3. Identifying MSM Steam Plant Components

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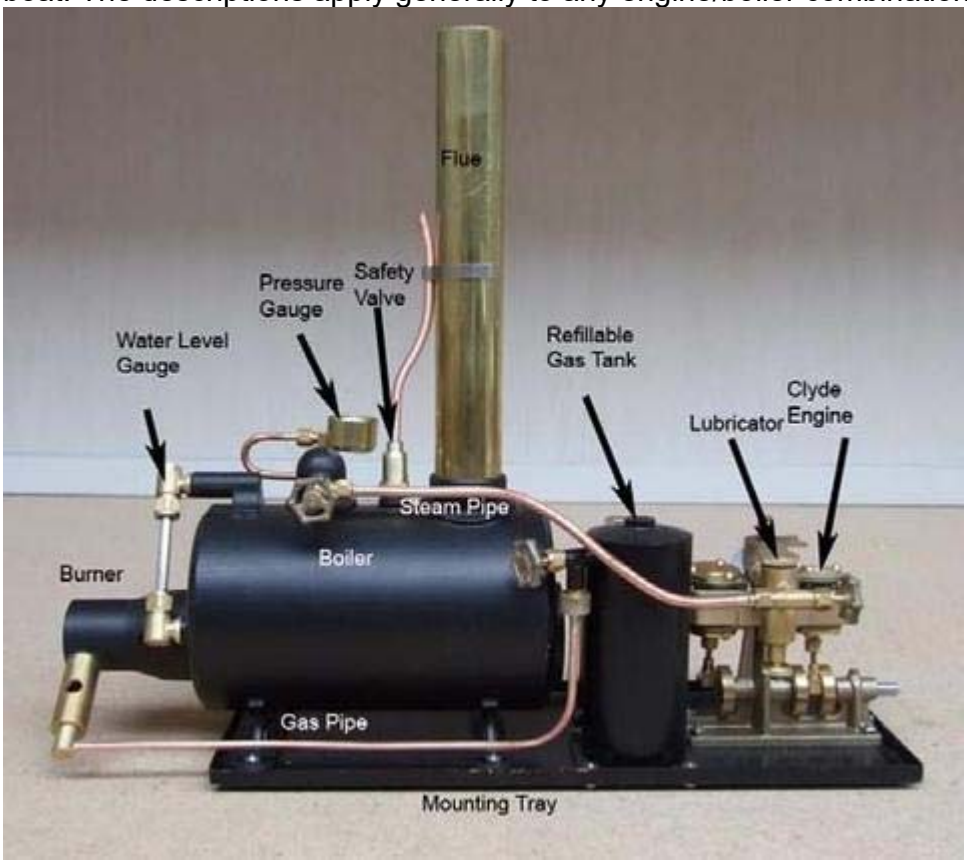
If you are familiar with these we suggest you go directly to:
"MSM Steam Plants and their selection" for assistance with selecting a steam plant
- whether to fit your own engine or select from the MSM range for your boat.
New stuff
This note is intended to address the interests of potential users of a “Miniature Steam” steam plant. Since an engine alone has no purpose but to look beautiful, its operation must be seen in the context of
the components that are required for it to perform its primary function of powering something - in this case we are highlighting the operation of an engine in an integrated steam plant using “Miniature Steam” 3” horizontal boiler and Clyde twin cylinder oscillating engine built to power a radio controlled boat. The descriptions apply generally to any engine/boiler combination.



STEAM PLANT COMPONENTS:

The engine must be mounted on a firm base – a brass Mounting Tray is used in the illustration. Beware of mounting the tray on an uneven surface. This could lead to distortion of the Clyde Engine base when screwed down. In turn this could cause binding of the crankshaft in its bearings leading to poor engine performance if not actual seizing of the engine. The plywood plate to which the plant is secured in the packaging is an excellent platform for commissioning the plant on a bench. It may also be useful as a base plate for mounting the engine in the boat.

The engine is connected to the Boiler by a Steam Pipe with a steam cock (valve) at the boiler for controlling the steam delivery to the engine. Steam passes through the boiler steam cock, through a displacement Lubricator before entering the engine. In the case of twin cylinder oscillating engines it passes through a valve (not identified) that controls the direction of rotation of the engine as well as the power required from the engine. It directs live steam into the engine and spent steam to the Oil Trap. (Basically, slide valve engines use the Stephenson's reversing linkage for a similar control function).

The oil trap separates the oil from the exhaust steam and clean steam is passed to the exhaust port (not shown).

The boiler Burner is powered, through the Gas Pipe from a Refillable Gas Tank. The tank is fitted in a way that enables easy removal from the tray for refilling, an important safety requirement. Please ensure you read Library Guide 10.Gas Basics for guidance on gases that should be used.

Steam pressure is indicated on a Pressure Gauge and a Safety Valve can be adjusted to release steam if the pressure exceeds a practical working level for the specific boiler.

Water level in the boiler is indicated by a Water Level Glass fitted to the end of the boiler.

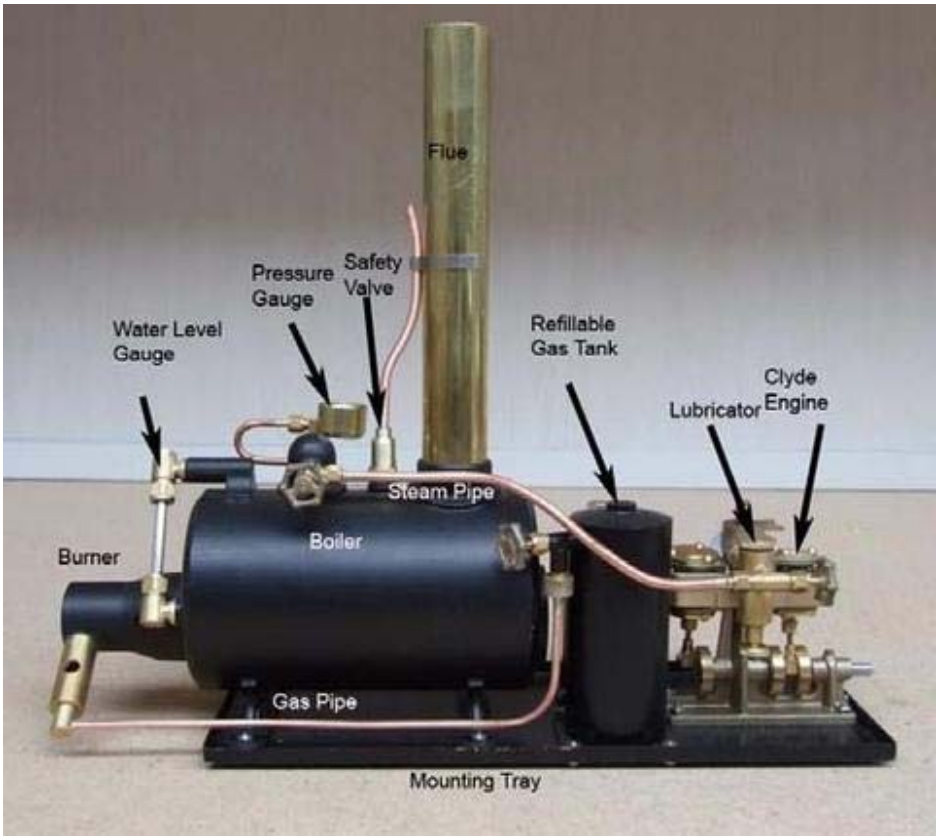
4. General Operation Of a Steam Plant

General Steam Plant Operating Guide

(The first page is a duplicate of Guide #1)

This note is intended to address the interests of potential users of a ***"Miniature Steam"*** steam plant. Since an engine alone has no purpose but to look beautiful, its operation must be seen in the context of the components that are required for it to perform its primary function of powering something - in this case we are highlighting the operation of an engine in an integrated steam plant using ***"Miniature Steam"*** 3" horizontal boiler and Clyde twin cylinder oscillating engine built to power a radio controlled boat. The descriptions apply generally to any engine/boiler combination.


Flue
Pressure Gauge
Refillable Gas Tank
Water Refill Port
Water Level Gauge
Oil Trap
Boiler
Burner
Clyde Engine
Mounting Tray


Flue
Pressure Gauge
Safety Valve
Water Level Gauge
Refillable Gas Tank
Clyde Engine
Lubricator
Steam Pipe
Boiler
Burner
Gas Pipe
Mounting Tray

STEAM PLANT COMPONENTS:

The engine must be mounted on a firm base – a brass **Mounting Tray** is used in the illustration. Beware of mounting the tray on an uneven surface. This could lead to distortion of the **Clyde Engine** base when screwed down. In turn this could cause binding of the crankshaft in its bearings leading to poor engine performance if not actual seizing of the engine.

The engine is connected to the **Boiler** by a **Steam Pipe** with a steam cock (valve) at the boiler for control- ling the steam delivery to the engine. Steam passes through the boiler steam cock, through a displacement **Lubricator** before entering the engine. In the case of twin cylinder oscillating engines it passes through a valve (not identified) that controls the direction of rotation of the engine as well as the power re- quired from the engine. It directs live steam into the engine and spent steam to the **Oil Trap**. (Basically slide valve engines use the Stevenson's reversing linkage for a similar control function).

The oil trap separates the oil from the exhaust steam and clean steam is passed to the exhaust port (not shown).

The boiler **Burner** is powered, through the **Gas Pipe** from a **Refillable Gas Tank**. The tank is fitted in a way that enables easy removal from the tray for refilling, an important safety requirement.

Steam pressure is indicated on a **Pressure Gauge** and a **Safety Valve** can be adjusted to release steam if the pressure exceeds a practical working level for the specific boiler.

Water level in the boiler is indicated by a **Water Level Glass** fitted to the end of the boiler. Exhaust gases from the boiler exhaust to the atmosphere through the **Flue** or stack or chimney.

STEAM GENERATION – BOILER OPERATION:

Compressed Air:

Use of compressed air to run any Miniature Steam “STEAM” engine will void our warranty. Do not use it as an alternative to steam at any time - please!

Burners:

Fundamental to operating a boiler is a heating device. Some of the smaller boilers in the market use spirit or tablet heat sources but the more powerful boilers are generally heated by various gas types delivered through, in MSM boilers, cast ceramic burner elements. Generally there are two types of ceramic burner elements – those that are machined out of general purpose heating tile blocks and those that are constructed as cast ceramic elements tailored for the burner/boiler combination. ***“Miniature Steam”*** boilers exclusively use the custom designed cast ceramic elements because of the superior heating performance that may be obtained. To obtain this maximum performance, these burners need to be tuned to the actual installation.

Guide # 6 sets out the the “tuning” or calibration procedure that **must** be undertaken as a first step

Boiler Water Level:

It is important that the correct water levels are maintained in the boiler by proper use of the water level sight glass. This is fitted to the boiler so that it shows water levels in a safe range. If the water level is not showing, the boiler has too much or too little water. Firing up the boiler with too little water can result in boiler damage. Doing so with too much water will impede the generation of steam and result in poor boiler performance and excessive water in the steam line. Boiler feed pumps, both steam driven and manually operated, can be used to maintain water levels during a run, but a well-designed system will have balanced gas supply vs. boiler water capacity that will give session running times of 15 to 20 minutes. ***"Miniature Steam"*** 2" boilers are refilled by re- moving the safety valve. The 3" and 4" boilers have separate filler nuts for water refills. With 3" vertical boilers this is located under the cowl and with the 3" & 4" horizontal boilers it is adjacent to the pressure release valve. Clean "soft" water should be used to minimise accumulation of scale in the boiler. The syringe supplied is used to add water through the filler port or to remove excess water the same way.

The Pressure Release Valve (Safety Valve)

Details of MSM Safety Valves are set out in Guide # 12.

Again it is important the safety valves are properly set during the commissioning process.

WARNING - DO NOT TRY TO GET IMPROVED OUTPUT FROM THE BOILER BY ADJUSTING THE PRESSURE (SAFETY) VALVE ABOVE THE RECOMMENDED MAXIMUM PRESSURE FOR THAT BOILER.

Each boiler is fitted with a pressure release valve that will vent the steam from the boiler if it passes a pressure appropriate to each boiler. This pressure is **NOT** set at the factory on delivery; the customer must make a setting according to local conditions and regulations. The 2" boilers and 3" vertical boiler have a valve that can be adjusted without removing it from the boiler. The valves on the 3" and 4" horizontal boilers must be removed to adjust the release pressure. During commissioning, on each run allow the valve to discharge and note the discharge pressure before drawing off steam. At the end of each run, **when the boiler is cool,** adjust the valve as follows:

For 2" and 3" Vertical boilers, slack off the locknut and rotate the valve setting nut (the component with 4 holes in it); clockwise to increase the release pressure anti-clockwise to reduce the release pressure, a quarter turn at a time. Re-tighten the locknut before starting the next run. For 3" & 4" Horizontal boilers remove the valve, slack off the locknut (the one on the end of the assembly) and vary the setting of the adjusting nut, a quarter turn at a time; clockwise to in- crease the release pressure, anti-clockwise to reduce the release pressure. Re-tighten the lock- nut and replace the valve in the boiler.

Repeat the procedure until the valve discharges at the required pressure. The boilers are certified at higher pressure than what we call "Sensible Operating Pressures"- SOP - determined by the engine type. These are: Tyne 15psi; Avon 20psi; Clyde 25psi; These are suggested for simple installations running under "normal" loads. If you experience substantial steam blowing out of the oscillating faces of the engine then the safety valve discharge pressure is probably set too high. The safety valves on these engines do not "pop" - there is a slow build-up of steam discharge as the boiler continues to heat the water.

Coping with condensate:

In simple terms, steam is water vapour that is produced when water is boiled. It will return to water if its temperature is reduced below the boiling point of water. When delivering steam from a boiler to an engine, the higher the delivery temperature and pressure the more power can be generated by the engine. Thus heat lost by the steam after leaving the boiler and arriving on the top of an engine piston will reduce the potential power of the engine. In the extreme case of steam being delivered to a cold engine the steam will condense to water in the engine cylinder and impede its operation.

With oscillating engines this results in water/steam bubbling between the cylinder and trunk during warm-up.

Slide valve engines have manually operated drain cocks opening to the top and bottom of each cylinder. These are more for authenticity than practical use in that condensate in these engines can usually be ejected with the exhaust steam.

Steam Oil Separator:

At the other end of the steam journey, to meet environmental requirements, the spent steam, with the lubricating oil drawn in from the displacement lubricator, has to be passed through a steam condenser/separator, sometimes called an oil trap or steam trap. In this component the lubricating oil in the steam is separated from the cooled steam and the clean steam proceeds to the atmosphere minus its oil load. The oil collected is extracted from the condenser, and discarded, at the end of each run using the syringe supplied. Do not be tempted to re-use the collected oil. Always use the syringe to take out the oil in the condenser while it is still warm. It can be difficult to draw out if it is allowed to cool before extraction.

Boiler Lagging:

Historically most working boilers were clad with insulating materials to minimise heat loss from the boiler shell. “Miniature Steam” 3” & 4” model boilers are supplied with a wood lagging kit for self-assembly to help minimize heat loss. There are a number of factors to consider before deciding to install lagging on your boiler. An additional benefit of the wood lagging is to improve the cosmetic appearance of the boiler and to minimise risk of contact skin burns during operation. If wood lagging is not desired for a particular situation, e.g. cold ambient temperatures requiring warming of the gas tank for efficient combustion, the highly efficient ***“Miniature Steam”*** cast ceramic burners generally provide sufficient heating capacity to cope with radiant heat losses from an unlagged boiler in reasonable ambient temperatures

There are a number of methods of lagging boilers. Our preferred method is as follows:

- starting at the top centre of the boiler cut the wood planks to fit between the castings
- glue the wood cut outs in place using super
- continue gluing the planks in place and cut out were
- after you have finished sand the planks to a smooth
- paint the planks with a satin or semi-gloss
- place the brass bands around the finished planks and bend up the
- drill holes in the bent up ends and secure in place with the screws

Why/how to lag the steam supply pipes:

In normal industrial situations the distance between a boiler and the engine generally was sufficient to require lagging of the steam supply line to minimise heat loss. This was a commercial imperative that does not necessarily apply to modeling situations when the original design is scaled down. It may be advisable where the steam line is relatively long, or when there are many stop/start actions that will leave live steam in the pipe long enough to lose significant heat when maneuvering the boat. Otherwise it only needs to be used to authenticate the model. This can be accomplished by closely wrapping fibrous string (cotton- not synthetic fibers) around the steam line and painting with a suitable white paint to simulate the full size practice.

ENGINE OPERATION:

Warm-up: (see **Coping with condensate** above).

During warm-up oscillating engines eliminate condensed steam and lubricator oil by “blubbering” between the cylinder and the trunk This is the process that happens as steam is being delivered to the engine while the engine is at a temperature that will condense the steam to water. As soon as the blubbering stops the engine will operate normally. This is also a safety feature of oscillating engines in that steam pressure beyond the design limit will cause the cylinder to lift off the trunk and relieve excess pressure. With oscillators if you experience prolonged blubbering at warm-up or during post warm-up activity this will indicate some serious overload on the engine that should be corrected before continuing.

The role of the displacement lubricator:

Refer to Guide #23

General lubrication after each run:

Refer to Guides # 20 External Lubrication & # 22 Steam Oil

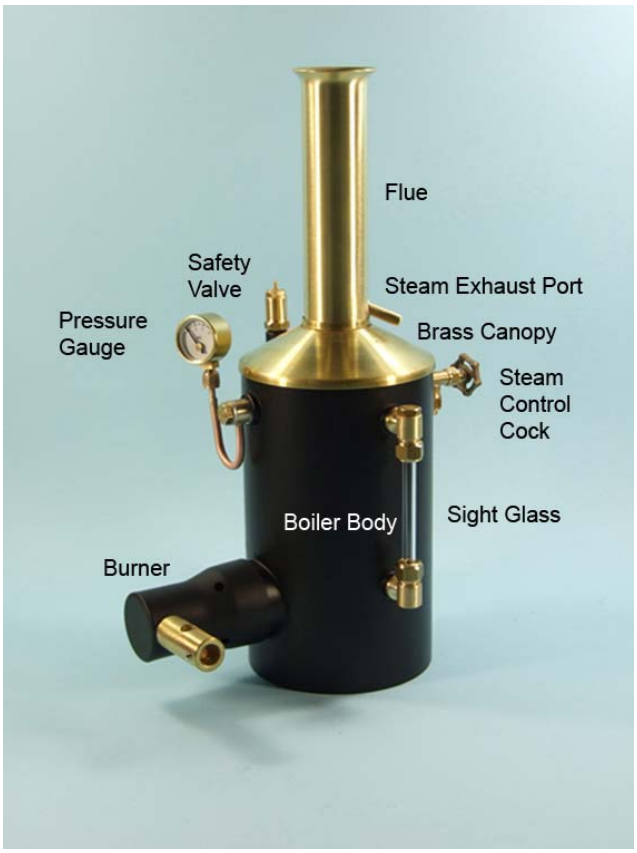
General housekeeping:

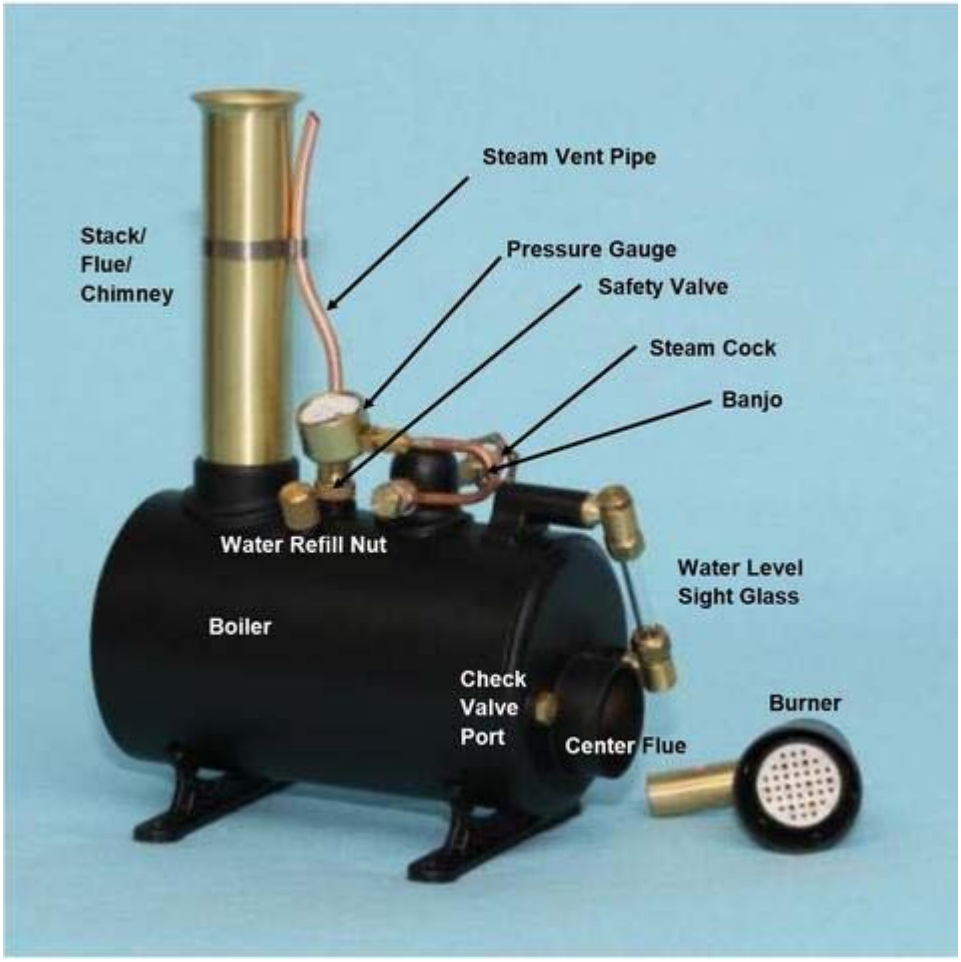
It is normal for steam plants to get “messy” during operation. The steam plant tray has fold up edges to collect water and oil to minimise the “messiness” extending to the rest of the installation. It is good practice to mop out the tray after each run and generally wipe away any splashes on the components.

Long term storage:

Generally an engine’s cast components are made from a marine grade non-corrosive alloy; the oscillators crankshaft is made from stainless steel the slide valve engines have a SG cast iron crankshafts which is only mildly susceptible to corrosion. The remainder of the machined components from brass. This combination provides maximum protection from corrosion during service if the engine is run regularly. However if you are planning to not run it for a prolonged period – say 3 months or more, the residual condensate that will remain in the cylinder after a run may cause some tarnishing of the cylinder bore. This could cause accelerated wear of the “O” rings in an Oscillator and increase the internal friction of the engine during initial startup. In these circumstances we recommend that you remove the top and bottom cylinder covers, soak up the condensate, directly lubricate the cylinder bore (preferably with benign rubber grease) and replace the cylinder covers before storing the engine. This advice does not apply to the Avon engine where the cylinder is factory assembled and should not be dismantled

6. MSM Boilers - General Description





General Description:
All MSM boilers incorporate a “center flue” design. This means that the heating gases generated by the burner pass through the centre of the boiler which has a central tube fitted with a spiral of cross tubes carrying boiler water that gives a maximum opportunity for the heat energy in the burner flame to be transferred to the water to generate steam.
Not shown in the pictures above is the gas pipe following .

This has a knurled nut on one end to connect to the gas tank and the gas jet holder on the other. This slides into the gas tube on the burner to allow adjustment of air entry in the process of “calibrating” the burner flame. See Library Guide 11. Setting up the Burner. When calibrated,
the burner is inserted into the center flue and is retained there by simple friction and the proper adjustment to the burner pipe shape to provide inward pressure on the burner. The outer part of the burner that fits onto the center flue is called the “burner shroud”.
The “banjo” is the pipe fitting that connects the boiler to the pressure gauge. It’s purpose is to retain a column of water between the boiler and the pressure gauge so that the pressure can be indicated to the gauge without allowing steam into the gauge internals.
The “check valve port” is a 1/4” x 40 tpi fitting that is delivered with a blanking nut fitted. It is provided to allow for easy connection of a boiler feedwater pump or as part of a gas regulator installation.
As noted in the table below this is not fitted to the 2” boilers.
The “steam vent pipe” is intended to be a stylish way of venting the steam from the safety valve when it releases.
Safety valves and their setting is detailed in Library Guide 12,Safety Valves.
The steam cock is only fitted to boilers bought individually or on steam plants with slide valve engines. The steam cock for steam plants using oscillator engines is usually integral to the displacement
lubricator.
Separate water filling ports are fitted to all boilers and should be obvious - except for the 3” & "Econo" vertical
boilers where the top cone has to be lifted to access it.
The water level sight glass is important for maintaining proper operation of the boiler. When operating the boiler a water level should show at all times. See Library Guide 9. Filling & Maintenance.
The above pictures and the annotations typify what could be shown for all our boilers—with the following variations. (Extract from Guide 12. Safety Valves)

Feature ˅ Boiler >	2" Horizontal	2" Vertical	2" Special	3" Horizontal	3" Vertical	4" Horizontal
Whistle	NO	NO	NO	Option	Option	Option
Steam Vent Pipe	NO	NO	NO	Standard	NO	Standard
Auxiliary Port (plugged)	NO	NO	NO	Standard	Standard	Standard
Pressure Gauge	0-60 psi	0-60 psi	0-60 psi	0-60 psi	0-60 psi	0-80 psi

One other variation is the 2” Special Vertical Boiler pictured below, has it’s burner built into the base for the boiler. It is still a center flue boiler with all the other features.