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(54) Multi-plate oil cooler

(57) A multi-plate water-cooled oil cooler has a pack (5) of double-walled plates (11). In the gap (16) between adjacent plates flow guides are provided in the form of outwardly stamped configurations (20, 21) which improve the flow in the gap (16), so as to achieve more even throughflow over the entire cross-section and enhanced cooling efficiency.

Fig. 2

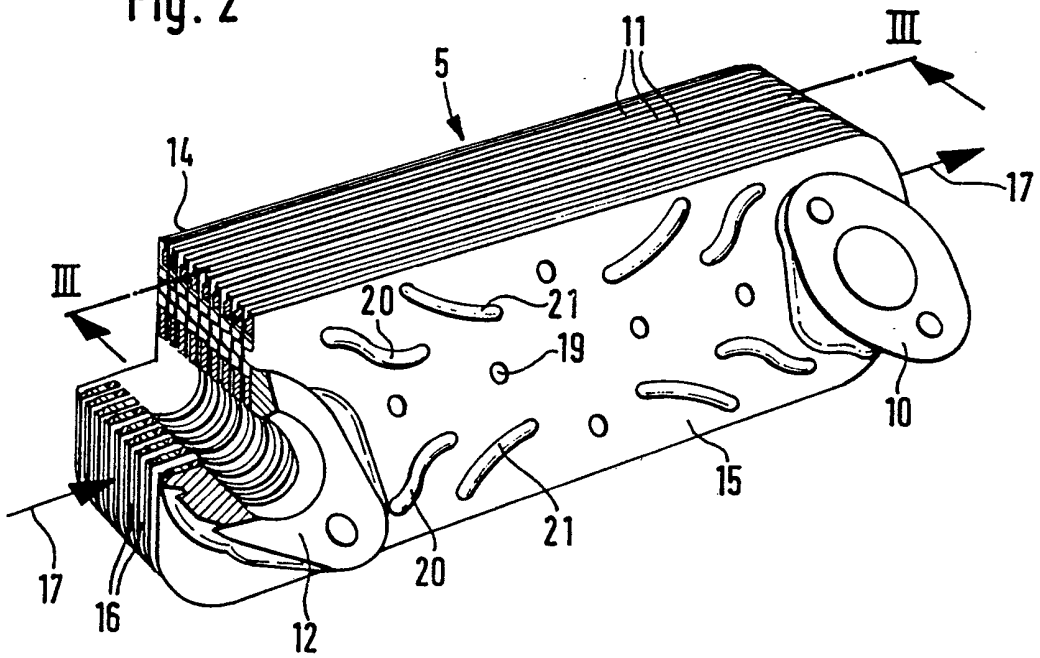

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Fig. 1

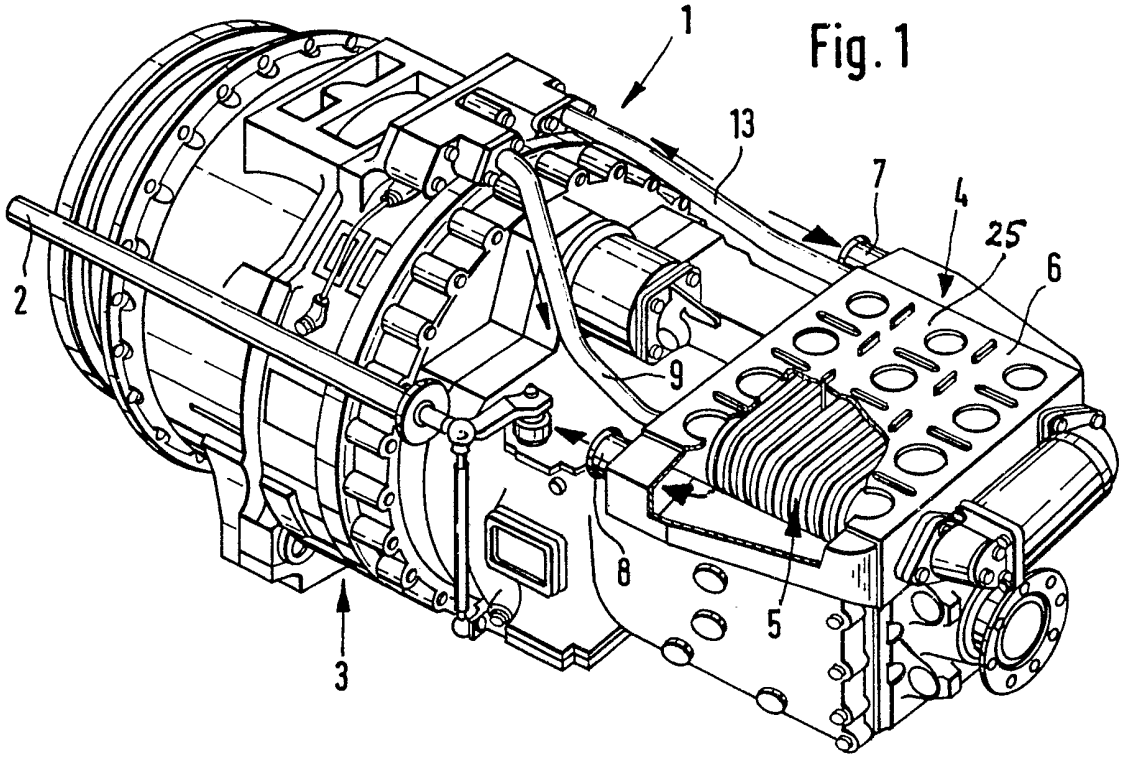

Fig. 2

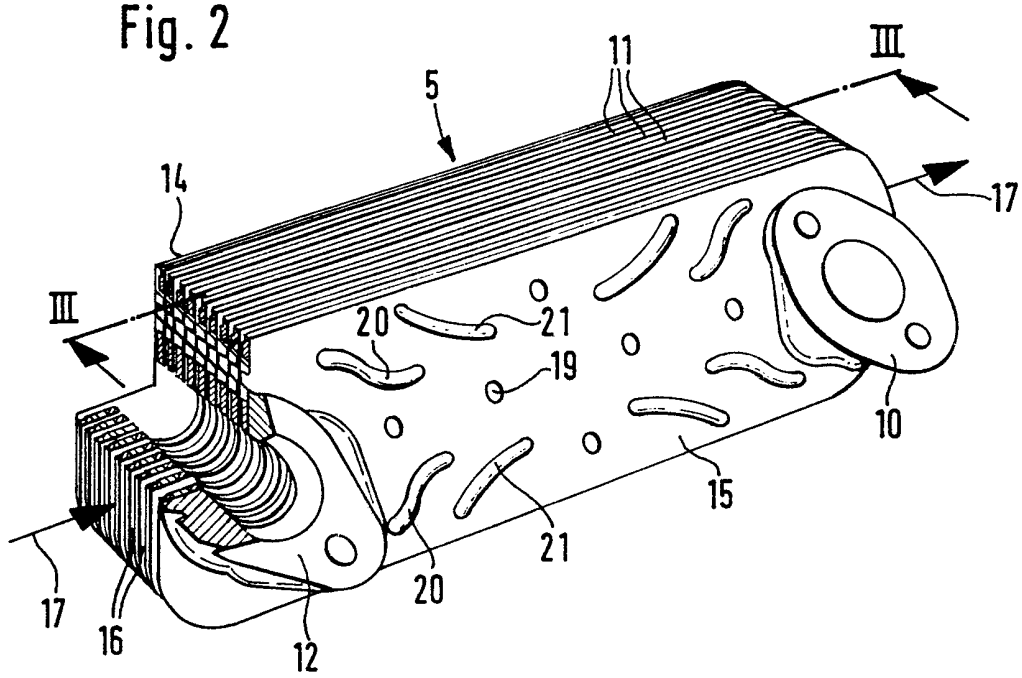

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Fig. 3

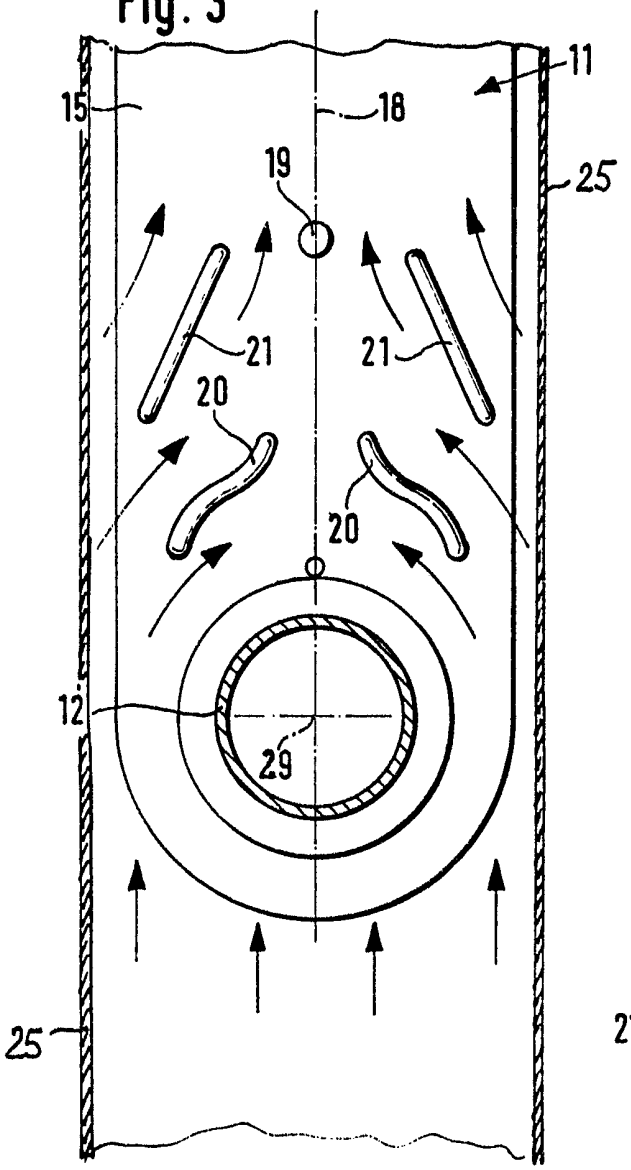
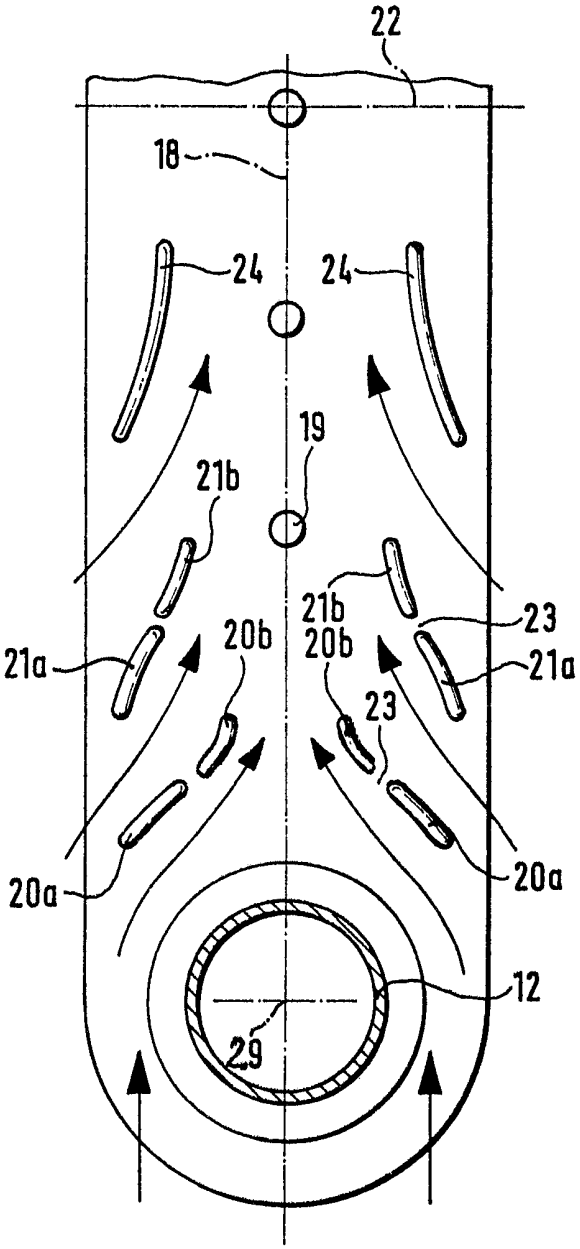


Fig. 4



SPECIFICATION

Multi-plate oil cooler

The invention relates to a multi-plate oil cooler, particularly a water-cooled oil cooler for internal combustion engines, comprising a plurality of package-wise superposed and oil traversed plate members which have on one of their walls outwardly directed stamped configurations which rest on the other wall of the adjacent plate member, bridging between two plate members a gap through which water flows.

Oil coolers of this type are known. The plate members generally consist of two sheet metal plates soldered along their edges and defining a cavity through which oil flows and in which turbulence generating inserts are located. All plate members which are built up in this way are connected to one another by an oil feed and an oil discharge connector, being soldered to this latter. In order to establish the necessary stability, boss-like stamped-out configurations are furthermore provided on one of the walls of the plate member and rest on the adjacent other wall of the nearest plate member in order to determine the width of the gap between two adjacent plate members. In known constructions, these bosses are also soldered to the adjacent walls so that all in all a very compact cooling member is provided, which is also space-saving by reason of the plate construction. These packages of plates have water flowing through the gaps and according to the construction, so the flow may take place transversely of or parallel with the connecting plate between feed and discharge connectors. If the quantity of heat to be transferred and thus the cooling efficiency require to be increased, then accordingly more plate members must be provided so that more space is required.

The present invention is based on the problem of increasing the cooling efficiency of such multi-plate oil coolers without the need for additional space.

In the case of an oil cooler of the type mentioned at the outset the invention resides in that flow guide means are provided in the gap between two plate members. This design makes it possible to improve the flow conditions in the gap between the plate members and also to compel that portion of the water which would otherwise not be guided through the gaps due to resistance to flow, indeed to flow through the gaps. Thus on the one hand a comparable throughflow over the entire cross-section is achieved, which results in increased cooling efficiency.

A very simple embodiment of the invention is arrived at by constructing the flow guide means as outwardly stamped configurations which are advantageously corrugations or beads in the form or curved or straight guide profiles. This configuration achieves on the one hand the purpose of the invention, which is to increase the surface area involved in heat exchange while on the other the stability of the construction of the entire multi-plate oil cooler can be enhanced, which for example prevents a per se undesirable deformation under heat, so guaranteeing constant heat transfer conditions. A plurality of such corrugations or beads may be constructed along a curve in relation to the guide profiles, so that any breakaway of the flow is avoided.

It is also possible to apply the flow guide means to the plate members as metal guide strips, e.g. soldering them into position. From the point of view of manufacture, it is true that this embodiment is more expensive but it can have its advantages in terms of heat dissipation.

Further features and advantages will become evident from the sub-claims as well as from the ensuing description of an example of embodiment of the invention which is shown in the accompanying drawings, in which:

Fig. 1 is a perspective and diagrammatic view of a torque converter change-speed gearbox with a retarder and with a multi-plate oil cooler according to the invention, and with a casing through which coolant flows;

Fig. 2 is a diagrammatic and perspective view of the disc package of the oil cooler in Fig. 1 without a casing;

Fig. 3 is a diagrammatic partial section through the plate package taken on the line III—III in Fig. 2, with an indication of the casing walls, and

Fig. 4 is an alternative form of guide profile in the oil cooler in the gap between two plate members viewed as in Fig. 3.

Fig. 1 shows a torque converter change-speed gearbox 1 which can be actuated via the gear shift selector rod 2. The change-speed gearbox has a retarder part 3 such as is used for utility vehicles. The oil filling of the retarder is cooled by a multi-plate type of oil cooler 4 which is constructed according to the invention and which is essentially built up from the plate package 5 shown on an enlarged scale in Fig. 2 and through which oil flows, and the water casing 6 which encloses this plate package. The cooling water which in known manner contains anti-freeze or anti-corrosive agent is supplied to the water casing 6 in a manner which is not shown in greater detail, for example via feed connector 7 and leaves the water casing 6 again via the discharge connector 8. In the case of utility vehicles, this cooling water is branched off from the cooling water system of the internal combustion engine.

The oil to be cooled passes through a feed pipe 9 and a feed connector 10 into the interior of the individual plates 11 and flows therein through turbulence-generating inserts to the oil discharge connector 12 and thence through the pipe 13 back to the retarder 3. This flow, like the flow of the cooling water, is positively maintained by a pump.

Fig. 2 shows that each plate member 11 is in per se known manner constructed from two walls 14 and 15 which are soldered to each other along their outer edges, Fig. 2 showing only that wall 15 which is towards the viewer. The interior of each of the plate members 11 communicates with the feed and discharge connectors 10 and 12.

Formed between the individual plate member 11 are gaps 16 through which water flows in the direction of the arrows 17. In the case of the example of embodiment illustrated, therefore, flow takes place along the longitudinal central plane 18 indicated by dash-dotted lines in Figs. 3 and 4 and extending through the axes 29 of the feed and discharge connectors 10 and 12 respectively. With such a flow pattern, which is advantageous for reasons of space, because flat coolers result, suffer in the known constructions from the disadvantage that areas of still water form behind the oil discharge connector 12 which is upstream as shown in Fig. 3, these areas of still water adversely affecting the transfer of heat in this area.

According to the invention, therefore, there are provided alongside the bracing projections 19 of known constructions also outwardly extending stamped configurations in the form of corrugations 20 or 21 which form water flow guide profiles in the gap between two adjacent plate members 11 and, as can be seen clearly from the directional arrows indicating the flow pattern in the drawings, ensure that also the areas directly behind the discharge connector 12 have a sufficient throughflow of water. This development therefore increases efficiency in heat transference. The corrugations 20, 21 are at the same height as the bracing projections 19 and, like these, they can at their zenith be soldered to the adjacent (not shown) and plane wall 14 of the adjacently disposed plate member 11. The result is a very compact and stable plate member which can also largely resist heat deformation and which can therefore guarantee stable flow conditions in the gaps between the individual plate members.

The plate members shown in Figs. 2 and 3 can be built up in the same way as was also the case with conventional plate members. The corrugations 20, 21 can be pressed out during the production of the wall 15 for the plate member. No additional production cost is therefore required. All wall parts 15 can be very easily constructed in the same way so that the finished plate member can then, as Fig. 2 shows, have on one side the outwardly pressed corrugations 20, 21 while on the other side, as was previously the case, it may have a plane wall 14. It is naturally also possible to press such corrugations out of both side walls so that in each case the corrugations can be soldered to one another. The advantage of such an embodiment would be the greater width of the gap which could be achieved between the plate members.

As can be seen in Fig. 3, the corrugations 20, 21 are located symmetrically in relation to the longitudinal central plane 18. The coolant which flows through the water casing, of which the walls 25 are indicated, is thus also conveyed into areas in which zones of still water would occur but for the construction according to the invention. As Fig. 4 shows, with an otherwise symmetrical overall construction of the multi-plate cooler, the corrugations 20, 21 can also be located symmetrically of the transverse central plane 22.

Fig. 4 shows an alternative embodiment in that here the guide profiles formed by the corrugations 20, 21 are in each case formed by two corrugations 20a, 20b or 21a, 21b disposed one after another along the guide profile contour, which has the advantage that pressure equalisation is possible in the intermediate space 23 between the serially disposed corrugations 20a and 20b or 21a and 21b, so that no areas of still water are created in the region of the corrugations. In addition, in the case of the embodiment shown in Fig. 4, further guide profiles are provided in the form of corrugations 24 which are disposed likewise symmetrically of the longitudinal central plane 8 and, as is not shown in greater detail, also symmetrically in relation to the transverse central plane 22. Therefore, with such a symmetrical arrangement, it is immaterial in what direction of the plate cooler, the flow occurs along the longitudinal central plane 18.

It goes without saying that it is also possible to form corresponding guide profiles by corrugations if the flow is parallel with the transverse central plane 22. In this case, areas of still water occur behind the feed and discharge connectors 10 and 12 respectively, so that guide profiles must be so provided that these areas are covered. Thus, an improvement in performance can be achieved by the invention also in the case of multi-plate oil coolers with a transverse flow pattern, particularly if the form of the plates is different and if there is a larger area behind the feed or discharge connectors.

Naturally, it is also possible to construct the guide profiles in some other manner, for example in the form of solid strips and incorporate them into the gap 16. The manner of producing the guide profiles which is shown in the embodiment illustrated is however particularly simple and is therefore to be recommended for mass production purposes.

The invention has been explained with reference to a multi-plate oil cooler which is used on a change-speed gearbox which has a retarder. Naturally, multi-plate oil coolers of the type according to the invention can also be used in all other applications where space-saving coolers with a high heat exchange capacity have to be provided. Therefore, the embodiment of oil coolers according to the invention has found particularly numerous application possibilities in motor vehicle construction for cooling the oil in internal combustion engines.

CLAIMS

1. Multi-plate oil cooler, for example a water-cooled oil cooler for an internal combustion engine, the cooler comprising a pack of superposed oil traversed plates each having on one wall outwardly directed configurations which abut a wall of an adjacent plate, bridging between the two plates a gap through which coolant flows, wherein flow guides are provided in the gap between two plates.

2. A cooler according to claim 1, wherein the

flow guide are additional outwardly directed configurations.

3. A cooler according to claim 2, wherein the outwardly directed flow guide configurations are corrugations in the form of curved or straight guides.

4. A cooler according to claim 3, wherein the corrugations are disposed symmetrically of a longitudinal central plane which extends through the axes of oil feed and discharge connectors of the cooler.

5. Oil cooler according to claim 4, characterised in that the corrugations (20, 21, 24) are disposed symmetrically of the transverse central plane (19).

6. Oil cooler according to one of claims 1 to 5 through which water flows in the direction of the longitudinal central plane through the feed and discharge connectors, characterised in that associated with each oil feed and/or oil discharge connector (10, 12) there are corrugations (20) which extend from the connector in each case obliquely outwardly towards the longitudinal central plane (18).

7. Oil cooler according to one of claims 1 to 6, characterised in that the corrugations (20, 21, 24) are at least partly soldered to the adjacent plate at the points at which they rest thereon.

8. Oil cooler according to claim 9, characterised in that guide profiles are formed by a plurality of corrugations (20a, 20b, 21a, 21b) disposed along a curve or a straight line.

9. Oil cooler according to claim 1, characterised in that the flow guide means are mounted on the plate members in the form of baffles.

10. Oil cooler according to claim 9, characterised in that the baffles are produced as solid guide strips from readily heat conductive material.

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