Dec. 23, 1941. H. M. GRAHAM 2,267,695

HEAT EXCHANGER

Filed Sept. 26, 1939 2 Sheets-Sheet 1

Fig. 1.

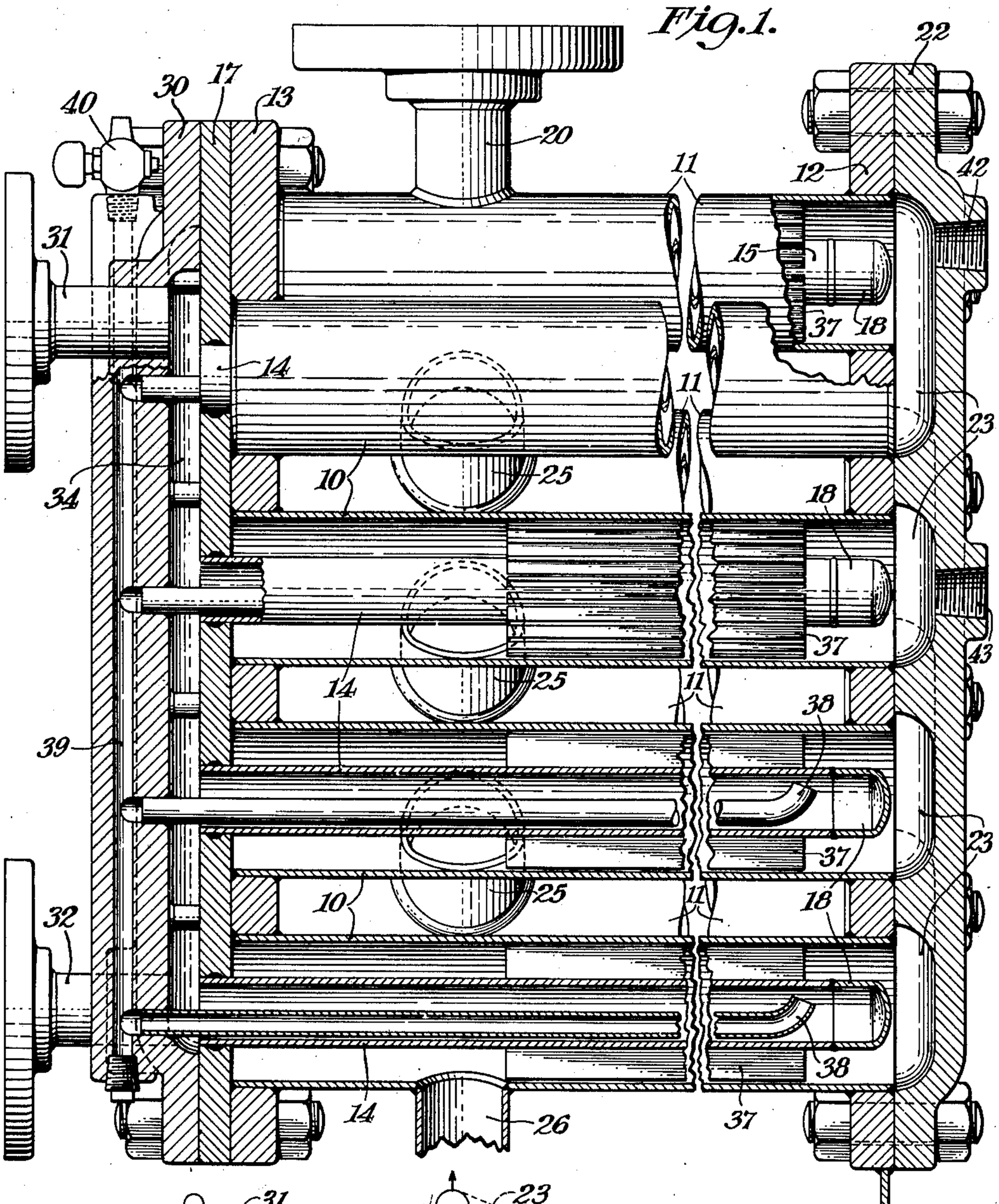
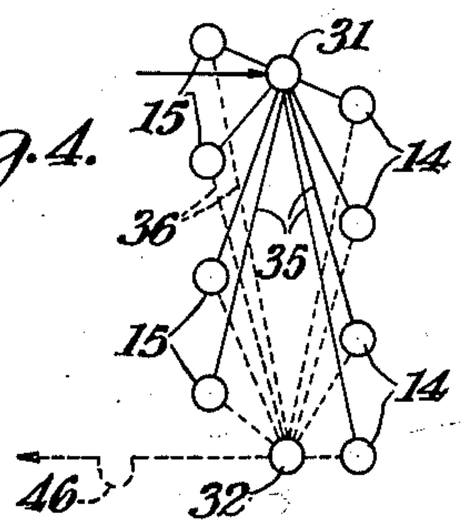


Fig. 4.



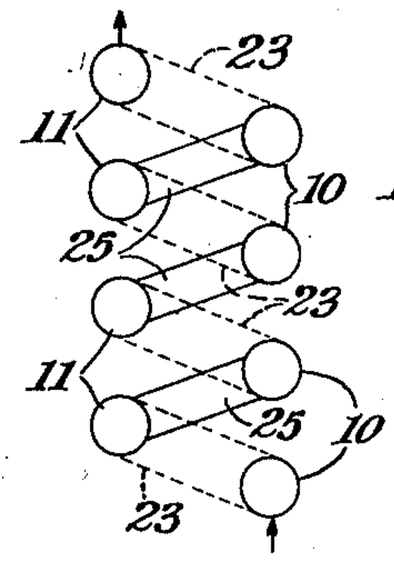


Fig. 5.

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Fig. 2.

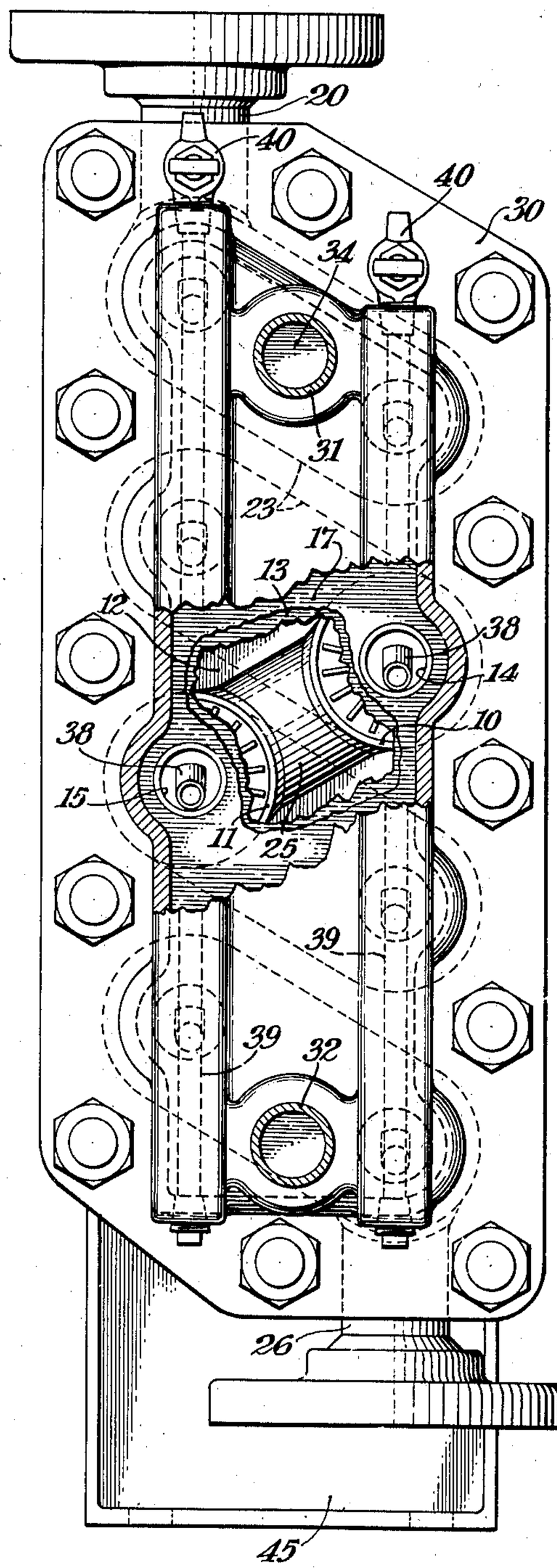
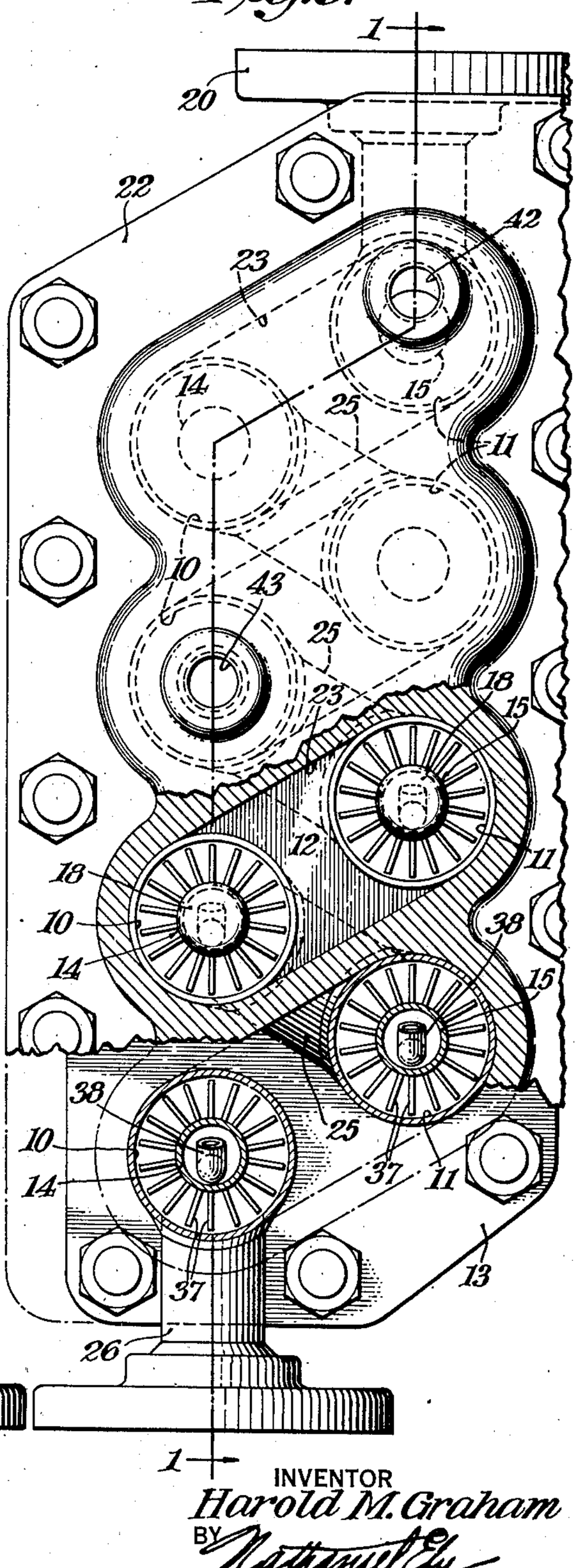


Fig. 3.



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UNITED STATES PATENT OFFICE

2,267,695

HEAT EXCHANGER

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Application September 26, 1939, Serial No. 296,535

3 Claims. (Cl. 257—247)

This invention relates to heat exchangers, and more particularly to heat exchangers of the double pipe type.

It has heretofore been suggested that double pipe heat exchangers be used on certain special service in which extremely intimate contact was required between the two materials in heat exchange. It has been the practice to make this double pipe heat exchanger of a tortuous path type with a limited extent of straight pipe, the ends of which were joined by suitable U-bends. In such construction, it has been difficult to dismantle the U-bends and, therefore, difficult to clean the tubes, with the result that such apparatus has been expensive in operation as well as construction.

In accordance with my invention, I provide a double pipe type heat exchanger, in which the flow of material through one of the tubes is tortuous but no U-bends are used, and in lieu thereof, standard type headers are provided.

Another object of the invention is to provide a double type heat exchanger in which one series of pipes is closed at one end and is provided with a common header for the other end.

A still further object of the invention is to provide a multiple series double pipe heat exchanger, which is particularly adapted for the heat exchange between a gaseous material, such as steam, and a liquid material, such as oil, and in which extended surface tubes are used for a relatively equal heat exchange efficiency, such extended surface tubes being interconnected in common header constructions.

Further objects and advantages of my invention will appear from the following description of a preferred form of embodiment thereof, taken in connection with the attached drawings, in which

Fig. 1 is a vertical section with parts broken away and parts in elevation of a double pipe heat exchanger;

Figs. 2 and 3 are end elevations with parts in section of the respective ends of the heat exchanger shown in Fig. 1;

Figs. 4 and 5 are diagrammatic views showing the fluid flow.

In accordance with the preferred form of embodiment of my invention, the heat exchanger is shown as comprising a plurality of outer pipes 10 and 11 in spaced vertical rows, such pipes being suitably secured to tube sheets 12 and 13 as by welding.

Inner pipes 14 and 15, which project into the respective pipes 10 and 11, are suitably secured to tube sheet indicated at 17 as by welding. These inner pipes have their other end blanked off at 18.

The top pipe in one vertical row of the outer pipes 11 is provided with a nozzle 20 and the bottom pipe 10 in the other row is provided with a nozzle 26. Flow through these outer pipes is established by a header 22 having internal channels 23, which connect with the ends of the pipes 10 and 11. In addition, intermediate pipes 10 and 11 have conduits 25 and, as shown in Fig. 5, a tortuous flow is set up from lower nozzle 26 in pipe 10 to nozzle 20 in upper pipe 11.

The inner pipes 14 and 15 extend to a header 30, which has a common recess or internal channel 34 which interconnects all of the inner pipes. An inlet 31 is provided for such internal channel and an outlet is provided at 32.

It will thus be apparent that with the tube sheet 13 and tube sheet 17 bolted to the header 30, and with the header 22 bolted to the tube sheet 12, that there will be a continuous flow through the outer pipes 10 and 11 surrounding the inner pipes 13 and 14, and there will be a continuous flow into all of the inner pipes, which are connected to the inlet and outlet 31 and 32.

When the apparatus is used as a heater for oil, the oil enters the lower nozzle 26 and is heated by contact with a heating medium, such as steam, within the pipes 14 and 15. Inasmuch as the heat transfer rate between oil and steel is low and for the same temperature, the steam to steel rate is high, it is usually desirable to provide extended surface pipes. As shown, pipes 14 and 15 thus have extended surface in the form of longitudinal fins 37.

The steam flow is indicated in Fig. 4 by the solid lines 35 and the condensate is indicated by the dotted lines 36. A trap, diagrammatically indicated at 46, is used to maintain a suitable steam head within the pipes.

I also find it desirable to provide internal bleeder tubes 38 projecting into pipes 14 and 15, such bleeder tubes being connected into recesses or vertical risers 39 in the header and tube sheet 30. Valves 40 may be provided to release the air which may collect in the inner pipes.

I also provide a vent opening 42 and a relief valve connection 43 for the outer pipes 10 and 11, which may be used if found desirable. The exchanger is preferably mounted in a horizontal position with one or more brackets 45.

Assembly and disassembly of the unit is easily accomplished. If the outer pipes are to be cleaned, it is only necessary to remove header

22, which immediately exposes all of the pipes 10 and 11. If a more complete cleaning is required, the header 17 may be removed and all of the internal pipes 14 and 15 simultaneously removed. Such removal of the header 17 also permits complete cleaning of the interior of inner pipes 14 and 15.

No return bends are necessary and only standard flanges and simplified construction is required. The unit is especially rugged as the outer pipes are permanently welded to the respective tube sheets 12 and 13 and no expansion difficulties exist as the internal pipes merely float within the outer pipes.

The exchanger is also especially useful with heavy duty requirements and has been constructed for steam pressures in the range of 600 pounds per square inch and oil pressures in the range of 300 pounds per square inch. With the extended surface, the heat transfer coefficient is approximately equal.

While I have shown and described a preferred form of embodiment of my invention, I am aware that modifications may be made thereto and I, therefore, desire a broad interpretation of my invention within the scope and spirit of the description herein and of the claims appended hereinafter.

I claim:

1. A heat exchanger of the class described comprising a pair of apertured end plates forming tube sheets, a series of external tubes extending into said apertures and between said tube sheets, means to integrally secure said tubes to said tube sheets to form a rigid skeleton framework, nozzles in certain of said external tubes for inlet and outlet of a first fluid, means to interconnect the ends of adjacent external tubes at one end of the heat exchanger, means to interconnect other pairs of said external tubes near their other ends whereby a continuous fluid path is established from inlet to outlet, and means to establish a heat exchange between a second fluid and the first fluid, said means including a series of intermediate tubes each having extended heat transfer surface and a closed end, each of said intermediate tubes extending into one of the respective external tubes to limit the fluid path of the first fluid, a tube sheet for the open end of all of said intermediate tubes, means to secure said intermediate tubes to said tube sheet, said last-named tube sheet being secured in sealed relation against the face of one of said first-named tube sheets whereby the open ends of said external tubes are simultaneously closed, means to introduce the second fluid to and remove it from the intermediate tubes, said means including a series of internal tubes, each of which extends substantially to the closed end of the respective intermediate tube, a tube sheet header for the other end of said internal tubes, means to secure said internal tubes to said tube sheet header, said last-mentioned tube sheet header having nozzle means communicating with the internal and the intermediate tubes, means to bolt all of said tube sheets and the tube sheet header at one end together, the tube sheet header for the internal tubes being outermost and the tube sheet for the intermediate tubes being between the other tube sheet and the tube sheet header whereby the internal tubes and intermediate tubes may be removed as separate groups with their tube sheet and tube sheet header after the tube sheets and tube sheet header are unbolted.

2. A heat exchanger as claimed in claim 1 in which the tube sheet header for the internal tubes has recess portions communicating with the open ends of all of the internal tubes whereby free communication is had with the closed ends of all of the intermediate tubes, said tube sheet header also having a recess portion communicating with the nozzle means and the open ends of all of said intermediate tubes.

3. A heat exchanger having a framework consisting of a group of external tubes and tube sheets therefor whereby said heat exchanger may be supported as a unit, a group of intermediate tubes within said external tubes, and a group of internal tubes within the intermediate tubes, the intermediate tubes being closed on one end, the external tubes being interconnected in continuous fluid path adjacent the closed end of the intermediate tubes, a tube sheet for supporting the open ends of the intermediate tubes, said tube sheet closing the adjacent ends of the external tubes, a tube sheet header for the internal tubes, said internal tube sheet header having recesses independent of each other, certain of said recesses forming a collecting chamber for the ends of the internal tubes, the other recess forming a distributing chamber for the intermediate tubes, and separate nozzle means intercommunicating with the respective recesses whereby a continuous fluid path can be set up between the respective nozzles and through substantially the full length of the internal and the intermediate tubes, means to bolt all of the tube sheets and tube sheet header at one end of the heat exchanger together whereby said internal tubes and the intermediate tubes are completely removable from the respective surrounding tubes from one end of the heat exchange unit when the bolting means is released, separate nozzle means interconnecting certain of the adjacent external tubes, and nozzles in other of said external tubes for interconnection to a second fluid source.

HAROLD M. GRAHAM.

CERTIFICATE OF CORRECTION.

Patent No. 2,267,695. December 23, 1941.

HAROLD M. GRAHAM.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 38, claim 3, for the words "internal tube sheet" read --internal tube tube sheet--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of January, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)