June 30, 1931. M. L. BENSON 1,812,509

HEAT EXCHANGER

Filed June 27, 1928 2 Sheets-Sheet 1

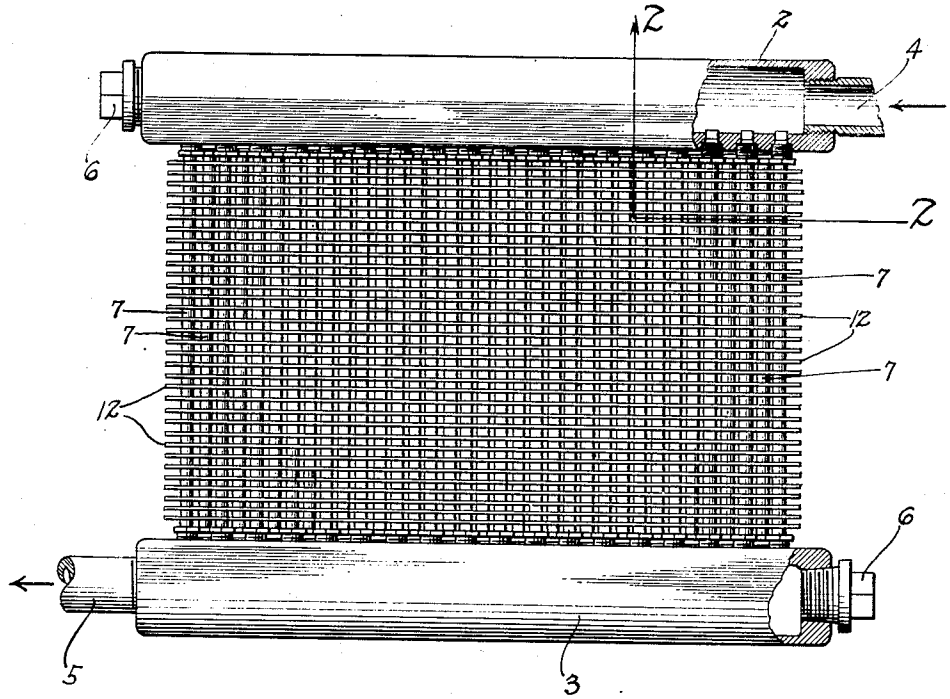



Fig. 1

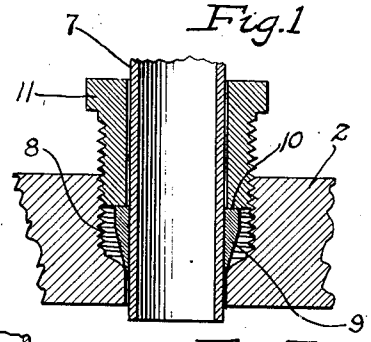



Fig. 3

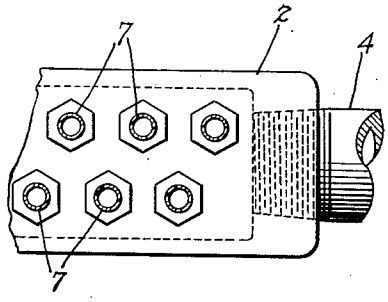



Fig. 2

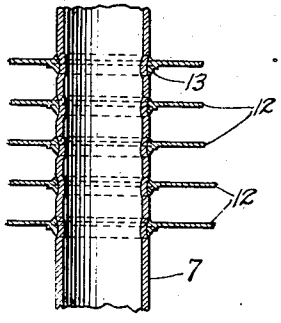



Fig. 5

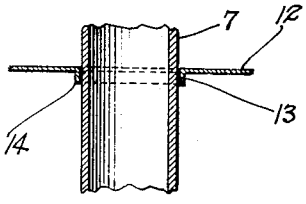



Fig. 4

INVENTOR
MERRILL L. BENSON
By Paul, Paul & Woods
Attorneys

June 30, 1931. M. L. BENSON 1,812,509

HEAT EXCHANGER

Filed June 27, 1928 2 Sheets-Sheet 2

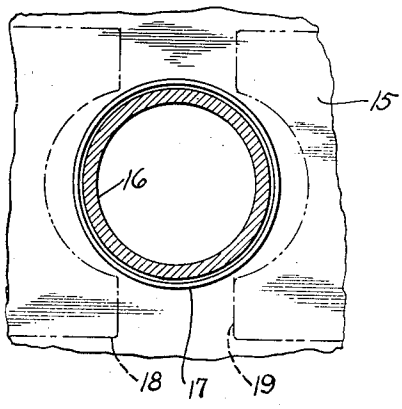



Fig. 6

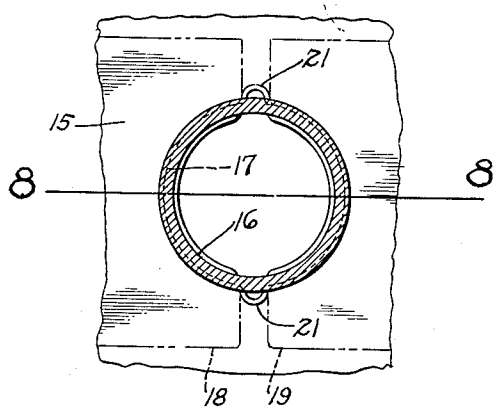



Fig. 7

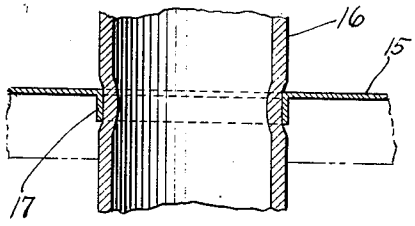



Fig. 8

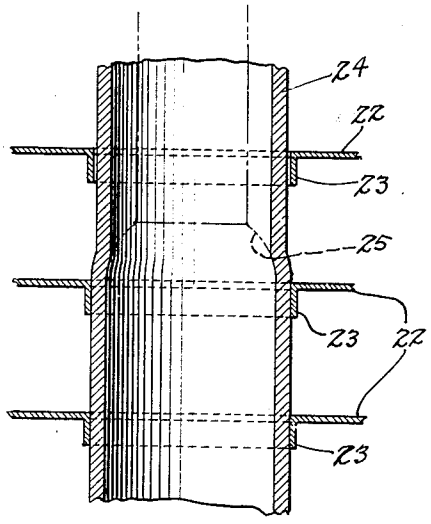



Fig. 9

INVENTOR
MERRILL L. BENSON
By Paul, Paul & Moore
Attorneys

Patented June 30, 1931 1,812,509

# UNITED STATES PATENT OFFICE

MERRILL L. BENSON, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SUPER RADIATOR CORPORATION, OF MINNEAPOLIS, MINNESOTA, A CORPORATION OF MINNESOTA

## HEAT EXCHANGER

Application filed June 27, 1928. Serial No. 288,651.

This invention relates to new and useful improvements in heat exchangers and an object of the invention is to provide such a heater having solderless joints, the heat-radiating plates or fins being conductively secured to the circulation tubes by suitably distorting the walls of the tubes.

A further object of the invention is to provide a heat exhanger comprising spaced headers, each having a plurality of threaded sockets in the walls thereof, each of which is adapted to receive a tapered gland; and a plurality of circulation tubes being interposed between said headers and having their terminals traversing said glands and rigidly secured thereto and to the walls of the headers by means of suitable packing nuts or sleeves received in threaded engagement with the sockets.

A further object is to provide a heat exchanger comprising spaced headers having a plurality of circulation tubes interposed therebetween and secured thereto without the use of solder, and a plurality of heat-radiating plates or fins being mounted in spaced relation upon the tubes and conductively secured thereto by expanding the walls of the tubes, thereby providing solderless joints between the fins and tubes.

A further object is to provide a heat exchanger comprising a plurality of circulation tubes of comparatively small diameter and having spaced heat-radiating plates or fins mounted thereon and conductively secured thereto by distorting the walls of the tubes, and the apertures provided in said fins for receiving the tubes, each being surrounded by an annular flange adapted to engage the walls of the tubes, so that when the tube walls are expanded, the latter will tightly engage the flanges on the fins, thereby rigidly securing the latter to the tubes and at the same time providing efficient heat-conducting joints between fins and tubes.

Other objects of the invention will appear from the following description and accompanying drawings and will be pointed out in the annexed claim.

In the accompanying drawings, there has been disclosed a structure designed to carry out the various objects of the invention, but it is to be understood that the invention is not confined to the exact features shown as various changes may be made within the scope of the claim which follows.

In the accompanying drawings forming part of this specification;

Figure 1 is a side elevation of a unit heater, showing the invention embodied therein;

Figure 2 is a detail sectional view on the line 2—2 of Figure 1;

Figure 3 is an enlarged detail sectional view, showing the means provided in the walls of the headers for securing the tubes thereto;

Figure 4 is a detail sectional view, showing a tube inserted through one of the heat-radiating fins;

Figure 5 is a similar view, showing the annular flanges surrounding the apertures in the fins upset to provide efficient heat-conducting joints between the tube walls and fins;

Figure 6 is a modified view, showing a tube inserted through one of the flanged openings in a heat-radiating fin, the dotted lines indicating dies for contracting the annular flange to press it into tight contact with the walls of the tube;

Figure 7 is a view similar to Figure 6, showing the flange after having been pressed into contact with the walls of the tube by the action of the dies;

Figure 8 is a cross sectional view on the line 8—8 of Figure 7, showing the flange pressed into engagement with the wall of the tube; and

Figure 9 is a view, showing another method of securing the fins to the tube walls.

The novel heat exchanger featured in this invention comprises spaced headers 2 and 3, the former having a supply pipe 4 connected therewith and the latter a return pipe 5, similarly connected therewith. The headers 2 and 3 are preferably of like structure and each has a plug 6 mounted in one end thereof as shown in Figure 1. A plurality of circulation tubes 7 are interposed between the

headers 2 and 3 and communicate with the interiors thereof.

An important feature of the invention which will form the subject-matter of a divisional application resides in the novel means provided for securing the tubes 7 to the walls of the headers. As shown in Figure 3, a plurality of threaded sockets 8 are provided in the wall of each header, and each socket is adapted to receive a tapered gland 9, having an abutment surface 10. These glands are traversed by the terminals of the tubes 7. A suitable threaded sleeve or packing nut 11 is received in threaded engagement with each socket 8 and is adapted to engage the abutment surface 10 of its complementary gland 9 to force it downwardly against the rounded shoulder 20 at the bottom of the socket, whereby the tapered end of the gland is compressed against the walls of the tube mounted therein. These glands and nuts thus provide leak-proof joints between the tubes and the walls of the headers, without the use of solder. Also, by thus securing the tubes to the headers, the latter may readily be removed therefrom, when necessary.

Another important feature of this invention resides in the means provided for conductively connecting the fins 12 to the walls of the tubes 7. Each heat-radiating plate or fin 12 is provided with a plurality of apertures 13 corresponding in diameter and number to the diameter and number of the tubes interposed between the headers 2 and 3. The fins 12 are preferably of a thin heat-conducting metal such, for example, as copper, and the apertures 13 provided therein are formed with flanges 14, as shown in Figure 4. These flanges may extend outwardly from the surfaces of the fins 12 to provide spacers for the fins when mounted upon the tubes. To conductively secure the fins to the tubes, the flanges 13 are preferably upset and compressed against the walls of the tubes, as shown in Figure 5, thereby tightly securing the fins to the walls of the tube to prevent relative movement of the fins thereon, and providing efficient heat-conducting joints between tubes and fins without the use of solder. By thus constructing the entire heater without the use of solder, the manufacturing cost thereof is lowered and at the same time, the efficiency of the heater is increased because of the metal-to-metal contact between fins and tubes, and also between the tubes and headers.

Figures 6, 7, and 8 illustrate another method of securing the fins 15 to the walls of the tubes 16. In the form here shown, the flanges 17, encircling the apertures, provided in the fins 15, are compressed by means of suitable dies 18 and 19, indicated in dotted lines in Figures 4 and 5. These dies are adapted to compress the flanges 17 into contact with the walls of the tube as shown in Figures 7 and 8, small loops 21 being formed in the flanges 17 at opposite sides of the tubes 16, because of the action of the dies 18 and 19.

Figure 9 illustrates another form wherein the fins 22 are provided with similar flanges 23 adapted to be conductively engaged with the walls of the tubes 24, by expanding the tube walls by means of a suitable expanding tool 25, indicated in dotted lines in Figure 7.

I claim as my invention:

A heat exchanger comprising a plurality of tubes, a plurality of relatively thin sheet-like fins disposed in parallel spaced relation, each fin having a plurality of apertures, a flange surrounding each aperture of each fin, each fin having all of the tubes passing through its apertures, each tube being outwardly expanded so that each fin adjacent each aperture is frictionally held to each tube to provide a substantially rigid unitary heat exchanger with the fins, and the interior of each tube throughout that portion of its length surrounded by said fins having a uniform smooth bore to minimize frictional resistance to fluid circulation therethrough.

In witness whereof, I have hereunto set my hand this 23rd day of June, 1928.

MERRILL L. BENSON.