

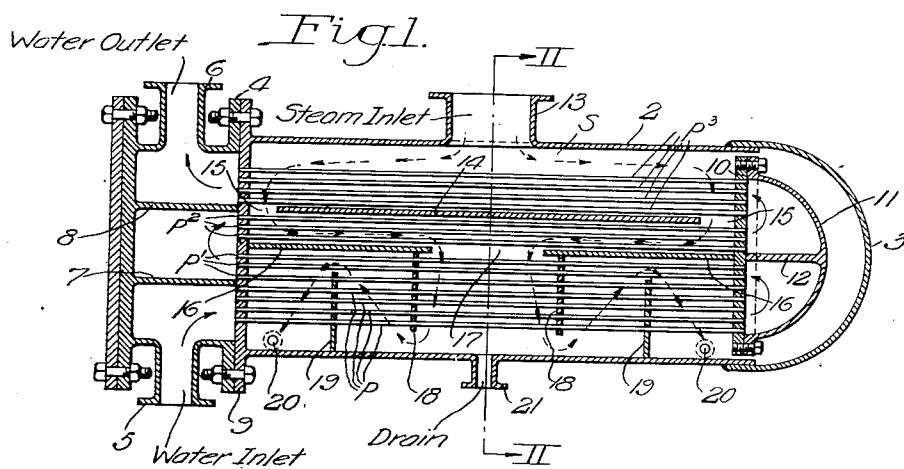
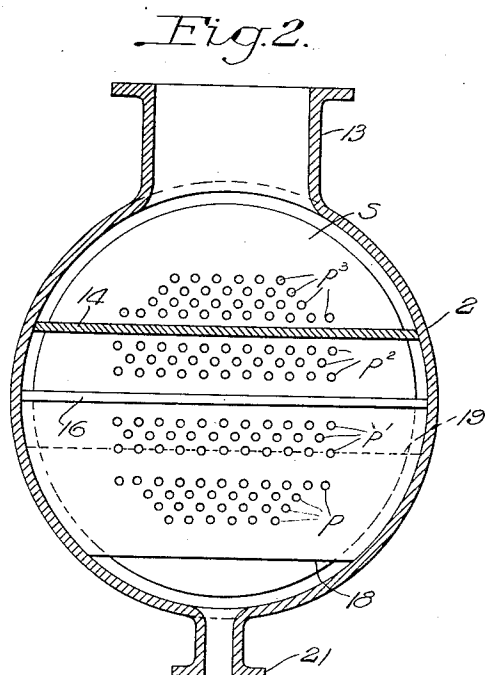
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J. R. McDERMET

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HEATER

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INVENTOR

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UNITED STATES PATENT OFFICE

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HEATER

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The present invention relates broadly to the art of heat exchange, and more particularly to heat exchange apparatus of the type referred to as closed heaters.

5 In view of the fact that a steam turbine is fundamentally a device for converting heat energy into work and that steam is an effective carrier of heat, the efficiency of a steam turbine is dependent primarily on the amount
10 of heat which the steam carries and the difference in temperature head available. The temperature head obviously measures the availability of the heat to be converted into work. In view of these conditions, it is quite
15 customary to utilize steam having a high degree of superheat in order to obtain as large an amount of heat and heat head as possible. In the process of expansion, as the steam passes through the turbine, the superheat is
20 gradually destroyed and the steam finally arrives at the turbine exhaust in a saturated condition.

It is customary in the art of heating feed water for boilers in a modern station utilizing
25 turbines to pass the water in sequence through a plurality of closed heaters successively connected to stages on the turbine having increasing pressures, the increasing pressures being produced by the progressive expansion of the steam. Where a large number
30 of heaters is utilized, certain of these heaters inevitably cooperate with the turbine at such a point that they receive superheated steam from the turbine.

35 A conventional closed feed water heater will deliver water within from three to six degrees of the temperature of saturated steam, the difference in heat head measured by the three to six degrees being necessary
40 in order to force the heat through the heater surfaces.

It may thus be stated that superheat in steam is extremely valuable from the standpoint of the turbine, but is of no value to a
45 feed water heater other than the actual heat quantity which it contains. Feed water heaters as at present designed are not capable of raising the water temperature above the point indicated.

50 It is one of the objects of the present in-

vention to provide a heater of improved construction, effective for utilizing heat in superheated steam for elevating the water temperature above the temperatures now attained with feed water heaters. By such a construction, the heater will also to some extent be
55 able to utilize the heat head and thereby secure increased efficiency.

In the accompanying drawing I have shown more or less diagrammatically, a preferred embodiment of the present invention.

In the drawing:—

Figure 1 is a longitudinal sectional view of one form of heater embodying the present
65 invention, and

Figure 2 is a transverse sectional view on the line II—II of Figure 1, looking in the direction of the arrows.

In carrying out the present invention, there may be utilized a closed heater comprising
70 a shell 2, provided with a closure 3 for one end thereof, and with a removable head 4 for the opposite end. The head 4 is of such construction as to provide a water inlet 5
75 and a water outlet 6. It is also provided intermediate the inlet and outlet with transversely extending partitions 7 and 8, dividing the water box into a plurality of separate chambers.

Cooperating at one end with the tube plate
80 9 forming part of the header 4 is a nest of tubes so arranged as to provide successive passes p , p' , p^2 , and p^3 . These tubes, at their opposite ends, cooperate with a floating head 10 mounted within the shell and
85 providing a water box 11 formed with a transverse partition 12. By reason of the location and arrangement of the partitions 7, 8 and 12, it will be apparent that the water is caused to pass from the inlet to the out-
90 let in the direction indicated by the arrows, the flow being progressively through the passes p , p' , p^2 , and p^3 .

A construction of the character referred to provides a heater of the so-called parallel
95 shell type. Such a construction provides, of necessity, an annular space S around the entire tube nest, the dimensions of the annular space being determined primarily by the room required for the bolts which secure the
100

floating head in position, it being impossible to insert tubes in a space required for such bolts.

The shell may be provided with any desired form of steam inlet 13 by means of which the steam, in superheated condition, as drawn from the turbine, is delivered to the interior of the heater and the space around the tubes.

Extending in substantially parallel relation to the tubes and substantially normal to the axis of flow through the inlet 13, is a baffle 14, causing the steam to travel in the direction indicated by the broken arrows substantially along the tubes to the spaces 15 provided adjacent the ends of the baffle.

Provided below the baffle 14, and in substantially parallel relation thereto, are baffles 16 of similar construction extending to the ends of the tube nests, but spaced at their intermediate portions to provide a port 17. This construction compels the steam, which is passed through the spaces 15 to flow in a direction substantially parallel to the tube axes to the port 17, and thence downwardly through the port in a direction at substantially right angles to the axes of the tubes.

The space below the baffles 16 is divided into a series of chambers by means of baffles 18 and 19, the baffles 18 being suitably secured to the baffles 16 and providing a steam flow space below the lower ends thereof, while the baffles 19 extend into a position substantially adjacent the condenser shell. This staggered arrangement of the baffles requires the steam to pass in a direction generally at right angles to the tube axes, the direction being reversed adjacent each of the baffles. Adjacent the flow termini of the steam in the heater are provided vents 20, by means of which the air and other non-condensable gases are withdrawn from the heater shell. The heater is also provided with one or more condensate drains 21.

With a construction as described, that portion of the heater above the baffle 14 comprises a space occupied by tubes and a portion of the space S which is available for steam distribution.

The area of the space available for steam distribution is preferably greater than the area occupied by the tubes. This not only insures efficient distribution of the steam, but provides a comparatively large quantity of steam in contact with the tube pass p^3 , which is the last pass through the heater and the one in which it is desired to raise the temperature of the water to its highest point. The baffles 18 and 19, on the other hand, substantially completely cover and bug the circumference of the shell, except in so far as they provide steam flow ports. As a result of this construction, the annular space S below the baffles 16 is divided in a manner different

from that in which it is divided above these baffles.

The superheat of steam supplied to a heater is an extremely variable quantity in practice, so that it is not feasible to give precise figures to indicate the magnitude of the saving effected by a construction of the character before described. In actual practice, however, I have found that it is possible to effect an increase in water temperature of from four to six degrees, this representing the additional amount of heat contributed by the superheat in the steam in contact with the last tube pass. The steam is giving up this heat quantity to the water in the last tube pass is substantially desuperheated, so that the section of the heater above the baffle 14 may be considered as a desuperheating section or as a temperature boosting or elevating section, depending upon whether it is desired to construe the operation from the standpoint of the steam or from the standpoint of the water being heated by the steam.

The steam, after losing its superheat in the desuperheating section, passes through spaces 15 into contact with the tubes in the tube pass p^2 , and thence alternately across the tubes of the passes p and p' .

To those skilled in the art, it will thus be apparent that I have provided a heater which may be efficiently directly connected to any desired stage of a turbine and which, when so connected, is effective for utilizing the superheat in the steam to obtain an increase in the temperature of the feed water being heated. At the same time, by destruction of the superheat, it reduces the steam substantially to a condition of saturation ready for condensation in the succeeding passes of the heater wherein there is rendered available the latent heat of the steam in condensing.

I thus provide in a single structure a combined closed heater and desuperheater. In this combination, the desuperheater is preferably of such construction that the area available for steam distribution is greater than that available for heating tubes.

The advantages arising from such a combination in a unitary structure are obvious from the statement of the problems attendant upon the use of superheated steam as hereinbefore referred to.

While I have herein illustrated and described a preferred embodiment of the present invention, it will be apparent that changes in the construction and operation of the heater may be made without departing either from the spirit of my invention, or the scope of my broader claims.

I claim:

1. In a heat exchanger, a shell, tubes therein, baffling means dividing the interior of the shell into two substantially equal divisions, longitudinally extending baffling means co-operating with one division, and transversely

extending baffling means cooperating with the other division.

2. In a heat exchanger, a shell, a tube nest therein circumferentially spaced from said shell to provide a substantially annular space between the tube nest and shell, and baffling means within said shell so arranged that a portion of said space on one side of the longitudinal axis of the heat exchanger is available for free longitudinal steam flow throughout substantially the entire length of the shell on opposite sides of a longitudinally extending baffle while the space on the opposite side of said axis is divided transversely.

3. In a heat exchanger, a shell, a tube nest therein circumferentially spaced from said shell to provide a substantially annular space between the tube nest and shell, baffling means within said shell so arranged that a portion of said space on one side of the longitudinal axis of the heat exchanger is available for free longitudinal steam flow throughout substantially the entire length of the shell while the space on the opposite side of said axis is divided transversely, and longitudinally extending baffling means for the portion of said space on the first mentioned side of the heat exchanger axis.

4. In a heat exchanger, a shell, a tube nest therein circumferentially spaced from said shell to provide a substantially annular space between the tube nest and shell, baffling means within said shell so arranged that a portion of said space on one side of the longitudinal axis of the heat exchanger is available for free longitudinal steam flow throughout substantially the entire length of the shell while the space on the opposite side of said axis is divided transversely, longitudinally extending baffling means for the portion of said space on the first mentioned side of the heat exchanger axis and a steam inlet communicating with the portion of the space having a free longitudinal steam flow.

5. In a heat exchanger, a shell, tubes therein, longitudinally extending baffling means dividing the interior of the shell into two substantially equal divisions, longitudinally extending baffling means within one of said divisions, and transversely extending baffling means within the other of said divisions.

6. In a heat exchanger, a shell, tubes therein longitudinally extending baffling means dividing the interior of the shell into two substantially equal divisions, longitudinally extending baffling means within one of said divisions, and transversely extending baffling means within the other of said divisions, said longitudinally extending baffling means contacting with said shell throughout the length of the baffling means.

7. In a heat exchanger, a shell, tubes therein extending longitudinally of the shell, means dividing the tubes into a number of distinct passes, a plurality of transversely extending baffling means cooperating with certain of said passes, and a plurality of longitudinally extending baffling means extending to said shell and cooperating with other of said passes.

8. In a heat exchanger, a shell, a head at each end of the shell, water tubes extending longitudinally of the shell, means dividing the tubes into a plurality of distinct passes, there being a steam inlet into the shell adjacent the last tube pass, means cooperating with said last mentioned tube pass for producing a substantially unobstructed steam flow from said inlet longitudinally of the shell and in opposite directions along and in contact with the tubes of said last mentioned pass toward said heads then away from said heads along a second tube pass, the steam flow space along the tubes of said last mentioned passes being unobstructed transversely from head to head, and means cooperating with other of the tube passes for producing a steam flow in a direction generally transversely of the shell and toward said heads.

9. In a heater, a shell having a steam inlet, a tube nest having a water inlet and a water outlet, and baffling means within said shell spaced from both ends of the shell but engaging the sides thereof and extending substantially parallel to the axes of the tubes of said nest, said baffling means providing thereabove a desuperheating space having a materially greater area available for steam distribution longitudinally of the shell than the area occupied by the tubes therein.

10. In a heater, a shell having a steam inlet, a tube nest having a water inlet and a water outlet, baffling means within said shell spaced from both ends of the shell but engaging the sides thereof and extending substantially parallel to the axes of the tubes of said nest, said baffling means providing thereabove a desuperheating space having a materially greater area available for steam distribution longitudinally of the shell than the area occupied by the tubes therein, baffling means below said first mentioned baffling means and extending substantially parallel thereto and engaging the ends of the shell, and transversely extending baffling means entirely on one side only of said last mentioned baffling means.

In testimony whereof I have hereunto set my hand.

JOHN R. McDERMET.