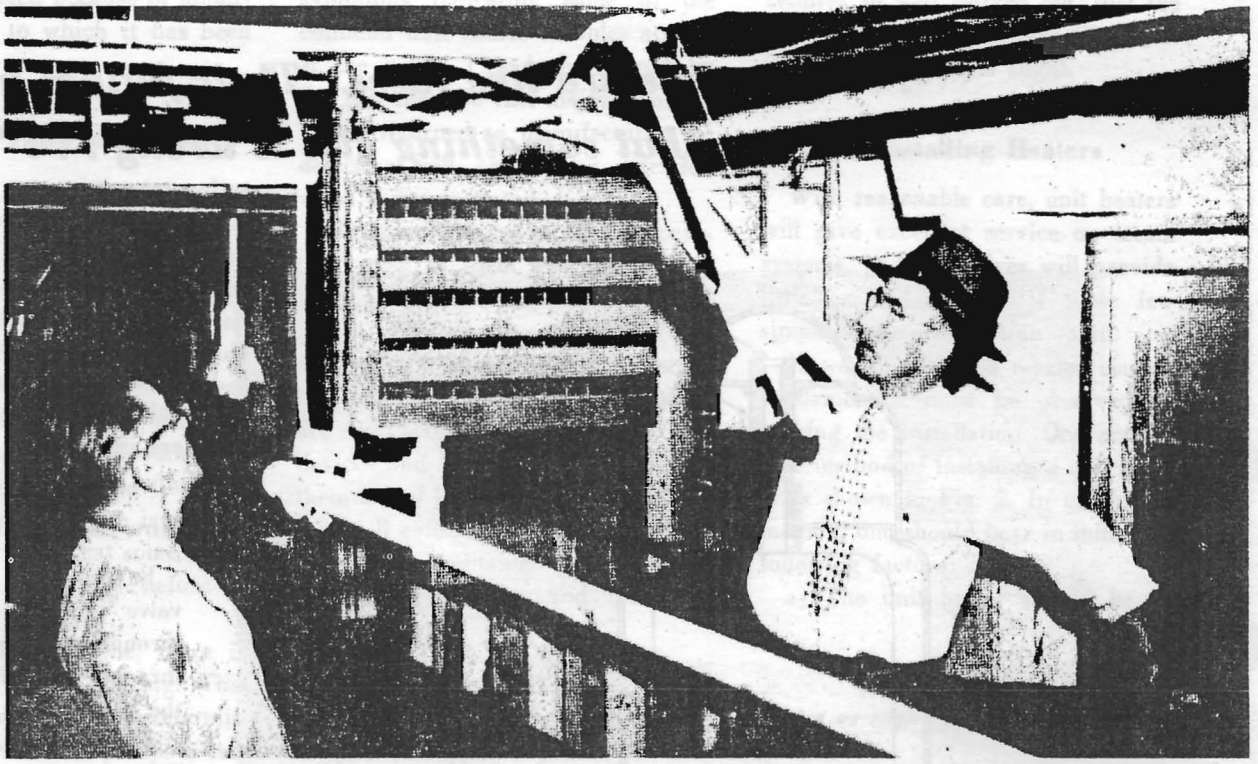

"SOME PEOPLE, suspecting valve trouble, try to cure it by hitting the valve with a stick."

What You Should Know About

Venting Unit Heaters

By Henry H. Aronson
Chief Application Engineer
Heating Div., The Dole Valve Co.

• Unit heaters in low pressure steam systems show excellent results when correctly installed and operated. One key to continuously satisfactory operation is proper venting through air valves. How this should be done is discussed here, with a few tips for installing heaters correctly.

VENTING IS ALL IMPORTANT when unit heaters are used on low pressure gravity steam systems. Everything can be perfect in the system, but if the venting is improper, results will be unsatisfactory.

The correct use of air vents is sometimes misunderstood. When this is the case, trouble is the result. Often the vents are suspected of being defective and are replaced. But this does no good if the basic causes of the trouble are not determined and corrected.

In some ways, air vents are like

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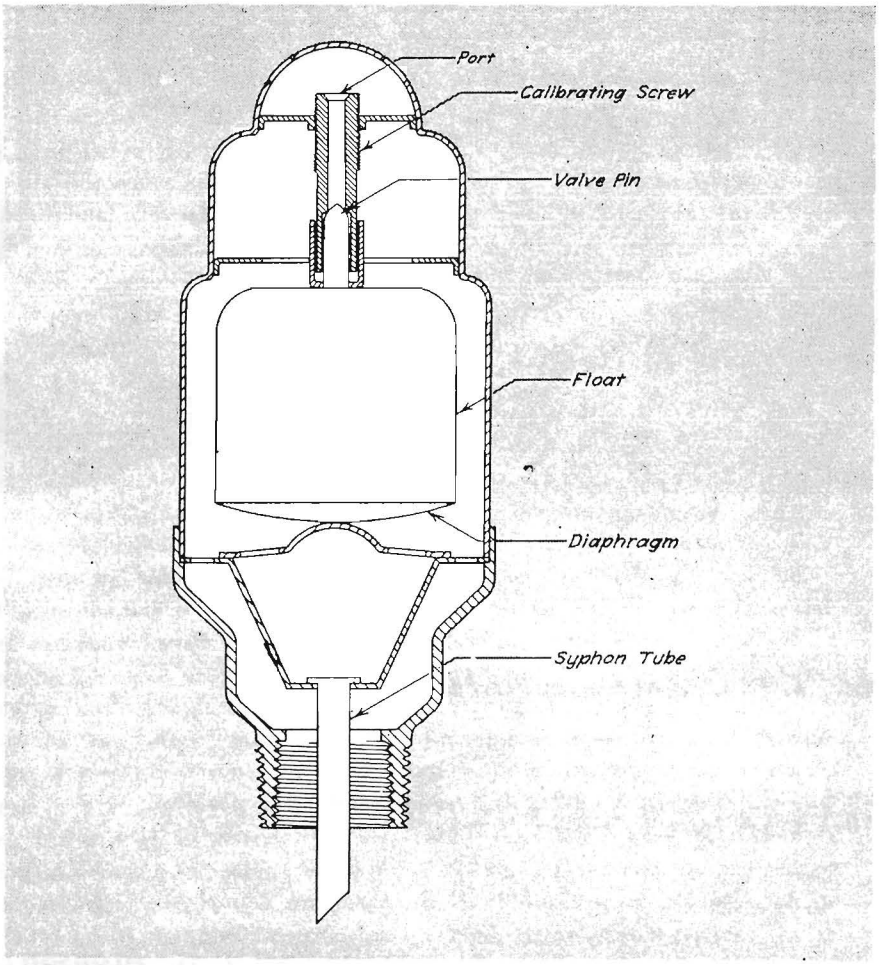
". . . Air vents are like fuses. Their failure may indicate that something else is wrong . . ."



1 AIR VALVE OPERATION is basically simple—see text, right. Excessively high pressure can blow the valve shut. Also, if the heater floods and the valve fills with water, the float will close the port

fuses. Their failure may indicate that something else is wrong. Replacing them may permit operation for a while, but when the same fault again appears, the same difficulty will occur. Because air valve failure is mainly symptomatic and seldom causative, there are some things that should be understood about their operation.

Don't Vent Too Fast, Too Slow

Venting unit heaters too fast can cause trouble, especially if the returns are too small or if they are restricted by dirt or scale. If the condensation rate is rapid, condensate will accumulate faster than the returns can handle it. For the same reason, it sometimes happens that when several unit heaters are operated from a single thermostat or control, condensate may be produced faster than the lines can handle it. By controlling the unit heaters so that only one goes on at a time, with just a short period between their starting, this problem can be minimized.

If the air valve vents too fast, steam will enter the unit too quickly. If it vents too slow, a partial vacuum may develop.

A section through a typical air valve of the type used on unit heaters is shown in Fig. 1.

How the Air Valve Operates

Basically, the operation of an air valve is quite simple. Air passes through the nipple, into the shell, through the valve and out through the port.

The float contains a volatile liquid. When steam comes in contact with the float, this liquid vaporizes and expands. This expansion forces the diaphragm — on the bottom of the float — outward. This diaphragm is forced against the base, raising the float and valve pin. The pin is forced into the valve seat, closing the port. Any steam that condenses within the shell returns to the system when the level of water in the valve reaches the syphon tube opening.

Excessively high pressures can also blow the valve shut. Lesser pressures can hold the valve closed after it has been closed thermally. Very often air-bound unit heaters are caused by pressure closure of the valve. The remedy is to lower the operating pressure and/or increase the differential on the pressure control. This will enable the valve to cycle oftener.

If the valve should fill with water due to the heater flooding, the float will raise and close the port. Should this happen, it is an indication that something is wrong with the system and this action of the valve is purely an emergency feature.

Leaking, spurting, or sticking of the valve is usually only a symptom of some basic difficulty within the heating system. When these difficulties are corrected, air valve action will become normal, unless the valve

has been damaged because of abnormal operation to which it has been subjected.

What Causes Valve to Spurt?

A valve will not spurt water unless water gets into the valve in the first place. This in itself is abnormal and indicates something wrong which must be corrected. The float in an air valve of this type is not made for continuous operation. It is there so that in an emergency it will close off and prevent serious flooding. As the water rises it carries the float and closes the valve. But there is a small amount of inertia so that some water will get past the valve before it closes.

With water in the line, there is often quite a bit of surging. This opens and closes the valve intermittently and more or less pumps a certain amount of water through the valve as long as the surging continues. If the surge is sufficient to produce water hammer, the valve may be ruined.

It is more than likely that the water will also carry grease, dirt, or scale into the valve. If this lodges in the port, the valve will either leak or stick from then on.

Spitting is due to condensation taking place in a fast moving air stream. The condensation is mixed with the air. The temperature of the mixture is too low to close the valve thermally and there is no water column to lift the float. This spitting occurs just before dry steam reaches the valve and closes it. The cause is usually excess pressure or too fast an air valve.

Dirt the Greatest Enemy

The greatest enemy of air valves is dirt and most true air valve failures are due to dirt, scale, or corrosion of the valves. Particles of dirt or scale can get lodged in the seat and cause it to leak or stick. Also, scale or other hard material may score the valve pin or seat so that a tight closure is impossible.

Many other problems are associated with the air valves, because the symptoms indicating some of the common unit heater troubles appear at the valve. This is borne out by the fact that the vast majority of air valves returned to manufacturers as defective will operate as intended when they are tested.

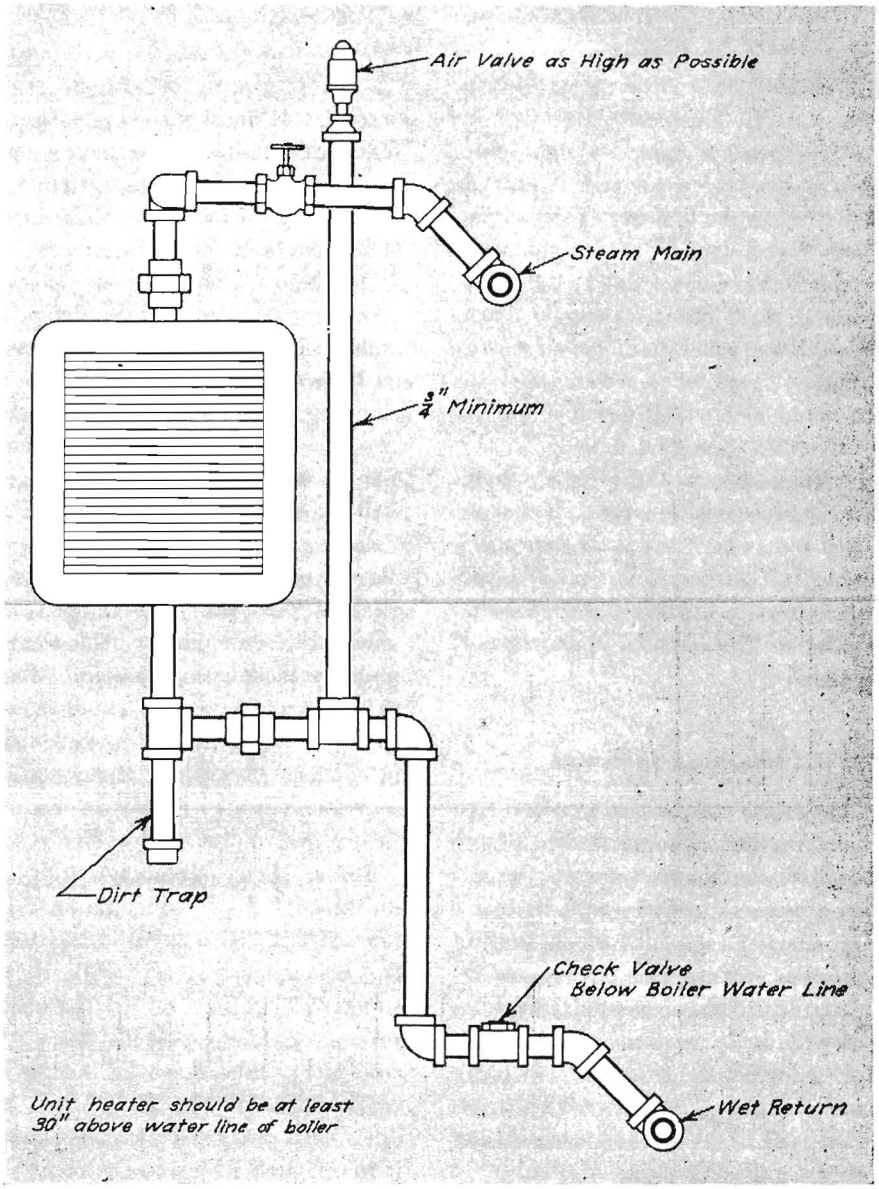
Of valves that are actually inoperative, most of them are either dirty or have been physically damaged. It seems that some people, suspecting valve trouble, try to cure it by hitting the valve with a stick. While valves are not fragile, they are precision devices and hitting them may knock them out of line or put dents in them that will cause the float to bind. Air valves of reputable manufacturers are so well made, and test procedures so well worked out, that the chance of an actually defective valve reaching the field is slight.

Tips on Installing Heaters

With reasonable care, unit heaters will give excellent service on steam systems, and air valves will provide little or no difficulty if these few simple facts are kept in mind.

However, for good results, certain fundamentals must be observed in making the installation. One acceptable method of installing a unit heater is shown in Fig. 2. In using this method, one should bear in mind the following factors:

a) The unit heater should be as



2 ILLUSTRATED is one method of installing a unit heater. The air valve should be as high above the unit as possible.

". . . Correct piping design with proper venting helps to prevent flooding . . ."

high as possible above the water line of the boiler, and never less than 30 in.

b) The check valve should be below the water line of the boiler and in a horizontal pipe.

c) The air valve should be as high above the unit as possible.

d) The larger the pipe leading to the air valve the better. It is advisable to use a regular tee and make this pipe the same size as the riser. In no case should it be less than ¾ in.

e) The connection should be made a few inches below the heater and a full 6 in. cleanout pipe should drop below it.

Sometimes it is necessary to use a dry return. This is not desirable, but if it is unavoidable, a tight check valve must be used and it must be well below the unit heater. It is sometimes necessary to use an equalizing loop with the check valve in the horizontal pipe. The loop should extend below the water line. This does two things: it provides a water seal and insures better action of the check valve, but it may be noisy.

Needless to say, the piping design must be basically correct. If the piping is too small, the units improperly sized or installed, or poor piping practices are followed, the system will be inefficient and not operate as intended.

What Flooding Indicates

The most usual causes of unit heater troubles from other than basic design defects, stem from excess pressures, or small or obstructed returns. A common complaint of unit heater operation is flooding. This prevents proper heat release from the heater, and the usual symptom of this difficulty is that the air valves will leak and spurt steam and water. This usually leads to the erroneous conclusion that the air valve itself is faulty.

When flooding occurs, it is an indication of something inherently wrong in the system. The most common causes of flooding are:

a) Excessive pressures,

b) Check valve too close to unit,

c) Unit too close to boiler water line,

d) Undersized returns,

e) Obstructed returns and

f) Sticking check valve.

First, remember that a pressure of 1 psi will raise a column of water 28 in. In a boiler, pressure is exerted equally in all directions. Force is exerted to back water up in the returns as well as to force steam into the mains. When a system reaches equilibrium, the pressures are more or less equal on both sides of the system with the pressure differential seldom more than ½ psi. This differential is due to the pressure drop caused by the friction of the piping. With ½ psi differential, the water level in the returns will be 14 in. above the boiler water level.

During the time the system is warming up, however, it may be completely unbalanced. Bear in mind that when water is turned into steam it expands 1600 times. On the other hand when steam enters a condensing unit, it shrinks to 1/1600th of its volume upon condensation. In a closed system this will produce a vacuum. However, with open air valves the unit heater will remain under atmospheric pressure. When this occurs, the system is unbalanced and the return system is under the full boiler pressure. Condensation may take place so rapidly in the unit heater that it has no pressure at all.

Under these conditions, a boiler pressure of 2 psi will tend to raise the water in the returns 56 in. above the boiler water level, while 3 psi will tend to raise it 84 in. The check valve is used to prevent the water from doing this. However, it must be realized that the check valve will not open until the head of water above it is sufficiently high to overcome the pressure below it, plus the head about 4 in. — necessary to operate tne check valve. The water will accumulate above the valve. The lower the check valve, the more storage space there will be for condensate.

In a properly operating and well designed system, equilibrium will be reached before the unit, the drip line, and the air valve become flooded. If it does flood, something is wrong, as mentioned previously. It should also be remembered that when water fills the returns, the boiler water level drops. If an automatic fill is used and the system is unbalanced for an extended period of time. the boiler itself may be flooded.

It is apparent that these problems stem from an inability to return the condensate properly.

Keep Pressures Low

In operating unit heaters on one pipe steam systems, pressures should be as low as possible and operation should be as nearly continuous as practical. Evidently this pressure concept is often misunderstood because of the widespread belief that heat can be forced around a system faster and farther with higher pressures. With cold heaters and a head of steam this is sometimes true but when the system is once filled, the only benefit is a slightly higher steam temperature. Since the important heat emission is directly attributed to the condensation rate, the steam temperature has relatively little significance, especially as the latent heat decreases with pressure. This refers to low pressure gravity operations and not high pressure systems, which are entirely different. However, the pressures can be a big factor in poor air valve operation. Generally, inability to provide proper heating with low pressures indicates an undersized heater.

Under most conditions, 2 or 3 psi should be an adequate operation pressure. Occasionally 5 psi may be needed where runs are exceptionally long and exposed. In all cases, the height of the unit heaters above the water line, the capacity of the returns, and the steam condensing ability of the system will determine the maximum pressure that can be satisfactorily maintained.