Sept. 11, 1945. E. VILLIGER 2,384,714

TUBULAR HEAT EXCHANGER

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Fig. 1

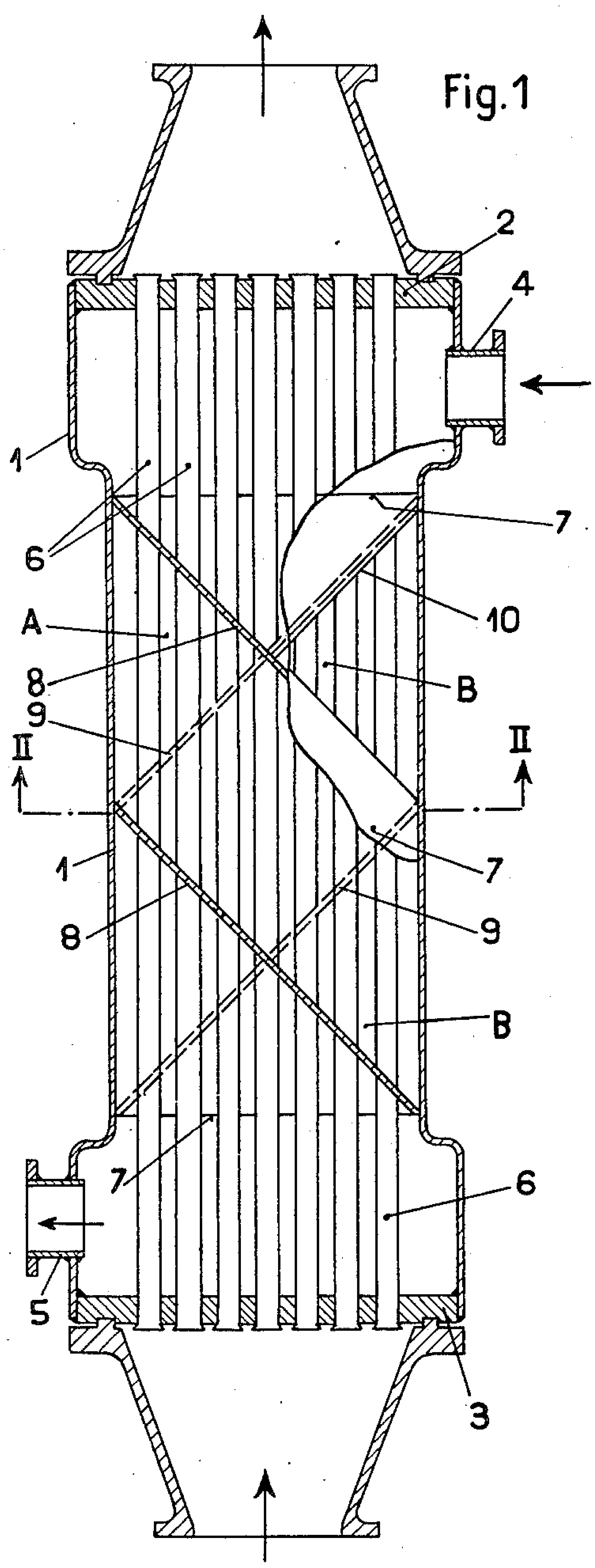

Fig. 3

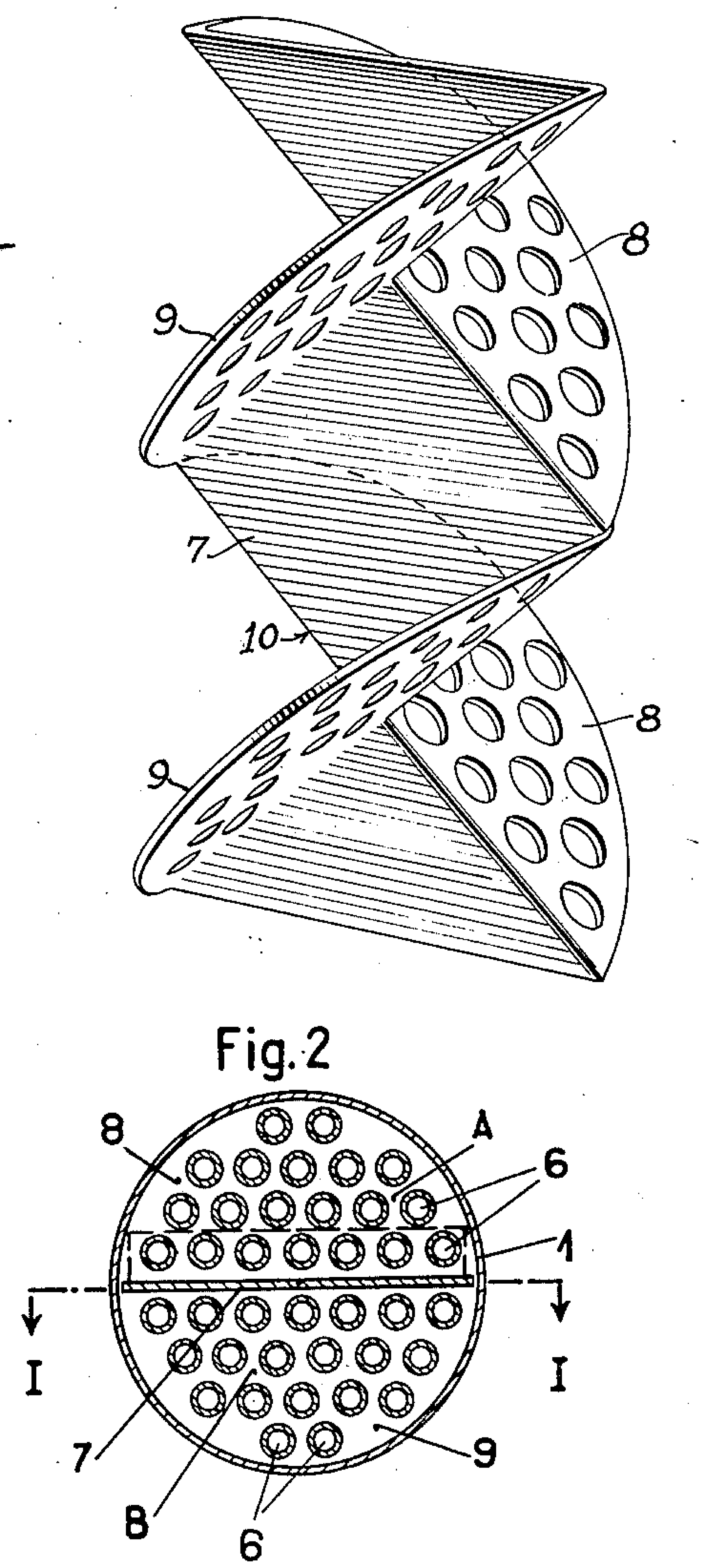

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Fig. 4

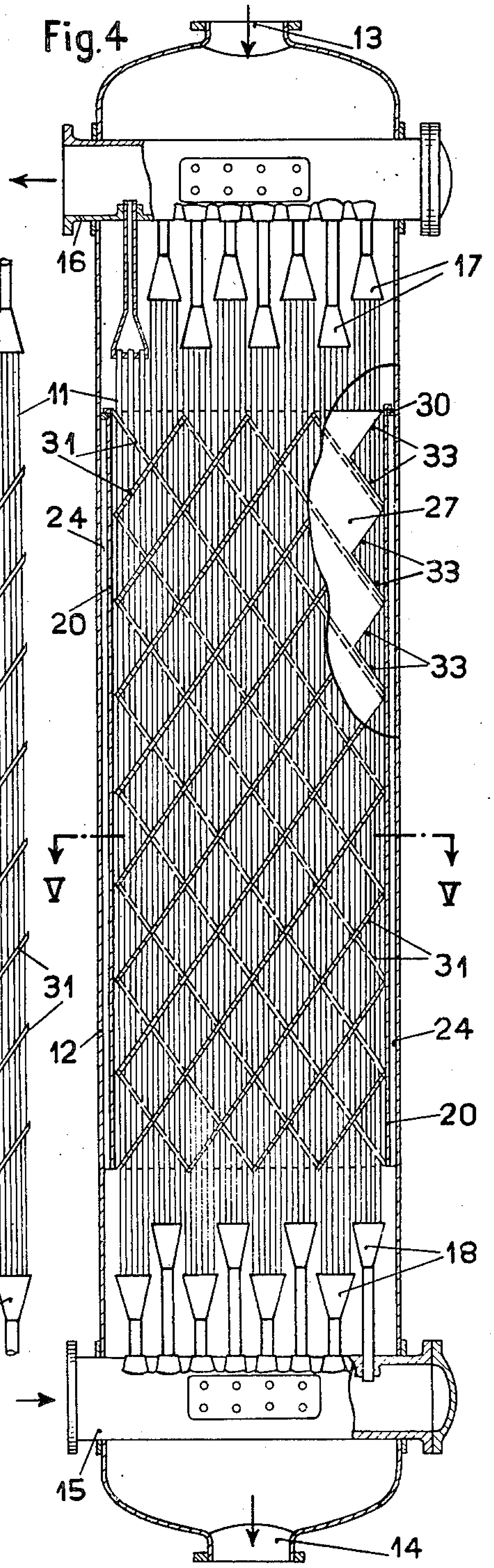


Fig. 6

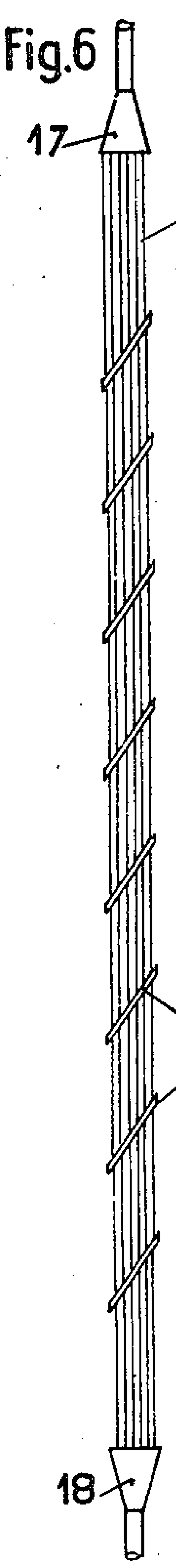


Fig. 5

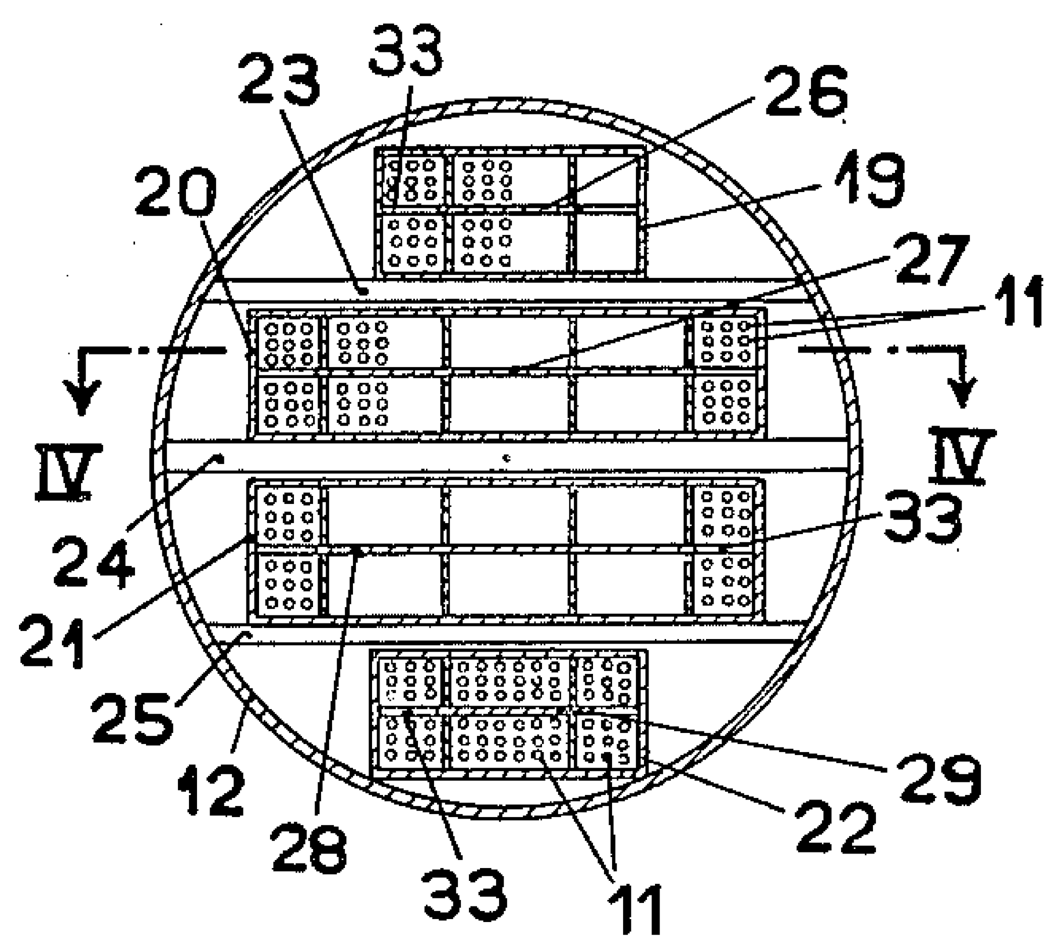
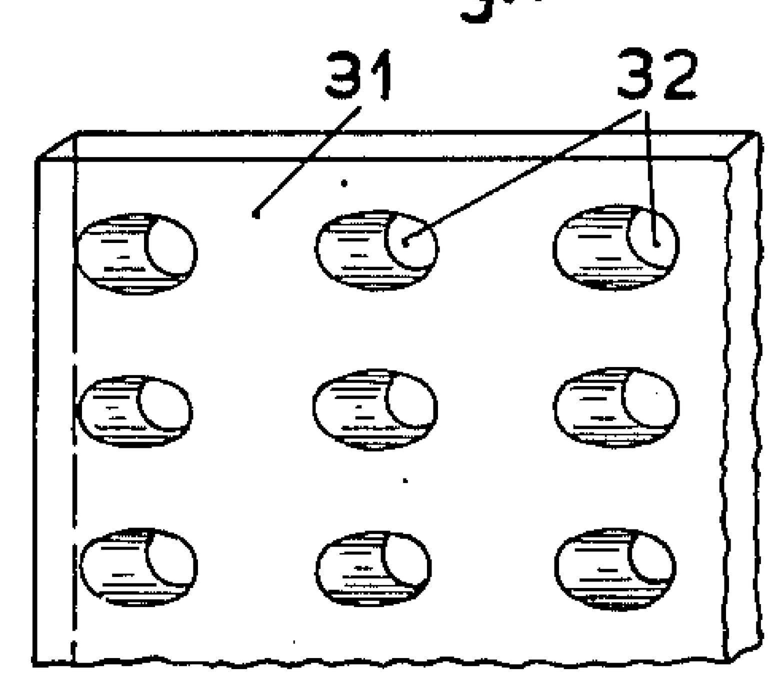


Fig. 7



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TUBULAR HEAT EXCHANGER

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4 Claims. (Cl. 257—224)

This invention relates to a tubular heat exchanger, and its object is to render the exchange of heat in such an apparatus more intense whilst involving only small lossses in pressure with regard to the media passing through, so that, for otherwise equal conditions, a smaller total heat exchanging surface suffices compared with that of the heat exchangers hitherto built. For this purpose according to the invention the tubes of the heat exchanger are subdivided into groups by at least one division plate extending in the ngitudinal direction of the heat exchanger, and furthermore a number of perforated baffle plates are slipped over the tubes. These plates are arranged obliquely to the axis of the tubes and they delimit channels on each side of the division plate, the channels on the one side of said plate crossing the channels on the other side of the plate. Each of these channels is connected at one end by an associated opening in the partition plate to a channel situated on the opposite side of said plate, the effect being to produce an approximation of helical flow.

Two preferred constructional forms of the subject matter of the invention are shown by way of example in the accompanying drawings in which:

Fig. 1 shows a longitudinal section on the line I—I in Fig. 2 through a first embodiment.

Fig. 2 is a cross section on the line II—II in Fig. 1 and

Fig. 3 is a perspective view of the division plate and the related oblique baffle plates.

Fig. 4 is a horizontal longitudinal section on the line IV—IV in Fig. 5 through a second embodiment.

Fig. 5 is a vertical cross section on the line V—V in Fig. 4.

Fig. 6 shows a single tube nest, on the tubes of which a number of perforated baffle plates have been fitted at an angle to the longitudinal axis of the tubes.

Fig. 7 shows a view of a part of a perforated baffle plate.

In Figs. 1 and 2 the numeral 1 denotes the pressure resisting shell of a heat exchanger. To this shell 1 covers 2 and 3 are fixed at either end. The numeral 4 denotes a branch of the shell 1, through which one of the heat exchanging media flows into the heat exchanger, whilst 5 denotes a further branch of the shell 1 through which said medium leaves the exchanger. The numeral 6 denotes tubes beaded into the tube plates 2, 3 and through which the second heat exchanging medium passes. The tubes 6 are subdivided into two groups A and B by a partition or division plate 7 extending in the longitudinal direction of the heat exchanger, but not up to the covers 2, 3.

In Fig. 3 a part of this plate 7 is shown in a plan view. On the tubes 6 of the two groups A and B a number of perforated baffle plates 8 and 9 are fitted. The baffle plates 8 and 9 delimit channels on either side of the division plate 7, to which channels the medium supplied through branch 4 can flow unhindered. Seen in a plan view, the channels on one side of the division plate 7 cross those on the other side of said plate 7. Furthermore, each of these channels is connected at one end by an associated opening 10 in the plate 7 to the inlet of another channel situated on the opposite side of said plate. In other words, the perforated baffle plates 8 delimit channels which, with reference to Fig. 1, extend from the upper left hand side diagonally to the lower right hand side, whilst the perforated baffle plates 9 delimit channels which extend diagonally from the upper right hand side to the lower left hand side. The size of the holes in plates 8, 9, which holes are drilled obliquely to the frontal face of these plates, is suited as far as possible to the external diameter of the tubes 6, so that only a small quantity of medium can leak through said holes.

In a heat exchanger of the kind herein described the greater part of the medium supplied through branch 4 is canalized by the baffle plates 8 and 9 and caused to sweep over the tubes 6 obliquely, corners, in which the medium might stagnate, being avoided to the greatest possible extent. The baffle plates 8 and 9 compel the various partial currents to describe a zigzag course alternately on opposite sides of the division plate 7, all currents of the medium flowing approximately the same lineal distance between inlet and discharge. This ensures the intense exchange of heat aimed at, so that with a minimum heat exchanging surface a maximum exchange of heat can be attained. At the same time the perforated plates 8 and 9 serve as distance pieces for the tubes 6. This simplifies the design and reduces the manufacturing expenses, whilst it also ensures low losses in pressure since no additional distance pieces have to be installed.

To prevent the baffle plates 8 and 9, slipped over the tubes, being forced out of position or warped during operation, they can be conveniently welded, soldered or otherwise attached to some of the tubes 6.

Since the flow guiding structure is composed of flat plates, the expense of manufacture is comparatively small. Nevertheless it produces a close approximation of helical flow within the cylindrical shell 1 so that the resistance to flow is moderate.

Figs. 4 to 7 illustrate a constructional form in which the tubes 11 of the heat exchanger are assembled into nests. The axis of the cylindrical shell is assumed to be horizontal in the following description. In these figures the numeral 12 denotes the pressure resisting shell of the heat exchanger in which two branches 13 and 14 for the supply and outlet respectively of one of the heat exchanging media are provided. Furthermore 15 denotes a distributor arranged transversely to the longitudinal axis of the shell 12 and extending through the latter; through this distributor 15 enters a second heat exchanging medium. The numeral 16 denotes a collector for the second medium, which is likewise arranged transversely to the longitudinal axis of shell 12 and through which the second medium leaves the heat exchanger. Distributor 15 and collector 16 are connected by the above mentioned tubes 11 assembled into nests and by distributing pieces 18 and collecting pieces 17 for these nests. The tube nests 11 are arranged in groups each comprising two superimposed rows, and each group of two rows is placed in a container 19, 20, 21 and 22 respectively, which is open at both ends. The container 19 is supported by a longitudinal frame 23, the container 20 by a longitudinal frame 24 and the container 21 by a longitudinal frame 25, whilst the container 22 rests immediately on the pressure resisting shell 12. Each of the containers 19, 20, 21 and 22 is subdivided into two chambers by respective division plates 26, 27, 28 or 29, as the case may be, placed between the corresponding two rows of tube nests, the medium supplied through opening 13 having unobstructed access to said chambers. By the provision of suitably shaped transverse intercepting plates 30 (Fig. 4) at least at one end of the containers 19, 20, 21 and 22 and by means of the longitudinal frames 23, 24 and 25 it is possible to ensure that no medium flows through the chambers delimited by the external surfaces of the containers, the longitudinal frames and the pressure resisting shell 12.

Each tube nest comprises also a number of perforated baffle plates 31. Since in this case the holes 32 to be provided in the plates 31 in order to permit of the tubes being passed through, are also drilled diagonally to the frontal side of the plates 31 (see Fig. 7), the plates 31 slipped over the tubes 11 are at a slant to the longitudinal axis of the nest. The size of the holes 32 in the plates 31 is again suited as far as possible to the external diameter of the tubes 11. All tube nests are of equal length and each of them has an equal number of baffle plates 31, the distance between each two of such plates 31 being equal in all the tube nests. As a consequence when all tube nests have been inserted, the baffle plates 31 delimit channels, which serve for guiding the medium supplied through opening 13. As shown in Fig. 4 also in this case the channels on one side of a division plate, when seen in a plan view, cross the channels on the opposite side of the corresponding plate. In other words, the baffle plates 31 of the tube nests, which, for example, are situated in front of the partition 27 and are represented in Fig. 4 by the full lines, delimit channels which extend diagonally from the upper right hand side to the lower left hand side, whereas the baffle plates 31 situated behind the partition 27 and marked in Fig. 4 by hyphenated lines, delimit channels which extend diagonally from the upper left hand side to the lower right hand side. At the same time each channel is connected at its end, which is always adjacent to a lateral container wall, through an associated opening, i. e. a notch 33 provided in the corresponding division plate, with the inlet of a channel situated on the opposite side of the plate. In Fig. 4 three such notches 33 are shown. The medium supplied through opening 13 is thus here also canalized by the baffle plates 31 and caused to sweep over the tubes 11 of the various tube nests as a diagonal current and to take a generally helical or zigzag course above and below the corresponding division plate, all currents of the medium describing paths of approximately equal length.

For the application of the invention it is immaterial whether both heat exchanging media are gases, or whether one of same is a gas and the other a liquid, or whether both media are liquids. Thus tubular heat exchangers of the kind herein described can serve for heating or cooling gaseous or liquid working media, or heat conveying media and furthermore also for the condensation of vapours, the recooling of lubricating oil, etc.

What is claimed is:

1. A baffling structure for heat exchangers of the shell and tube type in which the fluid flowing externally of the tubes enters adjacent one end of the shell and leaves adjacent the other, said baffling structure constraining said fluid to flow in a generally helical path and comprising a flat plate which extends longitudinally of the shell between two sets of tubes and has notched lateral edges adapted to permit flow around the plate, and flat plate-like oblique baffles located on opposite sides of said plate, the baffles on one side of the plate being reversely inclined with respect to those on the other and so arranged as to define paths communicating with said notches.

2. The combination defined in claim 1 in which the oblique baffles are connected with at least some of the tubes by a fused metal connection.

3. A heat exchanger of the shell and tube type including inlet and discharge connections for the fluid which flows externally of the tubes located adjacent opposite ends of the shell, longitudinal open ended sleeves embracing groups of tubes in said exchanger and defining segregated flow paths between said inlet and discharge connections and a baffling structure in each of said sleeves, said baffling structures each comprising a flat plate which extends longitudinally of the sleeve between tubes and has notched lateral edges to permit flow around the plate and flat plate-like oblique baffles located on opposite sides of the said plate, the baffles on one side of the plate being reversely inclined with respect to those on the other and so arranged as to define paths communicating with corresponding notches.

4. The combination defined in claim 3 in which the tubes and their enclosing sleeves extend substantially horizontally, the sleeves sustaining the tubes by means of the respective baffling structures, there being supporting members carried by the shell of the heat exchanger and directly supporting the sleeves.

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