Feb. 7, 1933. L. P. WHITAKER 1,896,502

HEAT EXCHANGER

Original Filed Jan. 31, 1931 2 Sheets-Sheet 1

Fig. 1.

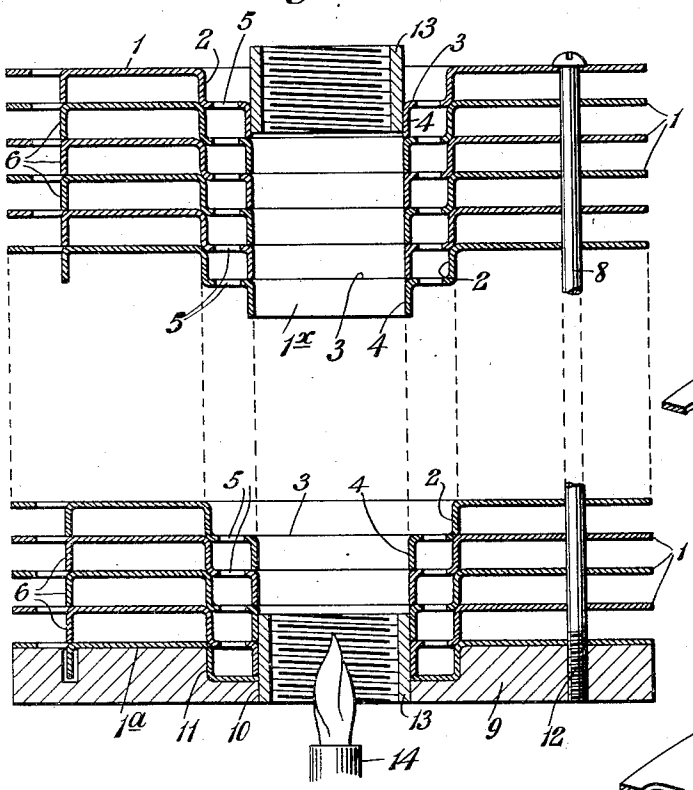
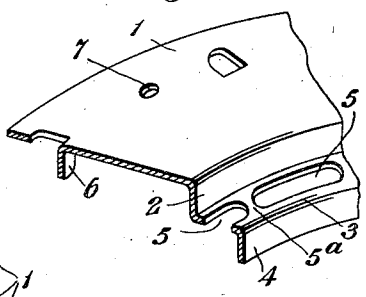


Fig. 3.



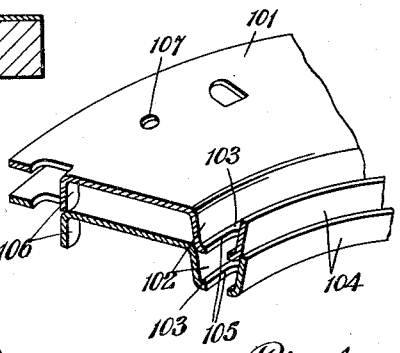
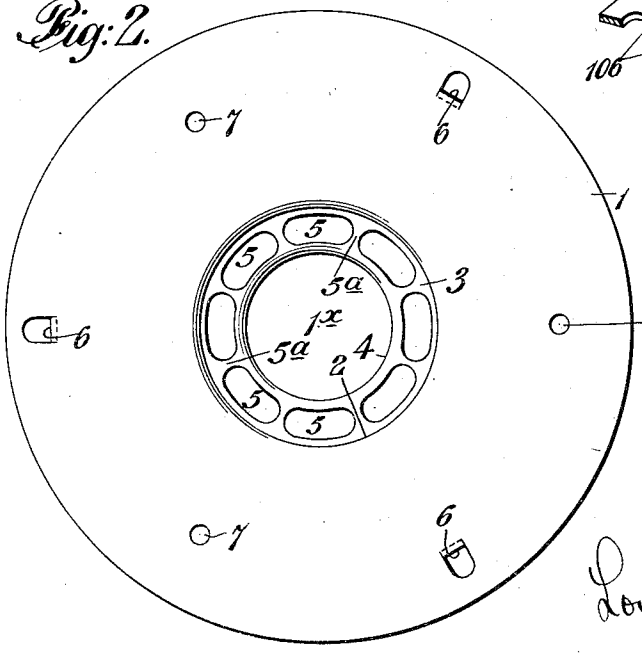


Fig. 4.

Fig. 2.



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Fig: 5.

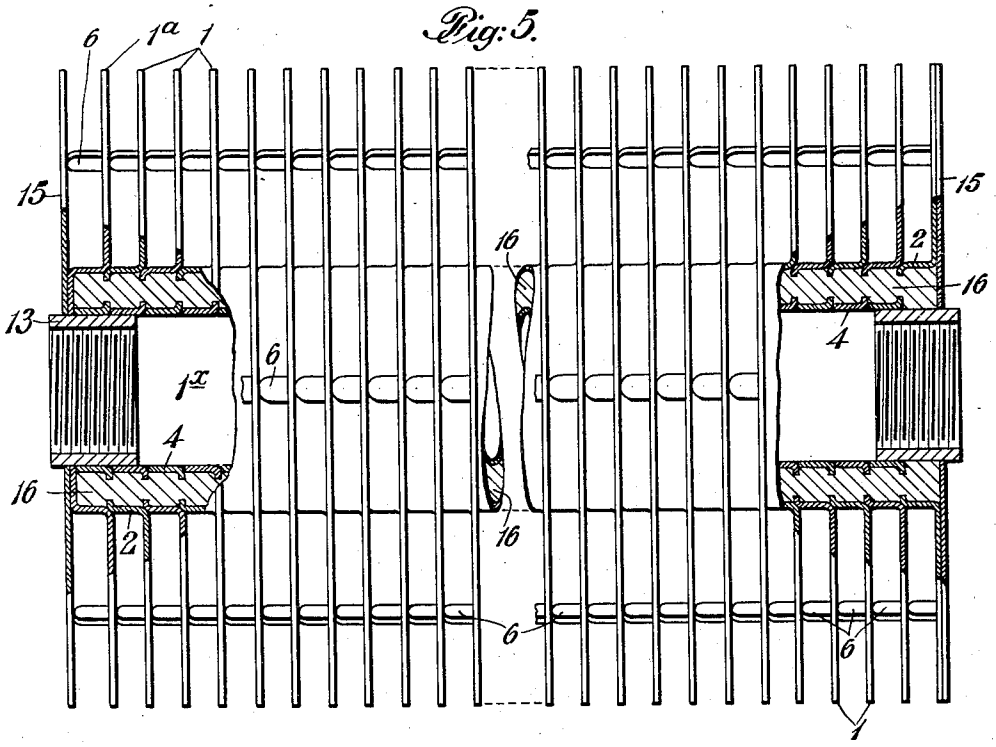


Fig: 6.

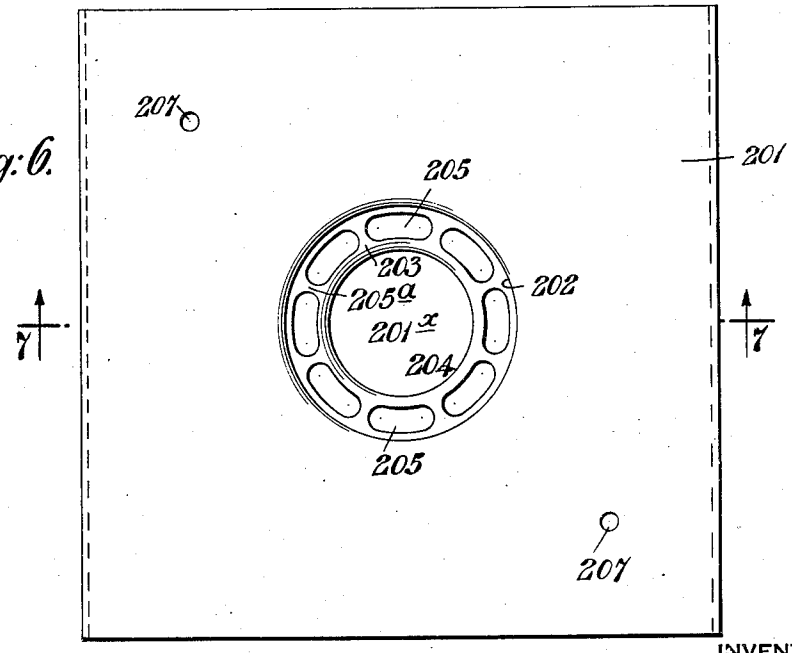
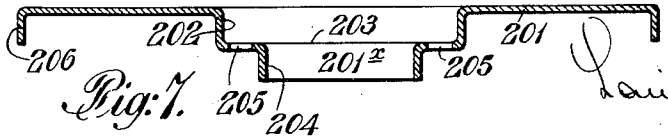


Fig: 7.



INVENTOR

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Patented Feb. 7, 1933

1,896,502

UNITED STATES PATENT OFFICE

LOUIS PREVOST WHITAKER, OF NEW YORK, N. Y., ASSIGNOR TO S. R. DRESSER MANUFACTURING COMPANY, OF BRADFORD, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

HEAT EXCHANGER

Original application filed January 31, 1931, Serial No. 512,576. Divided and this application filed October 10, 1931. Serial No. 568,007.

My invention consists in the novel features hereinafter described, reference being had to the accompanying drawings, which show several embodiments in which my invention may be carried into effect, selected by me for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

My invention is an improved heat exchanger, adapted especially for the transmission of heat in heating or cooling systems. The process which I preferably employ in the manufacture of my improved heat exchangers as hereinafter described, is not claimed herein, as it forms the subject matter of my former application for Letters Patent of the United States, filed January 31, 1931, Serial No. 512,576, of which this application is a division.

Heat exchangers of this kind ordinarily comprise a plurality of fins or plates in spaced parallel relation, and extending in all directions from a fluid conducting passage or conduit with which the fins are united.

In carrying out my present invention I provide a plurality of plates or fins formed of sheet metal, each having an aperture (or apertures) therein surrounded by integral cylindrical flange portions of different diameters, and connected by an annular portion, substantially parallel to the plane of the plate or fin, and provided with apertures formed by cutting away a very large proportion of the metal of said annular flange, leaving separated portions connecting the cylindrical portions. A plurality of said plates or fins are assembled in a built up relation in connection with a suitable support, with the cylindrical portions in registration, and forming inner and outer cylindrical mold walls, between which a suitable casting metal is poured and passes down through the apertures in the annular flanges of the several plates or fins, forming when cooled a cylindrical cast wall between said cylindrical flanges, in which the connecting portions of said annular flanges are interlocked and embedded or fused, and connecting the plates or fins to form a heat exchanging unit. It will be understood that the cylindrical portions of smaller diameter form the inner mold wall, while those of larger diameter form the outer mold wall, thus dispensing, if desired, with the use of mold members conforming to the inner and outer faces of the tubular casting, and leaving the space within the cylindrical flanges of smaller diameter entirely free from one end to the other, and I prefer to heat the interior mold wall so formed, by means such as highly heated air or gases, or products of combustion, or other heating means, during the casting, to assist in insuring the proper flow of the cast metal through the apertures in the annular flanges of the plates or fins, and around the connecting portions thereof. The plates or fins may be held in spaced relation by one or both of the cylindrical portions thereof, and may be provided with stamped-up spacing devices at a distance from the cylindrical portions, if desired. The plates or fins may also be conveniently provided with registering holes to receive connecting bolts for holding them in assembled relation, prior to and during the casting operation, which bolts can be removed after the casting operation. The unit is preferably provided at each end of the tubular wall formed by the inner and outer cylindrical portions and the cast portions therebetween, with internally threaded collars, which may be pressed in position prior to the casting operation or thereafter, and plain end plates may be pressed upon or otherwise secured to the threaded collars, or to the unit, to impart a finish at the ends, if desired.

My invention also comprises certain novel features of construction and combination of parts hereinafter fully described and particularly pointed out in the claims.

Referring to the accompanying drawings,

Fig. 1 is a sectional view, with the central portion omitted and indicated in dotted lines, showing a plurality of plates or fins, assembled in association with a bottom mold member, ready for pouring the casting metal.

Fig. 2 is a plan view of one of the fin plates.

Fig. 3 is a perspective view, partly in section, of a portion of one of the fin plates or fins.

Fig. 4 is a similar view showing two plates

or fins, of a slightly modified form in assembled relation.

Fig. 5 is a side view, partly in section, and partly broken away, of a completed unit, constructed as shown in Figs. 1, 2, and 3.

Fig. 6 is a plan view of another modified form of plate or fin.

Fig. 7 is a sectional view on the line 7—7 of Fig. 6.

In carrying out my invention I form a plurality of plates or fins, 1, one form of which I have indicated in Figs. 1, 2 and 3, and which are preferably pressed or stamped from sheet metal such as copper, aluminum, iron or steel, for example, and which may be circular or rectangular, or of any other desired form. Each plate is preferably provided with a centrally located aperture, 1*x*, and the marginal portions surrounding said apertures are pressed so as to form two cylindrical flanges, 2 and 4, respectively, substantially perpendicular to the plane of the plate, of different diameters, and connected by an annular flange, 3, extending from one cylindrical flange to the other. The flange 2, of greater diameter, extends from the main body of the plate, 1, to the outer edge of the annular flange, 3, and the cylindrical flange 4, extends in the same direction from the inner edge of said annular flange, 3, in the form shown in Figs. 1, 2 and 3, forming annular steps, the cylindrical flanges, 2 and 4, being of the same length axially corresponding with the spacing desired between the plates. The annular flange, 3, is provided with large apertures 5, formed by cutting away a large proportion of the flange, leaving narrow separated portions, 5*a*, connecting the cylindrical flanges, 2 and 4. The plates, 1, are preferably provided with auxiliary spacing elements, located at a distance from the cylindrical portions, and these may be formed by portions of the plate bent perpendicularly thereto, for example, by struck up lugs or projections, 6, as shown in Figs. 1, 2 and 3. The plates, 1, are also preferably provided with a plurality of registering bolt holes, 7, to receive clamping bolts, 8, for holding the plates in assembled relation.

A plurality of these plates sufficient to form a fin unit of desired length, are assembled with the inner and outer cylindrical portions, 2 and 4, in registration, and with their bolt holes, 7, (where these are provided), also in registration, so as to form a built up structure, which is supported in vertical position upon a supporting plate, indicated at 9, provided preferably with a central aperture, 10, of the same diameter as the inner cylindrical flanges of the plates, and having an annular recess, 11, in its upper face, coaxial with said aperture to receive the outer cylindrical flange, 2, and annular flange, 3, of the lowermost plate of the series, indicated at 1*a*, which will preferably be formed with the inner cylindrical flange omitted, or removed therefrom. In Fig. 1, I have shown one of the connecting bolts, 8, extending through the registering bolt holes in the plates and having a threaded portion to engage a threaded aperture, 12, in the supporting plate, 9. Any desired number of connecting bolts may be used as desired, and they will hold the plates in assembled relation as shown in Fig. 1, the inner cylindrical portions, 4, forming a continuous interior mold wall, and the outer cylindrical portions forming a continuous exterior mold wall, the spaces between said mold walls being connected throughout the length of the built up structure by the apertures, 5, in the annular flanges, 3.

In this assembled relation the units can be readily handled and transported from the place of assembly to the place where the casting is to be performed.

As it is usually desirable to connect these units in a system by means of threaded connections, I find it convenient to provide interiorly threaded collars, 13, 13, which may be pressed into the inner cylindrical flanges of one or more of the plates adjacent to each end of the built up unit, as shown in Fig. 1, or they may be secured therein in any other desired way, either before or after the casting operation. It will be seen that in the built up unit the central longitudinal aperture is entirely unobstructed so that any desired heating means can be introduced therein during the casting operation to facilitate the flow of the cast metal and prevent its cooling too soon by contact with the plates. Any desired form of heating means may be employed to maintain the plates, and particularly the inner mold walls, and the adjacent portions of the plates at the desired temperature.

In the drawings I have illustrated, in Fig. 1, a gas burner, 14, located below the supporting plate, 9, and discharging its products of combustion, and if necessary the flame itself upwardly through the central passage within the inner mold walls. This will heat all portions of the plate and will heat the lower plates to a greater extent than those near the upper end, which will first come into contact with the casting metal, thus compensating for the loss of heat in the casting metal as it flows toward the bottom of the mold. I do not limit myself, however, to this form of heating means.

The casting metal may be of any suitable kind. I prefer to employ a casting metal having a lower fusing or melting point than the metal from which the plates are formed. I find it desirable to use aluminum or aluminum alloy, as the casting metal, in which case the plates are conveniently made of copper, sheet iron, or steel, or aluminum alloy of higher melting point than the casting alloy.

The built up structure being supported in substantially vertical position, and heated as before described, the casting metal is poured into the connected annular spaces between the inner and outer mold walls formed by the integral cylindrical flanges of the plates, and around the connecting portions, 5a, of the flanges, 3, as shown at 16 in Fig. 5, and will unite all the plates of the unit into a substantially integral body comprising the central tubular passage, and the spaced radiating fins or plates, the portions, 5a, of which are interlocked in or in some instances fused in the cast metal, 16, which is also united with the inner and outer cylindrical flanges of each plate. A very satisfactory heat exchanger is thus formed, in which the heat is readily and quickly transmitted through the tubular portion to the fins or vice versa. If desired, to add symmetry to the unit, plain end plates, 15, of the same size as the plates or fins, 1, and provided with apertures to engage the collars, 13, may be pressed upon said collars, as shown in Fig. 5, or otherwise secured to the unit.

In Fig. 4 I have shown a modified form of plate in which the parts are indicated by the same reference characters, with the addition of 100. In this figure the plates, 101, are constructed exactly as before described, except that the inner cylindrical flange, 104, of smaller diameter, is bent backward from the annular flange, 103, and lies on the same side of it as the cylindrical portion, 102, of larger diameter. In assembling the plates, these cylindrical portions space the plates and form inner and outer mold walls, as previously described. It will be possible in using this construction also by having the edges of the cylindrical portions, 102 and 104 remote from the annular flange, 103, separated a slightly greater distance than they are at the opposite edges of the flange, 103, and making the flanges, 102 and 104 of slightly greater depth than the auxiliary spacing elements, 106, to slightly "nest" the plates with the channel portion formed by flanges, 102, 103, 104, of one inserted slightly into the channel portion of the adjacent plate, and thus assisting in preventing any escape of casting metal between plates and stiffening the structure. This nesting of the plates is illustrated in Fig. 4, but is not essential to the use of this form of plates.

In Figs. 6 and 7, in which the corresponding parts are given the same reference numerals with the addition of 200, I have shown another modified form of plate, 201, which is rectangular in form and has two opposite edges bent at right angles on the same face of the plate to form auxiliary spacing elements, 206, the other portions of the plate being formed as shown in Fig. 1.

It will be understood that while I have shown a unit in which the plates are provided with a single tubular conducting passage, units may be formed in like manner with two or more tubular passages, if desired. I prefer, however, to form them as shown, as in many instances the comparatively small dimensions of the plates will permit them to be stamped, pressed or formed from scrap plate or other waste material, with corresponding economy of production.

In the formation of the plates or fins it is immaterial so far as my present invention is concerned, whether they are produced by a single stamping or pressing or punching operation, or by a series of successive operations.

While I find it convenient and desirable to apply a heating medium to the cylindrical passage formed by the aligned cylindrical portions of the plates of smaller diameter, and to introduce the heating medium as shown at the lower end of the built up structure and pass it through the cylindrical passage, in a direction opposite to the flow of the casting metal, and during the pouring of the casting metal, as previously described, it is within the scope of my invention to heat the entire built up structure to a desired temperature before the casting metal is poured, and this may be done in any desired way, as by loading the built up structures of plates on suitable conveyors and passing them through a heating oven, for example.

I further desire it to be understood that if desired, the longitudinal passage within the aligned cylindrical plate portions of smaller diameter may be reinforced temporarily by a removable core of sand or other suitable material, although I prefer to keep this central passage open for the introduction of heating medium into said passage. It is also to be understood that the outer mold wall formed by the cylindrical plate portions of larger diameter, may also be temporarily reinforced in suitable manner, if desired, as by packing sand between the outer portions of the plates and in contact with said cylindrical portions of greater diameter, if this should be desired, or temporarily reinforcing or supporting said cylindrical portions in any other desired manner during the casting operation.

It will be understood that in the finished unit the fins or plates, 1, are firmly bonded to the body of cast metal formed between the inner and outer mold walls, and that the substantially radially extending and spaced connecting portions, 6, which unite the cylindrical portions of different diameters of each plate are firmly anchored within or embedded in the body of cast metal. The character of the bond between the cast metal body and these spaced connecting portions of the plates will vary, depending on the character of the metals. For example, the bond may be

formed by the shrinkage of the metal in cooling, in which case the surface will be held in mechanical contact in a manner similar to mechanical clamping. On the other hand, there may be a direct adhesion between the cast metal and the contacting portions of the plates analogous to brazing or soldering, and in some instances, where the cast metal is of the same or nearly the same type as the metal from which the plates are made, there may even be fusion, that is to say, a union analogous to welding between the cast metal and the portions of the plates with which they come in contact. In such cases, however, it would be desirable or necessary to support the inner and outer mold walls formed by the cylindrical portions of different diameters of the plates, during the casting of the tubular portion, in order to prevent said walls from collapsing.

What I claim and desire to secure by Letters Patent is:

1. A heat exchanger comprising a plurality of spaced apertured plates, each provided with cylindrical portions of different diameters coaxial with the aperture in the plate and united by spaced connecting portions, the cylindrical portions of larger and smaller diameter respectively being in substantial alignment, and a cylindrical body of cast metal completely filling the space between the aligned cylindrical portions of different diameters, uniting said plates and having said connecting portions anchored therein.

2. A heat exchanger comprising a plurality of spaced apertured plates, each provided with two integral cylindrical flange portions of different diameters coaxial with the aperture in the plate and connected by an annular flange disposed in a plane parallel to the plane of the main body of the plate and at a distance therefrom, said annular flange being cut away at intervals to form substantially radial connecting portions between said cylindrical flanges, the cylindrical flanges of larger and smaller diameters of said plates being respectively disposed in alignment, and a cylindrical body of cast metal located between the cylindrical portions of larger and smaller diameter connecting said plates and having said radial connecting portions thereof anchored in said cast metal body.

3. A heat exchanger comprising a plurality of spaced apertured plates, each provided with two integral cylindrical flange portions of different diameters coaxial with the aperture in the plate and connected by an annular flange disposed in a plane parallel to the plane of the main body of the plate and at a distance therefrom, said annular flange being cut away at intervals to form substantially radial connecting portions between said cylindrical flanges, said cylindrical flanges lying on opposite sides of said annular flange, the cylindrical flange of said plates of larger and smaller diameter respectively being in alignment, and a cast metal cylindrical wall lying between said flanges of different diameters, connecting all of said plates and having said radial connecting portions anchored therein.

4. A heat exchanger comprising a plurality of spaced apertured plates, each provided with cylindrical portions of different diameters coaxial with the aperture in the plate and united by spaced connecting portions, the cylindrical portions of larger and smaller diameter respectively being in substantial alignment, and a cylindrical body of cast metal between the aligned cylindrical portions of different diameters uniting said plates and having said connecting portions anchored therein, and internally threaded collars inserted within the cylindrical portions of certain of said plates adjacent to each end of the unit, and a face plate at each end of the unit having an aperture coaxial with the said collars and rigidly connected with the unit.

5. A heat exchanger comprising a plurality of spaced apertured plates, each provided with cylindrical portions of different diameters coaxial with the aperture in the plate and united by spaced connecting portions, the cylindrical portions of larger and smaller diameter respectively being in substantial alignment, and a cylindrical body of cast metal between the aligned cylindrical portions of different diameters uniting said plates and having said connecting portions anchored therein, and internally threaded collars inserted within the cylindrical portions of certain of said plates adjacent to each end of the unit, plain end plates provided with apertures for engaging the said collars at the opposite ends of the units and rigidly secured to said collars.

6. A heat exchanger comprising a plurality of spaced apertured plates, each provided with cylindrical portions of different diameters coaxial with the aperture in the plate and united by spaced connecting portions, the cylindrical portions of larger and smaller diameter respectively being in substantially alignment, and a cylindrical body of cast metal between the aligned cylindrical portions of different diameters uniting said plates and having said connecting portions anchored therein, each of said plates being provided with laterally disposed spacing means extending between it and an adjacent plate, and located at a distance from the said cylindrical portions of the plate.

7. A heat exchanger comprising a plurality of spaced parallel apertured plates, each provided with two integral cylindrical portions of different diameters coaxial with the aperture in said plate and united by spaced connecting portions located in a plane paral-

lel with but at a distance from the plane of the main body of the plate, the cylindrical portions of larger and smaller diameter being respectively disposed in alignment, and a cylindrical body of cast metal located between the cylindrical portions of larger and smaller diameter connecting said plates and having said connecting portions thereof anchored in said cast metal body.

8. A heat exchanger comprising a plurality of spaced parallel apertured plates, each provided with two integral cylindrical portions of different diameters coaxial with the aperture in said plate united by spaced connecting portions located in a plane parallel with but at a distance from the plane of the main body of the plate and lying on opposite sides of the plane of said connecting portions, the cylindrical portions of said plates of larger and smaller diameter respectively being in substantial alignment, and a cylindrical body of cast metal located between the cylindrical portions of larger and smaller diameter connecting said plates and having said connecting portions thereof anchored therein.

In testimony whereof I affix my signature.

LOUIS PREVOST WHITAKER.