle and the gears set so that the ends of the teeth are about one thirty-second of an inch from bottom, or as close as they can be and not grind.

The engine hanger strap should be kept in adjustment at both ends so there will be no lost motion, but care should be taken not to get them too tight.

Feed Water Heater

The feed water heater is the large tube attached to the under side of the right hand sill of the frame and extends from the engine nearly up to the front of the car, and has a pipe leading from it to the radiator.

Inside the large tube are two smaller ones, through which the water is pumped on its way to the boiler. These water tubes being surrounded by the exhaust steam on its way from the engine to the radiator, the water in them is thereby heated.

The Radiator

The radiator in order to be efficient must have a large amount of surface exposed to the air and be made of very thin material; consequently will not stand very hard usage.

There is a safety valve on it which is set to lift at four pounds pressure, so as to prevent getting an excessive pressure on it.

Any radiator may leak slightly without doing any material harm.

As soon as the throttle is closed the steam in the radiator will condense and the water will drain out into the tank; consequently there is nothing in it to freeze while the car is standing, and it cannot freeze while the car is running.

Storage Battery

The manufacturers instruct us as follows:

If any of the solution has been spilled, fresh solution (composed of one part chemically pure sulphuric acid and three parts water) should be added until plates are covered to the depth of half an inch.

Vent plugs should be removed and cells examined every week. *Plates must always be kept covered with solution.* The water in the solution evaporates, but the acid does not. When examination shows the top of the plates uncovered, refill cells by adding distilled water only, not acid.

Every car owner should have a specific gravity hydrometer for testing electrolyte to accurately determine the condition of the battery. The specific gravity of the solution should read

between 1.280 and 1.300 when battery is fully charged. If the reading is lower, don't add acid, but charge battery until specific gravity rises to the proper point.

In general, therefore, our condensed instructions are as follows:

Unscrew vent plugs and inspect cells weekly.

Keep plates fully covered with solution—always.

Never add anything to solution except distilled water.

Keep specific gravity at 1.280 to 1.300 by charging battery.

Emergency Repairs

Outside of the breaking down of one of the few vital parts of the car on the road, there are few things that can happen that would prevent the car being run home under its own power if a little ingenuity is used.

For instance, if the water tubes of the feed water heater should leak so that sufficient water could not be forced into the boiler, screw down the stem of the boiler check valve, take off the copper tube carrying the water from the indicator check valve to the heater, and from the heater to the boiler check valve, use one of these tubes to connect directly from the indicator check to the boiler check, thus cutting out the feed water heater from the line.

Again, if the vaporizing coil on top of the boiler should become clogged up so that sufficient fuel would not flow through the vaporizer, disconnect the tube leading from the top of the low water automatic valve to the coil, and from the other end of the coil to the main burner valve, and insert a tube directly from the low water automatic to the main burner valve, thus cutting the coil out of the line. In running the car under this condition the main burner valve should be opened only a little, so as to prevent a rush of liquid fuel from flooding the burner.

If the automatic by-pass fails to work properly, use the hand by-pass valve. If the indicator fails at the same time, close the by-pass valves until the boiler primes; then open them for a while, and close them again until it primes again, and so on. Under any adverse conditions be sure that there is plenty of water in the tank at all times.

It is advisable to carry in the car for emergencies one of the copper tubes with the flanged ends and the two union nuts

on it twenty-four inches long or more. This would replace almost any tube on the car that would be necessary for operating. It is also well to carry two or three extra copper tube union stubs.

Laying Up for the Winter

If the road conditions do not permit the car to be used in winter, to protect from injury by frost, fire up the car and run it either on the road or with the rear wheels jacked up so that everything will be hot. Turn out the fire and blow off the boiler. Before the steam is all blown off, open the safety valve and the siphon valve so as to clear the water out of these. Drain the water out of the tank. Take off the tube connecting the indicator glass with the indicator body and take the screw out of the top of the stand pipe so as to drain the water out of it. Disconnect the two copper tubes leading to and from the water tubes of the feed water heater and blow through one of them so as to clear the water from the tubes. Take the caps off the check valves on the water pumps and blow through them so as to clear the water out of them. It is advisable to take the steam gauge off and put it where it will not freeze, because it is very difficult to get all of the water out of the tube inside the gauge.

General Remarks

To operate an automobile with success and pleasure one must know the car thoroughly. To know how every part is constructed, how it is supposed to operate, and what to do in case any part fails to perform its function, implies a knowledge of the machine that can come only from careful study.

If your car is kept at a public station, do not say to the attendant when you come in at night, "Look this car over carefully, and be sure that everything is all right in the morning." But, instead, tell him exactly what to do, and, if necessary, just how to do it, and before starting out in the morning see that it has been done.

Always start the car slowly, bringing it up to the desired speed gradually.

As much as possible make adjustments in the garage, and not on the road.

Keep the boiler well filled with water, particularly on a strange road; otherwise an unexpected hard hill may compel the use of the hand pump, or the risk of low water.

Keep the tires well inflated. This makes the tires last longer, increases the speed of the car, and adds to the mileage on fuel and water.

Never open any of the valves more than two or three full revolutions, as, if they are turned twelve or fifteen revolutions, they will come clear out. If a valve on the fuel pressure system is screwed out while the fire is burning, it may cause serious fire.

Much more skill is required to run a car backward than forward. With the head turned so as to look backward, to operate the reverse, to open the throttle, and to steer, all at the same time, involves a combination of movements quite difficult for the beginner. After reversing, be sure that the pedal has come back so that the engine is in forward gear, before giving steam.

Remember that to back down a steep hill is much more difficult and dangerous than to back on level. Never reverse the engine when you are headed up a hill, even if you wish to back. Do not try it till certain you possess the skill to do it without an accident.

If while going up a steep hill it should become necessary to stop, hold the car from backing with the brakes and unhook the engine. With the engine hooked up if the car is already moving backward and the throttle is opened the steam pressure may accelerate the motion of the car, instead of checking it, because the steam cuts off so early in the stroke. When the engine is in full forward gear and the car moving backward, if the throttle is opened this would tend to stop the car, provided the reverse pedals were held in position so that the engine could not reverse itself, as it would have a tendency to do under these conditions, and might if the spring were not strong enough to prevent it.

