

Nov. 26, 1940.

W. R. RAMSAUR ET AL.

2,222,721

OIL COOLER

Filed April 13, 1936

4 Sheets-Sheet 1

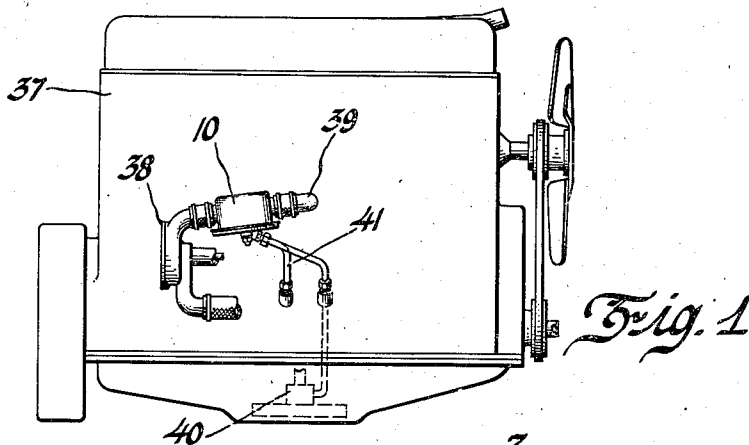


Fig. 1

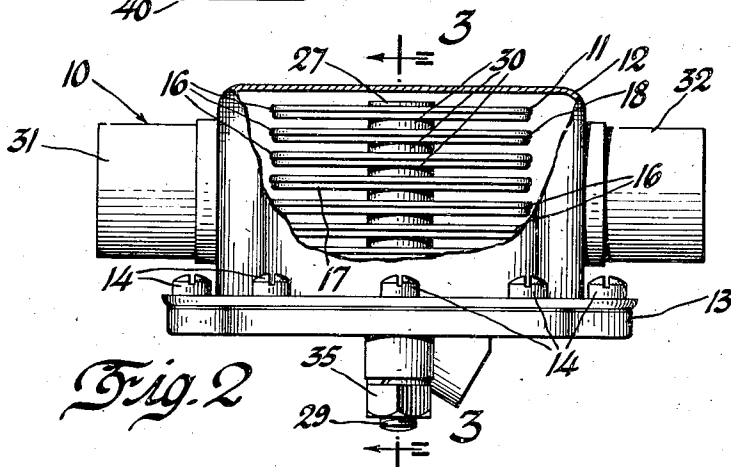


Fig. 2

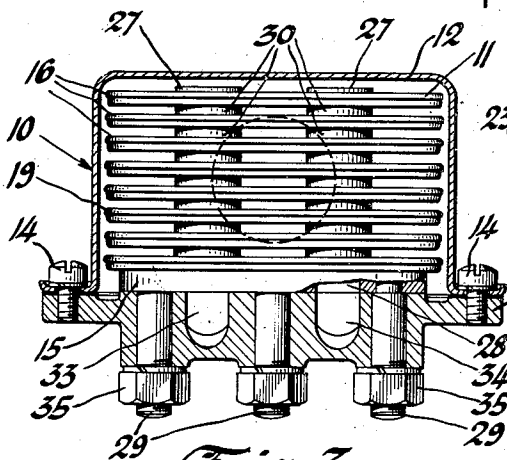


Fig. 3

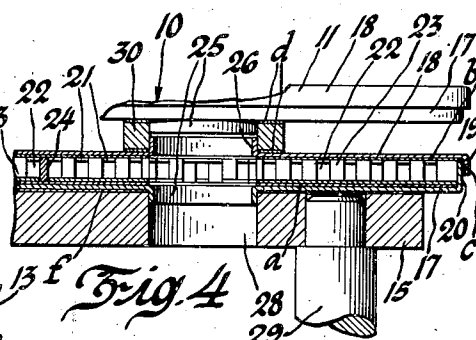


Fig. 4

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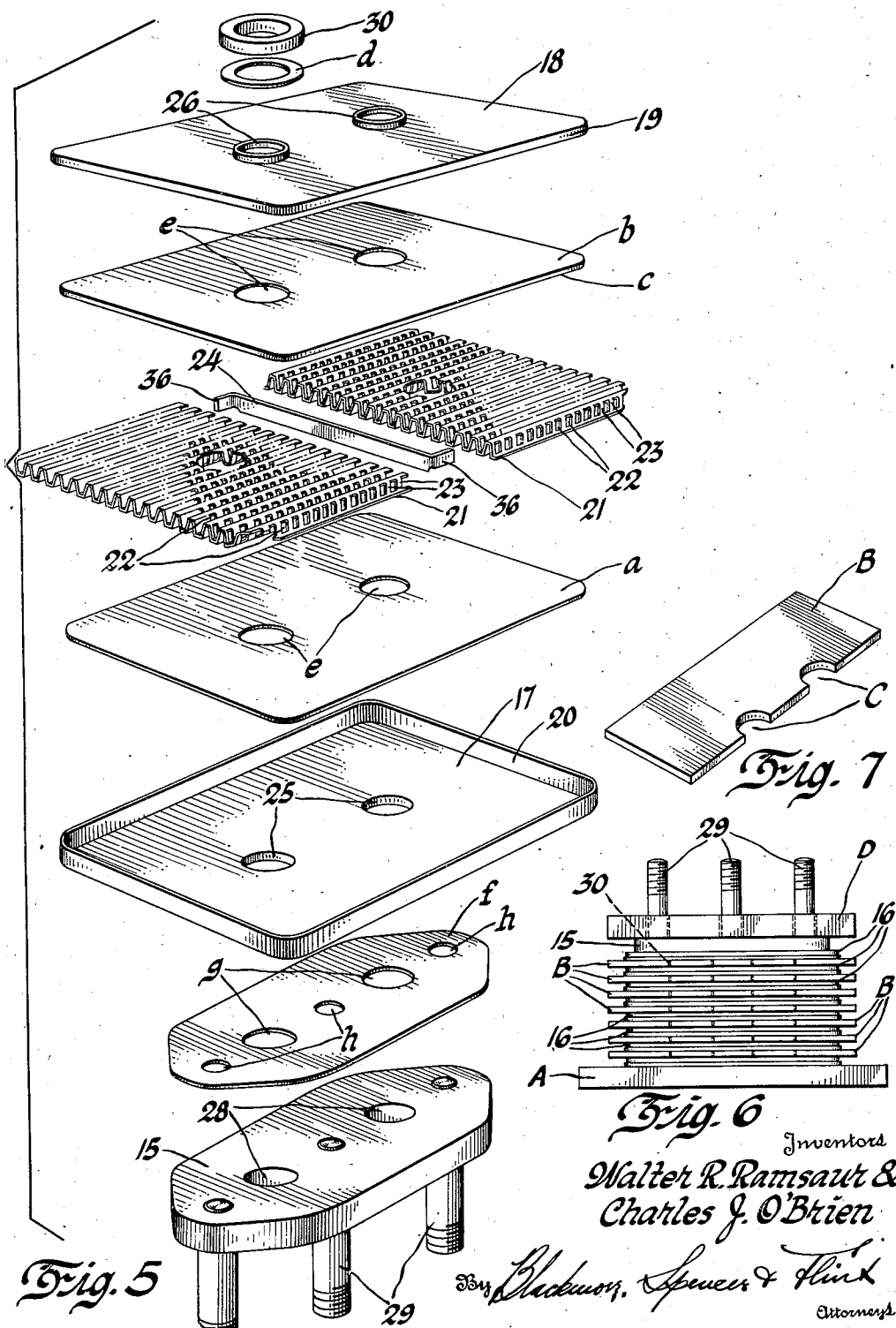
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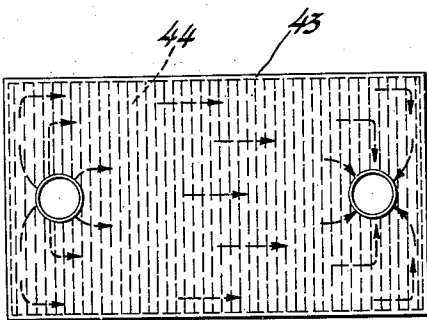
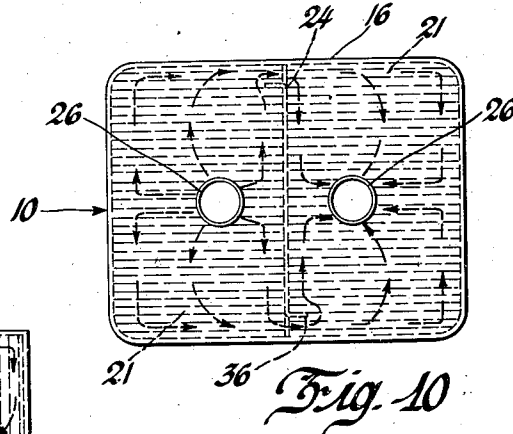
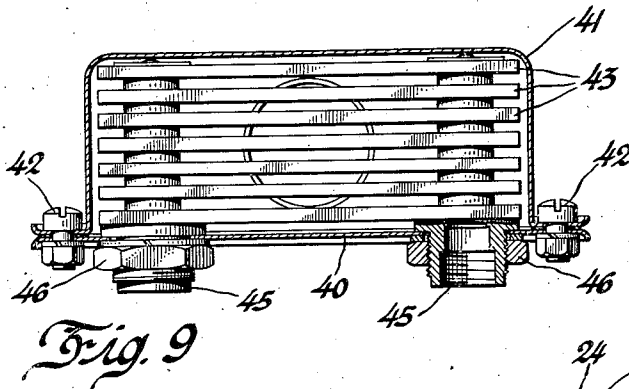
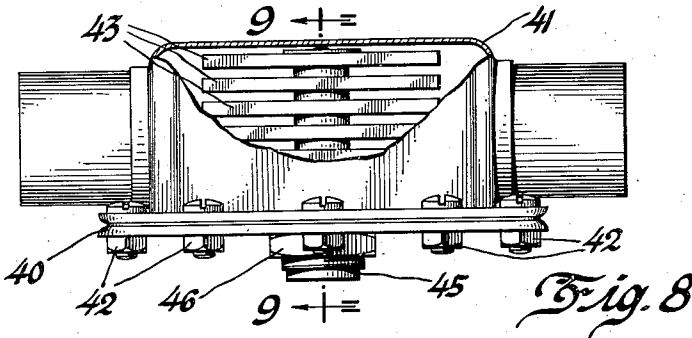
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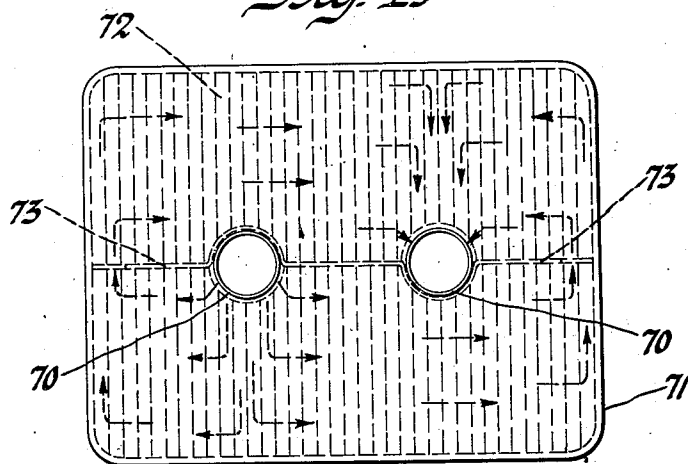
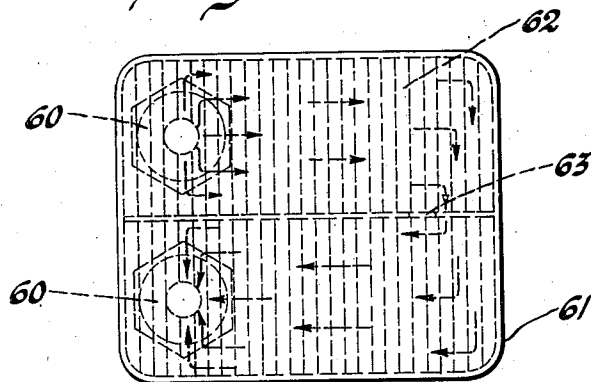
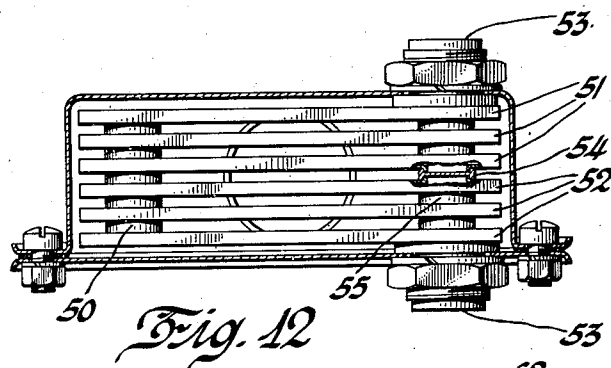
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UNITED STATES PATENT OFFICE

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OIL COOLER

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Application April 13, 1936, Serial No. 73,988

5 Claims. (Cl. 257—245)

This invention relates to heat exchangers and, particularly, to internal combustion engine lubricant temperature regulators which are hereafter referred to as "oil coolers."

One of the objects of the invention is to provide a heat exchanger of high efficiency which is capable of withstanding the temperatures and pressures to which it will be subjected when installed in an internal combustion engine pressure lubricating system and yet is of simple and inexpensive construction and offers little resistance to the passage of lubricant through it.

For a better understanding of the nature and objects of this invention, reference is made to the following specification and the accompanying drawings.

In the accompanying drawings:

Figure 1 shows an oil cooler in which our invention is embodied installed on an internal combustion engine.

Figure 2 is an enlarged view of the oil cooler shown in Figure 1 with parts broken away.

Figure 3 is a view in which the core of the oil cooler shown in the preceding figures is shown in elevation and the case thereof in section on the line 3—3 of Figure 2.

Figure 4 is an enlarged fragmentary view, mainly in section on the line 3—3 of Figure 2.

Figure 5 is an exploded view of elements employed in the manufacture of the core of the oil cooler shown in the preceding figures.

Figure 6 is a view of the elements of the core of the oil cooler shown in the preceding figures assembled in a brazing fixture.

Figure 7 is a perspective view of one of the spacers which constitute parts of the brazing fixture shown in Figure 6.

Figure 8 is a view similar to Figure 2 of another oil cooler.

Figure 9 is a view in which the core of the oil cooler shown in Figure 8 is shown in elevation and the case thereof in section on the line 9—9 of Figure 8.

Figure 10 is a phantom view of a tube of the oil cooler shown in Figures 1 to 4.

Figure 11 is a phantom view of a tube of the oil cooler shown in Figures 8 and 9.

Figure 12 is a view similar to Figures 2 and 8 of a third oil cooler.

Figure 13 is a phantom view of a tube of a fourth oil cooler.

Figure 14 is a phantom view of a tube of a fifth oil cooler.

The oil cooler 10 which is shown in Figures 1 to 4 and 10 consists of a core 11 and a case with-

in which the core is enclosed. The case consists of a sheet metal body 12 and a cast metal cover 13 to which the body is secured by screws 14. In opposite ends of the body 12, there are provided water inlet and outlet openings 31 and 32. In the cover 13, there are provided lubricant inlet and outlet openings 33 and 34. The core consists of a base 15 and a number of flat "tubes" 16 which are preferably made of 30% cupro-nickel and is disposed between the water inlet and outlet openings in the body and connected to the lubricant inlet and outlet openings in the cover of the case. The base 15 consists of a plate of metal, preferably iron, through which extend a pair of openings 28 and in which there are secured three studs 29.

Each of the tubes 16 consists of a generally rectangular tray-like male element 17 and a similar female element 18 whose rim 19 snugly embraces and is metallically bonded to the rim 20 of the male element. Within each tube, there are disposed two corrugated plates 21 which are preferably made of steel and are arranged end to end lengthwise of the tube with their corrugations extending lengthwise of the tube. The corrugations in the plates 21 are approximately rectangular in form and their crests are metallically bonded alternately to the male element and to the female element of the tube. In each side of each corrugation, there are provided a series of openings 22 separated by webs 23 so arranged that the openings in one side of each corrugation register with the webs in the other side thereof crosswise of the plate. Between the two plates 21 in each tube 16, there is located a baffle 24 which consists of a thin strip of metal, preferably steel, whose edges are metallically bonded, respectively, to the male and female elements of the tube. The length of the baffle 24 is considerably less than the width of the tube and its ends are spaced equidistantly from the edges of the tube.

Through the male and female elements of each tube, except the outermost, and the corrugated plates 21 at about the centers of the latter, there extend openings which are encircled by outwardly projecting flanges 25 and 26 on the male and female elements. Corresponding openings are formed in the male element of the outermost tube and in the corrugated plates in it but the female element of the outermost tube is left imperforate and reinforced opposite the openings in the male element and the corrugated plates by discs 27 of the same material as the element metallically bonded to it.

The innermost tube 16 is metallically bonded to

the base 15 with each of the flanges 25 on its male element projecting into one of the openings 28 in the base. Over each of the flanges 25 on the male element of each tube 16 (except the innermost) and over one of the flanges 26 on the female element of the tube immediately between it and the base 16 is sleeved a short length of tubing 30 which is made of the same material as the tubes and metallicity bonded to both.

The core 11 is secured by the studs 29 and nuts 35 to the cover 13 of the case with one of the openings 28 in the base 15 in registration with each of the oil inlet and outlet openings 33 and 34 in the cover.

In manufacturing the core of the oil cooler shown in Figures 1 to 4 and 10, the elements of each tube 16 are formed and assembled in the manner described and illustrated with a sheet *a* of copper foil about 0.002" thick interposed between the corrugated plates 21 and the baffle 24 and the male element and a sheet *b* of copper foil about 0.004" thick on which there is formed a rim *c* interposed between the corrugated plates and the baffle and the female element with its rim interposed between the rims of the male and female elements. In the sheets *a* and *b* which may be formed concurrently with the male and female elements of the tubes or formed separately and then introduced into the elements, there are, of course, provided openings *e* corresponding to the openings in the male and female elements of the tube and the corrugated plates. Then a washer *d* of copper foil about 0.002" thick is impaled on each of the flanges 25 and 26 on the male and female elements of the tube and one of the short lengths of tubing 30 sleeved over each of the flanges 25 and seated on the washer *d* which is impaled on it.

After a number of the tube assemblies described in the next preceding paragraph have been made up, one of the "outermost" tube assemblies is seated "upside down" on a suitable base plate A of stainless steel or other non-brazing heat-resisting metal. Then a pair of spacer plates B of the same material as the base plate are seated on top of the tube assembly with each of the semi-circular notches C partly encircling one of the short lengths of tubing 30 and the notched edges of the plates abutting each other. After this, an "inner" tube assembly is seated on top of the spacer plates B with each of the flanges 26 on its female element projecting into one of the short lengths of tubing 30 which are impaled on the flanges 25 on the male element of the tube on which the spacer plates are seated. The two operations last described are repeated until an assembly of the desired number of tubes has been produced. Then a core base 15 is seated on the uppermost tube of the assembly with one of the openings 28 in the base encircling each of the flanges 25 on the male element of the tube and a sheet *f* of copper foil about 0.002" thick in which there are provided openings *g* corresponding to the openings in the base and openings *h* through which the studs 29 may be inserted interposed between the male element of the tube and the base. After this, a top plate D of the same material as the base plate A and spacer plates B is seated on top of the core base with the studs 29 on the latter extending through openings in the former.

The core assembly in the fixture A-B-D is then transferred to a suitable furnace and heated in an atmosphere of hydrogen and other non-

oxidizing gases until the sheets and washers of copper foil have fused and metallicity bonded the several elements of the core. The tongues 36 on the extremities of the baffle 24 which extend into corrugations in the plates 21 prevent shifting of the baffle prior to the time it is metallicity bonded to the male and female elements of the tube within which it is disposed. The top plate D and the spacer plates B hold the elements of the core assembly firmly together and the spacer plates prevent the tubes being distorted by the weight of the top plate and the spacer plates above them during the brazing operation.

After the sheets and washers of copper foil have fused and metallicity bonded the several elements of the core, the core assembly is removed from the furnace and allowed to cool in the fixture A-B-D. After the core assembly has cooled, the top plate D is removed from it and the spacer plates B are withdrawn from between the tubes 16. The core is then ready for use.

As indicated in Figure 1, the oil cooler 10 shown in Figures 2, 3, 4 and 10 was designed for installation on an internal combustion engine 37 with one of the openings 31 and 32 in the body of the case connected to the discharge side of the engine cooling water pump 38 and the other to the engine water jacket inlet pipe 39 and with one of the openings 33 and 34 in the cover of the case connected to the discharge side of the engine lubricant pump 40 and the other to a pipe 41 which leads to bearings of the engine. When the oil cooler is so installed and the engine is operating, the pump 40 forces lubricant through one of the passages 33 and 34 in the cover 13 into what may be called the oil inlet duct of the core, thence in parallel through the several tubes 16 to what may be called the oil outlet duct of the core, and thence through the other of the passages 33 and 34 into the pipe 41 which leads to bearings of the engine. The terms "oil inlet duct" and "oil outlet duct" used in the next preceding sentence, of course, designate, respectively, the passage which extends from the first and the passage which extends from the last mentioned passage in the cover 13 through the base 15 of the core, the "inner" tubes 16 and the short lengths of tubing 30 into the "outermost" tube 16. In passing from the pump 38 into the pipe 39, the engine cooling water, of course, passes through the case of the oil cooler 10 and around and between the tubes 16 and extracts heat from or gives up heat to the oil within the core of the oil cooler.

The corrugated plates 21, of course, prevent distortion of the tubes 16 by the pressure of the oil within the tubes. They also serve as fins, and, consequently, expedite transfer of heat between the water and the oil. They, furthermore, effect constant subdivision and reunion of the streams of oil flowing through the tubes 16 and cause the streamlets of oil to follow tortuous courses and, consequently, raise the efficiency of the oil cooler. The efficiency of the oil cooler is further increased by the baffle 24 which, as Figure 10 indicates, causes the oil to travel circuitously instead of directly from the oil inlet duct to the oil outlet duct.

It is also to be noted that oil coolers of the type described are much less likely to be ruptured by the strains imposed on them while they are in use than oil coolers of the water tube type with soldered joints which have been used.

The use of oil tubes instead of water tubes reduces the likelihood of rupture as a result of freezing of water within the cooler because it facilitates drainage of water from the cooler and eliminates confinement of the water in spaces with small dimensions. The use of copper instead of solder to bond the several elements of the oil cooler together increases the mechanical strength of the joints and renders them less subject to deterioration by the heat to which they are subjected while the cooler is in use.

The oil coolers shown in Figures 8, 9 and 11, 12, 13 and 14 are generally similar in construction and operation to and may be made by the same general method as the oil cooler shown in Figures 1-4 and 10. Consequently, in describing these oil coolers, we shall in general confine ourselves to pointing out wherein they differ from one of those previously described.

Except in that the cover 40 of the case is of sheet instead of cast metal and is secured to the body 41 by bolts and nuts 42 instead of screws and the core is of somewhat different construction, the oil cooler shown in Figures 8, 9 and 11 does not differ materially from that shown in Figures 1-4 and 10. The core of the oil cooler shown in Figures 8, 9 and 11 differs from that shown in Figures 1-4 and 10 in two respects. One is that each tube 43 contains only a single corrugated plate 44 and the corrugations in this plate extend crosswise instead of lengthwise of the tube and the baffle 24 is, of course, omitted. The other difference is that instead of a base, such as 15, for the core, there are provided two nipples 45 which are connected, respectively, to the oil inlet duct and the oil outlet duct of the core and secured by nuts 46 in openings in the cover 40.

The oil cooler shown in Figure 12 differs materially from that shown in Figures 8, 9 and 11 only in that one of the ducts 50 which extends through the tubes 51 and 52 is closed at both ends and the other 55 is open at both ends and closed between the groups of tubes 51 and 52 by an imperforate disc 54. To each end of the duct 55, there is connected a nipple 53 of which one is secured in an opening in the body and the other in an opening in the cover of the case. The oil cooler shown in Figure 12 is designed to be installed on an internal combustion engine similarly to the oil cooler shown in Figures 1-4 and 10 with one of the nipples 53 connected to the discharge side of the lubricant pump and the other to the pipe which leads to bearings of the engine. The lubricant discharged from the pump, of course, flows in parallel through the tubes 51 (or 52) from the inlet section of the duct 55 to the duct 50 and, thence, in parallel through the tubes 52 (or 51) into the outlet section of the duct 55.

The oil cooler shown in Figure 13 differs materially from that shown in Figures 8, 9 and 11 only in that both of the ducts 60 which extend through the tubes 61 are located near one end of the tubes, that there are in each tube two corrugated plates 62 which are disposed end to end crosswise of the tube and that between the

corrugated plates in each tube there is interposed a baffle 63 which extends from the end of the tube near which the ducts 60 are located to a point near but at a distance from the opposite end of the tube. The baffle 63, of course, causes the oil which enters each tube 61 through the inlet duct 60 to follow the circuitous path indicated by the arrows in order to reach the outlet duct 60.

The oil cooler shown in Figure 14 differs materially from that shown in Figures 8, 9 and 11 only in that the oil inlet and outlet ducts 70 are located farther from the ends of the tubes 71, that there are in each tube two corrugated plates 72 which are disposed end to end crosswise of the tubes and that between the corrugated plate in each tube there is interposed a baffle 73 which extends from near one end to near the opposite end of the tube around one side of the oil inlet duct 70 and the other side 20 of the oil outlet duct 70. The baffle 73, of course, causes the oil which enters each tube from the oil inlet duct 70 to follow the circuitous path indicated by the arrows to reach the oil outlet duct 70.

We claim:

1. In a heat exchanger, a flat tube, a pair of corrugated sheets disposed end to end between the side walls of the tube, and a baffle interposed between the adjacent ends of the corrugated sheets.

2. In a heat exchanger, a case which includes a body and cover, a core which includes a flat tube disposed within the body, the tube having inlet and outlet openings in one of its side walls and a flat mounting plate in which there are provided inlet and outlet openings bonded as a unit to the mentioned side wall of the tube with the inlet and outlet openings therein in registration, respectively, with the inlet and outlet openings in the tube, the cover having in it inlet and outlet openings which register, respectively, with the inlet and outlet openings in the plate and being separately secured to the plate and the body.

3. In a heat exchanger, cooperating plates spaced apart to define a fluid passage, a pair of manifold fluid distributor sheets disposed end to end in the fluid passage between the specified plates, and a baffle interposed between the adjacent ends of the sheets.

4. In a heat exchanger, a flat tube, a pair of corrugated sheets disposed end to end between the side walls of the tube, and a baffle interposed between the adjacent ends of the corrugated sheets with an angularly disposed end projecting into one of the corrugations.

5. In a heat exchanger, a pair of tubes, an orifice encircled by a flange in a wall of one of the tubes, an orifice encircled by a flange in a wall of another of the tubes, and a tubular element which is closed between its ends telescoped around the mentioned flanges and connected to both tubes to space the tubes apart and relieve strain on the flanges.

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