

Dec. 1, 1942.

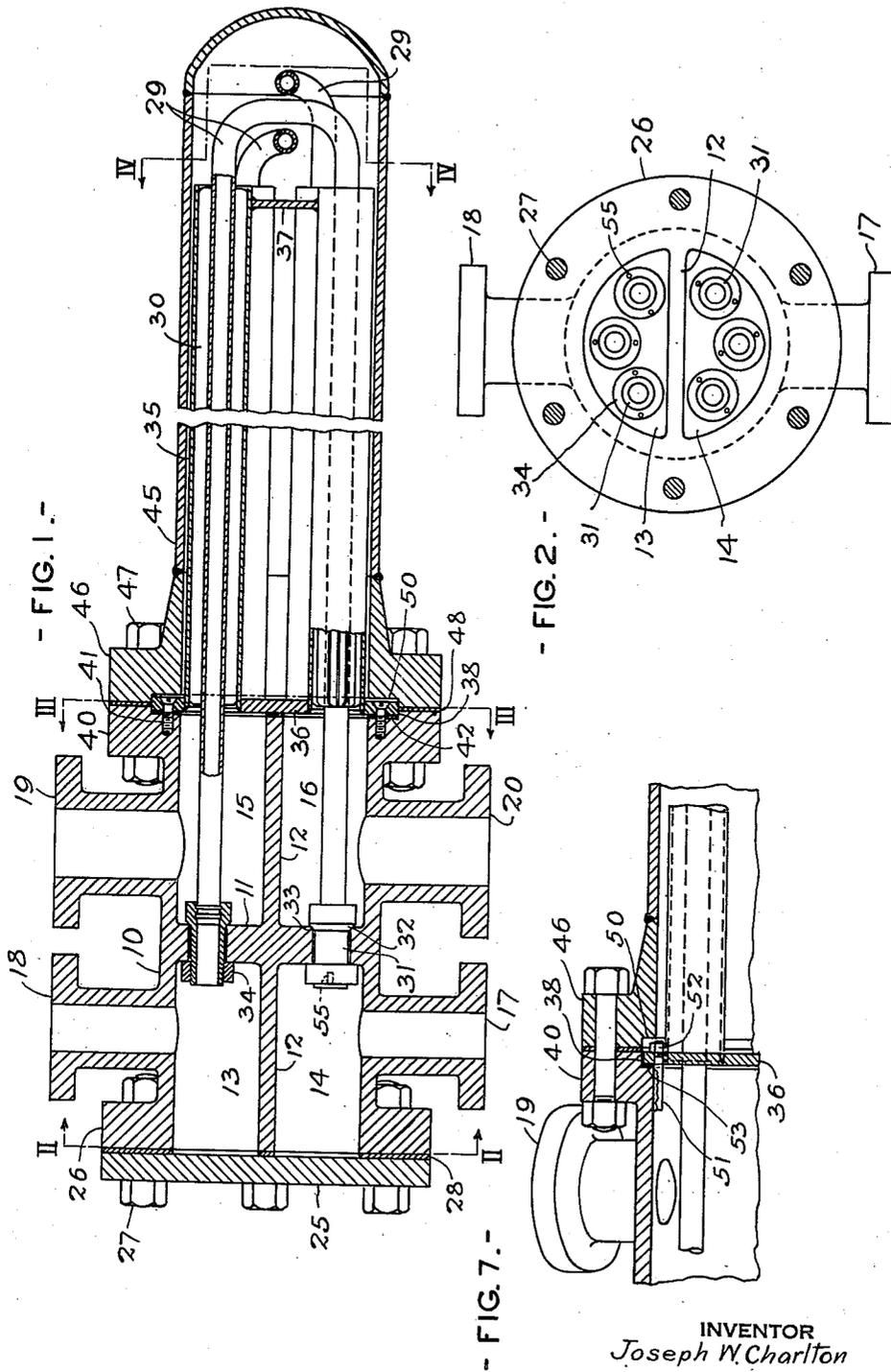
J. W. CHARLTON

2,303,613

HEAT TRANSFER APPARATUS

Filed April 29, 1941

2 Sheets-Sheet 1



INVENTOR
Joseph W. Charlton
BY *S. C. Yator*
ATTORNEY

Dec. 1, 1942.

J. W. CHARLTON

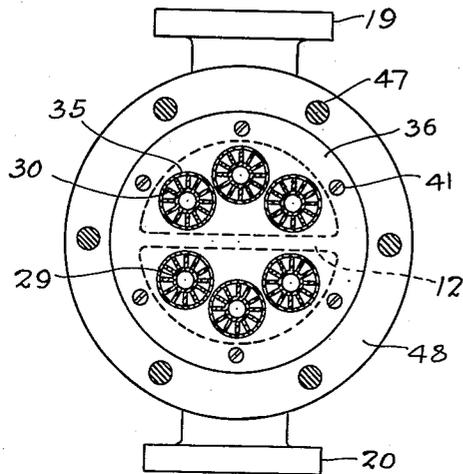
2,303,613

HEAT TRANSFER APPARATUS

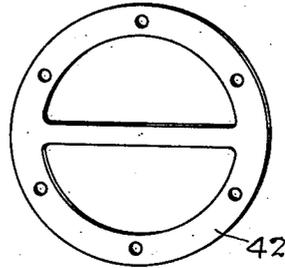
Filed April 29, 1941

2 Sheets-Sheet 2

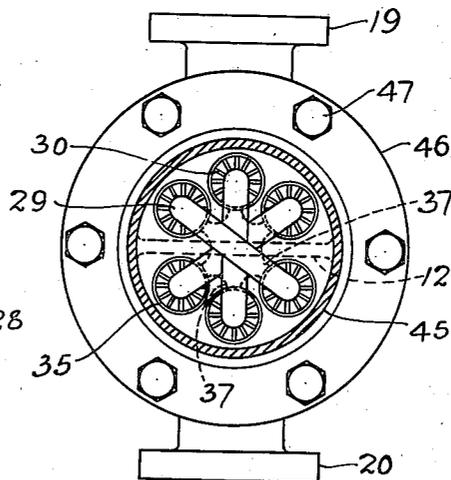
- FIG. 3.-



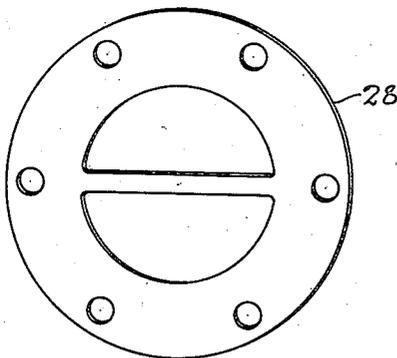
- FIG. 5.-



- FIG. 4.-



- FIG. 6.-



INVENTOR
Joseph W. Charlton
BY *B. C. Keaton*
ATTORNEY

UNITED STATES PATENT OFFICE

2,303,613

HEAT TRANSFER APPARATUS

Joseph W. Charlton, Bronxville, N. Y., assignor to
American Locomotive Company, New York,
N. Y., a corporation of New York

Application April 29, 1941, Serial No. 390,888

1 Claim. (Cl. 257-237)

This invention relates to improvements in heat transfer apparatus.

An object of this invention is to provide novel heat transfer apparatus including tubes, and sleeves therefor, which apparatus may be readily and easily assembled and disassembled for the better carrying out of various maintenance operations such as cleaning, replacing of parts, repairing and the like.

Other and further objects of this invention will appear from the following description, the accompanying drawings and the appended claim.

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like numbers refer to like parts throughout the several views:

Figure 1 is a sectional view in elevation of a parallel flow fin-tube vapor-liquid heat exchanger constituting a preferred embodiment of this invention showing the manner in which the various elements including tube sleeves and sleeve supporting baffle are arranged with respect to each other.

Fig. 2 is a view in section taken along the line 2-2 of Fig. 1;

Fig. 3 is a view in section taken along the line 3-3 of Fig. 1;

Fig. 4 is a view in section taken along the line 4-4 of Fig. 1;

Figs. 5 and 6 are detail views of gaskets utilized in the embodiment of Fig. 1; and,

Fig. 7 is a fragmentary view in sectional elevation of another embodiment of this invention showing an alternative mode of supporting the sleeve supporting baffle from the exchanger header.

In general, the objects of this invention may be accomplished through the provision of heat transfer apparatus embodying one or more U-tubes, preferably finned, and removably secured adjacent the terminal end of each leg to a header. Each leg of each U-tube is jacketed throughout a substantial portion of its length by a sleeve supported upon and in fixed relation to a sleeve supporting baffle so as to form therewith a unitary baffle-sleeve assembly which is, in turn, removably supported by and from the header. The unitary assembly and each U-tube are housed, collectively, within a shell, removably secured to the header, of which the wall thickness is substantially greater than that of the sleeves

Heat transfer apparatus so constructed is characterized by the fact, firstly, that it may readily be disassembled and assembled for various main-

tenance operations, particularly cleaning of the finned U-tubes and the tube sleeves. Secondly, the relatively thick shell wall permits the apparatus to be operated under substantial pressures even though relatively thin walled tube sleeves are employed for conducting fluid in efficient heat transfer relation with the finned U-tubes. Greater thickness of the tube sleeves is not required since, with the construction employed, the pressure differential between the inner and outer surfaces of the tube sleeves is negligible. Thus, fluid supplied to the header is conducted by one or more of the sleeves into the shell and, in consequence, surrounds the inner and outer surfaces of the sleeves and is then conducted by one or more sleeves back to the header from which it is discharged.

In disassembling the apparatus, the shell is first removed and after disconnecting the U-tubes from the header, they, in turn, may be withdrawn from the sleeves for cleaning or repair of their external and internal surfaces. Similarly, if the need arise, the baffle-sleeve assembly may be disconnected and removed as a unit from the header.

Referring now more particularly to the accompanying drawings, the invention as embodied is constituted by a vapor-liquid exchanger comprising a header 10 divided by partitions 11 and 12 into front upper and lower liquid compartments 13 and 14 respectively and into rear upper and lower vapor compartments 15 and 16 respectively.

The lower liquid compartment 14 is adapted to be supplied with cooling liquid through a coupling nozzle 17 and the upper compartment 13 is adapted to be emptied of cooling liquid through a coupling nozzle 18.

Similarly, the upper vapor compartment 15 is adapted to be supplied with hot vapor through a coupling nozzle 19 and the lower vapor compartment 16 is adapted to be emptied of vapor through the coupling nozzle 20.

As embodied, the header 10 is of unitary cast construction but it may obviously be of forged construction or assembled from a number of separately manufactured parts.

The compartments 13 and 14 are capped by a flat circular cover 25 secured to an outstanding annular flange 26 by means of bolts 27. A flat gasket 28 such as is best shown in Fig. 6 is provided between the opposed surfaces of the cover 25, the flange 26 and the partition 12, this type of gasketing being generally suitable for units subject to pressures up to about 400 lbs. per square inch. For units designed to be operated

at higher pressures, it may be desirable to employ a different type of gasketing such as, for example, a tongue and groove construction in which the gasket is compressed in the groove.

Cooling liquid is adapted to be conducted to and from the compartments 14 and 13, respectively by one or more U-tubes removably secured by means of suitable fittings to the partition 11. As embodied, the U-tubes, three in number and respectively designated by the numeral 29, are provided with fins 30 extending radially outwardly and have their respective terminal extremities secured through a rolled tongue and groove union within individual fittings 31 which extend through the partition 11. As here embodied, the partition 11 is provided with openings, six in number, symmetrically positioned with their centers on a circle concentric with the longitudinal axis of the header. Each fitting 31 is provided with a conical shoulder 32 adapted to be drawn into sealing engagement with a matching conical shoulder 33 on the rear face of the partition 11 by means of a nut 34 threadedly engaging the fitting 31 and abutting the opposite face of the partition wall. The shoulders 32 and 33 are preferably provided with ground surfaces which when engaged effectively seal the openings against leakage of fluid between the front and rear compartments. Various other suitable types of fittings may obviously be employed. As embodied, the U-tubes are of suitably different lengths so that they may cross each other at the U-bends but the spacing of the legs of each U-tube is the same. Obviously however, the spacing may be different as between U-tubes so that the tubes may be positioned in parallel rather than in intersecting planes.

Each leg of each U-tube is jacketed throughout a substantial portion of its length by a sleeve which though in spaced relation thereto is in substantially close fitting engagement with the outer extremities of the tube fins 30. As here embodied, relatively thin-walled sleeves 35 jacket each leg of the U-tubes as shown throughout a substantial portion of their length, each sleeve 35 being snugly fitted at one end in a separate opening in a circular sleeve supporting baffle 36 to which the sleeves are secured. As here embodied, the sleeves are welded circumferentially thereof to the baffle although threaded or other forms of engagement may be utilized.

The baffle 36 and the sleeves 35 together form a relatively light weight unitary assembly which is stiffened by a spider 37 securing the opposite ends of the sleeves to each other to assist in maintaining the fixed alignment desired in the assembly.

The baffle-sleeve assembly is removably secured to the header 10. As here embodied, the sleeve supporting baffle is seated in an annular recess 38 formed in the outstanding annular flange 40 of the header 10 to which the baffle is removably secured by screw-bolts 41 which preferably lie flush with the baffle face. The floor of the recess lies in the plane of the adjacent end of the partition 12 and a gasket 42 best shown in Fig. 5 lies between the opposed surfaces of the baffle 36 and the header 10.

The sleeve-baffle assembly and the U-tubes are collectively housed within a shell of appreciable wall thickness capable of withstanding pressures substantially above atmospheric. As here embodied, a shell 45 is built up from a plurality of sections welded into an integral unit having an outstanding annular bolting flange 46 by which

the shell is removably secured to the bolting flange 46 of the header 10 by means of bolts 47 passing through the respective flanges and a ring gasket 48 positioned between the opposed surfaces.

The shell flange 46 is formed with an annular recess 50 to accommodate the baffle 36 which fits therewithin when the parts are assembled, the recess being of a depth sufficient to provide a slight clearance between the opposed faces of shell flange and baffle.

In Fig. 7, there is shown an alternative form of mounting for the baffle plate. As there embodied, the recess 38 in the bolting flange 46 is somewhat smaller in diameter but of greater depth so that the baffle 36 lies substantially flush with the plane surface of the bolting flange. The recess 50 in the shell flange is in consequence of somewhat smaller diameter thereby preserving substantially the full strength of the shell flange. A number of support rods such as the support rod 51 threaded at one end are welded at the other end to the inner wall of the header compartments 15 and 16 around which they may be symmetrically positioned so as to pass through correspondingly symmetrically located openings in the baffle 36 between the sleeves 35. Securing means such as the nut 52 threadedly engage the bolts to secure the baffle in position. A gasket 53 is positioned between the baffle and recess floor to seal the joint.

In the invention as here embodied, hot vapor enters the header 10 through the nozzle 19 and flows from the upper compartment 15 through the upper bank of sleeves 35 leading therefrom into the shell 45 wherein it surrounds the sleeves 35 which are thereby subjected to substantially the same pressure at their inner and outer surfaces. The hot vapor in flowing through the upper bank of sleeves 35 into the shell is cooled therein by indirect heat exchange with cooling liquid passing through the U-tubes in counter-current relation thereto and is further cooled in the same manner as it is connected by the lower bank of sleeves 35 from the shell into the lower compartment 16 from whence it is discharged through the nozzle 20. Cleaning of the sleeves or the finned U-tubes, or both, may be readily accomplished by removing the bolts 47 and removing the shell from the header. The cover 25 is then removed by removing the bolts 27 so that access may be had to the nuts 34 which are provided with spanner sockets 55 so that they may be rotated and unscrewed from the fittings 31. The finned U-tubes 29 with attached fittings 31 may then be withdrawn through the sleeves 35 for cleaning. The sleeve-baffle assembly may then be removed from the header by unscrewing the bolts 41.

Thus, it will be observed that the objects of this invention have been accomplished. There has been provided fin-tube heat transfer apparatus which may be readily and easily assembled and disassembled for the better carrying out of various maintenance operations such as cleaning, replacing of parts, repairing and the like. There has been provided fin-tube heat transfer apparatus for high pressure operation in which the possibility of leakage has been minimized and there has been provided heat transfer apparatus having jacketed fin-tubes, so constructed and arranged as to permit the use of lighter weight material for the jackets than has heretofore been deemed suitable for a given operating condition, to the end that considerable savings in the overall weight and cost of the apparatus may thereby be effected.

It will be observed that various changes may be made in details within the scope of the appended claim without departing from the spirit of this invention. It is, therefore, to be understood that this invention is not to be limited to the specific details described.

Having thus described the invention, what is claimed is:

A heat exchanger comprising a header having compartments at one end for supply and discharge of one fluid and compartments at the other end for supply and discharge of another fluid; a shell joined to said header at one end thereof and providing a fluid chamber extending throughout the length of said shell; a baffle-sleeve unitary assembly including a baffle forming a wall of each of the compartments at said one end of said header and further including sleeves opening at one end through said baffle to each of said last named compartments and ex-

tending from said baffle part way through said chamber and opening at the other end into said chamber for communication between the sleeves of one compartment and the sleeves of the other compartment through said chamber, said assembly beyond said baffle being in floating relation to said shell; a plurality of U-tubes, the legs thereof being detachably secured to said header, each leg in communication with one of the compartments at said other end of the header, and the U-bends thereof being disposed in said chamber beyond the ends of said sleeves opening into said chamber, and a leg of each U-tube extending through a sleeve of each compartment to form therewith a narrow annular passage; and means detachably securing said header, shell and baffle together whereby upon detachment of said U-tubes said shell and assembly may be removed from each other and from said header.

JOSEPH W. CHARLTON.