MAKING YOUR STEAM SYSTEM MORE EFFICIENT

The cry to conserve energy has been with us four or five years now and although the ears of some of us may be getting dulled to the sound, the conservation of energy is still important. If a plant uses steam for heating or process work, efficient use of this steam is a significant way to minimize energy consumption.

It is important that steam be produced within an efficient burner-boiler combination. However, this is not the subject of this presentation. Rather, it addresses itself to efficient distribution and consumption of steam after it leaves the boiler.

Steam is produced in the boiler and leaves the boiler somewhat wet. It is, therefore, important that boiler headers be drained or "dripped". A drip leg should be provided the same diameter as the header up to a 4" size. Above 4", the drip leg should be l/2 the header diameter, but not less than 4". The drip leg depth to the point of trap take-off at the side, should be l-1/2 times the header diameter. Assume a 10% carry over in sizing drip traps with a 3:l safety factor. We usually assume that only one of a series of boilers on a header will be priming at one time, and therefore, 3:l safety factor is applied only to the largest of the boiler outputs. (The above rules concerning drip legs may also be applied to their use on steam mains.)

Steam mains should be sized for reasonable velocity (see Flow of Fluids, Crane Technical Paper #410).

Reasonable Velocities for Flow of Steam Through Pipe

Condition of steam	Pressure **(P)** **Psig**		Reasonable Velocity **(V)** Feet per Minute
Saturated	0 to 25	**Heating (short** lines)	4,000 to 6,000
	24 **and up**	Power **house** equip process piping, etc.	6,000 to 10,000
Superheated	**200 and up**	Boiler &turbine leads, etc.	7,000 to 20,000

After determining a reasonable velocity of-flow, the correct size of the steam main can be chosen by referring to various engineering handbooks and manufacturers' literature. Remember that if the pipe is too small, there will be undesirable flow noise, erosion of pipe and fittings, irritating and often damaging water hammer, and also excessive pressure drop resulting in too low temperature possibly at the point of consumption.

Supply and return line should be sufficiently insulated and the insulation should be maintained. Insulating a steam supply main is usually taken for granted, as well it should be. Today a 400% **return on** investment can be realized by insulating a 4" supply operating at 500 $^{\circ}$F. Not as dramatic, but still dramatic, is the 100% return on investment frnm insulating a return main. (Insulating return mains means pumps must handle hotter condensate. Before insulating, be certain your pumps can handle it.)

Steam traps are a very important part of a steam distribution system. In order to do their job, they must serve three functions:

1) They must trap (hold back) the steam. They must make it do its work, giving up its latent heat.

2) They must be able to drain condensate so that there is no backup at any time.
AND

3) They must purge the piping or equipment of air and other non-condensables. This latter is important in order to maintain maximum steam temperature for high heat transfer efficiency.

FLOAT and THERMOSTATIC TRAPS (Fig. 1)

One of the primary types of steam traps is the Float & Thermostatic trap. It incorporates a ball float which is buoyant in condensate and, therefore, rises in the presence of condensate. The float is attached to a lever which has a valve in its assembly. When the float goes up, in the presence of condensate, the lever rises and pulls the valve off the seat thus opening the valve and, thereby, discharging the condensate. As long as condensate continues to flow to the trap, the float remains up and holds the valve open. As the flow of condensate falls off, and completely stops, the float modulates the valve downtowards the seat until it finally shuts off. The buoyancy of the float is the force available for opening the valve and when a trap is designed for a given differential the maximum valve size is determined which can be opened by the buoyant force of the float against the differential chosen. If the differential exceeds that of the design, the trap will "pressure lock shut" and cease to function. There will then be a backup of condensate. In designing the trap for higher pressures, a smaller orifice is chosen for each increasing pressure step in the design.

Separate flow paths are used for removal of air and condensate from the float and thermostatic trap. This type of trap is used most Often on systems in which the steam pressure modulates. On Startup, the main float-actuated valve is closed. Air is pushed through the open thermostatic air vent by system pressure. When condensate reaches the trap, the float rises to open the main valve and discharge condensate. Any remaining air continues to discharge through the open vent. When steam reaches the trap, the thermostatic air vent closes in response to temperature increase. Condensate continues to discharge from the trap at the Same rate as the flow into the trap. Air from the system begins to accumulate in the top of the trap. When the temperature drops, the action described for the thermostatic trap illustrated in Fig. 3 will result.

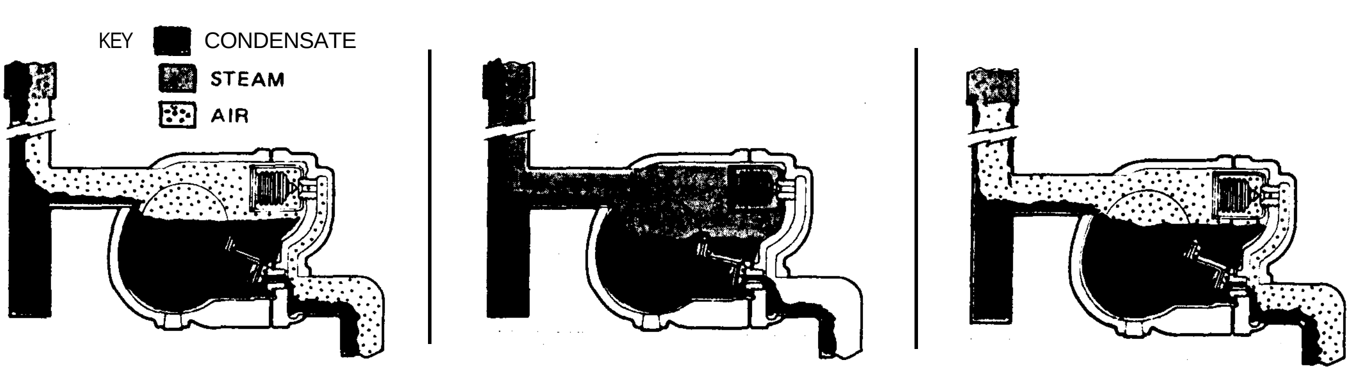


FIGURE 1

Conventional types of Float & Thermostatic traps incorporate a balanced pressure thermostatic bellows which actuates the air purge valve. This bellows in many instances has a partial water fill under vacuum. When it is exposed to 15 psig steam which has a saturation temperature of 250° it too comes up to the ~250° temperature. Since it has a water fill, it means that 15 psi steam is generated within the bellows, equalling the pressure surrounding the bellows. Under this balanced pressure condition, the bellows assumes its free length, that is extended, putting the valve on the seat. When air accumulates in the trap, it robs the steam of its temperature (Law of Partial Pressures) and although the 15 psig pressure is maintained, the temperature of ~250° is not. If for example sufficient air accumulates along with the steam in the steam trap, to reduce the temperature 20° to 230°, it means then that the bellows is subjected to ~230° temperature rather than 250°. Now instead of generating 15 psi steam inside the bellows, it will be generating 6 psi. The higher pressure outside the bellows, 15 psig, compresses the bellows which only contains a 6 psig pressure. When the bellows is compressed it pulls the valve off the seat and it discharges whatever air-steam mixture is in the steam trap. It discharges this mixture until near steam temperature is once more experienced when the balanced pressure condition inside and outside the bellows is restored. At this time, the bellows once more extends itself to its free length and closes the valve.

A closed float, and also the bellows, of a conventional trap are subject to water hammer damage. Severity of water hammer is very often 10 times or greater that of the system pressure. Since the float is a closed float, it must resist whatever pressure to which it is subjected. The bellows being rather delicate, having a wall thickness of only .005", can also be severely damaged.

The float and thermostatic trap is used where large quantities of air must be handled in connection with a vacuum breaker. In other words, where air, water or product are heated to a temperature of less than 212° with modulating steam pressure, there is a good application for a float & thermostatic trap, because of its ability to vent the air admitted to it by a vacuum breaker. The admission of air to a system through a vacuum breaker is essential to the proper functioning of the drainage trap whenever steam temperature of less than ~212° is supplied by an automatic control valve.

Do not use a float & thermostatic trap of this type where superheated steam can come in contact with it. The high superheat temperature surrounding the bellows will produce a pesssure within the bellows in excess of the pressure surrounding it, which then will result in the bellows bulging out of shape and therefore malfunctioning. A strainer is recommended ahead of an F&T because it modulates to the load. If the flow to the trap is 1 gpm, the flow out of the trap is 1 gpm. If it is on a light load, it modulates to a very small opening between the valve and the seat. Any scale or other undesirable material caught between the valve and seat would then prevent it from shutting off and could cause it to blow steam. Accumulation of dirt under the float could prevent its closing the valve. A strainer ahead of the trap would collect this dirt before it could do any damage.

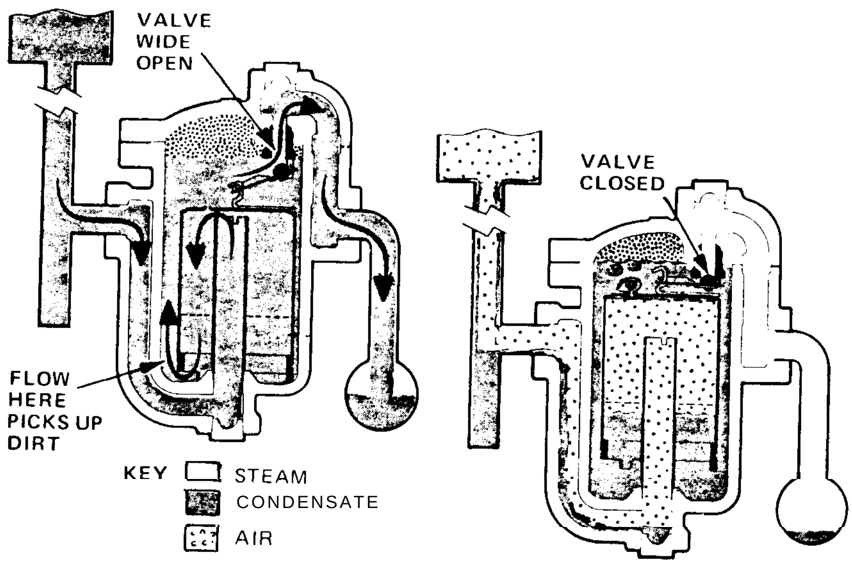
Our experience indicates that the average life of a float & thermostatic trap mechanism is three to four years. Of course, after it has been replaced it is practically speaking a brand new unit.

INVERTED BUCKET TRAPS (Fig. 2)

The thing to remember about the function of inverted bucket traps is that there are two condensate levels within the trap: one outside the bucket extends all the way up to the valve and seat and water seals the orifice; the other is within the bucket and determines whether the trap is open or shut.

When the bucket is approximately 2/3 full of steam, the bucket is buoyant enough to float which means it rises and puts the valve on the seat. Differential pressure then holds the valve on the seat. Condensate entering the trap enters beneath the bucket raising the level of condensate within the bucket. A rising condensate level means a decreasing steam volumn and, therefore, a decrease in buoyancy of the bucket. When the bucket is approximately 2/3 full of condensate, it is sufficiently heavy with a mechanical advantage of the valve lever, to sink and pull the valve off the seat to cause the trap to discharge. This cycle continues to repeat itself with the frequency of discharge varying with the load. If the load is extremely light, the trap will "dribble" which means it will have a rapid series of very small, partial openings. This is the normal way the inverted bucket trap functions on light loads. It is not blowing live steam.

Figure 2



The difference in density between steam and water is used to operate the inverted-bucket steam trap. Steam entering the inverted bucket causes the bucket to float (because it is submerged in condensate) and close the discharge valve. On startup, initial flow of condensate into the trap enters the bucket through the inlet tube and then flows under the bottom edge to the top of the trap. When the bucket is completely submerged and filled with condensate, the valve remains open to allow condensate discharge to the return header. Steam also enters the trap through the inlet tube under the bucket and rises and collects at the top, producing buoyancy. The bucket rises and closes the valve. Air and carbon dioxide continually bleed through the bucket vent and collect at the top of the trap. When the entering condensate brings the liquid level to the opening level, the weight of the bucket, acting with a mechanical advantage on a lever system, overcomes the pressure holding the valve on its seat. The bucket sinks and opens the trap valve to discharge accumulated air first and then condensate. Discharge continues until steam enters the bucket and again floats it upward to repeat the cycle.

Because the weight of the bucket is what is relied upon to open the valve, and the weight of the bucket is the same for all pressures in a given model number, it is necessary to vary the orifice size with the pressure: when pressures go up, the orifice size goes down. This makes it extremely important to get the right size orifice for the pressure at which the inverted bucket trap is going to be used. In exchange for this effort, the trap has a relatively long (5-10 years) efficient life of discharging condensate as fast as it forms at steam temperature.

Air is continously vented through the vent orifice in the top of the bucket. It accumulates at the top of the condensate and is discharged ahead of the condensate when the trap opens. There is no wait for a drop in temperature, the air is vented at steam temperature. Whatever steam passes through the vent of a standard inverted bucket trap is condensed by the radiation of the trap cap and body. No live steam passes the orifice.

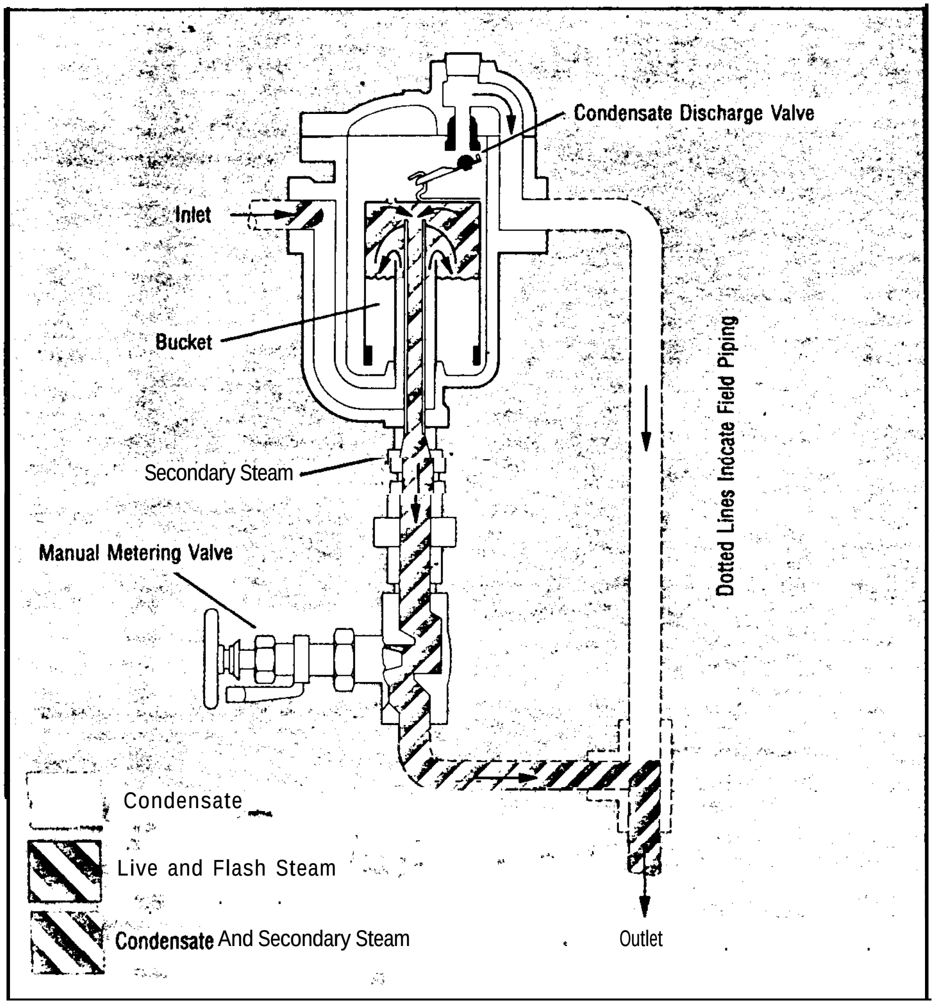
Since the open bucket has the same pressure inside and outside, it has good water hammer resistance. There is only one valve and seat to maintain and the intermittent discharge action produces a scrubbing action which moves dirt well. Normally, a strainer is not necessary ahead of an inverted bucket trap.

A standard form of inverted bucket trap, as described above, is used wherever there are no large volumes of air to be handled. Buckets with thermic vents can be had for a quick startup on "on-off" service.

The thermic vent opens a very large port in the top of the bucket preventing the bucket from floating and closing the valve while initial air and warmup condensate are being handled.

In some incidences a trap is called upon to discharge condensate that has been lifted from a lower level. Because of the pressure drop involved in going from the lower level to the level of the trap, flash steam is produced. Most traps will close on flash steam and result in the backing up of condensate. A larger than standard bucket vent can be provided in an inverted bucket trap to pass this flash steam. If large volumes of flash steam are to be anticipated, the condensate controller configuration can be used very efficiently. (See Figure 3)

When the steam is shutoff on a heat exchanger drained by an inverted bucket trap, there will be free drainage of condensate if there is a vacuum breaker between the heat exchanger and the steam trap inlet. If there is no vacuum breaker, the vacuum will be broken through the trap itself provided there are no check valves to prevent this. Because of the counterflow of air and condensate drainage may be somewhat sluggish. If a cast iron trap has its prime water frozen, it will crack. However, stainless steel inverted bucket traps are available which resist the force of the freezing prime.



Condensate enters through the controller inlet. The flash steam [secondary steam) passes through the by-pass at a rate controlled by the metering valve. This valve is adjusted to pass only the amount of steam generated as flash during full capacity operation. During such a period, the bucket remains down and the condensate discharge valve is wide open. During periods of light condensate load, a larger amount of live steam will reach the condensate controller, floating the bucket and closing the condensate valve.

Condensate Controller

Figure 3

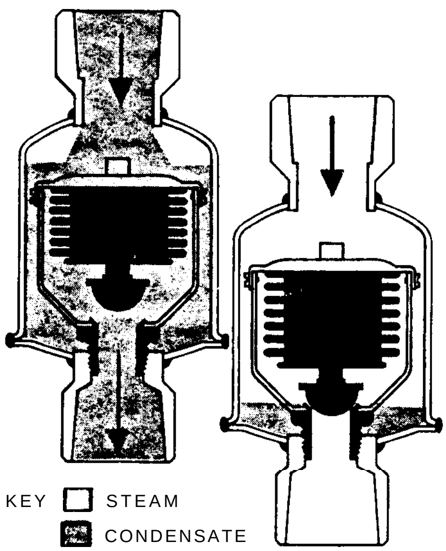
Inverted bucket traps are good for superheated steam service, however, they must be primed after maintenance. On normal startups, the startup condensate is adequate to prime them. On this type of service, we recommend the use of inlet tube, coupling and check valve, a burnished valve and seat and no insulation on the trap. The trap should not be oversized. A restricted orifice may be in order.

BALANCED PRESSURE BELLOWS - THERMOSTATIC TRAP or THERMOSTATIC AIR VENT (Fig. 4)

The element of the balanced pressure bellows thermostatic trap is essentially the same as the thermostatic element in the float & thermostatic trap. However, the valve opened by the thermostatic element not only vents air, but also discharges condensate. The temperature surrounding the bellows determines the bellows internal pressure which then determines whether or not the bellows is extended closing the valve or contracted opening the valve. The thermostatic trap requires a cooling leg to minimize the backup of condensate in the heat exchange coil or other apparatus. It does not pass condensate or vent air at steam temperature.

Figure 4

The bellows action of a thermostatic trap is caused by steam pressure and temperature as condensate flows to the trap. When condensate temperature is close to steam temperature, vapor pressure inside the bellows causes the bellows to expand and close the orifice. On startup, condensate and air are pushed ahead of steam directly through the trap. The thermostatic bellows element is fully contracted and the valve remains open until steam reaches the trap. As the temperature inside the trap increases, it quickly heats the charged bellows element, increasing the vapor pressure inside. When pressure inside the element becomes balanced with system pressure in the trap body, the spring effect of the bellows causes the element to expand and close the valve. When temperature in the trap drops a few degrees below saturated steam temperature, imbalanced pressure contracts the bellows, opening the valve. (Some bellows have an alcohol-water mix and depend on a higher pressure inside than outside to close the valve.)



A true balanced pressure bellows is charged with water so that it follows the steam saturation curve very closely. (Some allowance is made for the spring rate of the bellows.) Twenty degrees below saturation temperature is typical. In case of a leak in the bellows, the tendency is to fail closed.

In some cases, the bellows thermostatic trap element has an alcohol-water fill instead of pure water. This mixture results in a pressure in the bellows higher than that surrounding it, which when it is sufficiently high, will extend the bellows and close the trap. This type of trap, upon a leak in the bellows, usually results in failing open. When either type of fill is subjected to water hammer there is a tendency to crease the convolutions of the bellows or wafer of the element so that the pressure that is in the bellows is inadequate to overcome this spring rate and put the valve on the seat. They fail open. Should either of these traps be exposed to superheated steam, the internal pressure would be excessive resulting in a ruptured bellows since the bellows material is only about .005" think. Either type trap would probably fail shut.

Balanced pressure bellows traps tend to modulate on light loads, but tend to intermit on medium to heavy loads.

Upon shut down of steam, there is a substantial delay in the free drainage of the trap because again, the pressure inside the bellows follows the external pressure resulting in the closure mode. When finally cooled down, it is free draining, but often freezing can occur in some part of a heat exchanger or piping before the free draining occurs. The average life of the balanced pressure bellows thermostatic trap mechanism is 3-4 years.

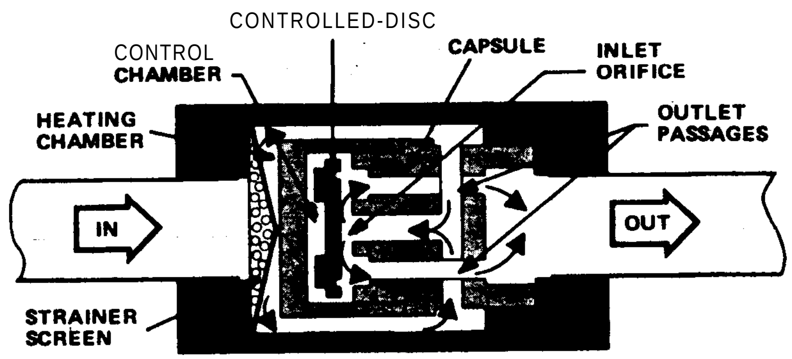
The bellows trap can be used advantageously as an air vent at points in heat exchange apparatus where the flow of steam is relatively stagnant, resulting in air stagnation. When used as an air vent, it should be installed at the top of a coil vertical-condensate-header or just ahead of the steam trap on a 1" pipe extended to a height somewhat above the coil. (Minimum height above a flat horizontal coil should be approximately 8".) As an air vent, its average life is 5-6 years.

THERMODYNAMIC TRAPS (Fig. 5)

Thermodynamic traps incorporate a disc valve. When the disc is seated, it is closing off both the inlet and the outlet ports of the trap. The inlet pressure elevates the disc from the seating surface. The flow takes place under the disc from the inlet port through the outlet port. When liquids flow through the trap, such as cold condensate, they flow through at a relatively low velocity and the pressure within the trap is essentially the same above and below the disc valve. However, when gases and vapors flow through the trap, they flow through at a much higher velocity. Because they do, the disc valve experiences a lower pressure on its surface facing the seating surfaces than it does on the other side (Bernoulli Principle). Because there is now a lower pressure on the seating side of the disc, the higher pressure on the other side moves the disc to the seat. Upon closure pressure which is the closing force is able to hold the valve on the seat inspite of the fact that the pressure at the inlet port is higher. Since the pressure on'the actuating side of the disc is exerted over the entire surface area of the disc, whereas that on the inlet port is exerted only on its relatively small area, that pressure on the actuating side of the disc produces the greater force, holding the valve shut.

Air and condensate entering the controlled-disc trap pass through a heating chamber surrounding the control chamber before passing through the inlet orifice. This flow lifts the disc from the inlet orifice and condensate flows to the outlet. When steam reaches the disc, increased flow velocity reduces pressure at the inlet while pressure in the control chamber remains the same, causing the disc to block the orifice. Heading steam from the control chamber causes the trap to open. If condensate is present, it is discharged. The trap recloses in the presence of steam and continues to cycle at a controlled rate. It also closes on the high velocity of air being purged at startup.

Figure 5



This type trap requires a bleed from the actuating side of the disc to the discharge port on the other side of the disc. Without this bleed, the trap would become air bound should it ever close on air. .Because of this bleed, some steam and air are constantly bled from the actuating side of the disc through the discharge port. This, of course, results in a reduction of pressure on the actuating side of the disc which is then eventually lowered enough to permit the inlet pressure to move the disc valve from the seating surface and discharge. If cold condensate comes to this trap, it will stay open, however, if live steam comes to the trap, it will case again because of the drop in pressure produced by the high velocity between the seating surface and the seating side of the disc. Should hot condensate flow to the trap, hot enough to flash, a drop in pressure is again going to be experienced between the seating surface and the seating side of the disc due to the high velocity of this flash steam. The trap will close. For this reason, it is desirable to place a cooling leg ahead of this trap in an effort to prevent the backup of condensate into your heat exchange apparatus or steam main.

The thermodynamic trap has limited air handling capability because it does close on air just as readily as it closes on steam. Once the trap is up to temperature, any air to be vented by it must be bled through the means provided by the trap manufacturer to prevent air binding. This may be a very fine groove or a few fine scratches.

Because the discharge pressure, or back pressure, of the trap is also exerted on the seat side of the disc valve, this trap is limited in the amount of back pressure against which it can work without excessive steam loss. Even though the trap may not be discharging steadily, its discharge frequencey can increase to the point where it is passing substantial amounts of live steam.

It is limited to an inlet pressure of approximately 10 psi minimum because, thermodynamic properties of steam at less than 10 psi are such to cause the trap to function inefficiently. It should not be used on modulating service because pressures less than 10 psi would be anticipated during modulating action.

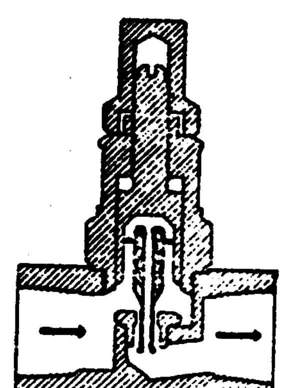
The trap disc and seating surfaces are lapped to extreme flatness. Tolerances are close. Therefore, it is recommended that strainers be placed ahead of these traps to prevent their fouling or their seating surfaces being scored by dirt. The average efficient life of this trap can be as low as 1-2 years on light loads; i.e. 15#/hr. or less.

It should be noted that this trap is not free draining if the trap experiences a reverse differential which does occur when steam is shut off'ahead of it. It will function as a check valve and close off tightly preventing the drainage of condensate. (This latter feature can be easily demonstrated by hooking it up backwards to a water hose.)

Another type of thermodynamic trap is the impulse trap. Although different in configuration and utilization of steam's energy, its resultant performance is about the same as a disc trap. (See Fig. 6)

Figure 6

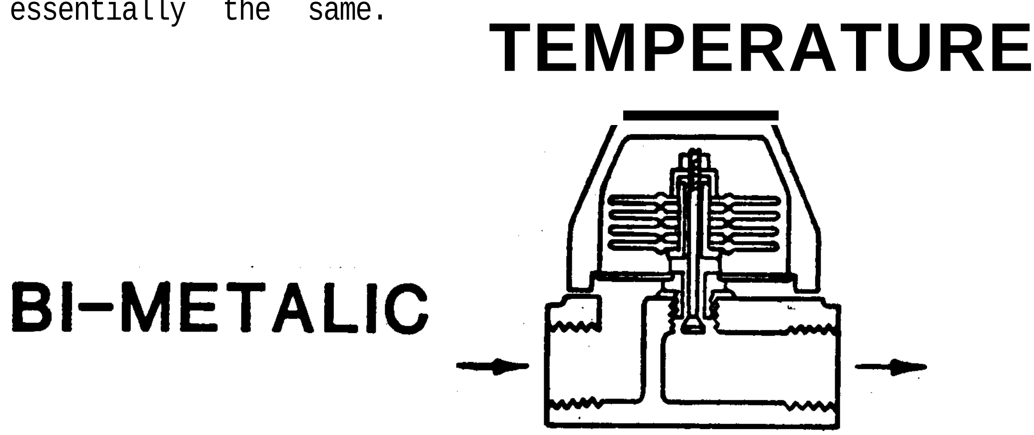
IMPULSE



SUB-COOLING TRAPS - BIMETAL, WAFER, etc. (See Fig. 7)

Sub-cooling traps are thermostatic traps which are designed to discharge condensate at temperatures substantially below the saturation temperature of the system to which they are connected. This results in the transfer of some sensible heat to the process involved. It also reduces or eliminates the discharge of flash steam, which of course, is often lost to atmosphere. Backing condensate into any type of heat exchange equipment drastically reduces its capacity. Sub-cooling of condensate in the presence of oxygen and carbon dioxide, which accumulate at the interface between the steam and condensate, results in a corrosive solution which varies in its potency. Backup of condensate inside heat transfer equipment can also result in damaging water hammer. Other types of sub-cooling traps incorporate liquid expansion elements, but the action is essentially the same.

Figure 7



TRAP MAINTENANCE IS WORTHWHILE

Maintaining steam traps brings quick returns. See Table I. Consider that most steam traps sell for $30 to $150. It costs about $100 to install a new one or half that to repair it. Depending on steam pressure, return line pressure and local fuel cost, payback periods or one to six months are common.

Table I

TABLE I. COST OF 100 PSI STEAM LEAKS

Orifice Diameter, in.	Monthly Steam Loo, lb	Monthly Cost, dollars ($5/1000 lb)	Annual Cost, dollars ($5/1000 lb)
118	52,500	$ 263	$ 3,160
3/16	117,000	585	7.020
1/4	210,000	1050	12,600
5/16	325,000	1625	19,500
3/8	470,000	2350	28,200
7/16	637,000	3185	38,220
112	835,000	4175	60,100

CONDENSATE RETURN SYSTEMS

Condensate return systems are valuable for several reasons. They save the heat energy which would otherwise be flashed off or dumped to the ground. They also save valuable water treatment chemicals and of course, the water itself. If a plant is required to pay for its sewage, this cost, in addition to the initial cost of the water, must be taken into consideration. Polls that we have conducted indicate that condensate is worth in the neighborhood of $.75 - $1.00/1000#.

Condensate can also be a nuisance where it is discharged, especially in cold weather when it freezes. Condensate return systems, of course, eliminate this problem.

It is extremely important that condensate return piping be the right size and properly pitched. Too'small and improperly pitched returns can cause damaging water hammer.

In order to save condensate, numerous pumps or other types of liquid movers may be required to return the condensate to the boiler house. The larger the plant and the greater the variation in elevations, the more important pumps become. Consider pressurized returns to hold the heat, but be sure to use pumping devices capable of handling high inlet temperatures.

TESTING STEAM TRAP.PERFORMANCE and CORRECTING BAD TRAPS

A good trap: 1) passes no live steam;

2) drains condensate without any back-up;

3) vents air as fast as it comes to the trap.

IF A TRAP IS COLD, the steam to it is shut off or its flow is blocked, internally or externally. A mechanical trap may be over-pressured. An inverted bucket vent may be clogged. A ball float may be collapsed. A bellows may have failed. If the trap is over-pressured, correct internals will solve the problem, otherwise, cleaning or replacing internals will correct the problem.

IF A TRAP IS HOT, it is OK or it is blowing live steam.

If it is in inverted bucket trap and is intermittently discharging, it is OK; if it is not and there is no distinct discharge, it is handling a light load. If it is discharging continuously and the bucket is dancing up and down, it has lost its prime and is blowing live steam. Loss of prime can usually be corrected by closing a valve upstream or down stream for a few moments and then re-opening. If it is discharging steadily and the bucket is quiet, it is too small. An inverted bucket trap's activities can be checked by listening to it. Is it intermitting? Is the bucket dancing, etc.?

If it is a disc trap and is intermitting six times per minute, it is OK. If it is intermitting 12 times a minute or more, it is worn and losing live steam. Replace working parts. If it is discharging steadily, it is blowing live steam because it's worn or dirt has jammed it open, or else it is too small. (Determining which may be a problem.) A disc trap's frequency can be found by listening to it. If the trap is discharging steadily, comparing the temperature upstream of the trap during normal operation with that after a good blow to atmosphere should indicate if sub-cooling is taking place. If so the trap is too small. (This test can be used to determine if any trap is too small.) If a disc trap is discharging to a return system, do not check its performance through a test valve to atmosphere. Removing the back pressure can cause a disc trap which is blowing live steam to perform satisfactorily.

A float and thermostatic trap discharges condensate steadily, when functioning properly. When malfunctioning, it discharges similarly, but live steam accompanies the condensate. Such a leak may be impossible to detect. It probably cannot be done by listening. The live steam just adds to the noise of the flashing condensate discharge. It cannot be detected by observing its discharge through a test valve to atmosphere because the live and flash steam mingle. The trap can only be dismantled and the parts checked physically. It can also be removed to a test stand where condensate flow to the trap can be metered and the total output can be weighed including condensed flash and any live steam. (Bear in mind that when the thermostatic element vents air, it also vents live steam.)

A thermostatic trap may discharge intermittently or modulate and discharge steadily. Whether -or not live steam accompanies the condensate again may be impossible to detect. The nature of the thermostatic trap discharge can also be determined by listening. (The cycle can be speeded up for testing by spraying water on it from a laundry moistening bottle.) It is difficult to pick up the live steam discharge which follows that of the condensate in a worn thermostatic trap. Sub-cooling, due to an undersized trap, can be checked as suggested above for the disc trap.

If a sub-cooling trap is losing live steam, it can be detected visually. Observe the discharge to atmosphere. If it is functioning as intended, there will be no flash steam or live steam.

Little mention has been made of checking traps by temperature methods. Whether or not a trap is functioning properly, there is virtually always a substantial pressure drop from inlet to outlet. This pressure drop accounts for a temperature drop regardless of whether condensate or steam or a combination of both is passing. And the more live steam there is compared to the amount of condensate, the lower the down stream temperature will be. (The reverse of what you might expect.) This is based on a constant total weight flow rate of condensate and steam.

CAUTION:

1) Watch out for modulating control valves that may change the performance of a trap while you are checking.

2) Flash steam discharge from a trap, which is normal, can seldom be distinguished from live steam discharge, which is unnecessary waste. Light loads are an exception: flash steam is lazy; live steam has velocity.

3) The foregoing are guidelines describing good and bad traps. There are gray areas between.

Although we endorse no instrument manufacturers, we can list a few if you presently have no names to refer to:

1) Microsonic Stethoscope Model EJ-300
EFI
14380 S.W. 139 court
Miami, FL 33186
Sound only, relatively high frequency

2) Microsonic Detection Kit
EFI
14380 S.W. 139 court
Miami, FL 33186
Sound and visual indication

3) Minearscope 500A
Minear Company
P.O. Box 547
One First Street
Los Altos, CA 94022
Sound only relatively low frequency

4) Son-Tector Model 112
Techsonics
Box 251
El Prado, NM 87529
Sound and visual indication

5) Pocket Pyrometer
Service Tectonics, Inc.
11646 Whittier Avenue
Detroit, MI 48224

6) Pyrometer Temperature Indicator
Syscon, International, Inc.
205 Syramore Street
South Bend, IN 46622
Temperature indication

7) Heat Prober Thermometer
William Wahl Corp.
12908 Panama Street
Los Angeles, CA 90066
Temperature indication

<u>Bear in mind</u>: a 3/16" diameter steam trap orifice leak on 100 psi steam would cost you $7060 per year if your steam costs you $5.00 per 1000 pounds. <u>MULTIPLY</u> this by an average of l/3 to l/2 faulty traps in a plant with little or no maintenance. Then correct for what your steam actually costs you. This is your potential for energy saving. You can't afford to do nothing.

In addition to maintaining your steam traps, consider returning condensate under pressure to your boiler room and then to the boilers, thus minimizing the energy necessary to generate each pound of steam.

If your plant uses both high and low pressure steam, flash steam from high pressure trap discharges can be directed into the low pressure distribution system by means of flash tanks. The various trap manufacturers can supply you with flash tank design data.

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10-27-81