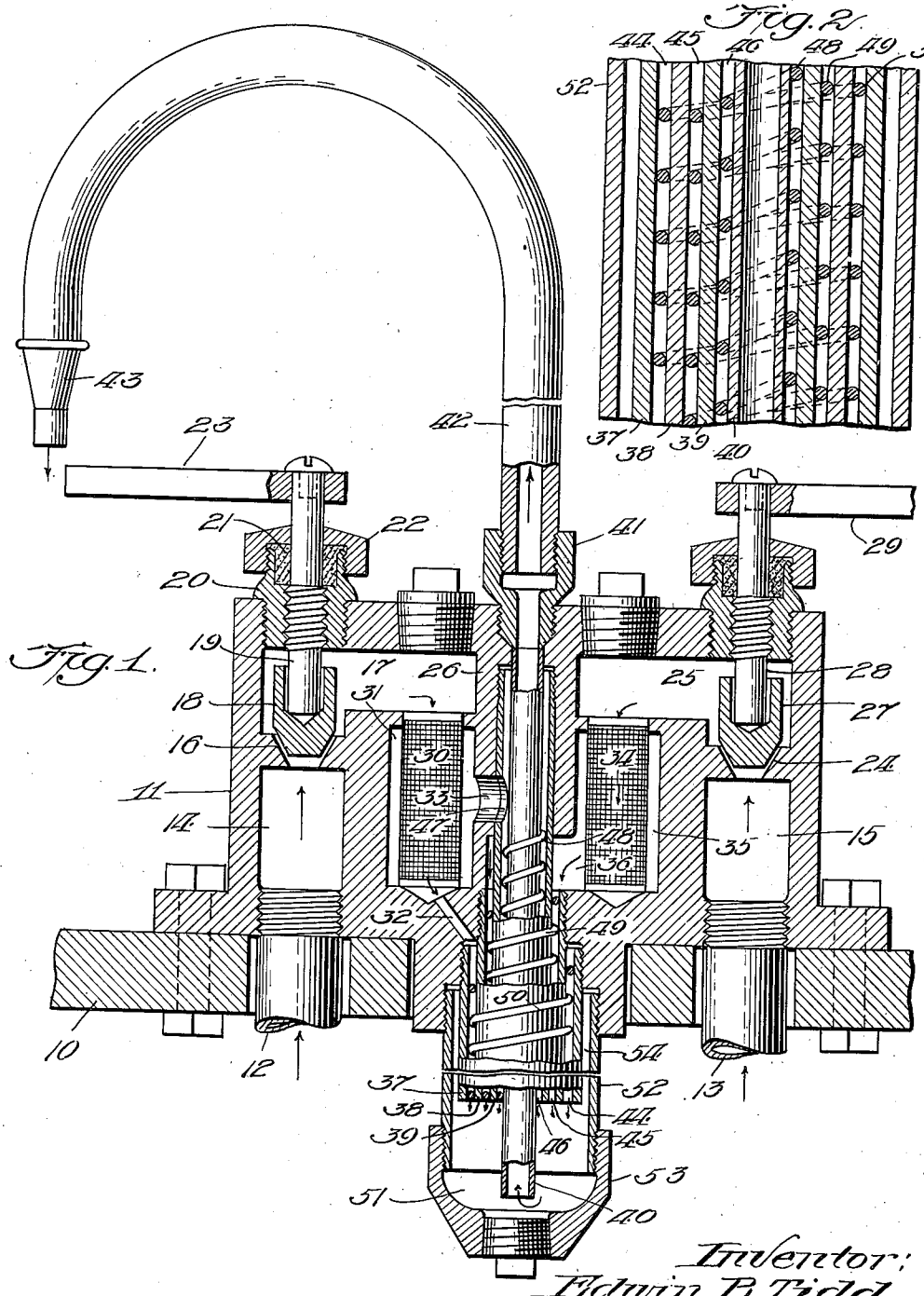
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STEAM AND WATER MIXER

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STEAM AND WATER MIXER

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7 Claims. (Cl. 261—10)

My invention relates to steam and water mixers in which continuously flowing streams of steam and water are brought into heat exchanging relation to provide hot water at an outlet.

In steam heating installations and in other layouts wherein steam provides motive power with or without space heating, it is frequently desirable to have always available copious quantities of hot water. Ordinarily this result is sought either by providing separate heating devices, by submerging a heating coil in the water space of the boiler, or by passing steam around coils through which cold water flows. However, the foregoing arrangements are characterized by a certain inflexibility in their adaptation to special operating conditions since the water is ordinarily heated remote from the point of use and may be deficient in capacity to produce water at a definite temperature under conditions of sustained draw at a plurality of outlets.

It is, therefore, the principal object of my invention to devise an apparatus wherein the heat exchange between the water and steam is effected at the point of use with certain economies in heat consumption and the space occupied by the device.

A further object is to provide an apparatus of the character indicated in which the steam and water are brought into heat exchanging relationship while traversing separate paths and are finally mixed with each other to completely condense any uncondensed particles of steam.

A further object is to provide a steam and water mixing apparatus which is capable of continuously producing in a device of economical size a continuous flow of water at high temperature.

These and further objects of my invention will be set forth in the following specification, reference being added to the accompanying drawing, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawing:

Fig. 1 is a sectional elevation of my improved mixer.

Fig. 2 is an enlarged, fragmentary and sectional elevation of the concentric tube assembly which constitutes the heat exchanging portion of the mixer.

Referring to the drawing, the numeral 10 designates a supporting base which may be a table, sink, or any other desired part and to which is bolted a header 11. Extending upwardly through the base 10 and threaded into the header 11 are cold water and steam pipes 12 and 13, respectively, which are preferably spaced from each other in the general manner indicated in the drawing so as to provide space for the heat exchanging portion of the mixer. However, this particular arrangement is merely illustrative as these parts of the apparatus may be arranged as desired.

Water and steam delivered by the pipes 12 and 13 flow into pockets 14 and 15, respectively, in the header, the pocket 14 communicating through a valve port 16 with a chamber 17. Flow of water through the port 16 may be controlled by a combination check and regulating valve 18 which is freely mounted on the lower end of a stem 19, the arrangement being such that when the stem is raised, the water pressure in the pipe 12 will lift the valve 18 from its seat and this valve may be returned to closing position by moving the stem 19 downwardly. The stem is threaded in a bushing 20 that is mounted in the header and extends through and beyond packing 21 and a gland nut 22 for attachment to an operating handle 23. The particular type of valve employed to control flow through the port 16 forms no part of the present invention and its construction may be varied as desired.

Similarly, the steam pocket 15 communicates through a valve port 24 with a chamber 25 which is separated from the chamber 17 by a central wall 26 in the header. Flow of steam through the port 24 may be controlled by a valve 27, similar to the valve 18, and which is mounted upon a stem 28 threaded in a bushing similar to the bushing 20 and having externally secured thereto an operating handle 29.

Water which is received within the chamber 17 flows downwardly through a strainer 30 that is mounted with a larger cavity 31, located to the left of the dividing wall 26, as illustrated in Fig. 1. The lower end of the cavity 31 communicates by means of a duct 32 and a lateral port 33 with the upper ends of annular water passages presently described.

In somewhat the same manner, steam flowing into the chamber 25 passes downwardly through a strainer 34 mounted in a larger cavity 35 located to the right of the dividing wall 26. The cavity 35 in turn communicates with a laterally extending chamber 36 which leads to an annular steam passage presently described.

Generally speaking, heat exchange between the flowing water and steam is achieved in a structure composed of a series of spaced, concentric tubes having a length sufficient to provide

the required heat transfer surface and within the annular passages between adjacent tubes may be located retarding and heat conducting elements for the dual purpose of sufficiently checking the flow of steam and water to insure adequate heat transfer and of conducting the heat well within the streams of water.

To this end there are provided spaced, concentric tubes **37**, **38**, **39** and **40**, the tube **37** being the outermost tube of the heat exchanger, and the remaining numerals indicating in order the other tubes of the assembly. The upper end of the tube **37** is threaded in the lower part of the header with its upper end terminating adjacent the delivery end of the duct **32**. The tube **38** is also threaded into the header with its upper end at a higher elevation than the upper end of the tube **37** and terminating adjacent the lateral steam chamber **36**, while tube **39** extends well up into and is threaded in a bore provided in the central wall **26** above the port **33**. The innermost tube **40** has its upper end secured within the wall **26** at a higher elevation than the upper end of the tube **39**, and the interior of the tube **40** communicates with a passage provided in a bushing **41** threaded in the top of the header and which in turn has a threaded connection with a gooseneck pipe **42** provided with a nozzle **43**.

The spacing of the tubes **37** and **38** provides an annular cold water passage whose upper end communicates with the duct **32**, while the spacing of the tubes **38** and **39** defines an annular steam passage **45** whose upper end communicates with the lateral steam chamber **36**. The spacing of the tubes **39** and **40** creates an annular water passage **46** which communicates through a port **47** in the wall of the tube **39** with the port **33**. From the foregoing, it will be understood that cold water flows simultaneously down through the passages **44** and **46** and disposed there-between is the passage **45** through which flows the steam.

In order to provide a mixer of economical size, it is deemed advisable to interpose in each of the annular passages metallic elements that act to increase the length of time required for any given unit of steam and water to traverse their respective passages relative to that which would be required if no retarding devices were employed. These retarding factors additionally transmit the heat from all portions of the flowing steam into all portions of the flowing water and the construction is such as to set up a turbulent action in order to facilitate and increase the rapidity of heat exchange.

For this purpose, I surround the tube **40** with a wire helix **48**, the tube **39** with a wire helix **49**, and the tube **38** with a wire helix **50**, the helix **48** extending the full length of the passage **46** below the port **47** and the helices **49** and **50** extending the full length of the passages **45** and **44**, respectively. The pitch of these several helices may be varied as desired and they may have only intermittent contact with the encasing tubes, or they may be definitely secured to the encasing tubes as by soldering. In the first instance, the helices merely exert a retarding effect on the otherwise free flow of the steam and water and will also set up a turbulent action of these fluids that greatly increases the rapidity of heat exchange, while in the second instance, i. e., one in which the diameters of the wire employed in the several helices is substantially equal to the width of the respective annular passages, the steam and water will be constrained to helical paths in flowing through their respective passages. It will be particularly noted, however, that whether the helices have intermittent contact with the tubes or are secured to the tubes, their conducting ability insures the transfer of heat from the steam into all portions of the water passing through the passages **44** and **46**, thus preventing any "skin" heating of the water which might otherwise leave the principal mass of water relatively unaffected by the heat.

Heated water and any uncondensed portions of steam which are delivered by the lower ends of the passages **44**, **45** and **46** are collected within a mixing chamber **51** formed by an outer tube **52**, which is spaced from and encircles the tube **37** and has its upper end threaded into the lower part of the header **11**, and a lower header **53** threaded on the lower end of the tube **52**. The spacing of the tubes **37** and **52** creates an air space **54** which serves to insulate the tube assembly and prevents undue loss of heat to the air. The fluid mixture which is collected in the mixing chamber **51** passes upwardly through the pipe **49** whose lower end extends well within the chamber **51** and below the lower ends of the tubes **37**, **38** and **39** so as to insure a complete mixing of the heated water and any uncondensed particles of steam and this mixing is carried further within the tube **46** so that only hot water issues from the nozzle **43**.

The amount of heat transfer surface, and hence the size of my apparatus will in general depend upon the relative temperatures of the cold water and steam which it is proposed to mix and also the final temperature of the heated water. In one design which I have employed and in which steam at fifteen pounds' pressure was used to heat cold water at normal city pressure, it was possible to obtain from one to one and one-half gallons of water per minute having a temperature of 180° F. at the nozzle **43**, the flow at the nozzle being constant and free from steam bubbles. For this particular design, I employed what is known in the trade as Type L heavy copper tubing for the tubes **37**, **38**, **39** and **40**, the outside diameter of these tubes being respectively 1 inch, ¾ inch, ½ inch, and ¼ inch. The outside diameter of the tube **52** was about 1¼ inches and the length of this tube was about 14 inches. The lengths of the other tubes were such as to provide a mixing chamber **51** of adequate size and also the required communication with the steam and water supply. Each of the helices were composed of brass wire having a diameter substantially equal to the width of the associated passage.

It will be understood, however, that where size of the apparatus is not a critical factor, it may be possible to eliminate the wire helices if the tube assembly is sufficiently long to provide the required amount of heat transfer surface, or if additional concentric tubes are used for the purpose of increasing the number of alternately disposed steam and water passages with appropriate changes in the header **11**. The wire helices may be used under either of the last named conditions.

The helices are intended to be generally representative of any elements, such as simple, straight or curved arms, disposed in the steam and water passages for the purpose of retarding the flow of these fluids, or of periodically changing the direction of flow, and with or without the additional capacity of conducting heat. Where heat conductance is not required, these

elements may be formed of non-metallic materials.

I claim:

1. A steam and water mixer for supplying a stream of heated water free from steam bubbles comprising a plurality of telescopically related pipes composed of heat conducting material and defining annular, alternately related water and steam passages therebetween, means in each of the passages for retarding the water and steam to facilitate heat exchange by lengthening the time interval of flow therethrough, one end of the innermost pipe being connected to a discharge outlet and the opposite end located adjacent the delivery ends of the passages, and means for directing the discharging steam and hot water into the innermost pipe to fully condense any free steam prior to final delivery.

2. A steam and water mixer for supplying a stream of heated water free from steam bubbles comprising a plurality of telescopically related pipes composed of heat conducting material and defining annular, alternately related water and steam passages therebetween, a wire helix disposed in each of the passages for retarding the flow of water and steam to promote heat exchange, one end of the innermost pipe being connected to a discharge outlet and the opposite end being located adjacent the delivery ends of the passages, and means for directing the discharging steam and heated water into the innermost pipe to fully condense any free steam pror to final delivery.

3. A steam and water mixer for supplying a stream of heated water free from steam bubbles comprising a plurality of telescopically related pipes composed of heat conducting material and defining annular, alternately related water and steam passages therebetween, means in each of the passages for retarding the water and steam to facilitate heat exchange by lengthening the time interval of flow therethrough, one end of the innermost pipe being connected to a discharge outlet and the opposite end extending beyond the delivery ends of the passages, and means comprising a chamber surrounding said opposite end in which the steam and hot water are intermingled and directed into the innermost pipe to finally condense any free steam prior to final delivery.

4. A steam and hot water mixer for supplying a stream of hot water free from steam bubbles comprising four telescopically related pipes composed of heat conducting material and defining three annular passages therebetween, steam flowing through the intermediate passage and water through the other passages, means in each of the passages for retarding the steam and water to facilitate heat exchange by lengthening the time interval of flow therethrough, one end of the innermost pipe being connected to a discharge outlet and the opposite end lying adjacent the delivery ends of the passages, and means for directing the discharging steam and hot water into the innermost pipe to fully condense any free steam prior to final delivery.

5. A steam and water mixer for supplying a stream of hot water free from steam bubbles comprising a header, a plurality of telescopically related pipes composed of heat conducting material mounted in the header and defining annular, alternately related water and steam passages therebetween, water and steam supplying conduits in the header communicating, respectively, with the water and steam passages, means in each of the passages for retarding the water and steam to facilitate heat exchange by lengthening the time interval of flow therethrough, a discharge nozzle mounted in the header, one end of the innermost pipe being connected to the nozzle and the opposite end lying adjacent the delivery ends of the passages, and means for directing the discharging steam and hot water into the innermost pipe to fully condense any free steam prior to discharge from the nozzle.

6. A steam and water mixer for supplying a stream of hot water free from steam bubbles comprising a header, a plurality of telescopically related pipes composed of heat conducting material mounted in the header and defining annular, alternately related water and steam passages therebetween, water and steam supplying conduits in the header communicating, respectively, with the water and steam passages, means in each of the passages for retarding the water and steam to facilitate heat exchange by lengthening the time interval of flow therethrough, a discharge nozzle mounted in the header, one end of the innermost pipe being connected to the nozzle and the opposite end lying adjacent the delivery ends of the passages, and a chamber forming part of the header into which the steam and hot water is discharged and intermingled and from which the mixture is directed into the innermost pipe to fully condense any particles of steam.

7. A steam and water mixer for supplying a stream of hot water free from steam bubbles comprising a header, a plurality of telescopically related pipes composed of heat conducting material mounted in the header and defining annular, alternately related water and steam passages therebetween, water and steam supplying conduits in the header communicating, respectively, with the water and steam passages, means in each of the passages for retarding the water and steam to facilitate heat exchange by lengthening the time interval of flow therethrough, a discharge nozzle mounted in the header, one end of the innermost pipe being connected to the nozzle and the opposite end extending beyond the delivery ends of the passages, and a chamber forming part of the header into which the steam and hot water is discharged and intermingled and from which the mixture is directed into the innermost pipe to fully condense any particles of steam.

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