Oct. 10, 1933. D. W. RUDORFF 1,929,520

DESUPERHEATER

Filed Sept. 16, 1931 2 Sheets-Sheet 1

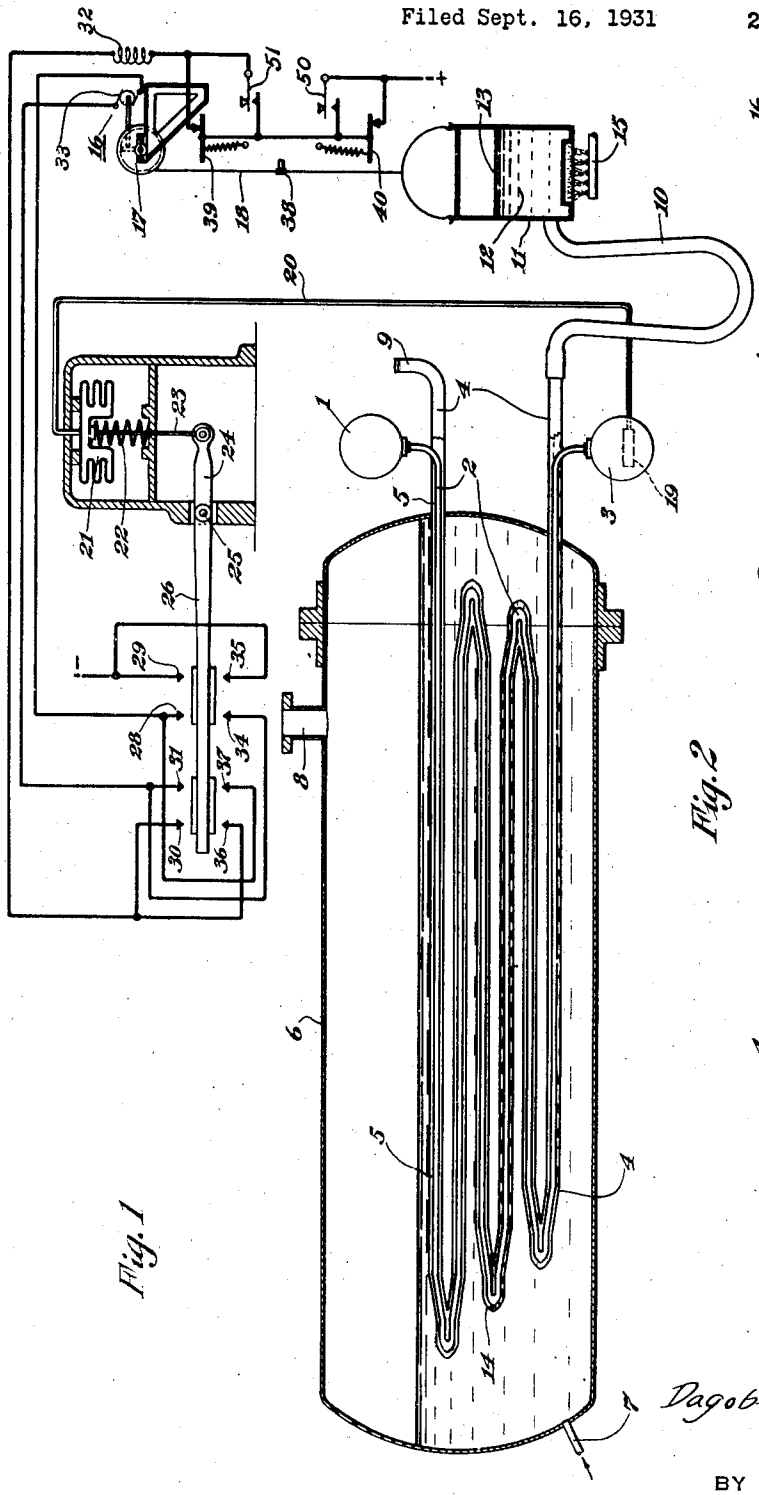


Fig. 1

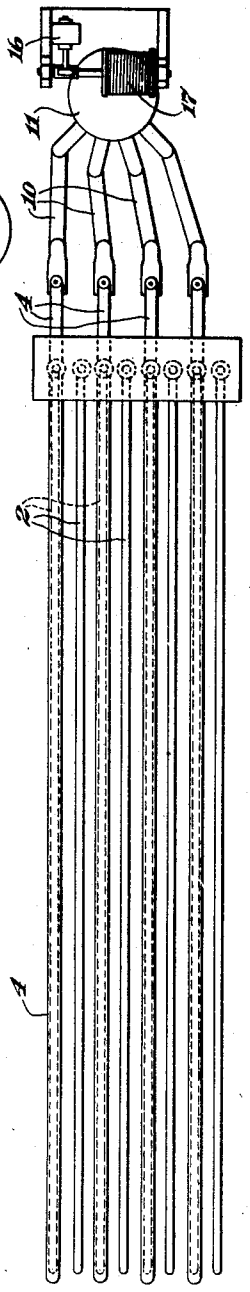


Fig. 2

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DESUPERHEATER

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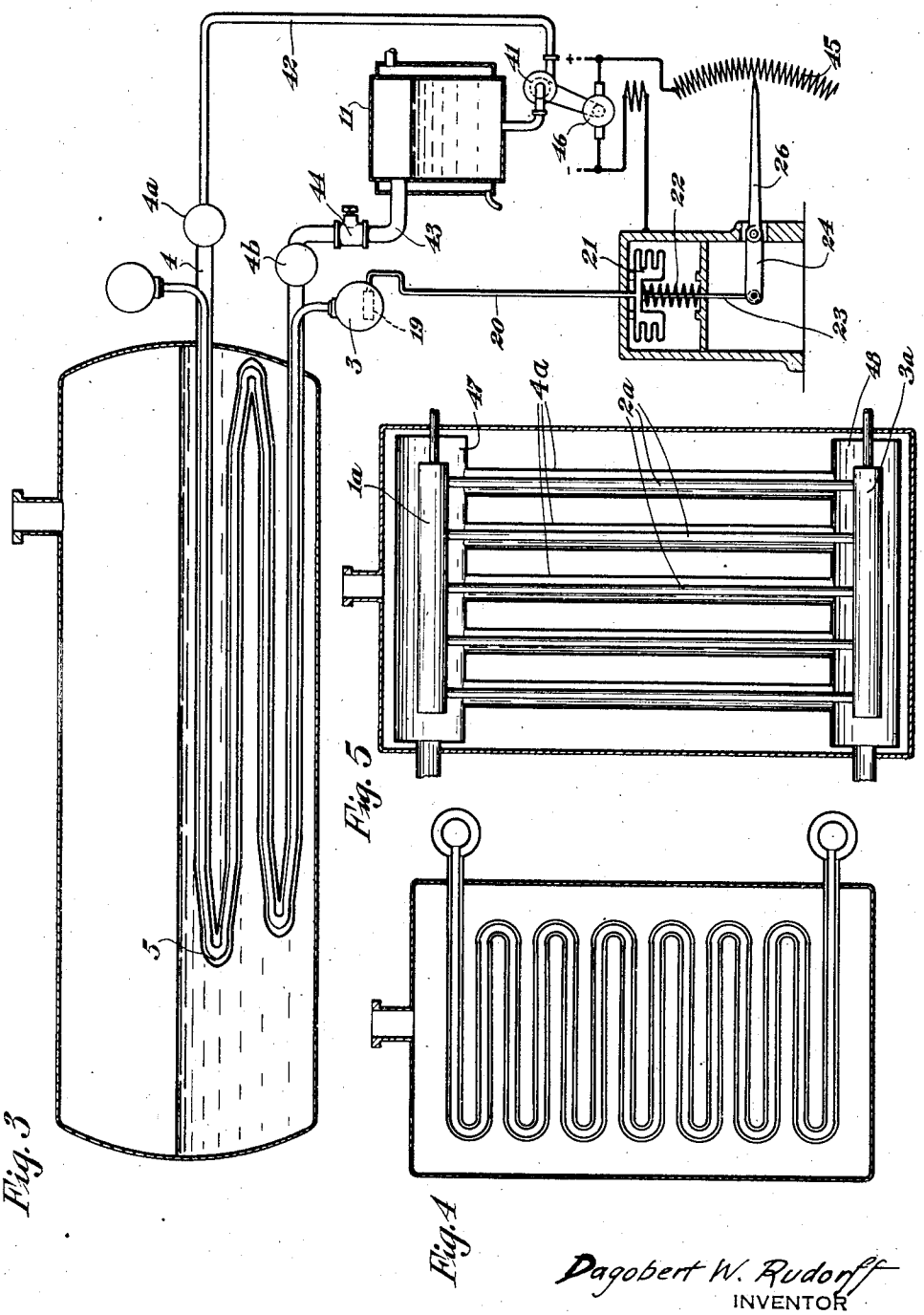


Fig. 3

Fig. 5

Fig. 4

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DESUPERHEATER

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Application September 16, 1931
Serial No. 563,107

14 Claims. (Cl. 122—479)

The invention relates to desuperheaters of the type in which the fluid to be desuperheated gives up heat to another fluid with which it is in heat interchanging relation but with which it does not mingle.

The usual field for these desuperheaters is that of superheated steam and the desuperheating medium is water which is usually evaporated in the process, and I am describing my invention in connection with these usual features although, as will be clear from what follows, the invention is not limited in these respects.

The object of the invention is to provide improved apparatus of this type.

The invention is illustrated in the drawings filed herewith, in which Fig. 1 illustrates more or less diagrammatically a system according to my invention, Fig. 2 being a top view of the same with certain parts omitted; Fig. 3 illustrates a system of a somewhat varied form; and Figs. 4 and 5 illustrate modified forms of the desuperheater proper which may be used.

Reference will first be made to the form of the invention illustrated in Figs. 1 and 2. The steam to be desuperheated is delivered from the superheater or other source to a header 1 from which it flows through the desuperheating elements or units 2 whose other ends are connected to an outlet collector or header 3. From this header 3 the steam is carried to the point of consumption by connections not shown. Some or all of the desuperheater elements 2 are enclosed in outer enveloping elements 4. As will be readily seen from Fig. 1, these outer sheathing elements follow in general the form of the elements 2 and enclose them completely, leaving everywhere between the two an annular space 5. As shown in Fig. 2, every other element 2 is left bare. This is done for reasons explained more fully below, and it will be clear from what is said further on that in some cases all of the elements may be enveloped in casings and that in general whether any are left unenveloped and how many will depend upon conditions in each individual case.

The elements 2 encased in the envelopes 4 extend into a drum 6. This drum is filled with water to a point above the topmost parts of the elements 2 or the sheaths or envelopes 4. At 7 is provided a connection for the introduction of water, and at 8 appears a connection for taking off steam that forms.

Each enveloping element 4 has its upper end 9 open to the atmosphere and has its lower end connected by means of the flexible connection 10 to a container 11. The container 11 is filled or partly filled with melted metal 12, such as Wood's metal, having a low fusion point. The free level 13 of this metal is in the figure at such a height that the annular space 5 is filled up to the point 14 with melted metal. In order to keep the metal in the vessel 11 melted, some means of heating, such as a burner 15 or the equivalent, may be provided. In some cases this may be unnecessary.

It will be clear from the above that the steam flowing through the elements 2 will give up heat to the water in the drum 6 in those portions of its path where the annular space 5 is filled with the metal 12 and will thereby lose some of its superheat. The water in drum 6 will evaporate and the steam formed will flow off through connection 8. In practice, the pressure in the drum 6 may be atmospheric or may be above atmosphere. The connection 8 may, if desired, be connected to the boiler supplying the steam in which case the water inlet connection 7 is preferably connected to the water space of the boiler. If it is desired to keep the level of the water in the drum automatically at a point above the highest part of the elements, this can evidently be done by putting a float-controlled valve in the supply line 7.

There will be practically no heat transfer from the desuperheater elements 2 to the water in those portions of the structure in which the annular space 5 is not filled with metal. The extent of desuperheating can thus be varied by altering the level 14 at which the metal stands in the annular space 5. In Fig. 1 means are illustrated for varying this level. A motor 16 comprising field winding 32 and rotor 33 is provided for raising or lowering the vessel 11 by winding or unwinding the cable 18 on or off the drum 17. If the cable is wound on 17, the container will be raised and the level 13, and hence the level 14 will rise, and vice versa, if the cable is unwound these two levels will fall. The rate of heat transfer to the water and therefore the amount of desuperheating of the steam will thus be varied by raising or lowering of the container 11. This raising or lowering is preferably done automatically in response to the temperature of the steam in the outlet header 3, since it is desired to keep this temperature constant. Obviously, if such constancy of outlet steam temperature is not desired, the motion of the container can be caused in response to some other desired factor.

The thermostatic element 19 in the outlet header 3 is connected by means of the pipe 20 to the expansible bellows element 21, whose expan-

sion is opposed by the spring 22. A rise in the temperature of the steam and header 3 will result in an expansion of the bellows 21 and a consequent downward movement of the rod 23 with an accompanying compression of the spring 22. The rod 23 is pivotally connected to the lever 24 pivoted at 25 so that this downward motion of the rod 23 results in an upward swing of the outer end 26 of the lever 24.

Conversely a drop in the temperature of the steam in header 3 results in allowing the spring 22 to compress the bellows 21 thereby lifting the rod 23 and lowering the arm 26 of the lever 24.

Suitable electrical connections are made by the upward or downward swing of the arm 26 just described to cause the motor 16 to run in the required direction to raise and lower the vessel 11 respectively. These connections and the associated parts are shown diagrammatically. An upward swing of the arm 26 closes the circuit between the points 28 and 29, and between 30 and 31, and consequently a circuit is established to operate motor 16 and raise the elevation of the vessel. This circuit comprises, a battery, closed switches 40 and 39, field winding 32, closed contacts 30 and 31, rotor 33 and closed contacts 28 and 29 to ground.

A lowering of the arm 26 on the other hand connects the points 34 with 35 and 36 with 37, as will be noted from an inspection of the figure, thereby establishing a circuit in which the current to flow in the same direction as in the first instance through the field 32 but reversing it thru the rotor 33 as compared with its flow when the arm 26 is swung upward. This circuit comprises battery, closed switches 40 and 39, field winding 32, closed contacts 36 and 37, rotor 33, closed contacts 34 and 35 to ground. This will therefore result in the motor 16 running in the opposite direction and unwinding the cable 18 and lowering the bucket 11.

The connection from the motor 16 to the drum 17 is through a very slow worm gear drive so that the change in the elevation of the container 11 is very gradual. Before it has been raised or lowered any great distance, an alternation in temperature conditions in outlet header 3 has occurred so that the thermostatic element has broken the connections causing the motion of the motor and perhaps even reversed the motion of the motor.

As a safety device, the cable 18 is equipped with a stop 38 which will come into contact with and open the switches 39 and 40 respectively, if the motion of the motor in either direction is for any reason not stopped in time. Manually controlled switches 50 and 51 are employed to impart an initial electric impulse to start motor 16 in the event trip 38 has arrived at a position to open either of the switches 39 or 40.

In Fig. 3 is shown a variation of the system just described, the variation relating to the means used for raising or lowering the level of the fluid metal. An electrically driven pump 41 takes metal from the vessel 11 and delivers it through the pipe 42 to the header 4*a*, to which are connected the upper ends of the sheathing elements 4. This metal returns to the vessel 11 by way of lower header 4*b* and thence through the pipe 43 which is equipped with an adjustable valve 44. With any given speed of the pump 41 the level of the metal in the annular spaces 5 will stand at some certain point, such point being determined by the setting of the valve 44. This setting is left permanent when once it is determined what it shall be. A variation in the speed of the pump 41 will result in a change in the level at which the liquid stands. The speed of the pump is regulated in response to the outlet temperature in the header 3 by means of a thermostatic control. The thermostatic element 19 is connected by means of the tube 20 to the bellows element 21. The expansion of this bellows is opposed by the spring 22. An expansion of the bellows results in a lowering of the rod 23 and in a raising of the arm 26 of the lever 24. These parts, it will be noted, are closely like the corresponding ones in Fig. 1. The lever 24 by its motion varies the amount of resistance 45 in series with the rotor 46, this rotor being in the driving element for the pump 41 to which it is belted. As the temperature rises and the bellows 21 expands, the arm 26 is thrown upward, the amount of resistance is decreased, and the rotor speeds up, thereby speeding up the pump 41 and raising the level of the melted metal in the annular space 5. This brings about the desired increase in the amount of desuperheating. Conversely, if the temperature in header 3 decreases, spring 22 will cause the bellows 21 to collapse, the rod 23 will raise its end of the lever 24 thereby introducing more resistance of the rheostat 45 into the rotor and slowing up the speed of the rotor and the pump 41, thus causing a drop in the level of the melted metal in annular space 5. This will result in a smaller amount of desuperheating.

The above are merely two illustrative mechanisms for effecting the desired variation in the level of the melted metal. It will be obvious that other methods can readily be devised.

In Fig. 4 is shown a desuperheating vessel having a greater vertical height and a larger number of coils and therefore making possible a finer adjustment of the degree of desuperheating. In this desuperheater a slight change in the level of the melted metal will not bring about so great a variation in the desuperheating.

This is carried to an even further extent in the form shown in Fig. 5 where the inlet header 1*a* is connected to the outlet header 3*a* by means of the straight desuperheater elements 2*a* which in turn are enclosed by the enveloping tubes 4*a*, these tubes 4*a* being connected to the upper header 47 and lower header 48. Here the variation in the degree of desuperheating will, in addition, be the same at any point for a given change in level of the metal.

What I claim is:

1. In a desuperheating system, a water drum, steam conveying elements associated therewith, sheathing enveloping said elements in spaced relation, means for supplying a heat transfer agent between the elements and sheathing to place the steam and the water into heat-transfer relation and to desuperheat the steam, and means operative to control the amount of agent to be supplied.

2. In combination, a water drum, steam headers, steam conveying elements disposed within said drum and connected to said headers, sheathing enclosing said elements in spaced relation, means for supplying a heat-transfer agent between said elements and sheathing to desuperheat the steam in said elements, and means to control the supply of said agent between said elements and sheathing in response to the temperature of the desuperheated steam in one of said headers.

3. In combination, a water drum, steam headers, steam conveying elements submerged in the

water of said drum and connected to said headers, sheathing disposed over said elements and spaced therefrom, means for supplying a heated metal between the tubing and sheathing to desuperheat the steam in said elements, and automatic means operative in response to the temperature of the desuperheated steam for controlling the supply of said metal between the tubing and sheathing.

4. In combination, a water drum, steam conveying elements within said drum and submerged in the water thereof, sheathing disposed over and in spaced relation with said elements, a vessel containing liquid metal connected to one end of said sheathing to supply metal between the sheathing and said elements and desuperheat the steam, and thermostatic means for controlling the supply of said metal between the sheathing and elements.

5. In a desuperheating system, the combination of a water drum, superheated steam conveying elements out of contact with said water and disposed in said drum, sheathing for said elements spaced therefrom and in contact with said water, a source of liquid metal connected to said sheathing, means for controlling the head of said liquid source and the head of liquid between said sheathing and elements to desuperheat said steam and maintain its temperature constant or substantially constant.

6. A desuperheater having a plurality of interconnected superheated steam carrying pipes out of contact with water, interconnected sheathing enveloping said pipes and spaced therefrom, means admitting a heat-transfer agent between said pipes and sheathing to desuperheat the steam in said pipes, and means operative to adjust the supply of said agent admitted between the pipes and sheathing in response to the temperature of the desuperheated steam.

7. In a desuperheating system, the combination of a plurality of interconnected superheated steam carrying pipes out of contact with water, a covering spaced over each pipe with adjacent coverings interconnected, means for connecting one or more of said pipes or a portion thereof with respective coverings or a portion thereof by a heat-transfer agent in accordance with the extent of the active heat-transfer surfaces required to desuperheat said steam to the desired temperature.

8. In a desuperheater, the combination of a plurality of superheated steam carrying interconnected pipes out of contact with water, a covering spaced over each pipe with adjacent coverings interconnected, said coverings being in contact with the water, and fluid means variably connecting one or more of said pipes or portions thereof with the respective coverings of portions thereof for controlling the extent of heat transfer surfaces thereof active to desuperheat said steam.

9. In a desuperheater system, the combination of a plurality of superheated steam carrying and interconnected pipes out of contact with water, a covering in contact with water for each pipe and spaced therefrom with adjacent coverings interconnected, heat-transfer means to desuperheat said steam variably connecting a portion of a tube and its respective covering or one or more of said tubes and adjacent coverings or portions thereof, and means responsive to the temperature of said desuperheated steam to regulate the amount of said heat-transfer means between the coverings and said tubes in proportion to the surfaces thereof required to desuperheat said steam to the desired temperature.

10. A desuperheating system having in combination a water drum, steam conveying elements in said drum out of contact with said water, sheathing encasing said elements and in contact with said water, a steam header connected to each end of said elements, a vessel containing heated liquid metal connected to one end of said sheathing, a device responsive to fluctuation in temperature connected to one of said headers, a motor, and means associated with said motor and responsive to the operation of said device to adjust the elevation of said vessel and head of liquid metal between said sheathing and elements.

11. The system defined in claim 10 in which said last mentioned means comprises circuit reversing means for changing the direction of rotation of said motor.

12. In the art of desuperheating steam, the step of supplying a heat-transfer agent between superheated steam conveying elements out of contact with water and sheathing arranged over said elements and in contact with said water to desuperheat said steam.

13. In a desuperheating system, comprising, in combination, a water drum, steam elements disposed within said drum, sheathing covering said elements and spaced therefrom and in contact with said water, inlet and outlet steam headers connected to said elements, a vessel containing heat-transfer means connected to said sheathing, a pump, driving means for said pump, a regulator responsive to the temperatures of the steam in said outlet header for changing the speed of said driving means to deliver variable amounts of said heat transfer means into said sheathing and contact said elements over areas thereof proportional to fluctuations of said regulator.

14. In a desuperheating arrangement, spaced steam headers, steam conveying elements connecting said headers, a casing surrounding each header, sheathing connecting said casings and surrounding in spaced relation said elements, one of said casings containing heat-transfer means to establish heat-transfer relation between said sheathing and elements, and means for controlling the amount of said heat-transfer means between the elements and sheathing in accordance with any fluctuations in temperature of steam in one of said headers.

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