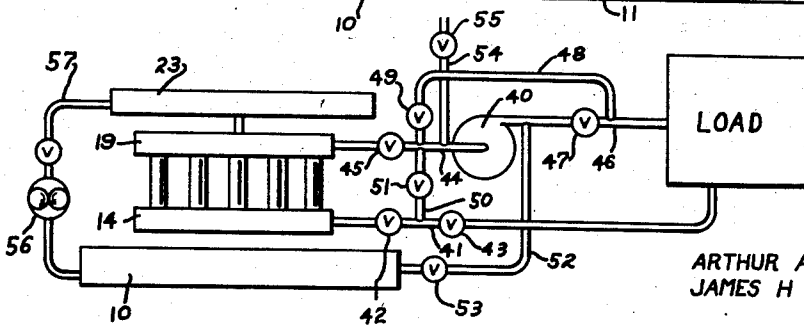
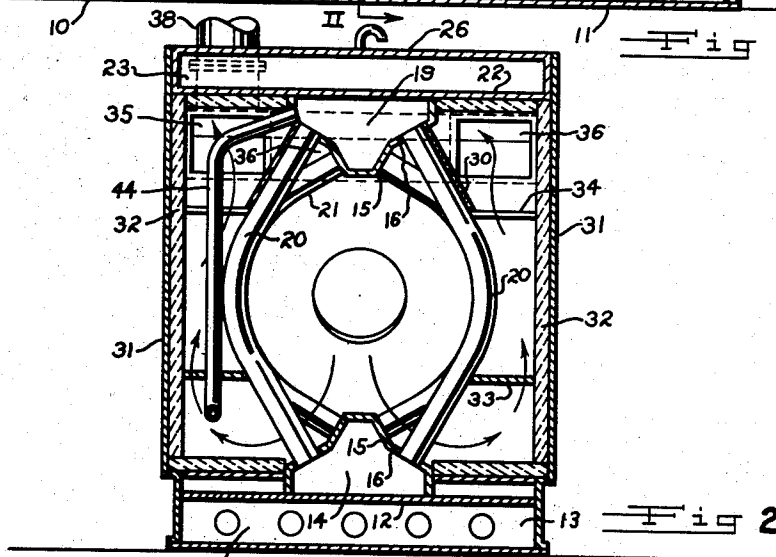
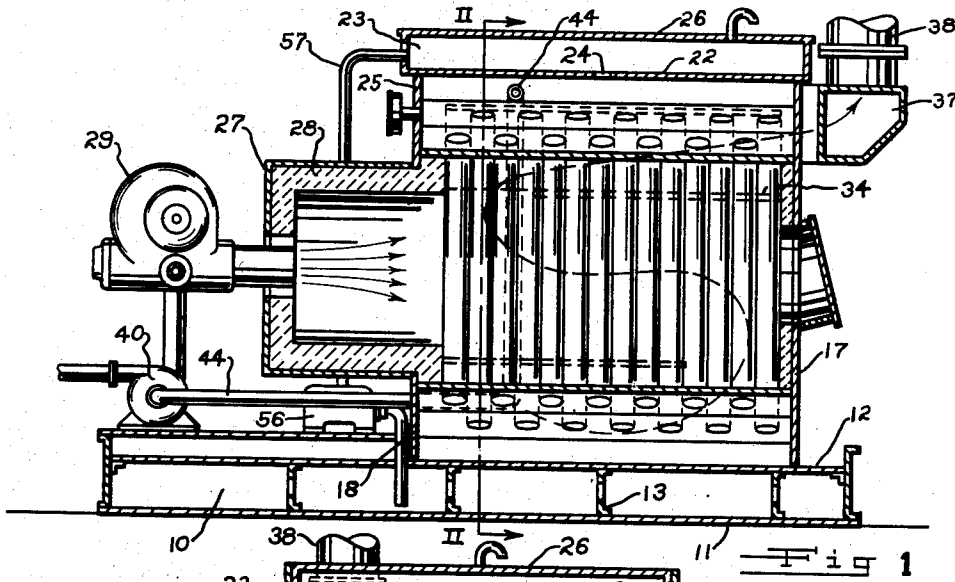


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PORTABLE FLUID HEATER

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PORTABLE FLUID HEATER

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This invention relates to fluid heating devices and more particularly to a fluid heating and storage assembly of a portable nature which is of particular utility in supplying heated fluid, preferably oil, to the heat exchanging devices of mobile and stationary tanks used for storing viscous fluids, asphalt and other materials normally requiring heat to facilitate the flow thereof.

The principal object of the present invention is the provision of an improved portable and self contained assembly for supplying heated fluid particularly for the purposes indicated which is economical in design, rugged in construction, and which has improved characteristics as to the transfer of heat from the burner employed to the fluid to be heated and as to the storage and flow of the fluid through the assembly. More particularly, the invention provides, in an assembly of the kind described, an improved heat exchanger which is fast acting and highly efficient yet effectively disperses the hot gases to prevent localized overheating which may have an adverse coking action on oil being heated, and which allows the circulation or flow of the fluid being heated with a minimum of turbulence and resistance whereby the power required to recirculate the fluid is kept to a minimum and the fluid passages remain clean and bright for maximum heat transfer.

Another object of the invention is the provision of an improved physical structure incorporating the assembly of fluid storage chambers, a heat exchanger for the fluid, and combustion apparatus which is compact and self contained and capable of being loaded and unloaded bodily onto and off a transportation rig whereby the assembly may, for example, be readily moved from one construction job to another.

A further object of the invention is the provision in apparatus of the kind mentioned of an improved arrangement for filling the apparatus with fluid, for circulating the fluid through the apparatus and the heat exchanger of the external storage tank to be heated in series, and for reclaiming the fluid from said heat exchanger upon completion of the need for heat in said external storage tank.

The above and other objects and advantages of the invention will become apparent upon consideration of the following detailed specification and the accompanying drawing wherein there is disclosed a certain preferred embodiment of the invention.

In the drawing:

Figure 1 is a longitudinal section through a fluid storage and heat assembly constructed in accordance with the principles of our invention;

Figure 2 is a transverse section through the apparatus of Figure 1 taken along the line II—II of Figure 1 and

Figure 3 is a schematic showing of the fluid pumping and valving system utilized in the assemblies of Figures 1 and 2.

Reference numeral 10 designates generally a flat elongated hollow base which we utilize for fluid storage and, as shown, this base comprises a bottom wall 11, a top wall 12 and a plurality of apertured transverse webs 13. Extending longitudinally above one end portion of the plate 12 and supported thereon is an inverted channel-shaped header 14 having on either side a pair of angularly disposed flat surfaces 15 and 16 arranged symmetrically on each side of an imaginary vertical median plane bisecting the header 14. Surface 16 is lower in position and less inclined to the horizontal than is the surface 15. The outer end of the header 14 is closed off by a large

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end plate 17 while the inner end thereof is closed off by a smaller end plate 18. Of course, the end and bottom edges of the channel making up the header 14 is welded in a fluid-tight manner to the plates 12, 17 and 18 and the lower edges of the plates 17 and 18 are likewise affixed to the plate 12 so that the header 14 is made completely fluid-tight.

A second channel member, identical with the channel member making up the header 14, is employed to provide an upper header 19 and again each side of the channel forming the upper header is provided with longitudinally extending but angularly related flat surfaces 15 and 16. Spanning the surfaces 16 of the upper and lower headers and having their ends received in apertures formed in the surfaces 16 are a plurality of curved tubes 20. Similarly other tubes 21 interconnect the surfaces 15 of the upper and lower headers on either side of the heat exchanger. Tubes 21 are bent about a greater circumferential extent than the tubes 20, as shown in Figure 2, but it should be noted that for a substantial length in the center of the tubes both tubes 20 and 21 are curved about the same radius. Tubes 20 alternate with tubes 21 and in their center portions have continuous contact with each other. There is thus formed side wall structures which are hollow but substantially fluid impervious between upper and lower limiting planes. A substantial part of the top and bottom walls of the heat exchanger is formed by the channels making up the headers 14 and 19 and the wall structure is completed by those portions of the tubes 20 and 21 which extend above and below the aforementioned planes and connect with the header channels. Due to the divergence of such extending portions of the tubes 20 and 21 there is provided a series of longitudinally spaced openings extending along the top and bottom of each side of the heat exchanger whereby products of combustion injected into the exchanger may be dispersed and exhausted therefrom.

The upper edge of the channel forming the upper header 19 is welded to a flat horizontally disposed plate 22 which forms the bottom wall of a surge chamber 23, communication between the upper header and the chamber 23 being provided by an aperture 24 formed in plate 22. The outer end of the channel forming the header 19 is closed off by plate 17 while the inner end of such channel is closed off by a smaller plate 25. A top plate 26 forms the top wall of the chamber 23 and as shown in Figures 1 and 2 suitable end and side walls of a fluid-impervious nature are provided for the chamber 23.

It should be particularly observed that the integrated structure described above is most efficient as regards economy of structural material and assembly operations in relation to the functional components provided, and as regards structural strength and durability. The deep beam-like structures provided by the channel members making up the headers 14 and 19 in combination with the planes 12 and 22 lend great structural strength and rigidity to the assembly so that the assembly may be subjected to severe twisting strains and other abuse in handling and in use without danger of opening any of the joints. Further advantages accrue from the use of the plates 12 and 22 as common walls between the storage and surge chambers and the headers since in the case of the former the fluid being stored is preheated or the storage chamber 13 serves as insulation and in the case of the latter the overall height of the assembly is diminished and the elimination of joints and connecting tubes further reduces the possibility of leakage which is always troublesome in portable apparatus of the general nature involved.

Extending forwardly of the plates 18 and 25, which plates may be parts of the same sheet if desired, is a sheet metal casing 27 which is lined with refractory material 28 to form a combustion zone for the generation of hot gases to be utilized in the heat exchanger for heating the fluid. We preferably employ an oil burner 29 the nozzle of which extends through a centrally disposed aperture formed in the end wall of the casings 27, 28. In practice the axis of discharge of the burner 29 is centrally disposed with respect to the headers 14 and 19 and to the tubes 20, 21 on either side of the apparatus. The hot gaseous products of combustion issuing from the flame generated

by the burner 29 therefore have an initial horizontal movement but upon entering into the space between the walls formed by the tubes 20, 21 mushroom radially outward in substantially all directions due to the quadruple spacing of the outlets formed between the divergent ends of the tubes 20 and 21. This is highly effective in distributing the heat of the gases both longitudinally and circumferentially of the generally tubular heat exchanger and enables the burner to be operated at a high rate of heat input without danger of damaging the apparatus or of coking the oil, if oil is being heated. Further, this arrangement insures maximum and uniform utilization of the steel of the heat exchanger and a high rate of operating efficiency. To compensate for the natural tendency of the hot gases to rise and to escape largely through the upper ports of the heat exchanger we provide longitudinally extending baffles 30 which lie against the outer surfaces of the inwardly inclined end portions of the tubes 20. In this manner we are enabled to drive the heat downwardly so that the lower ends of the tubes 20 and 21 may be subjected to substantially the same temperature as the upper ends thereof. In actual practice a much greater volume of gas will escape through these lower ports than through the upper ports.

The furnace structure of our invention further includes metal side wall panels 31 which extend vertically between the topside edges of the base 13 to the surge chamber 23 and lining these panels 31 are slabs of refractory insulating material 32. Likewise, the top and bottom walls and the end walls of the chambers bounded by the tubes 20, 21 and the slabs 32 are lined with refractory insulating material as shown on the drawing. The gases escaping from the bottom ports of the heat exchanger are caused to move horizontally back and forth across the outer face of the banks of tubes 20, 21 by the overlapped horizontal but vertically spaced baffles 33 and 34. After passing longitudinally above the top baffles 34 the gases are discharged from the furnace casing through the tube ports 35 and 36 and are then collected in an exterior header 37 for transmission to stack 38.

We provide a motor driven pump 40 mounted on the base 10 forwardly of the heat exchanger to circulate the fluid heated through the load which, stated above, may be the heating coil of a railway tank car, to charge the apparatus of our invention with a supply of fluid, and to withdraw a charge of fluid from the load back into the heat exchanger or storage tank of our apparatus. Thus, in addition to the pump 40 we mount on our apparatus a conduit 41 and valves 42 and 43 whereby the lower header may be connected with a load, a conduit 44 and valve 45 whereby the upper header may be connected with the inlet of the pump 40, and a conduit 46 and valve 47 for connecting the outlet of pump 40 with the load. In normal operation with the valves 42, 43, 45 and 47 open and the pump 40 operating the oil or other fluid is pumped directly out of the upper header 19, through the load and then back into the lower header 14. The relatively low length to diameter ratio of the tubes 20, 21 and the absence of severe bends in these tubes result in low losses in the flow of the fluid through the heat exchanger so that the power required for operation of the pump 40 is kept low. The continuous recirculation of the fluid and the absence of hidden pockets in the heat exchanger keep the exchanger free of clogging debris and always at maximum operating efficiency.

Interconnecting conduit 44 between valve 45 and pump 40 and conduit 46 beyond the valve 47 are a conduit 48 and valve 49. Interconnecting conduit 41 between valves 42 and 43 and conduit 44 between valve 45 and pump 40 are a conduit 50 and valve 51, and interconnecting the discharge of pump 40 with the storage tank 10 are a conduit 52 and a valve 53. When it is desired to withdraw the fluid from a load back into the storage tank 10 the valves 42, 45, 49 and 47 are closed while valves 43, 51 and 53 are opened thereby providing a path through the pump for the fluid from the load to tank 10. To charge additional fluid into the system we provide a supply conduit 54 having a valve 55 therein which is connected to the inlet of the pump 40 and it should be observed that upon the closure of all the valves except valves 53 and 55 the pump 40 would be operative to pump fluid from supply conduit 54 through conduit 52 and thus into tank 10.

Also bounded on the base of the apparatus forwardly of the heat exchanger is a second motor driven pump

56 having its inlet connected with tank 10 and its outlet connected with the surge chamber 23 through the valve conduit 57. This is provided so that during normal operation of the apparatus sufficient fluid may be added to the system to make up for losses as may occur by leakage.

The conduit 48 and valve 49 are provided to enable fluid to be pumped from the load through either of the two connections made with the load—it being understood that if valves 47, 55, 45, 51 and 43 are closed while valves 49 and 53 are opened the pump will exhaust fluid from the upper connection of the load through conduit 48 and deliver the same into the storage tank 10 through conduit 52.

It should now be apparent that we have provided improved apparatus of a compact, portable and self-contained nature for supplying heated fluid which accomplishes the objects initially set out. The heat exchanger devised and employed is rugged and efficient and while requiring but a small space may be operated continuously at a higher rate of heat input. By combining structural elements of a storage tank and surge chamber with essential elements of the heat exchanger economy of weight and production is achieved as is also strength and rigidity arising from the deep beam-like structures which result. Further economy of space and materials is achieved by positioning the storage tank for the fluid in the base and by mounting all the operative parts of the assembly including the combustion chamber, the heat exchanger, the surge chamber, the burner, and the various required pumps and valves on the base. A further advantage is obtained from this arrangement in that in moving from place to place all the essential apparatus as well as the essential heat exchanging fluid may be moved as one integrated package.

Having thus described our invention and explained the advantages thereof what we claim is novel and desire to secure by Letters Patent is:

1. In apparatus for supplying heated fluid, a base having a top wall, a heat exchanger having a lower header comprised of an inverted channel secured along its lower marginal edges to the top surface of said wall, an upper header comprised of an upwardly open channel and a flat horizontally disposed plate supported on said last mentioned channel and secured to the upper marginal edges thereof, means forming a surge chamber of which said flat plate is its bottom wall, said flat plate being apertured to provide communication between said surge chamber and said upper header, a plurality of outwardly curved fluid-conducting tubes interconnecting said lower and upper headers on opposite sides thereof to form with said channels a generally cylindrical combustion chamber, and means at one axial end of said combustion chamber to supply hot gases for heating fluid contained in said tubes and headers.

2. Apparatus according to claim 1 further characterized in that the tubes on each side of the combustion chamber are arranged in contacting side-by-side relation and the top and bottom end portions of adjacent tubes being divergently related to thereby provide outlet ports for the heating gases furnished the combustion chamber.

3. Fluid heating apparatus comprising a pair of spaced parallel header-forming channels with the free edges thereof extending in opposite outward directions, a plate secured to the said edges of each of said channels to thereby close the same and form fluid-tight headers, the inner opposed walls of each of said channels having on each side of the channel-bisecting median plane a pair of longitudinally extending and inclined but angularly related flat wall portions formed with longitudinally spaced apertures, a plurality of longitudinally spaced fluid-conducting tubes spanning the channels on each side of said median plane and having their ends received in the apertures in the said flat wall portions which are furthest removed from said median plane, and a plurality of other fluid-conducting tubes positioned contiguously between said first mentioned tubes in spanning relation to said channels on each side of said median plane and having their ends received in the apertures formed in said flat wall portions which are closest to said median plane, said first mentioned tubes and said other tubes being curved outwardly identically in their midportions, the divergence of the end portions of said other tubes with respect to the end portions of said first mentioned tubes forming longitudinally spaced outlet ports in the generally cylindrical

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chamber formed by said channels and the midportions of said tubes.

4. Apparatus according to claim 3 further characterized in that said channels are horizontally disposed in vertically spaced relation and further including on each side of said median plane a longitudinally extending baffle plate overlying the outer surfaces of the upper end portions of the first mentioned tubes to thereby diminish the cross sectional areas of the said ports which are adjacent the upper header-forming channel.

5. Portable apparatus for supplying heated fluid comprising a flat elongated hollow base constituting a flat reservoir, a heat exchanger comprising a lower longitudinally extending header supported on one end portion of said base, and an upper header extending longitudinally above said lower header, outwardly curved fluid-conducting tubes interconnecting said headers to provide a generally cylindrical chamber for the reception of heating gases, a burner retort at the axial end of said chamber opposite said one end portion and opening into said chamber, a liquid fuel burner mounted on the end portion of said base opposite said one end portion discharging into said retort, and pump means mounted on said base for conveying fluid from said reservoir into said heat exchanger and for circulating heated fluid from said upper header through an object to be heated and thence back into said lower header.

6. Apparatus according to claim 5 further characterized in that the adjacent tubes on opposite sides of said combustion chamber are in contacting side-by-side relation for a substantial portion of their length but have their lower end portions divergently related to thereby provide a plurality of longitudinally spaced ports on each side of the lower portion of said chamber for the escape of heating gases therefrom, an insulated casing supported on said base and having side walls spaced outwardly from said tubes, and longitudinally extending but vertically spaced and overlapped baffle plates interposed between said

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tubes and said insulated side walls to cause the heating gases which escape through said ports to move back and forth across the outer surface of said tubes.

7. Fluid heating apparatus comprising a pair of spaced parallel header-forming channels with the free edges thereof extending in opposite outward directions, a plate secured to the said edges of each of said channels to thereby close the same and form fluid-tight headers, the inner opposed walls of each of said channels having on each side of the channel bisecting median plane a pair of longitudinally extending and inclined but angularly related flat wall portions formed with longitudinally spaced apertures, a plurality of longitudinally spaced fluid-conducting tubes spanning the channels on each side of said median plane, and a plurality of other fluid-conducting tubes positioned contiguously between said first mentioned tubes in spanning relation to said channels on each side of said median plane, adjacent ends of said tubes being received alternately in apertures formed in said flat wall portions which are furthest removed from said median plane and apertures formed in said flat wall portions which are closest to said median plane whereby to form longitudinally spaced openings between said contiguously positioned first mentioned and other tubes.

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