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DESCRIPTION OF A METHOD OF PREVENTING THE LOSS OF HEAT CONTAINED IN THE CONDENSED WATER, COLLECTED FROM VESSELS USING STEAM FOR HEATING AND EVAPORATING PURPOSES.

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At the present time much attention is being given by engineers to the economical production of steam and to the efficient burning of fuel in boiler furnaces. Amongst the devices introduced having these objects in view are:—Fuel Economisers and Superheaters; which increase the area of heating surface, and thereby lower the temperature of the waste gases, before passing away through the chimney. For the more efficient burning of the fuel there are various systems of forced draught in use, and also several methods of heating the air required for combustion, having for their object the economical production of steam. As most of the members are no doubt conversant with these methods, and the economy resulting from their use, the writer ventures to bring under their notice a method of conserving some of the heat in the steam produced by the many economical devices used in connection with the steam boiler. In industrial operations such as breweries, jam factories, meat preserving works, sugar factories, and in many others, the most

of the steam supplied from the boilers is used for heating and evaporating purposes, either from the boilers direct or after it has done duty in the steam engines, the method of doing so being by means of closed vessels, such as circular copper coils, nests of pipes, or in semi-spherical vessels. The temperature of the steam, if used direct from the boilers, may range from 275 to 300 deg. Fah., and, if used after being utilized for power purposes in the steam engines of the factory, it may have a temperature varying from 230 deg. to 240 deg. Fah.; and as the condensed water issuing from the heating or evaporating vessels — controlled by means of steam traps—has practically the same temperature as the steam used in them, there is obviously a large amount of heat that may be conserved if the temperature of the condensed water be not allowed to fall to the temperature of say 200 deg. Fah.

It is generally known that if water at high temperature be drawn from a steam boiler or any other similar vessel into an open vessel exposed to the atmosphere it will fall to a temperature of about 200 deg Fah. in a very short time. Frequent observations by the writer have shown that condensed water issuing from steam traps, the temperature of which on the inlet side varied from 230 deg. to 300 deg. Fah., fell almost immediately to a temperature of from 200 deg. to 205 deg. Fah. when allowed to flow into an open topped collecting tank.

The method of handling the condensed water about to be described, is intended to prevent the loss of heat which takes place when it is allowed to fall in temperature as previously mentioned, or from the temperature corresponding with the steam pressure on the inlet side of the steam trap, to say 200 deg. Fah., in the receiving tank from which it is generally pumped into the boilers. In applying this method, a collecting ves-

sel is required, the capacity of which depends on the volume of condensed water to be handled per hour, and speaking generally, it may be taken at say six minutes' supply, so that a factory where the total condensed water is 6,000 gallons per hour, the capacity of the vessel would be 600 gallons. The shape and strength of the vessel would of course depend on the pressure of the steam used for heating or evaporating. As a practical example of the use of this method of handling the water condensed from steam used in heating or evaporating vessels and pumping it direct in the steam boilers, the diagram attached shews the arrangement of the collecting vessel and pipes in a factory, where steam at different pressures is used in the various heating and evaporating vessels, and where the total amount of condensed water to be handled is about 6,000 gallons per hour. In this instance the most of the steam condensed has a pressure of 10lb. per square inch, and the remainder about 60 lb. per square inch, and as the temperatures corresponding to the above pressures are about 240 deg. and 300 deg. Fah. respectively, provision is made to allow the steam evolved from the condensed water at 300 deg. Fah. falling to a temperature of 240 by contact with the heating surface of the vessels, containing steam at 10 lb. per square inch pressure.

The saving in fuel to be effected by handling the condensed water in this way, as compared with the ordinary method may be stated under three heads.

Firstly.—By preventing the loss of heat caused by the cooling of the condensed water, through a more or less range of temperature.

Secondly.—By preventing the loss of steam which would take place in the cooling of the condensed water if allowed to fall from, say 240 deg. Fah. to 200 deg.

Fah., which loss has subsequently to be made up with cold water.

Thirdly.—By pumping the water back into the steam boilers at a temperature of 240 deg. Fah., thereby obtaining an increased evaporative efficiency due to the better working conditions. The saving in fuel to be effected under the first and second heads may be calculated. Under the third head it cannot be definitely stated, unless special tests are carried out to determine it, but it is generally admitted to be considerable. Another advantage which may be claimed for this method of handling the feed water, is that of lessening the wear and tear of the boilers by greatly reducing the variation of the temperature which generally accompanies the practice of feeding boilers with feed water at low temperatures. It has also the merit of preventing air from finding its way into the boiler. There is also a slight saving effected in the amount of steam used by the feed pump, on account of the pressure on the suction side being about 10 lbs. per sq. in.

The following figures show the saving in fuel to be effected by the adoption of this method of handling the condensed water and feeding it into the steam boilers in a factory where the quantity treated is about 6,000 gallons per hour. The condensed water collected from heating and evaporating vessels using steam at 10 lbs. pressure, corresponding to a temperature of 240 deg. is 5,000 gallons per hour; therefore, 240 − 200 = 40 Fah. is the fall of temperature between the condensed water on the inlet side of the steam traps and the ordinary receiving tank. Therefore, 5,000 x 10 x 40 = 2,000,000 thermal units, is the saving in heat units effected under the first head if the fall in temperature be avoided. And $\frac{2,000,000}{966}$ = 2,070.4 lbs. or 207 gallons of feed water per hour or about 4 per cent. of the feed water used.

At another station the amount of condensed water collected is 1,000 gallons per hour, and the temperature on the inlet side of the traps is about 300 deg. Fah. Therefore 1,000 x 10 x (300 deg. − 200 deg.) = 1,000,000 B.T.Us., and $\frac{1,000,000}{966}$ = 1,035.7 lbs. = 103.5 gallons of feed water per hour, or about 10 per cent. of the feed water used as steam in this apparatus. From the above figures it is obvious that if the condensed water had been allowed to fall in temperature from that of the inlet side of the traps to that in the collecting tank, there would have been lost 310.5 gallons of water, and as the loss would have to be made up by water at a temperature of say 70 deg. Fah., which would have to be raised to 240 deg. Fah., which is the temperature of the water entering the boiler, therefore 240 deg. − 70 deg. Fah. = 170 deg. Fah. and 3,105 lbs. x 170 deg. = 527,850 B.T.U. Therefore, $\frac{527,850}{966}$ = 546 lbs. of steam per hour at 212 deg. Fah. required to heat the cold water, which would have to be added to make up the loss of vapour caused by the cooling of the condensed water from 240 deg. to 200 deg. The total saving expressed in lbs. of steam from and at 212 is as under:—

In preventing the cooling of 5,000 gallons of water from 240 deg. to 200 deg. Fah.	2070.4lbs.
In preventing the cooling of 1000 gallons 300 deg. to 200 deg.	1035.0lbs.
In heating make-up feed water (3105.4lbs.) from 70 deg. to 240 deg.	546.0lbs.
Total	3651.4lbs.

Or 365 gallons per hour, which is equal to 6.1 per cent. of the total water handled. The factory works 132 hours per week and the saving in coal, on the basis of 8½lbs. of water evaporated from and at 212 deg.

Fah. per lb. of coal is 25½ tons per week under the first and second heads.

Under the third head the saving of fuel that may be effected by pumping feed water into boilers at a temperature of 240 deg. instead of 200 deg. Fah. can be determined only by a careful test with the boilers under their normal working conditions. It has, however, been stated, as the result of many tests, that the economy is about 1 per cent. for every 10 deg. Fah. increase in temperature of the feed water. On this basis the saving in fuel due to feeding the water into the boilers at the higher temperature should be 4 per cent., making the total saving about 10 per cent., if the method of conserving all the heat in the condensed water be adopted. The total saving of fuel, if we admit the 4 per cent., saving due to pumping the water into the boilers at the higher temperature, is 43½ tons of coal per week.

There is nothing novel in the method of handling the condensed water collected from heating and evaporating vessels, and pumping it into steam boilers—at any pressure—as described, but it is necessary to observe the following points in connection with the system.

Firstly.—The steam traps used should have the inlet and outlet pipes of ample area to allow the condensed water to flow through them with only a slight head of pressure. They should be, preferably, of the float and valve type, or of the bucket type. Traps which act by means of the unequal expansion of pipes caused by a difference of temperature in them, are unsuitable as the temperature is equal or nearly so, in both inlet and outlet pipes.

Secondly.—The hot water receiver and all the pipes leading to and from it should be carefully lagged to prevent loss of heat by radiation.

Thirdly.—The feed pump used for forcing condensed water at a temperature of 240 deg. into the boiler should have ample area in the suction pipe and through the suction valves, so that the velocity of the water through them may be sufficiently low to prevent the formation of steam in the pump and valve chambers. The Blake special boiler feed pump has been found to work very satisfactorily in handling the high temperature feed water. The piston speed should not exceed from 35 to 40 feet per minute. Higher piston speeds may be used, but in that case the velocity through the suction pipe and suction valves should not exceed 60 feet per minute.

In conclusion, the writer would point out, that, by preventing the loss of feed water as described in the paper, very little make-up feed water would be required for the boilers, thus saving the cost of it when it has to be purchased. And as nearly all water, from whatever source obtained, contains scale-forming substances either in solution or suspension, reducing the amount of make-up feed water, will tend to make the inside of the boiler clean, and by this means raise its efficiency as a steam producer.