July 31, 1962 H. A. KULJIAN ETAL 3,046,956

PUMPLESS LIQUID HEATER AND TRANSLATOR

Filed June 3, 1959 4 Sheets-Sheet 1

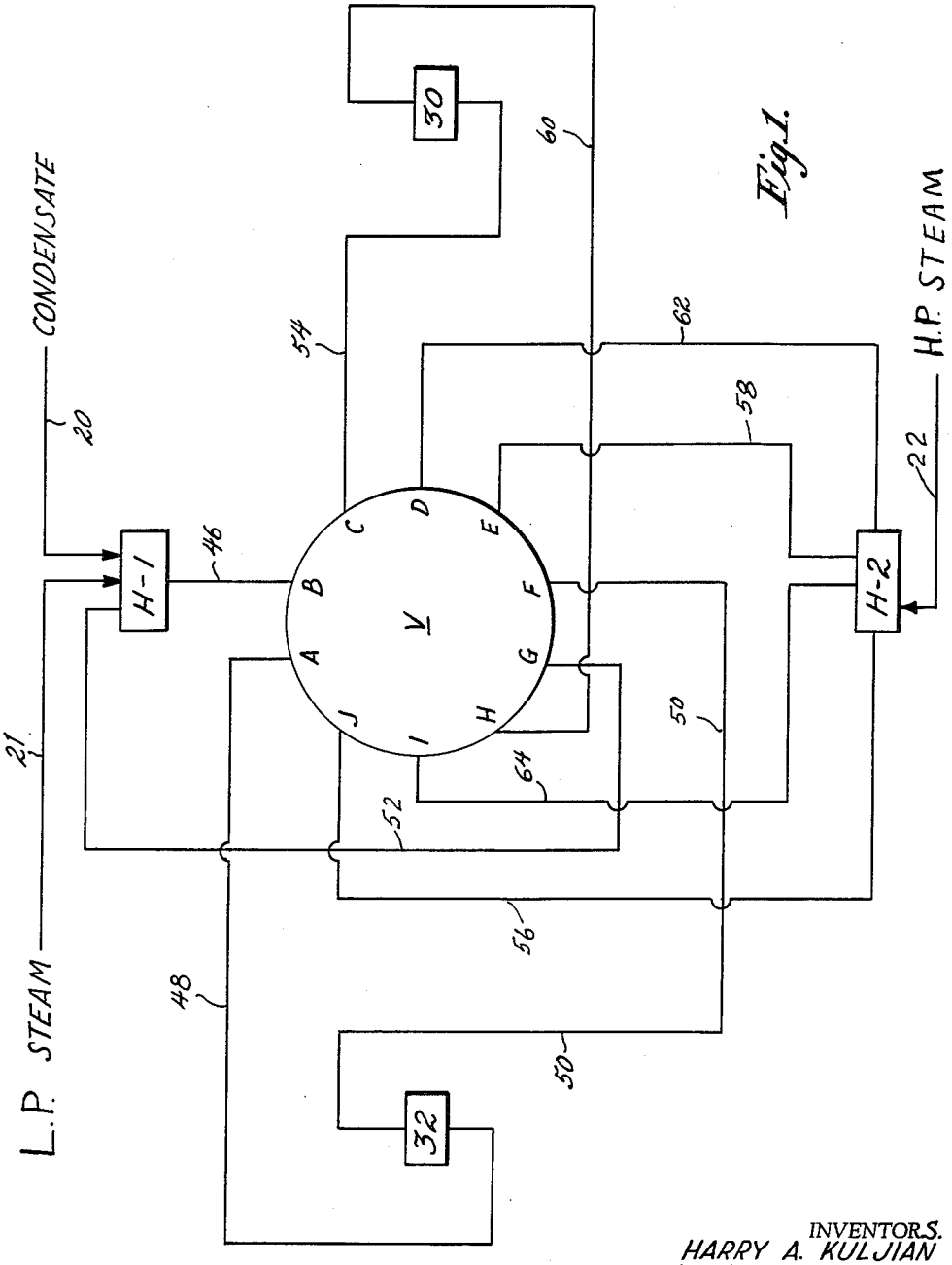


Fig. 1.

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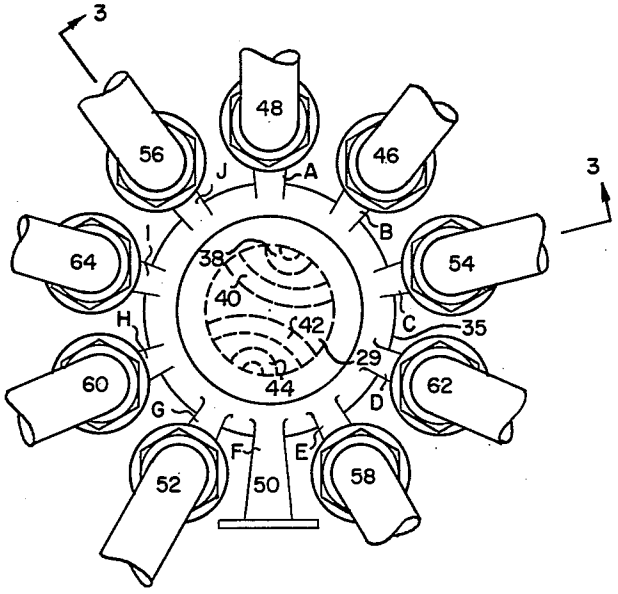


FIG. 2

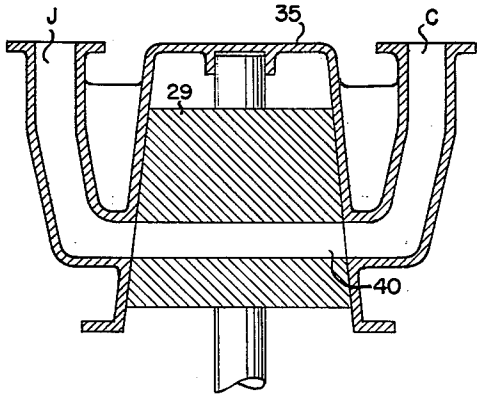


FIG. 3

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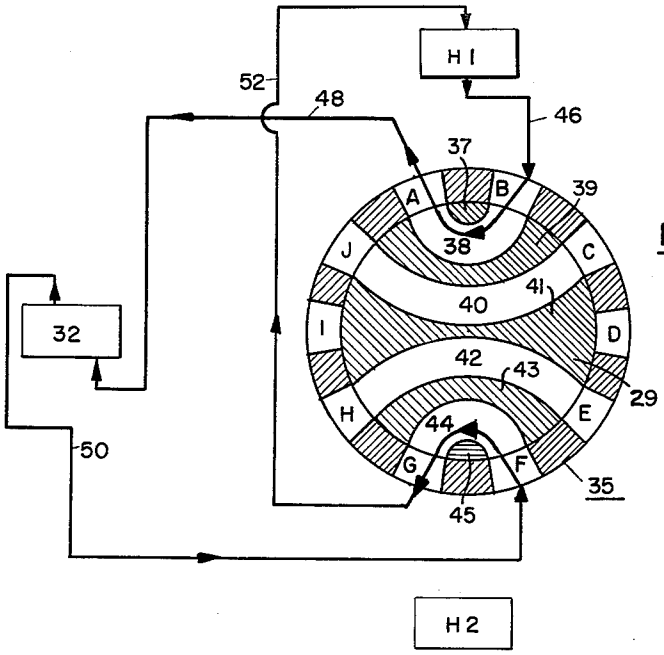


FIG. 4

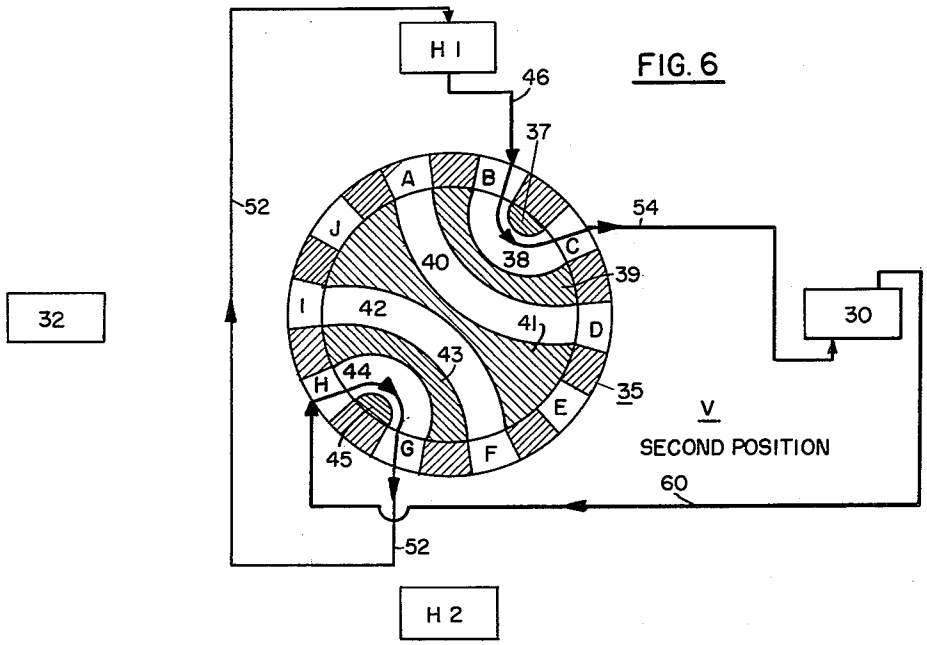


FIG. 6

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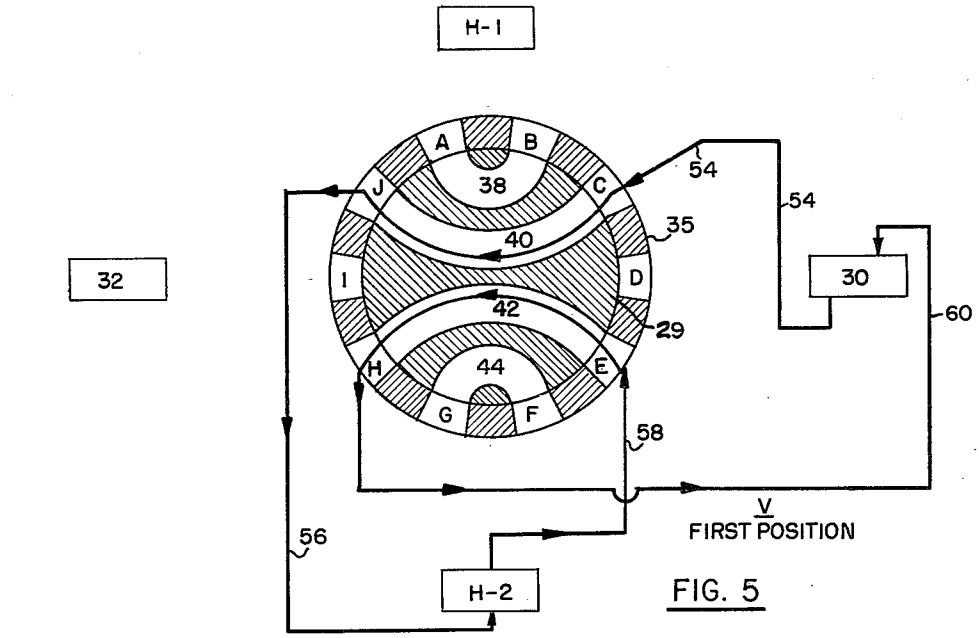


FIG. 5

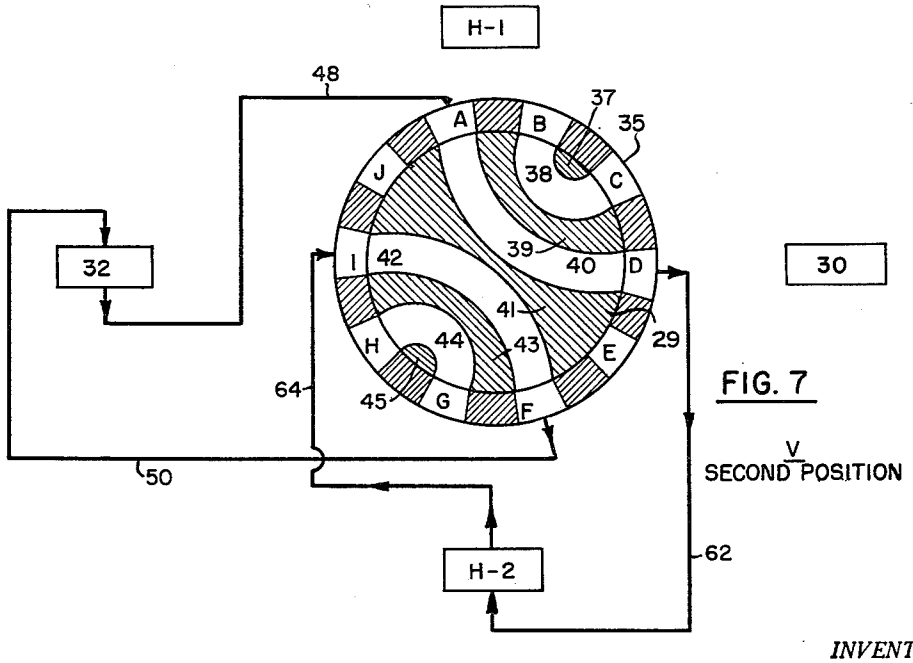


FIG. 7

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United States Patent Office 3,046,956 Patented July 31, 1962

3,046,956
PUMPLESS LIQUID HEATER AND TRANSLATOR

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Filed June 3 1959, Ser. No. 817,765
3 Claims. (Cl. 122—451)

This invention relates to a multi-stage pumpless liquid heater and translator for use in apparatus of the type shown in Patent No. 2,870,751 issued to Kuljian, et al. on January 27, 1959.

The apparatus disclosed in said patent includes at least one upper, relatively low pressure heater and at least one lower, relatively high pressure heater, means for admitting a supply of condensate to be heated to said upper heater, means admitting steam of a relatively low pressure to the upper heater and for admitting steam of a relatively high pressure to the lower heater, a pair of pressure equalizing chambers intermediate said heaters, a first conventional multi-way valve for alternately connecting the pressure equalizing chambers in liquid receiving relation with the low pressure heater and for alternately connecting said chambers in liquid discharging relation to the high pressure heater, and a second conventional valve for alternately connecting the pressure equalizing chambers in steam flow relation with the upper heater when said chambers are in liquid receiving relation to said heater and for alternately connecting the pressure equalizing chambers in steam flow relation with the lower heater when said chambers are in liquid discharge relation, whereby the pressure in the upper heater and the pressure in the chamber receiving liquid therefrom, are equalized and whereby the pressure in the lower heater and the pressure in the chamber discharging liquid thereinto are equalized so that liquid can flow from the low pressure heater to the high pressure heater by gravity and without the use of pumps. The apparatus disclosed in said patent also includes means for synchronizing the movement of the valves whereby, for example, while one pressure equalizing chamber is receiving liquid from the upper heater it is vented to said heater and whereby while the other pressure equalizing chamber is discharging liquid to the lower heater it receives steam from said lower heater, and vice versa.

Valves used for this purpose have to operate under relatively high fluid pressures and, if the pressure against the valve plug is unidirectional, a correspondingly great force will be needed to move the valve and the imbalance of the valve results in undue wear of the valve plugs, and the bearings and other parts.

The primary object of this invention is to produce improved single valve means for alternately connecting the upper and lower heaters in alternate steam and liquid flow relation with the equalizing chambers shown in the patent aforesaid.

A further object of the invention is to produce an arrangement in which the valve plug is always subjected to equal pressures exerted in opposite directions whereby the valve plug may be easily moved and whereby the wear on the bearings and associated parts is greatly reduced.

The full nature of the invention will be understood from the following specification and the accompanying drawings in which:

FIG. 1 is a diagrammatic view showing an upper, low pressure and a lower, high pressure heater, two pressure equalizing chambers therebetween, and a single valve for inter-connecting said heaters and said pressure equalizing chambers according to this invention.

FIG. 2 is a top plan view of the valve, showing some of the internal structure in phantom.

FIG. 3 is a sectional view looking in the direction of line 3—3 on FIG. 2.

FIGS. 4 to 7, inclusive, are sectional views showing the paths of flow in the various positions of the valve.

The embodiment illustrated includes an upper, relatively low pressure heater H–1, a pipe 20 for delivering condensate to be heated to said heater, a pipe 21 for delivering relatively low pressure steam to said heater, a lower, relatively high pressure heater H–2, a pipe 22 for delivering relatively high pressure steam to said heater, pressure equalizing chambers 30 and 32, a multi-way valve V, the casing 35 of which has circumferentially spaced ports A, B, C, D, E, F, G, H, I, and J formed in casing 35 thereof, and the rotary valve plug 29 of which has passages 38, 40, 42 and 44 formed therein and adapted selectively to register with said ports and pipes 46, 48, 50, 52, 54, 56, 58, 60, 62 and 64 for selectively interconnecting said heaters and said pressure equalizing chambers. Passages 38, 40, 42 and 44 are separated by solid segments 37, 39, 41, 43 and 45 which, in one position of plug 29, close all of the ports. It will be noted that, except for being reversely curved, passages 38 and 44 are identical and the same is true of passages 40 and 42. Plug 29 is tapered so that if it is moved slightly away from its seat, it can be easily rotated. But since this is a common expedient and since it forms no part of the invention, it is not shown nor described.

As will appear from the drawings, the valve has two operating positions and for clarity of illustration, the first operating position of the valve is shown in FIGS. 4 and 5 and the second operating position of the valve is shown in FIGS. 6 and 7. The reason for the use of two views to illustrate the two positions of the valve is that, if all the connections used in the first and second positions are shown in one view, the description of the operation may be hard to follow. It will be apparent that if the valve is turined in clockwise direction, as viewed in FIG. 4, to a position half-way between its first and second positions, the ends of segment 39 will close ports A and C; the ends of segment 41 will close ports I and J and ports D and E, respectively; the ends of segment 43 will close ports H and F; segment 37 will close port B and segment 45 will close port G. In this "off" position, nothing can flow.

Reference to FIG. 4 shows that liquid can flow, from relatively low pressure heater H–1, through pipe 46, port B, passage 38, port A and through pipe 48 to pressure equalizing chamber 32. Simultaneously, chamber 32 is vented through pipe 50, port F, passage 44, port G and through pipe 52 back to heater H–1. Venting chamber 32 to heater H–1 permits the liquid to flow by gravity, from heater H–1 to chamber 32 and lateral pressure exerted against the valve in passage 38 will be counteracted by the identical pressure in passage 44.

At the same time, and as shown in FIG. 5, liquid from pressure equalizing chamber 30 (which liquid was previously introduced to chamber 30 from heater H–1) can flow through pipe 54, port C, passage 40, port J and pipe 56 to relatively high pressure heater H–2. Simultaneously, steam can flow from heater H–2 through pipe 58, port E, passage 42, port H and pipe 60 to chamber 30. Venting heater H–2 to chamber 30 equalizes the pressure between chamber 30 and heater H–2 so that the liquid flows from chamber 30 to heater H–2 by gravity. Also, the presence of pressure in passage 40 is counteracted by the identical pressure in passage 42.

To reverse the operation, that is to connect chamber 30 in liquid receiving relation to heater H–1 and to connect chamber 32 in liquid discharge relation to heater

H–2, the valve plug is turned through an angle of 36°, or to the position shown in FIGS. 6 and 7.

Reference to FIG. 6 shows that liquid can flow from heater H–1, through pipe **46**, port B, passage **38** and port C and through pipe **54** to chamber **30** and that chamber **30** is vented, by pipe **60**, port H, passage **44**, port G and pipe **52** to heater H–1, so that, once again, the pressures in heater H–1 and chamber **30** and in passages **38** and **44** are identical.

Reference to FIG. 7 shows that liquid can flow from chamber **32** through pipe **48**, port A, passage **40**, port D and pipe **62** to heater H–2. Simultaneously, heater H–2 is vented through pipe **64**, port I, passage **42**, port F and pipe **50** to equalizing chamber **32**.

It will be seen that the valve is always subjected to opposite and equal lateral pressures and is never subjected to unidirectional pressure and therefore, the force needed to turn the valve is reduced and the wear on the valve which would result from imbalance of the valve is eliminated. It will also be seen that by equalizing the pressure between chambers **30** and **32** and heaters H–1 or H–2, liquid can flow from a low pressure heater, such as heater H–1, to a higher pressure vessel, such as heater H–2, without the use of pumps.

While the invention has been disclosed in connection with a boiler feed water apparatus, it can also be used in connection with other apparatus in which liquid is to be transmitted from a relatively low, to a relatively high pressure receptacle by gravity or by means of a pump which serves to overcome inertia but which need not be powerful enough to overcome the pressure differential. Therefore, in the appended claims the word "heater" is to be understood as including other receptacles connected in the relationship above disclosed; the word "steam" is to be understood as including other gases and "condensate" includes any liquid.

What we claim is:

1. A heat exchanger including a first upper heater having a condensate inlet, a condensate outlet, and a vent opening, means supplying liquid to be heated to said first heater through said inlet, means supplying steam of a relatively low pressure to said first heater to heat said liquid, a second heater having a condensate opening and a vent opening, means supplying steam of a relatively high pressure to said second heater, a first pressure equalizing chamber having a condensate opening and a vent opening, a second equalizing chamber having a condensate opening and a vent opening, a fixed valve casing having a plurality of circumferentially spaced ports, conduits connecting said ports with said outlet condensate of said first heater and said condensate and vent openings, in a predetermined order, a valve body rotatable in said casing, said valve body having a first and second passage therethrough located to one side of the axis of rotation of said valve body, with said second passage between said first passage and said axis, said valve body also having a third and fourth passage located to the other side of said axis and diametrically opposed to said first and second passages, said third passage being between said axis and said fourth passage, and means for rotating said valve body, said ports being so spaced circumferentially and so connected by

said conduits that, when said valve body is rotated to a first position, the ends of said first passage register with the ports which connect the condensate outlet of said first heater in liquid flow relation to the condensate opening of said first pressure equalizing chamber, and the ends of said fourth passage register with the ports which connect the vent opening of said first pressure equalizing chamber in steam flow relation to the vent opening of said first heater, and in which position the ends of said second passage register with ports which connect the condensate opening of said second pressure equalizing chamber in liquid flow relation to the condensate opening of said second heater and the ends of said third passage register with the ports which connect the vent opening of said second heater in steam flow relation to said second pressure equalizing chamber, whereby the pressure in said first and fourth passages will be equal to each other and the pressure in said second and third passages will be equal to each other, and so that when said valve is rotated to a second position, the ends of said first passage register with the ports which connect the condensate opening of said second pressure equalizing chamber in liquid flow relation to the condensate outlet of said first heater, and the ends of said fourth passage register with the ports which connect the vent opening of said second pressure equalizing chamber in steam flow relation to vent opening of said first heater, and in which second position the ends of said second passage register with the ports which connect the condensate opening of said first pressure equalizing chamber in liquid flow relation to the condensate opening of said second heater, and the ends of said third passage register with the ports which connect the vent opening of said second heater in steam flow relation to the vent opening of said first pressure equalizing chamber, whereby in said second position of said valve, the pressure in said first and fourth passages, and the pressure in said second and third passages will be equal.

2. The structure recited in claim 1 in which said pressure equalizing chambers are below said first heater and said second heater is below said pressure equalizing chambers.

3. The structure recited in claim 1 and said valve body having a segment interposed between said second and third passages and having each of its opposite ends wide enough to span and close one pair of two opposed pairs of said ports, a second segment interposed between said first and second passages and having each of its opposite ends wide enough to span and close one of a pair of opposed ports, and a third segment interposed between said third and fourth passages and having each of its opposite ends wide enough to span and close one of a pair of opposed ports whereby said valve body can be moved to a position closing all of said ports.

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