BOILERMAN 3 & 2

NAVY TRAINING COURSES

NAVPERS 10535-C

pressure, through atomizers which break up the oil into a foglike spray, and (3) forcing air into the furnace under pressure, in such a way that it mixes thoroughly with the oil spray.

The amount of fuel which can be burned properly and efficiently in a boiler is limited primarily by the amount of air which can be forced into the furnace. (The volume and shape of the furnace, and the capacity of the burner apparatus to mix the air with the fuel, are also limiting factors.) The end point for combustion is reached when the maximum amount of air which can be forced into the furnace is insufficient for complete combustion of the fuel. Therefore, if the end point is actually reached, the smoke in the uptakes will be black because it will contain particles of unburned fuel.

End Point for Moisture Carry-Over

Moisture in steam leaving the boiler is likely to cause corrosion of piping and machinery and erosion of internal parts of engines, piping, and fittings. In addition, moisture carried over in the steam may contain insoluble matter which, if deposited in superheater tubes, may form an insulating scale. Similarly, scale may be formed on turbine blades and on other machinery parts, and may in some cases cause unbalance of rotating parts. It is very important, therefore, to prevent excessive moisture carry-over from the boilers.

As the evaporation rate is increased, the the amount of moisture carried over is also increased. In modern naval boilers, the problem of moisture carry-over is complicated by the use of high steam pressures. As pressure increases, the density of the steam increases proportionately, so that a given volume of steam at a high pressure can carry with it more moisture than the same volume of steam at a lower pressure. If the end point for moisture carry-over is exceeded, the damage to machinery and equipment is likely to be extensive even if not immediately apparent.

In modern boilers, various arrangements of baffles, separators, and screens are installed in the steam drum to septhe pilot valve close. The closing of the pilot valve closes the actuating pipe line to the superheater unloading valve. The pressure above the disk of the unloading valve builds up again very quickly, and the disk is reseated sharply and cleanly.

Another type of pilot-operated superheater outlet safety valve assembly is similar to the one just described, except that it consists of only two valves: a pilot valve and a SPRING-LOADED superheater unloading valve. The pilot valve is a small safety valve with an additional outlet on one side. The pilot valve is connected by piping directly to an operating piston of the unloading valve. The unloading valve opens fully at almost the same moment as the pilot valve. If for any reason the pilot valve fails to open, the superheater valve will open at a slightly higher pressure, like any regular spring-loaded safety valve.

SOOT BLOWERS

Soot deposited on boiler tubes effectively insulates the tubes from furnace heat, and thus seriously reduces heat transfer. Soot blowers are installed adjacent to and between the boiler tubes, so that the boiler firesides may be cleared of soot deposits while the boiler is steaming. Several soot blowers are installed on each boiler. They are arranged so that operation in the proper sequence will sweep the soot progressively toward the uptakes. Figure 3–12 shows the general arrangement of soot blowers in an M-type boiler.

A soot blower is essentially a pipe with nozzle outlets. Superheated steam is admitted to the element and is discharged at high velocity through the nozzles, which direct the jets of steam so that they sweep over the tubes. The soot is thus loosened and carried out of the boiler by way of the uptakes and the stack.

One RETRACTABLE SINGLE-NOZZLE soot blower is installed in the roof of the superheater furnace of M-type boilers. Turning a handwheel advances the unit about 5 inches into

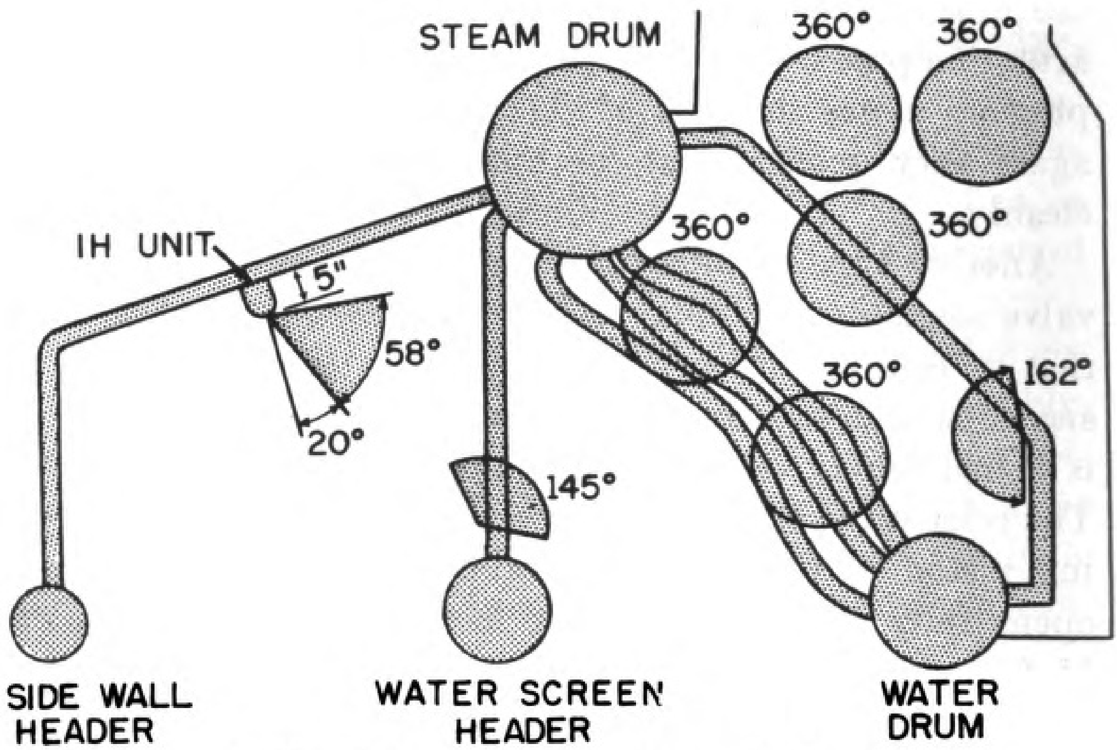

Figure 3–12.—Arrangement of soot blowers in M-type boiler.

the superheater furnace and causes an automatic admission of steam. The nozzle is then rotated by continued turning of the handwheel. Reversing the handwheel shuts off the steam and retracts the nozzle into a shroud between the inner and outer casings of the boiler. This retractable soot blower is usually referred to as the IH UNIT.

The other soot blowers are of the MULTI-NOZZLE type. In these blowers, a steam valve is actuated and the element is rotated by means of a crank or an endless chain. Steam is admitted from the soot blower head (shown in figure 3–13) into the element by means of a straight pipe which has small nozzles fitted along one side. The pipe can be rotated through 360°; on some blowers, however, the admission and cut-off of steam is so controlled that these blowers sweep during only a part of each revolution. Figure 3–12 shows the usual BLOWING ARCS for soot blowers on M-type boilers.

It should be noted that although the elements of multinozzle soot blowers are identical as to size and nozzle spacing,

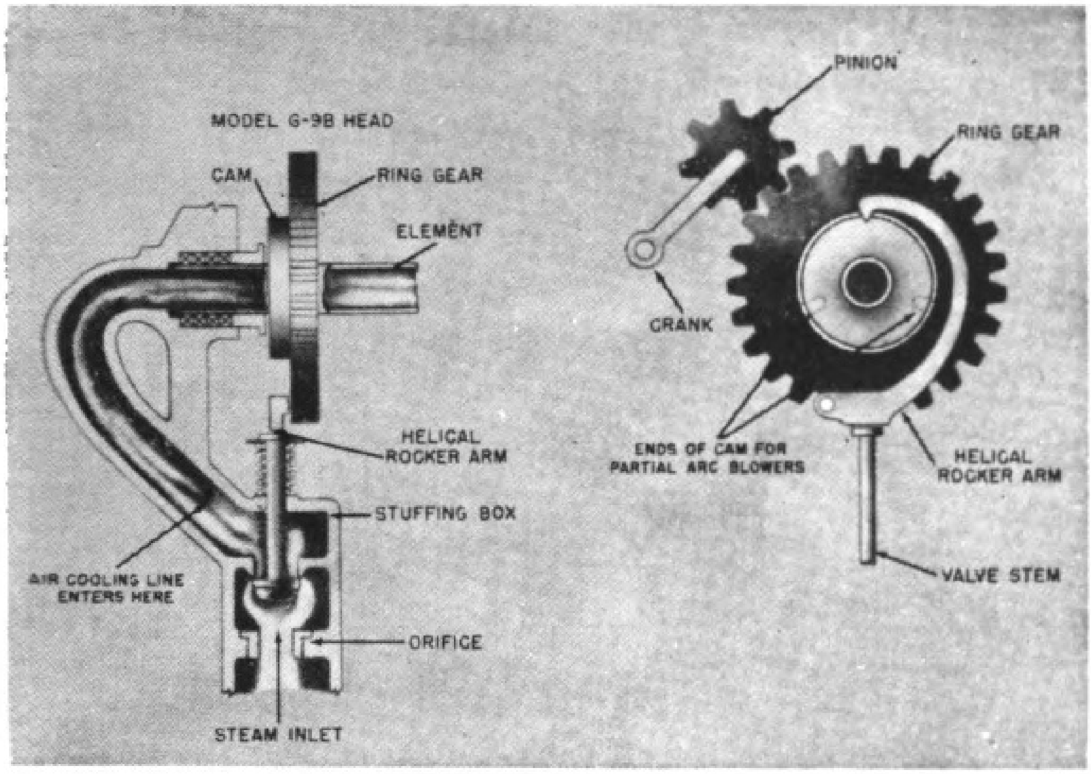

Figure 3–13.—Soot blower head.

they are NOT made of identical material, and are therefore NOT interchangeable. Each element is made of metal which is suitable for the temperatures to which it will be exposed; since the temperatures vary within the furnace, each soot blower element is designed for one location only.

SMOKE INDICATORS

Modern boilers are fitted with smoke indicators (sometimes called SMOKE PERISCOPES) which permit visual observation of the gases of combustion as they pass through the uptakes. Two smoke indicators are installed in the uptake of each two-furnace boiler; one permits observation of the gases coming from the saturated side, and the other of gases from the superheater side. Single-furnace boilers have only one smoke indicator.

Each smoke indicator consists of two units, one installed at the rear of the uptake, and the other at the front. The rear unit contains an electric light bulb and an optical lens; both are enclosed in a cylindrical casing which fits over a responsible for observing the remote water level indicator and making sure that the correct water level is maintained in the boiler. When automatic feed water regulators of this type are installed, they must be kept in use at all times; it is not necessary, therefore, to have a checkman stationed at the feed check valve.

When the engineering officer of the watch has obtained permission from the officer of the deck, the fireroom will be instructed to blow tubes. The man in charge of the watch may operate the soot blowers himself, or he may supervise the messenger or the auxiliary man in this work. The checkman must NEVER be given this or any other duty to distract him from his job.

In blowing tubes, the steam lines to the soot blowers must first be warmed and drained. A drain hole in the soot blower valve allows constant drainage to the bilges while the soot blowers are in operation. Tubes must be blown in the proper sequence. Soot blowers should be used at least once a watch while under way, twice a day during in-port steaming, and just prior to securing a boiler. On controlled superheat boilers, tubes must NEVER be blown on the superheater side unless the superheater side is lighted off. When blowing tubes, the forced draft blower speed must be increased sufficiently so that all soot will be blown from the furnace and out the stack.

In order to perform his duties, the man in charge of the watch must know the correct procedures to be followed in lighting off, operating, and securing boilers; the methods of lining up, starting, operating, and securing all fireroom machinery; the correct procedure for keeping fireroom logs and records; the location of all machinery, lines, manifolds, valves, and other parts of the installation; the use of all fire-fighting equipment; and all fireroom safety precautions and casualty procedures.

Checkman

As checkman, you are responsible for operating the feed stop valve and the feed check valve. The stop valve is kept fully opened at all times while the boiler is steaming, and be blown down at regular intervals, as indicated in the manufacturers' instruction books.

As a rule, automatic feed water regulators vary the supply of feed water by actuating a feed-regulating valve in the feed line. This valve is usually installed in the main feed line, between the feed stop and check valves and the economizer. When the automatic regulator is in use, the stop and check valves must be fully open; when the automatic regulator is not in use, the feed-regulating valve must be fully open so that it cannot interfere with manual feeding of the boiler.

The checkman should notify the PO in charge of the watch IMMEDIATELY of any abnormal operating condition or of any condition beyond his control. Procedures for dealing with high-water and low-water casualties are discussed in the chapter on fireroom casualty control.

Blowerman

As blowerman, you are responsible for operating the forced draft blowers which supply air for combustion. Although the air pressure is affected by the number of registers in use and the extent to which each register is open, it is primarily determined by the manner in which the forced draft blowers are operated. The opening, setting, or adjustment of the air registers is the burnerman's job; the control of the forced draft blowers is the blowerman's job. It is very important that the burnerman and the blowerman work in close cooperation, since both are concerned with the combustion of the fuel.

As blowerman, you must furnish the amount of air which, after adjustment of the air registers, will be sufficient for proper combustion of the oil. Any increase in air pressure beyond this point will result in EXCESS AIR. Excess air is undesirable because it is wasteful of fuel. The air which is not needed for combustion merely absorbs and carries off heat, thus increasing the fuel requirements and decreasing the steaming radius of the ship. WHITE SMOKE is always an indication of a very large amount of excess air.

On the other hand, you must be sure to supply ENOUGH air for complete combustion of the fuel. Insufficient air pressure will cause panting and vibration of the boiler, and will result in HEAVY BLACK SMOKE.

In operating the blowers, therefore, you must keep the air pressure at the point which will allow the fuel oil to burn completely, without creating smoke; but you must at the same time be sure that you are using the MINIMUM amount of air pressure required for combustion. For the sake of economy, you may be instructed to carry a LIGHT BROWN HAZE; in this case, you supply slightly LESS air than would be required for smokeless operation.

Since the amount of air to be supplied by the forced draft blowers depends upon the rate of combustion, the blowerman must always know what the burnerman is about to do. Air pressure must be increased BEFORE the rate of combustion is increased, and decreased AFTER the rate of combustion is decreased.

As you supply air to the boiler, you will be building up the air pressure in the space between the inner and outer boiler casings. This pressure is registered on the AIR PRESSURE GAGE. You will have to learn by experience how much air pressure is required to maintain good combustion when varying numbers of burners, sizes of sprayer plates, and oil pressures are used.

The actual operation of the blowers is accomplished by adjusting the blower throttle. You should use the MINIMUM number of blowers required to produce the desired air pressure. Remember, it is always more economical to run one blower at full capacity than to run two blowers at partial capacity.

The blowerman must keep a constant check on furnace conditions. Most modern boilers have SMOKE PERISCOPES through which you can observe the smoke conditions in the uptake. When a daylight bulb is used in the smoke periscope, the smoke and air conditions are indicated in the following manner:

Appearance of light	*Smoke and air conditions*
White	No smoke; but may be considerable excess air.
Slightly dimmed or hazy	Slight haze; air supply about right for most economical operation.
Increasingly dark	Increasing amounts of black smoke; more air required.
Slightly dimmed, with red tinge	Small amount of white smoke; large amount of excess air.
Completely black	Large amount of either white or black smoke; too much or too little air.

If observation through the smoke periscope indicates improper combustion conditions, you should check the appearance of the flames through the furnace peepholes. When operating at low or moderate combustion rates, the color of the flame is an indication of the furnace efficiency. An incandescent white flame, through which the furnace walls are clearly visible, indicates a considerable amount of excess air. A yellowish-orange or golden color at the end of the flame farthest from the atomizers, through which the seams in the furnace walls are just barely visible, indicates a minimum of excess air.

At very high rates of combustion, when the flame completely fills the furnace, it is more difficult to identify good and bad combustion conditions. An incandescent and dazzling white flame still indicates excess air; but a reduction in this excess air merely lowers the intensity of the whiteness, and does not cause the flame to appear yellowish-orange.

A perfectly clear smokestack is often deceiving. It may mean that you are operating with only a very small amount of excess air, but it may also mean that you have as much as 300 percent excess air. A clear stack is ideal when the flue gas analysis at the same time shows a high percentage of carbon dioxide, very little oxygen, and no carbon monoxide.

It should be noted that the presence of black smoke does not always indicate insufficient air. Smoke can be caused by poor atomization (due to faulty burners, low oil temperature, etc.), by poor mixture of air and oil, by unconsumed oil striking tubes or furnace walls, and by other factors. Defects of this type must be eliminated before proper oil and air regulation can be achieved.

Burnerman

The burnerman on an uncontrolled superheat boiler, or on the saturated side of a superheat control boiler, cuts burners in and out and adjusts the oil pressure in order to keep the steam pressure at the required point. He is guided by the steam drum pressure gage. In addition, he watches the annunciator, which shows the signals going from the bridge to the engineroom, and in this way he can tell what steam demands are going to be made.

The burnerman on the superheater side of a superheat control boiler cuts burners in and out and adjusts oil pressure in order to keep the superheater outlet temperature at the required point. The burnerman on the superheater side is guided by the distant-reading thermometer, which indicates the temperature of the steam at the superheater outlet. In addition, he must keep check on what the saturated-side burnerman is doing, so that he will always know how many burners are in use on the saturated side.

When two boilers are both furnishing steam to the same engine, the burnermen of both boilers must work together closely so that the load will be equally divided between the two boilers.

Under normal steaming conditions, the atomizer assemblies are kept in place in all burner openings, ready to be cut in when needed. It is important to remember that the same size sprayer plates must be used in all burners in any one