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A. J. GALLAHER
HEAT EXCHANGE DEVICE

2,395,543

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FIG. 1.

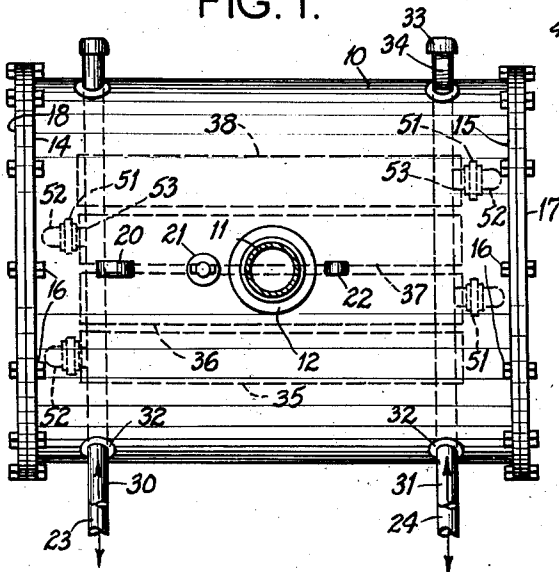


FIG. 4.

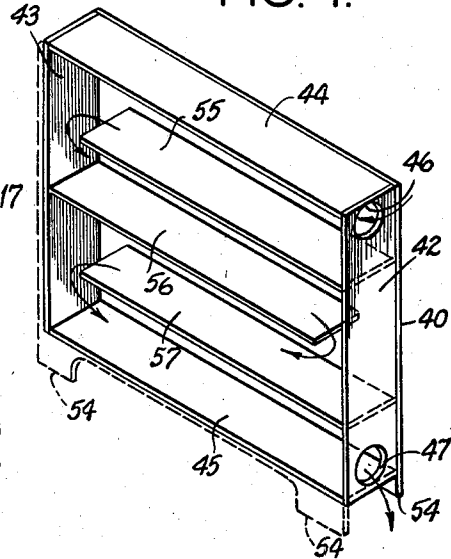


FIG. 2.

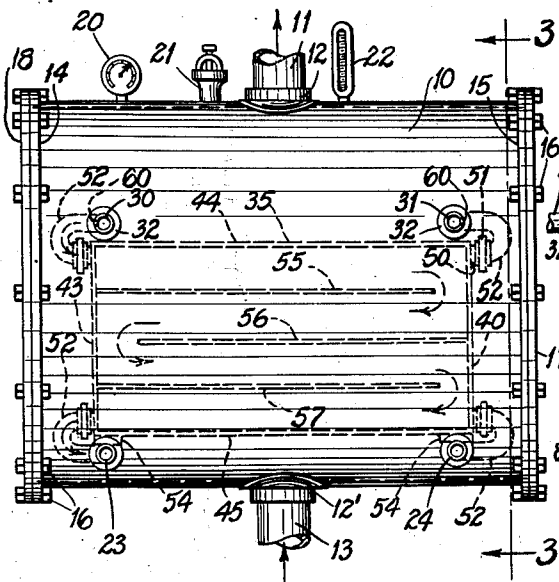
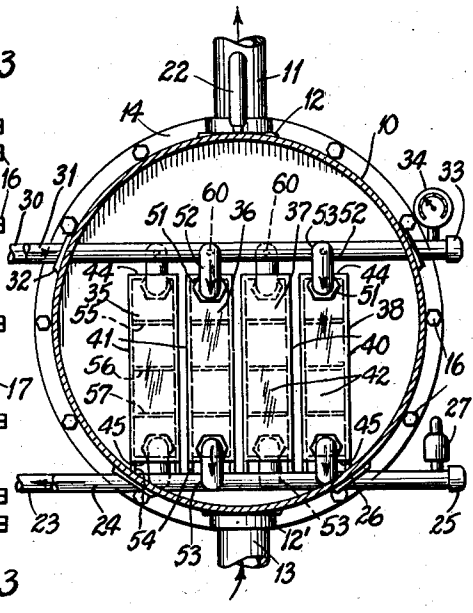


FIG. 3.



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HEAT EXCHANGE DEVICE

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3 Claims. (Cl. 257-233)

This invention relates to improvements in heat exchange devices, and more particularly to apparatus for circulating two or more fluids in proximity to each other in separate circulatory systems, for example as in steam condensers, water heaters and similar equipment.

Although many of the principles of the present invention are applicable to a wide variety of heat exchange apparatus, in the interest of brevity, principal reference will be made, but without limitation, to a device selected as an exemplary embodiment, in which steam is employed for the purpose of heating water.

Among the more important objects of the invention there is attained an improved construction of steam radiator assembly of such nature as to provide an increased length of steam travel, in relation to a surrounding flow or body of water; as preferably embodied in a water heater utilizing steam, this feature of improvements is realized in a steam circulating shell or sectional radiator unit which provides a serpentine path of steam flow along a course which extends from end to end of a steam-containing, heat-radiating unit or section.

A further important object of the invention is attained in an inner shell assembly of sectional construction surrounded or enclosed by an outer drum or shell for a second fluid, in which construction the innermost fluid-containing member is of a sectional construction, and so formed that each section or unit is removable and replaceable as for service or repair attention, or to provide for augmenting radiating surface, without necessarily disturbing in any way other companion sections of the same assembly.

A still further object of the invention is importantly realized in a marked simplicity of structure for the general purpose noted, and embodying an inner element and an outer element in which the several fluid-containing and -circulating portions are or may be formed of standard, normally readily available stock materials; for example, an outer drum or shell may be constructed of a length of standard steel tubing or pipe, and an inner sectional container, say for steam, may be formed of sheet steel or the like in such manner as to require little or no special tooling for fabrication of parts and their assembly.

Further objects and advantages will more clearly appear from the following detailed description of a presently preferred embodiment of the invention, particularly when considered in

connection with the accompanying drawing, in which:

Fig. 1 is a top or plan view of an assembly embodying the present improvements;

Fig. 2 is a side elevation of the structure shown in Fig. 1;

Fig. 3 is a longitudinal sectional elevation particularly showing the arrangement of parts and connections interiorly of the outer shell or drum, all as viewed along line 3-3 of Fig. 2, and

Fig. 4 is an elevation in perspective of one of the sectional steam-containing units, a side wall portion of which is removed in order to show features of interior construction.

Referring now by characters of reference to the drawing, the apparatus in a preferred embodiment selected for description, includes an outer shell or drum 10 which is preferably of substantially cylindrical form, and which is economically and conveniently constructed of a length of steel tubing or pipe of suitable diameter. The shell 10 is provided intermediate its ends and in its uppermost wall portion with a discharge connection 11 which conveniently comprises a bushing 12 welded in place to the shell 10, the bushing for example being interiorly threaded to receive the adjacent pipe fitting. Similarly, the lowermost or diametrically opposed portion of the shell 10 is provided with an inlet connection 13, consisting of a suitable length of pipe exteriorly threaded for engagement with interior threads of a bushing 12' fitted, for example, as by welding into the adjacent wall portion of the shell 10. A suitable stand (not shown) or other convenient supporting means of any suitable type may be employed for the assembly, and is omitted from description and drawing as constituting per se, no part of the present improvements.

At each opposite end of the shell 10, there is provided and permanently fixed to the shell a flange 14 at one end and a flange 15 at the opposite end, the flanges being suitably apertured for the reception of flange bolts 16. End closure members 17 and 18 consist of circular plate elements, each provided with a peripheral row of bolt apertures registering with those in the flanges 14 and 15, with or without an interposed gasket or other sealing element as desired. From this arrangement it will appear that upon removal of either of the closures 17 or 18, there exists at the corresponding end of shell 10, a full-diameter opening which facilitates assembly or removal of the interior steam-containing units or the like, later to be described.

Suitable adjunctive equipment may be of conventional nature but for completeness may be noted as usually including a pressure gauge 20, a safety release valve 21, and a thermometer 22.

As indicated by the arrows of Fig. 2, it is preferred in case the shell 10 is mounted horizontally as shown, to circulate water or other fluid to be heated, into the shell through fitting 13 and to utilize the connection 11—12 as an outlet from the chamber or space within the shell.

Serving the dual purpose of supporting and positioning elements for the structure within the shell, and of supply and return conduits to and from the radiation within the shell, there are provided near each end and in the lower portion of the shell 10, a pair of pipe or tubing elements 23 and 24 each of which extends chordwise and in transverse bridging relation to opposite wall portions of the shell; preferably also each of the tubes 23 and 24 extends at least slightly to the outside of the shell as will readily appear from Fig. 3, and is provided with suitable cap or other end sealing means 25. In assembly of the tubing elements 23 and 24 to the shell, the latter is provided with drilled openings which are reamed or slotted to an extent just sufficient to accommodate the pipe members 23 and 24, following which permanent securement is or may be effected as by a circular line of weld or a fillet 26 in each of the zones of projection of the pipe outwardly of the shell wall. At least one, but preferably both of the lines 23 and 24 are provided in a portion which projects beyond the shell 10 with an air regulator valve 27, which provides for escape of air from the system in a lower zone thereof.

Corresponding to the arrangement and assembly of tubes 23 and 24 there are provided, in chordwise relation and bridging the opposite walls of the cylindrical container 10 in its upper portion but spaced apart near the respective opposite ends of the outer shell, a similar pair of tubes 30 and 31 each tube being welded as through a fillet 32 to the shell 10, and being provided at its otherwise open end with a cap 33 and at least one of these tubes being preferably provided near its free end for example, with a steam gauge 34.

The assembly as shown and as will particularly appear from Figs. 1 and 3, includes an inner radiator or shell assembly adapted for steam circulation therethrough, and which consists of four sectional circulating units indicated generally at 35, 36, 37 and 38. Each of the units 35—38 is of a narrow, elongate, box-like construction, and comprises a pair of opposite side walls 40 and 41, a pair of end walls 42 and 43, a top closure portion 44, and a bottom closure portion 45. At least one of the ends of each section is provided with an aperture 46 constituting an inlet connection, and another indicated at 47, serving as an outlet or return opening, these being in spaced end portions of the section. The openings 46 and 47 may, if the end portion 42 be of sufficient thickness or gauge, be internally threaded to receive a pipe connection or nipple, or alternately may be provided with threaded bushings (not shown) or integral internal boss portions in case, as is contemplated, the sections may be formed as castings. Adjacent each of the openings 46 and 47 is disposed, besides a nipple or connection 50, a threaded connecting flange 51 and a U-shaped connection 52, the latter being welded

into a suitable opening 53 into one of the supply pipes 30 or 31 or in the case of the lower opening 47, into one of the return pipes 23 or 24.

It is preferred, although not strictly necessary, to extend each of the side elements 40 and 41 somewhat below the bottom element 45 of each section so as to provide supporting feet 54, one at each corner of the section, and through which each end of the section is supported by one of the pipes 23 or 24.

Although it is distinctly within the purview of present improvements to constitute the several steam sections as individual castings, each of integral cast-cored construction, it is in many cases preferred, particularly in smaller heater assemblies, to form the sides, top, bottom and ends of the section of sheet metal of a relatively heavy gauge united as by welding; however, irrespective of choice of section construction, it is a distinct preference to provide internally of the section a series of preferably horizontal baffle members 55, 56 and 57. These may be introduced in any desired plurality and spacing, according to required performance and characteristics of the unit, steam pressures available and heating capacities. Although shown as three in number, these baffles may be utilized singly or in any practical plurality. They are preferably so formed and located in the inner shells or sections as to provide at each end of the baffle, a vertical passage, say for steam, and where a plurality of baffles are employed, each baffle provides, with the walls of the assembly, for this passage at an opposite end of the assembly in relation to adjacent baffles. Thus, as will readily appear from the arrows indicating course or path of flow in Fig. 4, there results, upon the introduction of steam say through opening 46, even though but a single baffle be employed, the flow of steam which is of at least twice the length of the section. This back and forth, zig-zag or serpentine path may be extended to any degree desired according to the number of baffles introduced.

As will best appear from Figs. 1 and 3, it is a preference to locate the several sections constituting the inner shell structure in such manner that alternate sections are connected, both to supply and return, at relatively opposite ends of the assembly; for example, as shown, section 38 (being the uppermost section as shown in Fig. 1), will be connected at its right hand end to supply pipe 31 and to return pipe 24, whereas the next adjacent section 37 will be connected to supply pipe 30 and return pipe 23, and so alternately through the series. This arrangement has an advantage among others, particularly in smaller assemblies, of enhancing working clearance around each of the unions 51, making for relative freedom of access to, and ease of rotation of the union nuts as in initial assembly or in the event that service attention requires removal of any section and the insertion of the same or a substitute section.

The manner of use and operation of the apparatus is thought to have been fully apparent from the foregoing description of parts, their structural features and their relations in the flow circuits, but it may be briefly noted in the case of a steam heater or condenser for example, an outer fluid such as water is introduced as indicated, in a flow upwardly through the connection 13, thence completely filling the chamber within the shell 10 and resulting in an outward flow through the fitting 11 to a place of storage, deposit or usage.

The flow circuit for steam, for example, moving

into, through and beyond the inner system takes place as indicated by the arrows, from a boiler (not shown) into the pipes 30 and 31 thence through the several U-shaped connections 52, from pipe 30 to alternate sections and similarly from pipe 31 to the intervening sections. The condensate accumulating as a result of the serpentine steam flow lengthwise of, thence progressively below the several baffles 55, 56 and 57 is impelled outwardly through opening 47, thence into the connected tubing elements 23 or 24. The condensate is suitably disposed of by return to boiler, through a trap, or otherwise as desired.

It will have appeared that the assembly of the present invention may be economically and readily formed without expensive tooling equipment, from stock materials which normally are readily available; it will further appear that a marked simplicity of structure and economy of materials results from the fact of utilizing the piping elements 23, 24, 30 and 31 not only to function as conduits, but also as supports for the apparatus interiorly of the outer shell. It may here be noted as entirely feasible either to suspend the sections entirely from the uppermost conduits from which they will then derive sole primary support, or as a further choice, to support the sections entirely from the lowermost tube elements 23 and 24 or, as shown in the drawing, to derive the support of steam sections from all of the four tubing elements.

A further advantageous feature, particularly when utilizing a high-pressure steam source, consists in the provision of a regulating orifice 60 in the inlet flow to each steam section. This conveniently consists of a row of small drilled openings centrally of the several zones of welded connections into each of the supply pipes 30 and 31, although a similar throttling orifice may be provided anywhere in each of the several supply lines to the steam sections.

It will have appeared to those experienced in construction and design of heat exchanger equipment, that the arrangement of U-shaped connections 52 and the support of the several unit sections, solely upon and by the piping elements, possesses a marked advantage in providing for linear and other expansion of the several sections 35, 36, 37 and 38. The short lengths of pipe located in bridging, chordwise relation to the shell, are of minimum length and so their actual linear expansion even under a considerable temperature

rise is insufficient to cause any disruption of welded joints or the like 26. From the foregoing it will now clearly appear that the invention serves to attain each and all of the several objects above specifically stated as well as others which will have become apparent from the description.

Although the invention has been described by making detailed reference to a selected exemplary structure, the detail of description is to be understood solely in an instructive and not in any limiting sense because of the many changes possible within the scope of the claims hereunto appended.

I claim as my invention:

1. In apparatus of the general type described, a substantially cylindrical outer shell, a plurality of sectional inner shells, pipe elements extending chordwise through the outer shell and constituting supports for the several inner shell sections, the inner shell sections being disposed in alternately opposite, endwise interleaved relation with adjacent inner shells or sections connected to different pipe elements and at opposite ends of the inner shells.

2. In a heat exchange assembly, an outer shell of substantially cylindrical form, a plurality of fluid sections within the outer shell, supply pipes for the sections, chordwise traversing the upper portion of the outer shell, return pipes chordwise traversing the outer shell, at an opposite extremity of the sections, at least certain of said pipes constituting supports for the sections within the shell, and the sections being so arranged within the shell that adjacent sections are provided with end connections to supply and return pipes at opposite ends of alternate sections.

3. In a heat exchange assembly, an outer shell and means for circulating a fluid therethrough, a plurality of sections for circulating another fluid in heat exchange relation with the first said fluid, and located within the outer shell, supply pipes for the sections, horizontally disposed and traversing the upper portion of the outer shell, return pipes horizontally traversing the lower portion of the outer shell, the return pipes constituting immediate subjacent supports for the sections, and in turn supported by the outer shell walls, and the sections being so arranged within the shell that adjacent sections are provided with end connections to supply and return pipes at opposite ends of alternate sections.

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