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J. R. SHIELDS

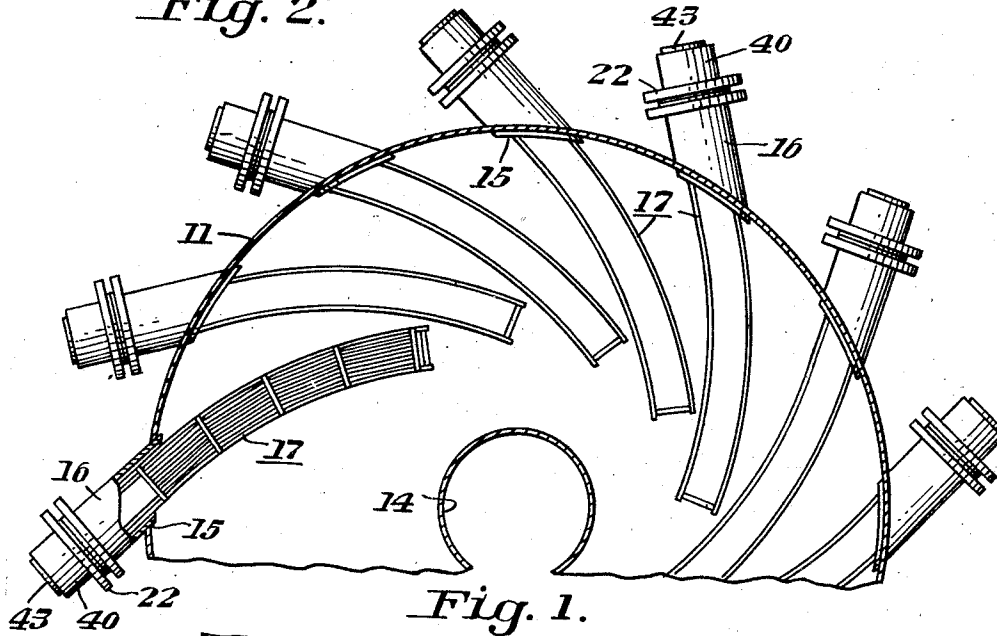
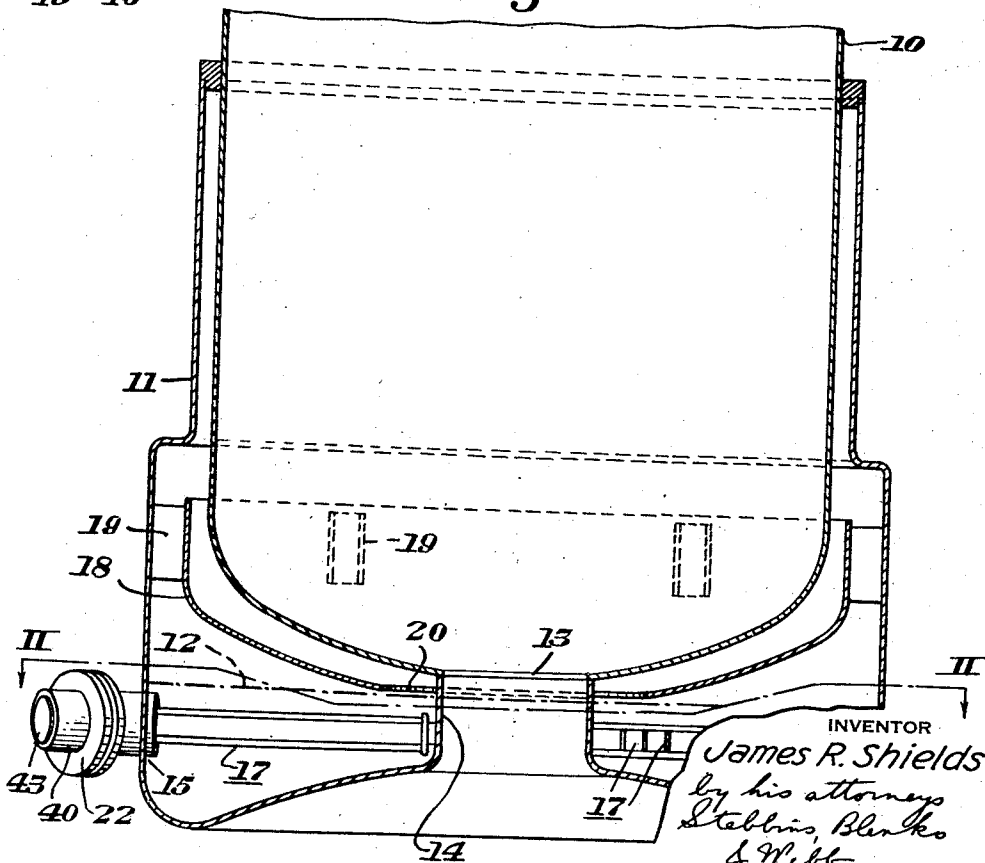
2,434,016

IMMERSION HEATER FOR VAPOR HEATING JACKETS OR THE LIKE

Filed Dec. 22, 1945

3 Sheets-Sheet 1

Fig. 2.



James R. Shields

by his attorneys
Stebbins, Blenko
& Webb

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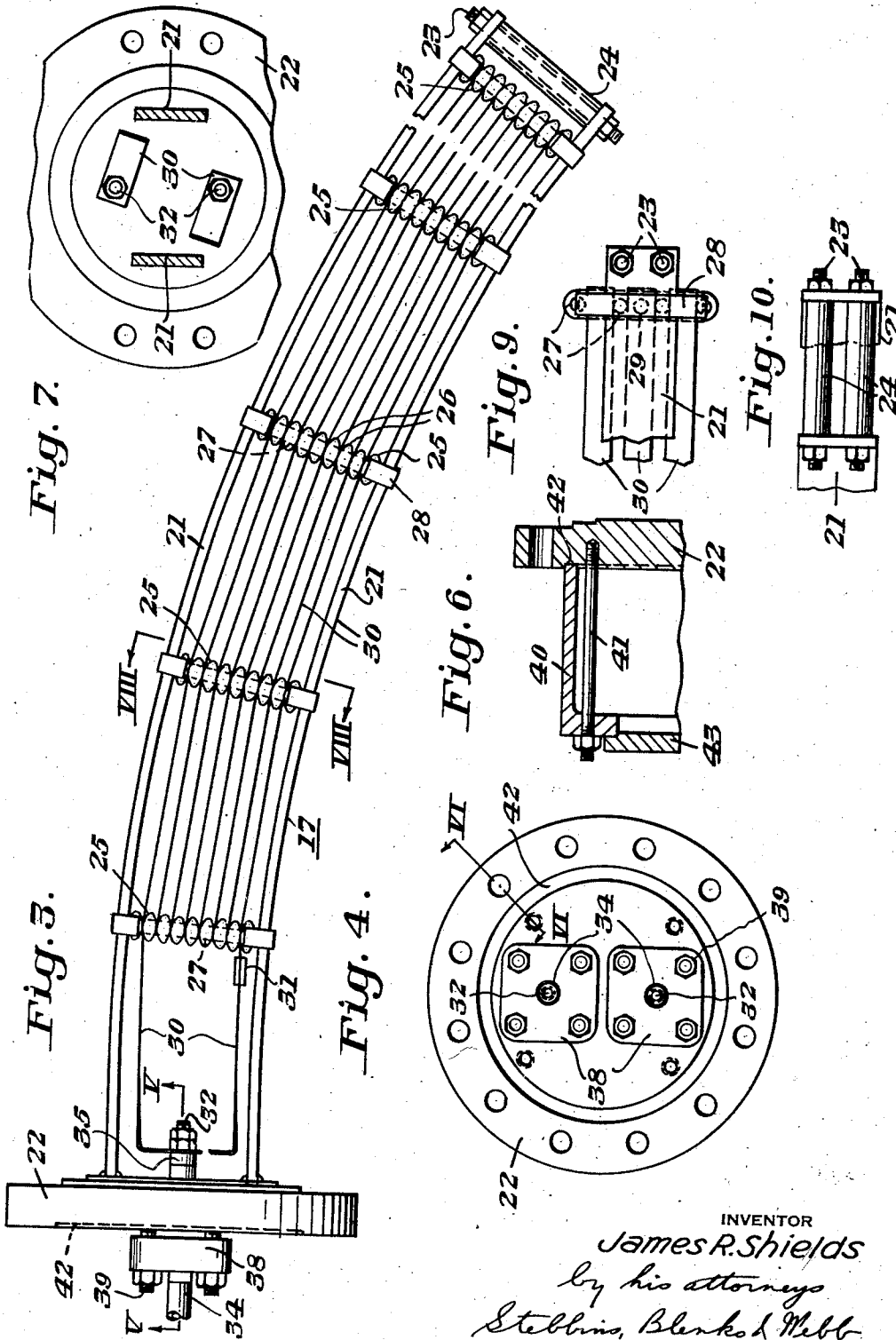
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3 Sheets-Sheet 2



INVENTOR
James R. Shields
by his attorneys
Stebbins, Benson & Webb

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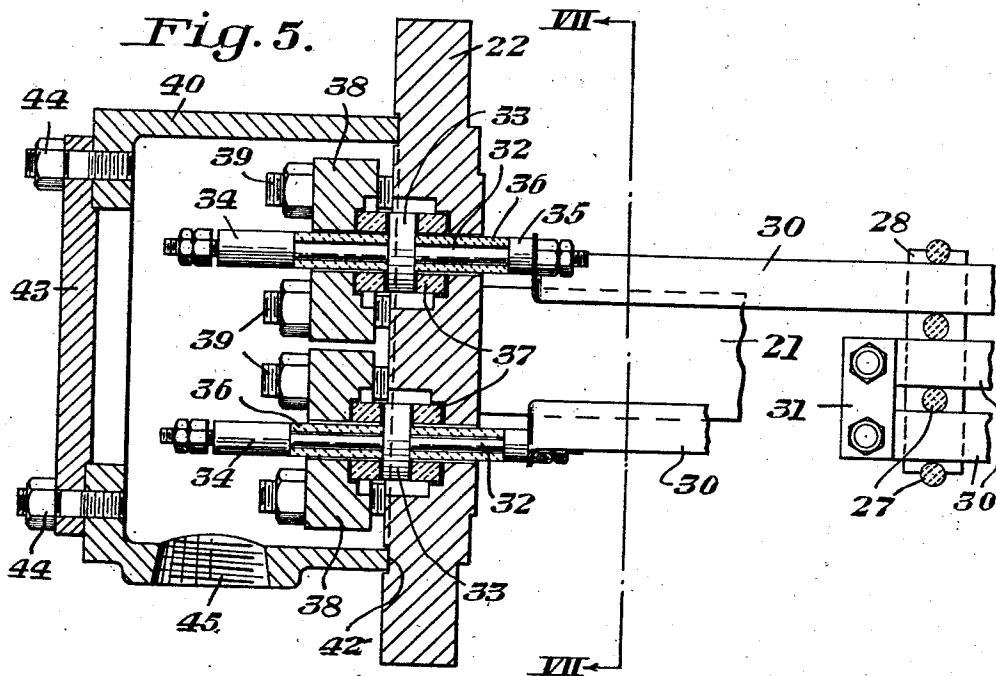
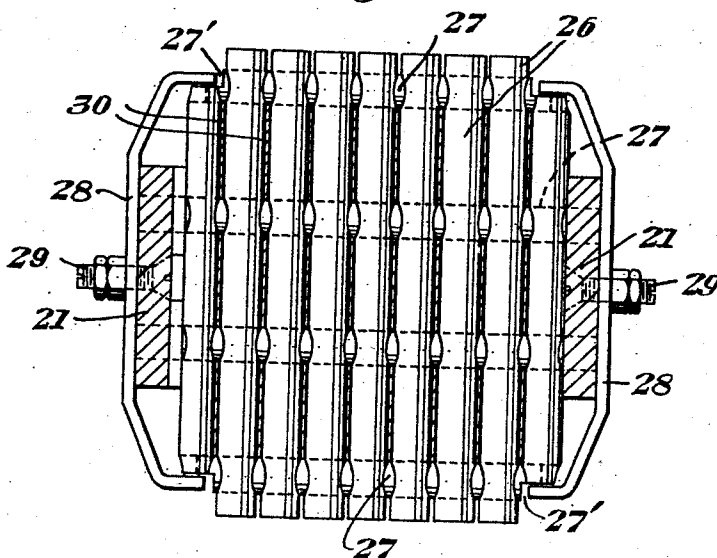


Fig. 8.



INVENTOR

INVENTOR
James R. Shields

by his attorney

Stebbins, Blenko & Webb

UNITED STATES PATENT OFFICE

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IMMERSION HEATER FOR VAPOR HEATING JACKETS OR THE LIKE

James R. Shields, Pittsburgh, Pa., assignor to Blaw-Knox Company, Pittsburgh, Pa., a corporation of New Jersey

Application December 22, 1945, Serial No. 636,912

6 Claims. (Cl. 219-44)

1

This invention relates to an immersion heater and, in particular, to a heater suitable for vaporizing the liquid in the bath of a vapor heating jacket, e. g., that surrounding the bottom of a processing vessel.

Immersion heaters used heretofore in the bath of a vapor heating jacket have generally been of conventional construction, including a resistance element enclosed in a layer of insulating material and an outer metallic sheath. Heaters of this type are subject to several disadvantages. In the first place, they cannot conveniently be constructed for high voltage. They also have a relatively high thermal inertia because of their considerable mass and the poor conductivity of the insulating layer. This introduces a considerable lag between changes in the energization of the heating element and the resulting changes in the temperature of the exterior surface. The actual thermal output per unit of volume, furthermore, is relatively limited.

I have invented a novel form of immersion heater particularly suited for use in the vapor-heating jacket of a processing vessel or the like, which overcomes the aforementioned objections and is capable of generating vapor at a high rate when inserted in a jacket providing a relatively shallow bath of limited volume. In a present preferred embodiment, my invention comprises an elongated supporting frame having a bare heating element in the form of a strip or ribbon conductor of suitable resistance strung in banks between insulating spacers carried on the frame. The frame is mounted on a closure member adapted to be secured to a port in the side wall of the heating jacket so that the frame extends inwardly toward the center thereof. The frame is preferably curved in the horizontal plane to a generally spiral shape, whereby a plurality of heaters may be arranged in closely spaced relation around the circumference of the jacket to provide a high aggregate heat output in a space having a vertical dimension such that it does not materially increase the total head room required for the installation of the vessel. Heating current is supplied to the ribbon conductor by terminal posts extending through the closure and suitably insulated therefrom. The insulating spacers mounted on the frame in spaced relation therealong maintain the several loops and banks of the ribbon in properly spaced relation. In order to improve the circulation of the liquid along the heaters, I provide a condensate-collecting shell or funnel between the heaters and the bottom of

2

the vessel which serves to return condensate to the inner ends of the heaters.

A complete understanding of the invention may be obtained from the following detailed description and explanation thereof which refer to the accompanying drawings illustrating the present preferred embodiment. In the drawings,

Figure 1 is a central vertical section through the lower portion of a processing vessel having a vapor heating jacket therearound equipped with immersion heaters of my invention;

Figure 2 is a partial horizontal section taken along the plane of line II—II of Figure 1;

Figure 3 is a plan view of one of the immersion heaters removed from the jacket;

Figure 4 is an elevation of the closure by which a heater is mounted in the jacket;

Figure 5 is a vertical section through the closure taken along the plane of line V—V of Figure 3, with parts in elevation, and including a removable terminal box;

Figure 6 is a partial section taken along the plane of line VI—VI of Figure 4 showing the manner of mounting the terminal box on the closure;

Figure 7 is a transverse section through the heater taken along the plane of line VII—VII of Figure 5;

Figure 8 is a similar section taken along the plane of line VIII—VIII of Figure 3 showing the insulating spacers to enlarged scale;

Figure 9 is a side elevation of the inner end of the heater; and

Figure 10 is an end view thereof, the insulating spacers being omitted.

Referring now in detail to the drawings and, for the present, to Figures 1 and 2 particularly, a processing vessel 10 has a vapor heating jacket 11 surrounding the bottom and lower portion thereof and adapted to contain vaporizable liquid to a level in the neighborhood of the chain line 12. The vessel 10 has a bottom discharge port 13 adapted to be closed by a suitable valve (not shown). The jacket 11 has a central passage 14 in alignment with the port 13. The side wall of the jacket 11 has a plurality of circumferentially spaced ports 15 having their centers substantially in a common horizontal plane intermediate the bottom of the vessel 10 and the bottom of the jacket. Necks 16 extend outwardly from the ports 15. These may be simply pieces of pipe of suitable length welded in the ports and having a coupling flange on the outer end. As shown in Figure 2, the necks 16 are disposed at an oblique

angle to the radii of the jacket through the centers of the ports. A heater indicated generally at 17 is inserted through each neck 16. The heaters may be straight but are preferably curved in the horizontal plane to the general form of a spiral and terminate at points spaced from the passage 14. A collecting shell or funnel 18 is supported in the jacket 11 between the heater 17 and the bottom of the vessel 10 by radial plates 19. The shell has a central opening 20, the edge of which is spaced from the wall of the passage 14. The funnel thus serves to collect condensate dropping from the outer surface of the vessel 10 and deliver it adjacent the inner ends of the heaters 17.

The details of construction of the heaters 17 are shown in Figures 3 through 10. Each heater comprises a frame including side bars 21 secured to a closure 22 in the form of a disc adapted to be bolted to the coupling flange on the neck 16. The bars are secured together at their inner ends by through bolts 23 having spacer sleeves 24 thereon. Insulating spacers 25 are carried by the bars 21 in spaced relation therealong. As shown in Figure 8, the spacers include vertical rods 26 of oval shape in section disposed side-by-side and having holes spaced therealong through which transverse rods 27 extend. The rods 26 and 27 when assembled in interlocking relation constitute a grid. The intermediate rods 27 extend through holes in the bars 21. This positions the grids longitudinally of the bars. The top and bottom rods 27 are retained by straps 28. The straps are secured to the bars by bolts 29 and have their ends bent over to enter notches 27' at the ends of the rods 27.

A ribbon or strip conductor 30 is wound in lengthwise loops, back and forth longitudinally of the frame and in three vertically spaced banks, the adjacent loops being spaced apart by the vertical rods 26 and the several banks by the horizontal rods 27. The conductor is bare and constitutes the resistance element of the heater. It is composed of a metal having suitable resistance and durability such as the well known nickel-chromium alloy. Each bank of loops is actually formed by a separate piece of conductor strip, the adjacent ends of the several strips being connected in series by vertical lengths of strip 31. The construction of the spacers 25 described above facilitates the winding of the several strips forming the conductor 30 in back and forth loops. For this purpose, the uppermost rods 27 of the spacers are removed and the strip which is to form the intermediate bank of loops is laid in the spaces between the rods 26. The uppermost rods 27 are then replaced and the next lower rods 27 are removed. The intermediate bank is then pushed downwardly to its final position and the rods 27 thereabove replaced. Thereafter the uppermost bank is wound in the same way. The heater is then turned over and the lowermost bank is similarly wound.

The outer ends of the conductor strips forming the top and bottom banks of loops are connected to vertically spaced terminal posts 32 extending through the closure 22. Each terminal post 32 has an integral flange 33 intermediate its ends and spools 34 and 35 adjacent the opposite ends adapted to cooperate with clamping nuts turned on the extreme ends of the posts which are threaded to receive them. Split insulated bushings 36 surround the posts between the flange 33 and the spools 34 and 35. Insulating rings 37 are disposed on both sides of the flange 33. Each

post is fixed in position on the closure 22 by a clamping block 38 secured thereto by studs 39. The closure and blocks are suitably recessed to accommodate the flange 33 and rings 37. Sealing gaskets are disposed between the closure 22 and the inner ring 37, between the blocks 38 and the outer ring 37, and between the flange 33 and the two rings on opposite sides thereof to prevent leakage of the heating vapor. The two terminal posts 32 are in vertical alinement and the ends of the conductor strips connected thereto are bent and twisted slightly as shown in Figure 3 to make contact therewith. In Figure 3, the end of the conductor strip forming the bottom bank of loops is broken off short of the terminal post to avoid obscuring the showing of the manner of attachment of the strip to the post in the plan view.

A cylindrical terminal box 40 is secured to the closure 22 by studs 41. The outer face of the closure has a circular groove 42 adapted to accommodate the inner edge of the box. A cover 43 is removably secured to the outer end of the box by studs 44. A tapped hole 45 is provided at the bottom of the box for the connection of a conduit through which suitable electrical conductors extend to the outer ends of the posts 32.

The terminal posts 32 and the insulating spacers 25 are also disclosed and claimed in the copending application of Herbert L. Barnebey for Electric immersion heater, Serial No. 656,570, filed March 23, 1946.

It will be apparent from the foregoing that my invention provides an electric heater particularly suited for installation in vapor heating jackets, having numerous advantages over heaters available for this purpose heretofore. Since the ribbon conductor which serves as the resistance heating element is bare, the liquid to be heated is subject to direct contact therewith. It is thus possible for the heating element to generate vapor at a rapid rate. Since the conductor strip is continuous and of uniform cross section, heat is generated at the same rate throughout all portions thereof. Rapid and vigorous circulation of the liquid being heated is assured by the disposition of the conductor strips on edge defining vertical passages therebetween. A high heating rate may thus be obtained without causing decomposition of the liquid, usually an organic compound. This makes it possible to use a higher value of watts input per unit area of heating resistor exposed to contact with the liquid than in heaters of known types.

The spiral curvature of the heaters in the horizontal plane renders them well adapted to be disposed in clustered arrangement about the central discharge passage through the jacket. A single design of heater, furthermore, may be installed in different patterns in jackets having different dimensions and overall numbers of heaters.

The condensate collecting shell aids in maintaining circulation of the liquid from the center of the jacket toward the exterior after it has been condensed on the outer surface of the vessel.

Each heater is a separate and independent unit so that it can be removed for inspection or repair without disturbing the others. The arrangement of the resistance element in long loops and in banks makes it possible to design the heater for a high capacity. The total length of the heating element, furthermore, is such that it may be designed for high voltages without making the strip so thin as to render it liable to breakage. Con-

5

siderable economy in the cost of the necessary switch gear is obtained by designing the heaters for higher voltages, thereby reducing the magnitude of the current to be interrupted. The alloy of which the conductor ribbon is composed has a coefficient of thermal expansion of the same order as the side bars of the supporting frame so that there is little or no sagging or stretching of the conductor loops on heating and cooling. Since the bars and conductor loops are immersed in the liquid bath, they are maintained at substantially the same temperature.

Although I have illustrated and described a preferred embodiment of my invention, it will be recognized that changes in the structural details and arrangement may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. Liquid-heating means for a cylindrical jacket surrounding the bottom of a vessel and adapted to contain vaporizable liquid and having ports in the side wall thereof, comprising immersion heaters extending into the ports and terminating at points spaced from the center of the jacket, said heaters being disposed substantially in a common horizontal plane spaced below the bottom of the vessel, and a funnel between the bottom of the vessel and said plane adapted to collect condensate falling from the bottom of the vessel and deliver it adjacent the inner ends of the heaters.

2. Liquid-heating means for a cylindrical jacket surrounding the bottom of a vessel, said jacket being adapted to contain a vaporizable liquid and having ports in the side wall thereof and a central passage for the discharge of the vessel's contents, said means comprising immersion heaters extending into said ports below the bottom of the vessel and terminating adjacent said passage, and a condensate-collecting pan between the heaters and the bottom of the vessel, the pan having a central opening the edge of which is spaced from said passage.

3. A heater for a vapor heating jacket comprising an elongated supporting frame adapted

6

to be inserted through a port in the jacket, a closure for the port on which the frame is mounted, insulating spacers carried on said frame and a bare resistance-heating conductor threaded between said spacers in loops extending back and forth longitudinally of said frame.

4. A heater as defined by claim 3 characterized by said conductor being a strip disposed on edge and including vertically spaced banks of loops providing vertical passages between loops for the liquid being heated.

5. An immersion heater for insertion through a port in the side wall of a heating jacket adapted to contain vaporizable liquid comprising a closure for said port, an elongated frame extending into the jacket from said closure, and an electrical-resistance heating element wound on said frame, said frame being curved in the horizontal plane and having a generally spiral conformation.

6. Liquid-heating means for a cylindrical jacket surrounding the bottom of a vessel and adapted to contain vaporizable liquid and having ports in the side wall thereof comprising an external neck for each port extending at an oblique angle to the radius through the port, a closure secured to the neck, a frame extending inwardly from the closure and an electrical-resistance heating element strung on said frame, said frame curving spirally in the horizontal plane and terminating at a point spaced from the center of the jacket.

JAMES R. SHIELDS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,337,633	Apfel	Apr. 20, 1920
1,937,059	Fountain	Nov. 28, 1933
1,939,125	Lubbock et al.	Dec. 12, 1933
2,000,640	Jackson et al.	May 7, 1935
2,328,210	Groen	Aug. 31, 1943