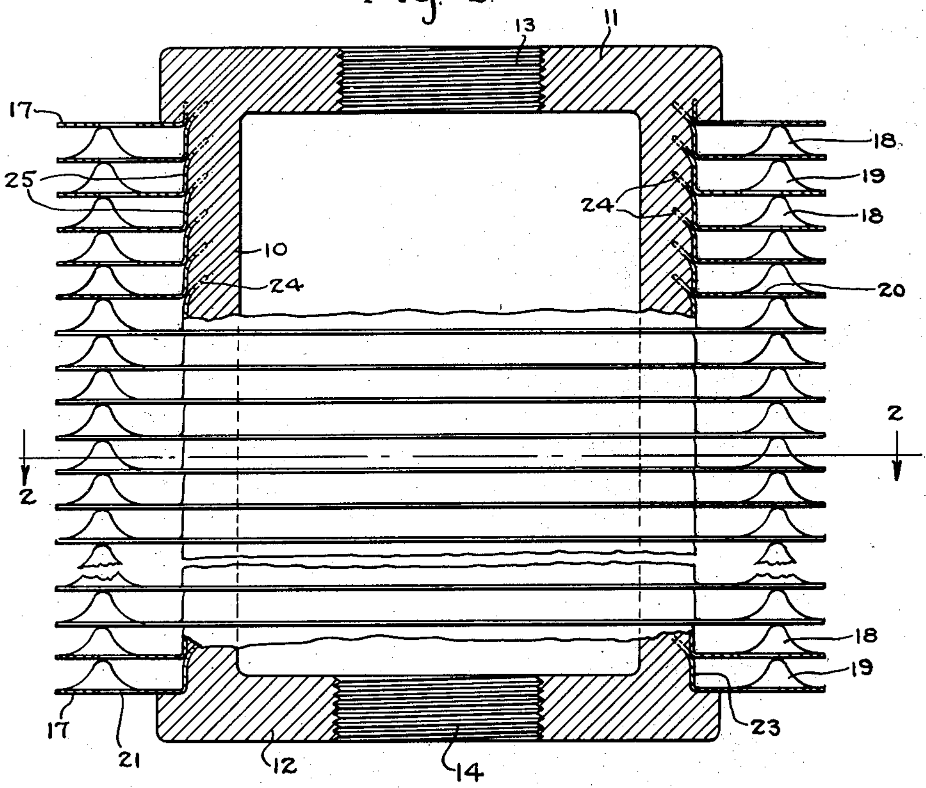
July 17, 1934. J. O. OLSON 1,966,559

HEAT EXCHANGER

Filed Nov. 22, 1930 4 Sheets-Sheet 1

Fig-1.



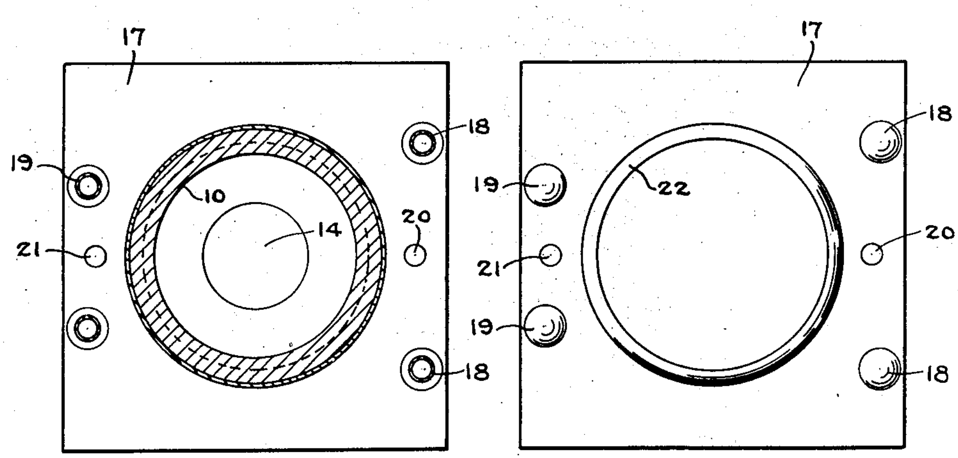


Fig-2. Fig-3

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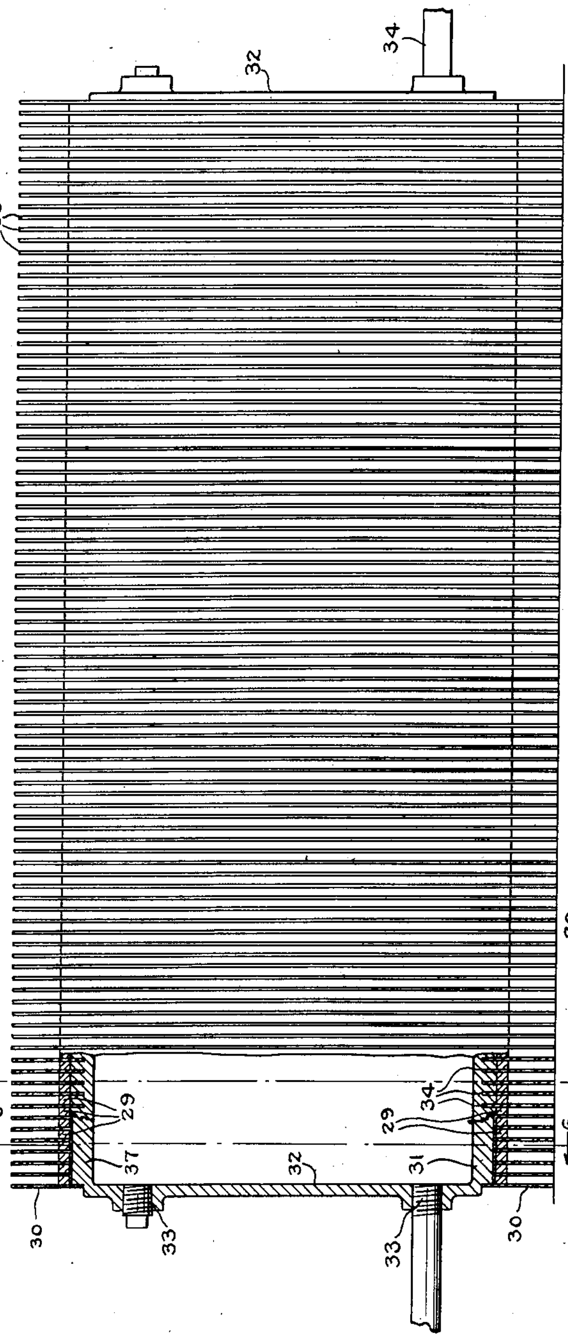

Fig-4

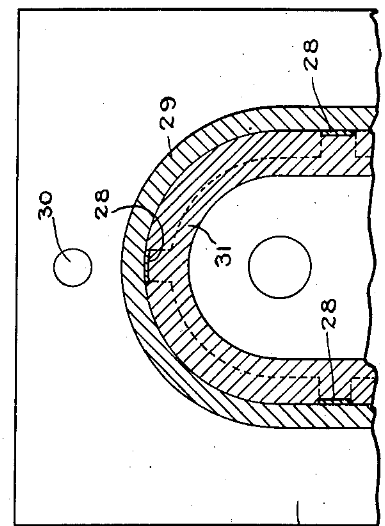

Fig-6

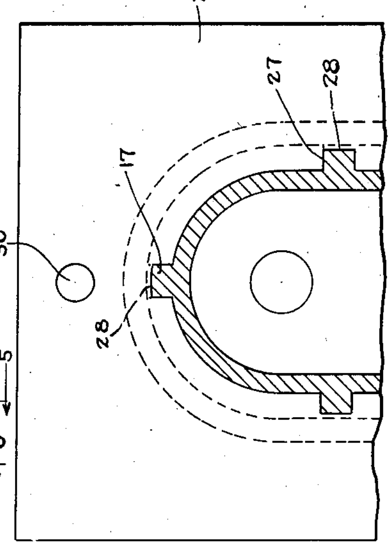

Fig-5

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HEAT EXCHANGER

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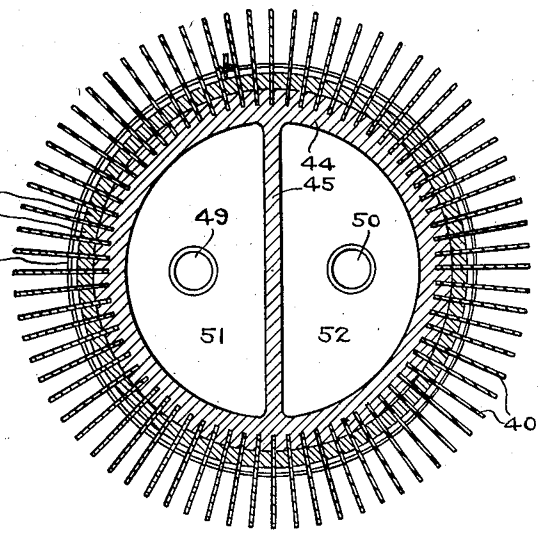
Fig-8



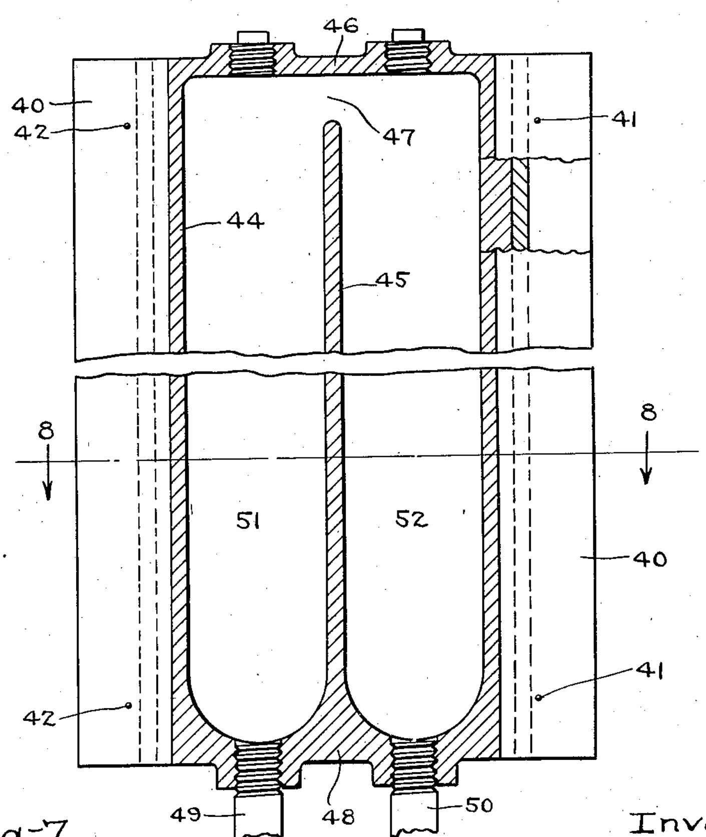


Fig-7

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Fig-9.

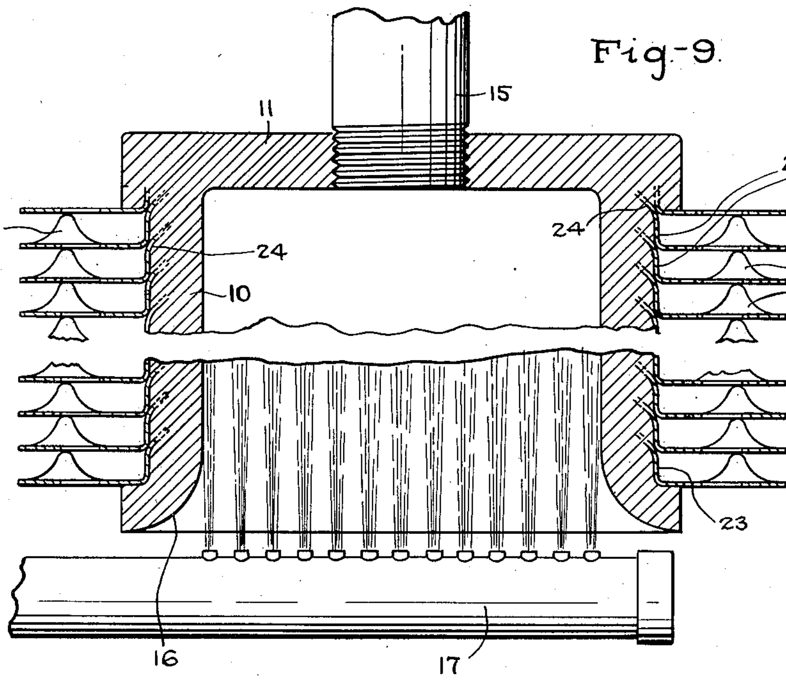
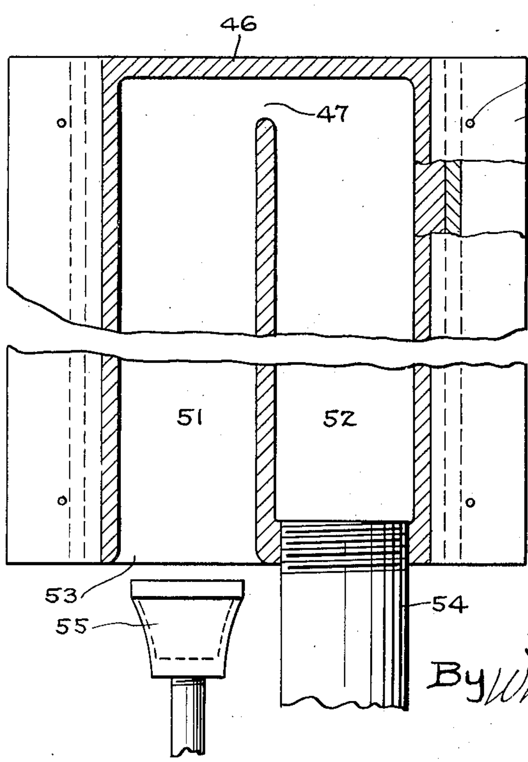


Fig-10.



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Patented July 17, 1934 1,966,559

UNITED STATES PATENT OFFICE

1,966,559

HEAT EXCHANGER

John Otto Olson, St. Paul, Minn.

Application November 22, 1930, Serial No. 497,571

17 Claims. (Cl. 257—248)

My invention relates to new and useful improvements in heat exchangers embodying fin type radiating members. It is the object of my invention to provide a heat exchanger element particularly adapted for direct gas firing but also adapted to use for the transfer of heat from any heating medium to any transfer medium, as air.

It is a principal object of my invention to provide a heat exchanger element having a central core of cast metal in which are embedded and integrated a multiplicity of fins of sheet metal, the free portions of which extend outwardly from the cast metal core and are adapted to engage the medium to which heat is exchanged, as air or water, or other fluid. In carrying out this object the central core may be of any desired shape, either cylindrical, oblong or any other shape wherein there is an enclosed cavity within the casting. The cast metal will comprise the inner layer or portion of this core, and over this is a layer of previously fabricated metal such as sheet metal or metal strips, and the fins pass through the outer layer of previously fabricated metal and into the cast core. Both the outer layer of previously formed metal and the inwardly protruding portions of the fins are integrated with the cast metal core so as to become in effect a part of it. If the cast metal is the same material as the previously fabricated metal and the fins so that each have substantially the same fusing point, there will necessarily be some degree of fusing of said metals with the cast metal which may be made more or less according to the temperature of the cast metal as poured. If, as is contemplated, the previously fabricated metal and the metal of the fins have a higher melting point than the cast metal, there will be firm embedment without fusing. Where there is fusing naturally the edges of the fins which are projected into the cast metal will be most largely fused. Likewise, since in the practice of my invention these edges are laterally spaced one from the other, forming circumferential or longitudinal channels between adjacent pairs, it must necessarily follow that in the expansion of the cast metal as it solidifies there will be a very firm binding and gripping of these portions of fins within the cast metal, resulting in making them substantially integral with the cast metal core.

The above-defined heat exchangers are fabricated in accordance with the process defined in my above-noted patent and also in some specific embodiments in accordance with a process for which application is being made on even date herewith, serial number 497,570.

The full objects and advantages of my invention will appear in connection with the detailed description thereof and the novel features of the invention are particularly pointed out in the claims.

In the drawings illustrating the application of my invention in some of its forms,—

Fig. 1 is a part sectional elevation view of a heat exchanger fabricated in accordance with my above-referred-to later-filed application. Fig. 2 is a sectional plan view on reduced scale on line 2—2 of Fig. 1. Fig. 3 is a plan view on reduced scale of one of the fin plates. Fig. 4 is a side elevation part sectional view of one form of heat exchanger made by the process of my Patent 1,742,556, the sectional part being taken in two planes through the retaining lugs and outside of the lugs respectively. Fig. 5 is a sectional view on line 5—5 of Fig. 4. Fig. 6 is a sectional view on line 6—6 of Fig. 4. Fig. 7 is a sectional elevation view of another form of heat exchanger disclosed in my aforesaid patent. Fig. 8 is a sectional plan view on line 8—8 of Fig. 7. Fig. 9 is a view similar to Fig. 1 showing the heat exchanger adapted to direct gas firing. Fig. 10 is a view similar to Fig. 7 also showing that heat exchanger adapted to gas firing.

As illustrated in Figs. 1, 2, 3 and 9, the heat exchanger comprises a cast metal inner lining having walls 10 which may be circular or of any desired shape in cross-section and a top wall 11 and bottom wall 12 in the form shown in Fig. 1 through which heating medium, as water or steam, is admitted through pipe openings 13, 14. In the form shown in Fig. 9 there will be the top wall 11 and dicharge pipe 15, but no bottom wall, the entire bottom portion of the chamber being open as indicated at 16 to permit direct firing from gas burner 17.

Before the inner shell 10, 11, 12 or 10, 11 is cast a built-up structure of sheet metal plates 17 is provided which in the casting operation forms an outer mold for the cast metal. Each of the plates 17 is provided with set-up studs or nipples 18, 19, as clearly shown in Figs. 1, 2 and 3. The studs 18 and 19 are in pairs on the opposite sides of the plates, studs 18 being more widely spaced than the studs 19. By this means, when the plates are laid one upon the other with the studs 19 of one plate in a plane with the studs 18 of adjacent plates, the plates will be held spaced a requisite distance, and bolts run through apertures 20 and 21 centrally positioned between the studs 18 and 19, respectively, will hold a stack of said plates in fixed and spaced relation. Each plate has its inner margin bent at 22 to form vertical cylindrical portions 23 and it is further bent as indicated at 24 to form inwardly-turned edges which after the metal is cast are embedded in the cast metal, and, where the metal of the plates and of the casting is the same, will be fused into it, as clearly indicated in Fig. 9. If the casting material has a lower fusing point, as, for example, aluminum cast upon steel fin plates, the projecting edge portions 24 will not fuse with the aluminum but will be firmly embedded therein and become substantially integral therewith so as to be highly effective in transmitting heat from the casting to the extended fin plates.

The cylindrical portions 23 vertical with respect to the plane of the plates 17 form in effect a series of spacer members from one plate to another which when the built-up structure is assembled provides a cylindrical skin or layer 25 of previously-fabricated metal surrounding the cast metal inner shell, with the fin plates extending outwardly from said layer of fabricated metal and having portions projected through said layer and anchored in the inner shell of cast metal. The resulting structure, therefore, whether the cast metal and fin plates be of the same fusibility in which case the projections will be fused into the cast metal, as in Fig. 9, or whether they be of different metals in which the plates may be merely firmly anchored in the cast metal, will comprise a shell or layer of previously-fabricated metal surrounding an inner shell of cast metal, with a multiplicity of sheet metal fins extending outwardly from the shell or layer of previously-fabricated metal, and having portions projected through said layer and anchored in the inner shell of cast metal.

Substantially the same result is obtained by the construction shown in Figs. 4, 5 and 6. As shown, fin plates 26 are provided with elongated oval openings and have notches 27 stamped at various points around the interior of that circumference whereby lugs 28 are bent at right angles to the main body of the plates 26. Surrounding these lugs and held in position thereby are a multiplicity of spacer rings 29, clearly shown in longitudinal section in Fig. 6 and in cross section in Fig. 4. Previous to casting the inner shall a multiplicity of fin plates 26 and spacer rings 29 are assembled to produce a built-up structure of previously-fabricated metal of the desired length. Bolts, not shown, which extend through bolt holes 30 (the bolts being removed after casting) hold the built-up structure in assembled position, and there is cast within the shell or layer of built-up metal formed by the spacer rings 29 an inner shell 31 of cast metal having top and bottom walls 32 also of cast metal. These walls may be perforated as indicated at 33 for the reception of steam or hot water inlet pipes and other pipes 34 will carry away the steam or hot water, or if desired one of the walls 32 may be eliminated and direct gas firing applied to the structure, as indicated in Fig. 9. It will be noted that each fin plate will have a portion 34 projected into the cast metal inner shell. These portions 34 will fuse with the cast metal if it is of the same kind of metal as the fin plates or of higher fusing point, and the fin plates will be firmly anchored in the cast metal if it has a lower fusing point.

The spacer elements of the form of construction shown in Figs. 1, 2, 3 and 9, and of Figs. 4, 5 and 6 are circumferential in position and build up the outer layer or shell of previously-fabricated metal by circumferential increments. In the form of the invention shown in Figs. 7, 8 and 10 the spacer elements are longitudinal and the fins extend longitudinally and project radially in all directions from this outer layer or shell of previously-fabricated material. As shown, the fin plates 40 are merely rectangular strips of sheet metal provided with small apertures 41 through which wires 42 extend. Wedge-shaped longitudinal spacer members 43 are provided and the whole is held in assembled position by means of the wires 42, after which an inner shell 44 of metal is cast in the manner disclosed in my aforesaid patent. A preferred construction of this form of the invention casts a dividing web 45 which terminates short of the top casting 46 which is continuous with shell 44, leaving a space 47 between the end of the web 45 and the top member 46. The bottom wall 48 in the form shown in Fig. 7 is provided with inlet and outlet pipes 49 and 50 respectively by which heating fluid such as steam or hot water may be caused to travel through chamber 51, passageway 47 and back down through chamber 52 to discharge pipe 50.

In the form of the invention shown in Fig. 10, the bottom wall 48 is modified so as to leave a free opening 53 to chamber 51 and a pipe discharge 54 from chamber 52 so that a gas burner 55 may be employed for direct firing, the burning gas and products of combustion traveling through chamber 51, passageway 47, chamber 52 and discharging from pipe 54.

In each of the forms above described it will be noted that there is always provided an outer shell or layer of previously-fabricated metal, an inner shell of cast metal and sheet metal fin members having radiating portions extended outwardly from the shell of fabricated metal and other portions projected through said fabricated shell and into the inner shell of cast metal to which they will be firmly anchored and integrated—by actual fusing when the metals have the same fusing point or the cast metal has a higher fusing point than the fin metal.

The advantages of this invention will clearly appear from the foregoing description thereof.

First and primarily, an enormous amount of radiating surface is provided in a very cheap and at the same time strong and efficient construction. It is well-known that the transmission of heat is most effective where it is through a continuous or integral metal body. The fin members are so thoroughly anchored and integrated to the cast metal inner shell that even where there is not actual fusing substantially integral metallic continuity is provided, and actual metal continuity is provided where there is fusing. Moreover, the use of the cast metal inner core, particularly where it is cast iron, makes practical direct firing with a gas flame which does not seriously deteriorate or corrode cast iron, and therefore produces particularly efficient heat exchange.

I claim:

1. A heat exchanger comprising an inner shell of cast metal forming an enclosed chamber, a layer of previously fabricated metal surrounding said shell, and a multiplicity of sheet metal fins

having portions projected through said layer and anchored in the inner shell of cast metal.

2. A heat exchanger comprising an inner shell of cast iron forming an enclosed chamber, a layer of previously fabricated metal surrounding said shell, and a multiplicity of sheet iron fins having portions projected through said layer, and having their inner portions fused into the inner shell of cast iron.

3. A heat exchanger comprising alternating metal fin sheets and metal spacer elements, said fin sheets embodying radiating fins extending outwardly and projections extending inwardly from said spacer elements, and an inner layer of cast metal embracing and being anchored to said inward projections.

4. A heat exchanger comprising a shell of fabricated metal, sheet metal fins having portions extending outwardly from said shell and other portions extending inwardly therefrom, and a layer of cast metal within said shell embracing and anchoring said inward projections.

5. A heat exchanger comprising a shell of fabricated metal, sheet metal fins having portions extending outwardly from said shell and other portions projecting inwardly therefrom, and a cast metal inner portion embracing and anchoring said inward projections adjacent the shell and formed with top and bottom portions to provide an enclosed chamber formed by the cast metal.

6. A heat exchanger comprising a shell of fabricated metal, sheet metal fins having portions extending outwardly from said shell and other portions projecting inwardly therefrom, a cast metal inner portion embracing and anchoring said inward projections adjacent the shell and formed with top and bottom portions to provide an enclosed chamber formed by the cast metal, and means to permit introduction and withdrawal of a heat-conveying medium into and from said chamber.

7. A heat exchanger comprising a multiplicity of fin plates each formed with a central opening and having the edges surrounding said opening bent substantially at right angles to the plate and inwardly, said plates being assembled so that the bent portions form a continuous sheet metal shell from which fins project outwardly and inner portions project inwardly, and an inner lining of cast metal embracing and anchored to said inner projections.

8. A heat exchanger comprising an inner cast metal portion and fin plates having projections extending into said cast metal portion and anchored thereto, each of said fin plates being offset circumferentially from said anchored portions to form jointly an outer layer or shell.

9. A heat exchanger comprising a multiplicity of fin plates, a corresponding number of spacer members extending between the fin plates to form an outer shell or layer of previously-fabricated metal, said fin plates having portions projecting inwardly from said layer, and a cast metal inner shell within said layer of fabricated metal embracing and anchored to said inwardly-projecting portions of the fin plates.

10. A heat exchanger comprising a cast metal inner shell and a cast metal top, said shell having an enlarged opening at the bottom adapted to receive a direct gas flame and an opening through said top to discharge the gas of combustion from said flame, and fin plates having portions forming a layer of metal surrounding said cast metal shell, and having portions thereof extending within and anchored to said cast metal shell.

11. A heat exchanger comprising an elongated body of cast metal forming a closed chamber, a layer or shell of fabricated metal surrounding said body and connected thereto, and a multiplicity of longitudinal fin plates extending outwardly from said layer of fabricated metal and having portions extending through the same and into the cast metal and being anchored thereto.

12. A heat exchanger comprising a cast metal inner portion forming a closed chamber and forming a partition dividing the chamber into two parts with a passageway connecting said parts at one end of the chamber, one of said parts being open at its bottom for receiving directly a gas flame and the other part being connected with a pipe for discharging the gases of combustion, and fin members formed of previously fabricated sheet metal having portions anchored within the body of said inner cast shell.

13. A heat exchanger comprising a shell formed of two layers of contacting and united metal, the inner layer being of cast metal and forming an enclosed chamber and the outer layer being composed of a multiplicity of portions of previously fabricated metal, all contacting and secured to said layer of cast metal, and a corresponding number of sheet metal fins having portions within the layer of fabricated metal projecting into and anchored to the inner shell of cast metal.

14. A heat exchanger comprising a hollow core of cast metal, sheet metal fin members having portions entering and anchored to said core and other portions extending outwardly therefrom, and previously fabricated metal filling the spaces between the fin members and anchored to said cast core.

15. A heat exchanger comprising a hollow core of cast metal, sheet metal fin members having portions entering and anchored to said core and other portions extending outwardly therefrom, previously fabricated metal filling the spaces between the fin members and anchored to said cast core, and means for permitting introduction and withdrawal of a heat-conveying medium into and from the hollow interior of the core.

16. A heat exchanger comprising a multiplicity of fin plates each formed with a central opening, spacer elements for holding said fin plates separated a predetermined distance at said central opening, each spacer element and an adjacent plate being formed integral, said spacer elements and fin plates forming in conjunction a substantially continuous wall, and a cast metal inner shell within and fused upon said wall.

17. A heat exchanger comprising a multiplicity of fin plates each formed with a spacer member, said fin plates and spacer members forming conjointly an outer shell or layer of previously-fabricated metal, and a cast metal inner shell within and fused to said outer shell.

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