Aug. 12, 1930. J. R. McDERMET 1,773,053

METHOD FOR DESUPERHEATING STEAM

Filed July 13, 1923

Fig. 1.

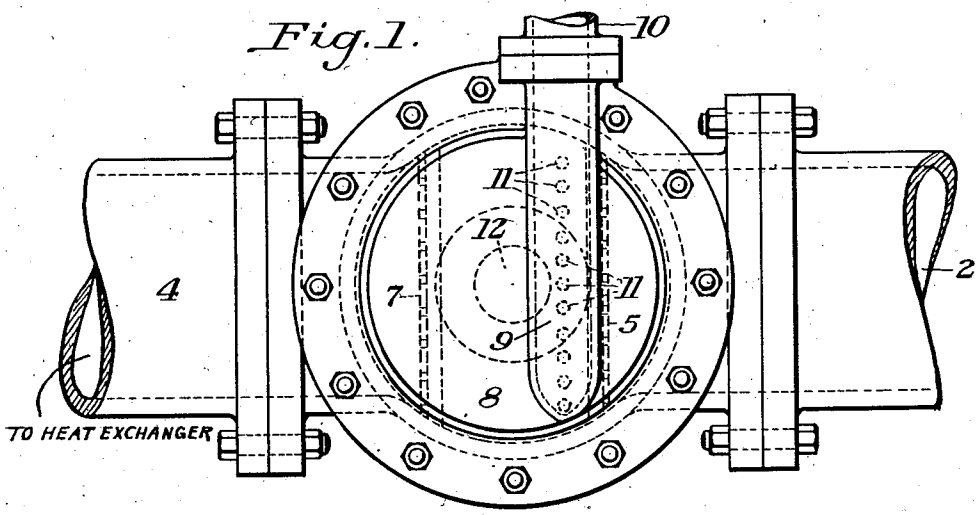
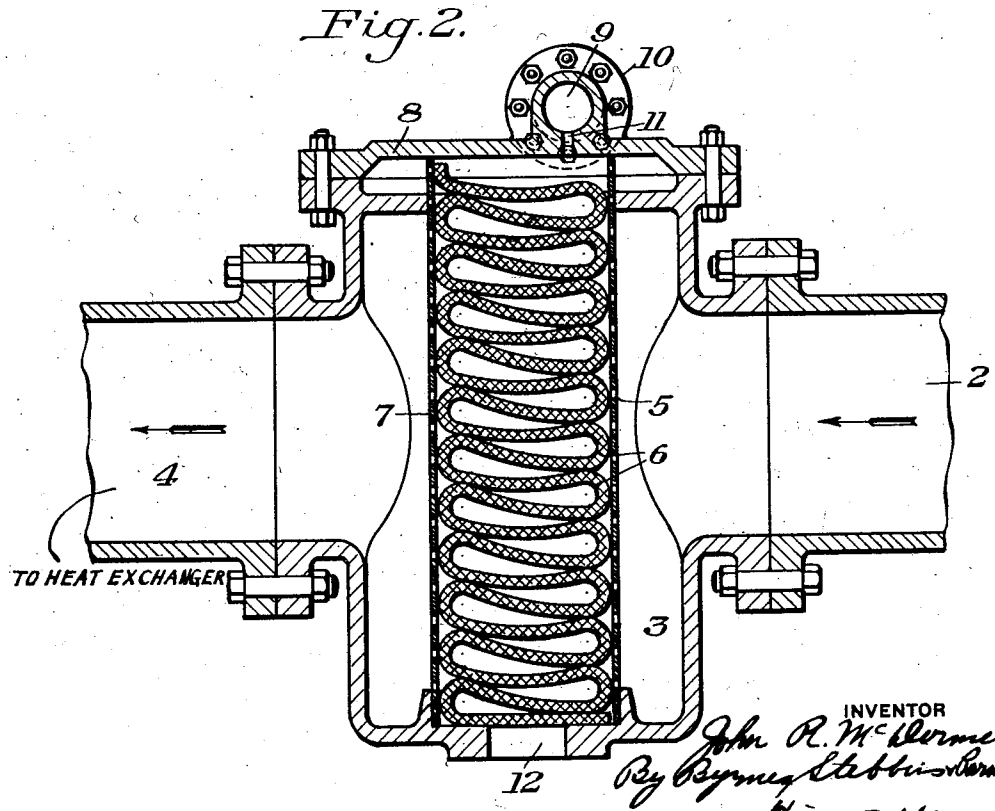


Fig. 2.



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Patented Aug. 12, 1930 1,773,053

UNITED STATES PATENT OFFICE

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METHOD FOR DESUPERHEATING STEAM

Application filed July 13, 1923. Serial No. 651,301.

The present invention relates broadly to power plant equipment, and more particularly to a method for desuperheating steam. In accordance with this invention, the superheated steam is treated, whereby it is adapted for heating purposes.

With the increase of steam pressures and superheat in power station practice, the exhaust steam from auxiliary turbines and the like is becoming highly superheated, sometimes as much as 200°. This is occasioned by the initial high energy content of the steam before entering the turbine, due to the increase of superheat and pressures, and also partly to the relative inefficiency of small turbines, these turbines being ordinarily proportioned for economic considerations other than very high heat economy.

The same situation exists with steam discharged from the gland seals of large turbines, this steam having been used for sealing purposes and throttled from the condition of initial high superheat and pressure to approximately atmospheric conditions.

As a matter of technical fact, the superheated steam has only about one-thirtieth the conductivity of saturated steam from the standpoint of heater performance. It is well known that the major transfer of heat in heater condensation is from the latent heat of the steam in condensing. In the case of superheated steam, therefore, it is necessary to first destroy the superheat and reduce the steam to a condition of saturation before the latent heat is available. This becomes readily apparent when it is considered that the specific heat of saturated steam is approximately .46 B. t. u. per pound, while the latent heat is substantially 970 B. t. u. per pound under the usual conditions of operation.

In the average closed feed water heater, the superheat is destroyed to some extent by the condensation which ultimately forms on the tubes, due to the removal of heat; and the value "one-thirtieth", before referred to, for performance may, therefore, not be the actual value obtained in practice. It is, however, a practical fact that it is almost impossible to use superheated steam efficiently from a heating standpoint in closed heaters. It is necessary to provide sufficient surface within the heater and such conditions as to permit the condensate which ultimately forms in the heater, due to the removal of heat, to act as a desuperheating medium.

From the foregoing, it becomes apparent that much more effective results could be obtained if it were possible to desuperheat the steam before its passage to the heater, and thereby render the latent heat available for use.

The present invention relates to such a desuperheating and provides means for efficiently producing the results desired by reducing the superheated steam to a saturated condition by intimately mixing water therewith. In this process, an amount of water equivalent to the superheat of the steam is evaporated in the desuperheater, and the same heat quantity, under the same pressure conditions, goes into the heater, but under a condition of saturation and with an increased amount of steam, due to the evaporation in the desuperheater.

I have found that spraying water into the path of superheated steam is not a very effective means of desuperheating. This is perhaps primarily because of difficulty in sufficiently atomizing the water to intimately mingle it with the steam, and still retain it within the body of the desuperheater. It is not efficient, in general, to allow water from the desuperheater to flow over into the heater, as water, it being desirable that it go over as saturated vapor. I have also found that heat transfer takes place more readily from steam to metal when the metal is covered with water than from a spray as referred to. This is probably due to the increased time limit in which the water and steam are in contact. The present invention, therefore, involves the treatment of the superheated steam under ideal conditions for the evaporation of the treating water and for the reduction of the superheat in the steam to a condition of saturation.

In the accompanying drawings there is shown for purposes of illustration only a preferred embodiment of an apparatus for effecting such desuperheating of steam, it being

understood that the drawings do not define the limits of the invention, as changes may obviously be made in the construction and operation disclosed without departing from the spirit of the invention or scope of the broader claims.

In the drawings:

Figure 1 is an end elevation of a portion of a desuperheater embodying the present invention; and

Figure 2 is a vertical sectional view through the apparatus illustrated in Figure 1.

In accordance with the present invention, superheated steam from any desired source may be conducted to the desuperheater through an inlet 2. This inlet is in communication, as clearly shown in Figure 2, with the interior of the desuperheating chamber 3. In order to pass through this chamber to the outlet 4, it is necessary for the steam to first pass through the baffle 5, the wire mesh 6, and the baffle 7. These baffles may advantageously be constructed of perforated Monel metal and the wire mesh 6 therebetween may be of Monel spacer cloth loosely woven of interlocked Monel wire, although other materials may be used, if desired. Preferably the wire mesh is in the form of a ribbon of material having a width substantialy equal to the width of the chamber 3, and adapted to be inserted between the perforated plates by permitting the same to fold over upon itself, as clearly indicated in the drawings. Due to this construction, the baffle plates and the wire mesh form, in effect, a cartridge which can be bodily inserted in or removed from the chamber 3. To facilitate such insertion and removal, the chamber may be provided with a removable head 8.

Carried by the head 8 is a water manifold 9, having an inlet connection 10 leading to a suitable source of water supply and provided with a series of discharge outlets or nozzles 11 extending substantially across the removable cartridge. These nozzles distribute the water uniformly over the wire mesh, so that it runs slowly thereover, but any excess not evaporated by the superheated steam is discharged through a suitable outlet 12 in the bottom of the desuperheater chamber.

It will be apparent that the steam is effectively broken up and brought into intimate contact with a large area of metal surface covered with water, thereby providing a very efficient means for reducing superheated steam to a condition of saturation. The steam increased in quantity, due to the evaporation of the water supplied for desuperheating, but containing the same heat content under the same pressure conditions, then passes through the outlet connection 4, to a suitable heater, not shown. This apparatus provides for a transfer of heat partly direct from the steam to the water in the slow process of the flow of water through the apparatus, and partly from the steam to the wire mesh, together with a secondary transfer of this heat from the wire mesh to the water.

It will be apparent that in the process of evaporation of water in the desuperheater, particularly with natural sources of supply, it is inevitable that some scale may form on the desuperheater element. Normally the extreme temperature ranges which the apparatus encounters will detach this scale from the wire mesh by the difference in expansion between the scale and wire. The present construction, however, makes it possible to effectively remove any remaining scale periodically as may be desired, by simply removing the cartridge bodily and then shaking the chain or tape of wire mesh. Thereafter the mesh may be again lapped or folded into position and the cartridge inserted in the desuperheater chamber.

Certain advantages of the present invention arise from the provision of a desuperheater embodying a porous body or a body pervious to the passage of steam, together with means for supplying water in such manner that an efficient contact between the water and steam is insured.

Other advantages arise from the provision of means for effectively bringing the desuperheating water into contact with superheated steam in such manner that the superheated steam is reduced to a condition of saturation.

Still other advantages arise from the construction permitting the removal of the cartridge and cleaning of the parts as may be desired.

I claim:

1. In the method of desuperheating steam, the steps comprising providing a body of water in broken up condition intersecting the path of flow of the superheated steam, and breaking up the steam and bringing it into contact with the water while both are in broken up condition.

2. In the method of desuperheating steam, the steps comprising providing a body of water in broken up condition intersecting the path of flow of the steam, breaking up the steam and bringing the steam and water while in broken up condition into contact with each other, and continuously supplying water to an amount sufficient only to substantially reduce the superheat in the steam to a condition of saturation.

3. In the method of treating steam, the steps comprising providing a body of water in broken up condition and holding the water against bodily removal as such by the steam, and then bringing the steam into contact with the water while so held.

4. In the method of treating steam, the steps comprising passing the steam in broken up condition through a plurality of tortuous paths, and supplying water to the steam while traveling through said paths.

5. In the method of treating steam, the steps comprising maintaining a film of water in steam intersecting position by capillary action on the water, and then passing the steam through said film.

6. In the method of treating steam, the steps comprising providing a plurality of tortuous flow paths for the steam, maintaining desuperheating water in intimate relation to said flow paths by capillary action, and passing steam through said paths in contact with the water.

7. In the method of desuperheating, the steps comprising breaking the steam into irregular bodies and producing a random flow of such bodies in confined space, and supplying water to such spaces as required to destroy the superheat in the steam.

In testimony whereof I have hereunto set my hand.

JOHN R. McDERMET.