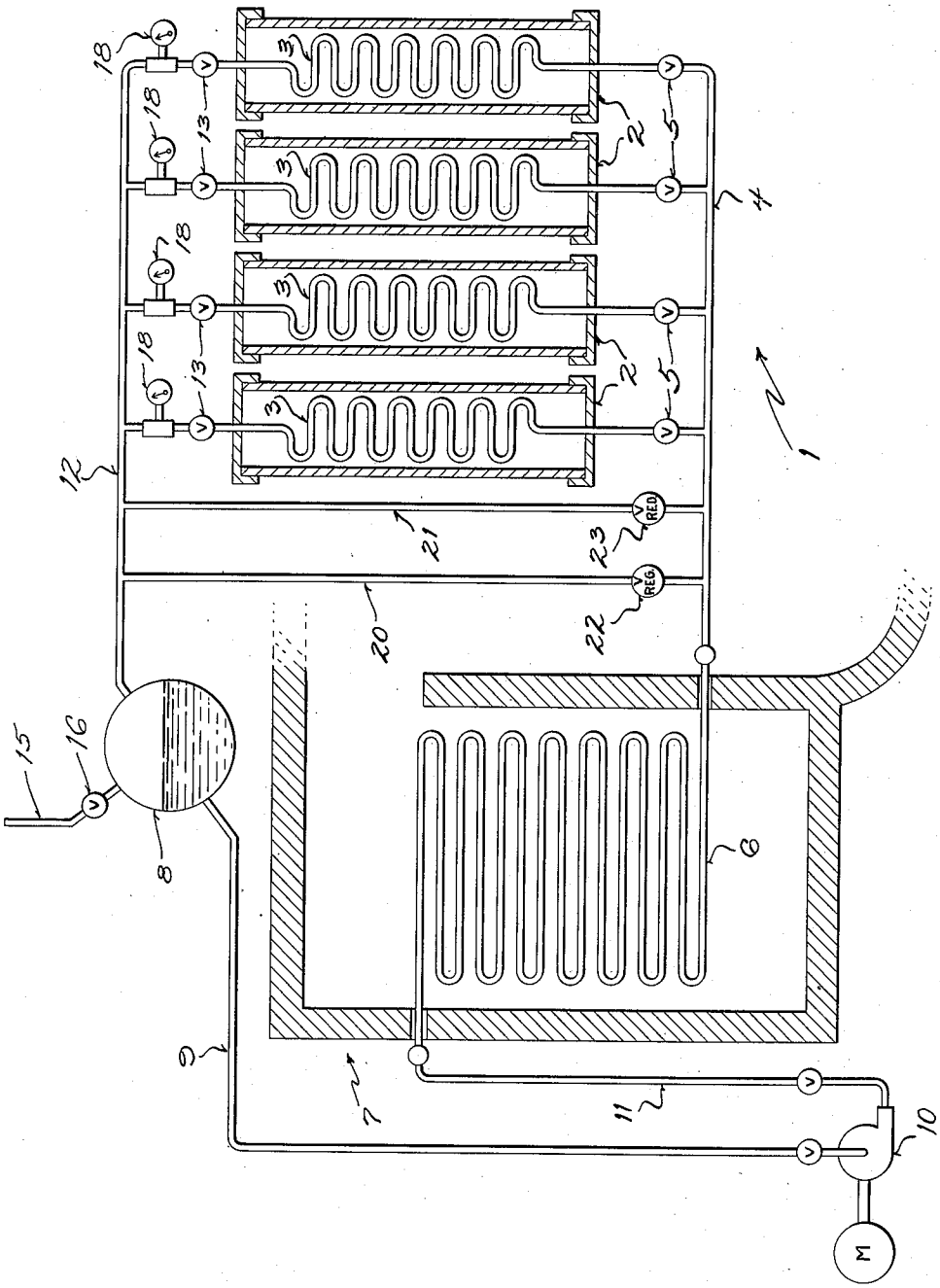
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METHOD OF HEATING

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METHOD OF HEATING

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This invention relates to methods of heating, and has more particular reference to an improved method of effecting transfer of heat from a source thereof to means to be heated.

Heat is required in many industrial processes, and where direct exposure of materials to be heated to a fire or the heat of an oven is impossible, generally one of three methods have been employed in the past for such heating.

The first of these methods involved circulation of hot water usually obtained from a steam boiler, through the materials to be heated in a device similar to a heat exchanger. This method has the objection of requiring the circulation of an exceptionally great quantity of hot water through the heat absorbing device in proportion to the quantity of heat transferred to the materials, and this, of course, increases the power requirements of pumps necessary to handle such large quantities of water. In addition, the temperature of the boiler water is lowered to a degree depending upon the heat quantity absorbed by the materials being treated and ordinarily requires considerable reheating before it can be returned to the boiler system.

A second method, which has met with little success for the heating of various materials in industrial processes, involved the subjection of the materials to be heated to high pressure steam, likewise in a device similar to a heat exchanger. If steam generated at high pressure in a boiler plant is caused to condense in the heat supplying section of the device containing the materials being heated, a condensate remover must be provided. Since a reliable condensate remover which must operate under conditions of high pressure has never been developed, this method is also objectionable.

A third method which has been proposed and found to be generally unsatisfactory makes use of heating by special liquids having a suitable curve of saturation. These liquids are often organic and must be selected with extreme care to assure against decomposition at high pressures and corresponding temperatures which might result in deposits being formed on ducts through which the liquids are circulated. Moreover such liquids when in gaseous form must be non-poisonous.

With these objections to past heating processes in mind it is an object of the present invention to provide an improved method for heating various materials by which all of the foregoing objections are overcome.

In accordance with the method of this invention, a steam-water emulsion is generated in the tubes of a boiler plant at a substantially high pressure and related temperature, and this steam-water emulsion comprises the heat supplying medium for the heating of materials, such as chemicals, in devices similar to heat exchangers. The method of this invention further contemplates the circulation of such steam-water emulsion through the heat exchangers or heat absorbing devices, at a rate permitting only partial condensation of the steam content of the emulsion so as to effect heat transfer between the emulsion and the materials being heated without lowering the temperature of the emulsion.

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This is especially important in the chemical industry where materials often must be heated to a relatively high temperature and the entire volume undergoing treatment must be maintained at a predetermined uniform temperature. To assure such uniform heating of the entire volume of material undergoing treatment the heat exchanger supplying the heat to the material must be of uniform temperature throughout its entire extent. This invention achieves this objective by circulating a steam-water emulsion through the heat exchanger supplying the heat to the material to be heated, in a manner to assure only partial condensation of the steam, since as long as some steam bubbles remain in the fluid leaving the heat exchanger, the temperature of the fluid leaving the heat exchanger is the same as that of the fluid entering the exchanger, less only the very slight decrease due to the small pressure drop occasioned by line friction.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel method and sequence of operations substantially as hereinafter described and more particularly defined by the appended claims.

The accompanying drawing illustrates one complete example of the method of this invention propounded in accordance with the best procedure so far devised for the practical application of the principles thereof, and in which the single figure diagrammatically illustrates the manner in which steam-water emulsion generated in the tubes of a boiler plant can be utilized in a heating process in a most advantageous manner to supply all of the heat necessary for the process and in addition to provide steam for many other uses.

Referring now more particularly to the accompanying drawing, the numeral 1 generally indi-

cates a battery of heat absorbing devices or heat exchangers 2, which may be in the nature of vessels in which materials are placed to be heated. A coil-like conduit 3 is disposed inside each of the vessels and is adapted to conduct a steam-water emulsion through the vessel for the heating of materials therein. The inlets of all of the coils 3 lead to a common supply conduit 4 through valves 5 which may be employed both for shutting off and for throttling the flow of steam-water emulsion through the coils.

The supply conduit 4 connects with the outlet header of the boiler tubes 6 of a steam generating plant generally designated 7, and boiler water contained in the steam dome 8 of the plant is drawn from the steam dome through a conduit 9 and forcefully circulated through the boiler tubes 6 by a pump 10, a conduit 11 connecting the outlet of the pump with the inlet header of the boiler tubes.

The outlet of each of the coils 3 connects with a common discharge conduit 12 through a valve 13, and the conduit 12 leads to the upper portion of the steam dome 8 to conduct the steam-water emulsion thereinto after its passage through the heat absorbing devices 2.

According to the method of this invention, the boiler system is operated at a pressure high enough to produce and maintain a specified uniform temperature in the system lying in the range of between 170° and 320° C., and the pump 10 circulates boiler water through the boiler tubes 6 at a rate such as to cause a steam-water emulsion to be generated in the boiler tubes at the desired pressure and temperature with the steam content of the emulsion great enough so as to permit only partial condensation of the steam during its passage through the coils 3 of the heat absorbing devices.

In this manner the heat of condensation of the steam thus condensed is transferred to the materials being heated in the vessels 2 without producing any appreciable drop in temperature of the steam-water emulsion, and the steam content of the emulsion discharging from the heat absorbing devices 2 is separated from the water upon discharge of the emulsion into the steam dome 8 where the steam is retained under pressure for use as desired. As shown in the diagram, such steam may be drawn from the steam dome through a conduit 15 under the control of a valve 16.

Control of the rate of flow of the steam-water emulsion through the coils 3 of the heat absorbing devices 2 to permit only partial condensation of the steam in these coils is facilitated by the throttle valves 5 adjacent to the inlets of the coils. If desired, gauges 18 may be connected to the outlets of the coils 3 to indicate the temperature of the steam-water emulsion prior to discharge thereof into the discharge duct 12 leading to the steam dome. If these gauges show a drop in temperature at the outlets of the coils 3, it is an indication that all of the steam content of the steam-water emulsion is being condensed in the coils by reason of travel of the emulsion through the coils at a slower rate than desired, which condition can be corrected by adjustment of the valves 5.

The apparatus is preferably also provided with a pair of by-pass conduits 20 and 21 connecting between the conduits 4 and 12 ahead of the battery of heat absorbing devices. A pressure regulating valve 22 in the conduit 20 operates to by-pass steam-water emulsion past the battery of heat absorbing devices in the event of a rise in pressure in the supply conduit 4 for any reason such as shutting off of one or more of the devices by their valves 5.

A reducing valve 23 is preferably incorporated in the by-pass conduit 21 to allow part of the steam-water emulsion generated in the boiler tubes 6 to by-pass the bank of heat absorbing devices as long as pressure in excess of a predetermined value obtains in the feed line 4 due to the boiler generating more steam-water emulsion than needed by the heat absorbing devices in operation. The valve 23 thus cooperates with the regulating valve 22 to govern the pressure in the conduit 4 and maintain it at a predetermined differential above that obtaining in the conduit 12 sufficient to overcome the line friction losses through the coils 3 of the heat absorbing device in operation, and hence these valves cooperate with the valve 5 to regulate the flow of steam-water emulsion through the devices 2.

While it is preferable to generate the steam-water emulsion required for the heating process in the boiler tubes 6, it will be readily appreciated that the steam-water emulsion may be produced by drawing hot water from one part of the system and mixed with steam from another part of the system in order to obtain the desired emulsion.

From the foregoing description taken in connection with the accompanying drawing, it will be apparent that this invention provides a method for heating which contemplates the use of a steam boiler plant in an exceptionally advantageous manner since it utilizes the phenomenon known as latent heat of condensation to maintain substantially uniform temperature in all parts of a heat exchanger used to effect heat transfer from the boiler fluid to material to be heated.

What I claim as my invention is:

1. The method of transferring heat from a steam boiler to a heat absorbing device remote from the boiler, which comprises: positively circulating steam-water emulsion from the boiler through the heat absorbing device; and regulating the flow of the steam-water emulsion through the heat absorbing device so that the steam of the emulsion is condensed in its passage through the heat absorbing device at such rate that the temperature of the steam-water emulsion leaving the heat absorbing device is substantially the same as that of the steam-water emulsion entering the heat absorbing device, whereby heat transfer takes place between the steam-water emulsion and the heat absorbing device principally by the absorption of latent heat of condensation.

2. The method set forth in claim 1 further characterized by the delivery of the steam water emulsion discharged from said heat absorbing device to a separator for use of the steam as desired.

3. The hereindescribed method of heating materials in a heat absorbing device, which comprises: generating a steam-water emulsion in the tubes of a boiler system at a pressure high enough to bring the temperature of the emulsion to a value at least equal to the temperature to which the materials are to be heated; effecting forced circulation of such steam-water emulsion through the heat absorbing device under said pressure and at a rate permitting only partial condensation of the steam content of the emulsion so as to effect heat transfer between said

materials and the emulsion without substantial drop in temperature of the emulsion; and returning the steam-water emulsion leaving the heat absorbing device to the steam dome of the boiler system for use of the steam fraction of said emulsion as desired.

4. The hereindescribed method of supplying heat to a heat absorbing device which comprises: generating a steam-water emulsion in the tubes of a boiler system at a pressure high enough to bring the temperature of the emulsion to a value in excess of the temperature sought in the heat absorbing device; forcefully circulating steam-water emulsion thus generated through the heat absorbing device to effect heat transfer between the emulsion and said device; regulating the rate of flow of steam-water emulsion through said heat absorbing device, while maintaining substantially said pressure thereon, so that only partial condensation of the steam content of the emulsion takes place in the heat absorbing device and so that the emulsion leaves the heat absorbing device at the steaming temperature of the boiler water; and delivering the steam-water

emulsion leaving the heat absorbing device to the steam dome of the boiler system for use of the steam fraction of said emulsion as desired.

5. The method set forth in claim 3 wherein steam-water emulsion produced by the generator is by-passed directly to the steam dome whenever the pressure at the steam-water inlet of said heat absorbing device exceeds a predetermined value.

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