May 28, 1935. J. F. McINTIRE 2,002,904

APPARATUS FOR MAKING RADIATORS

Original Filed Aug. 15, 1932 4 Sheets-Sheet 1

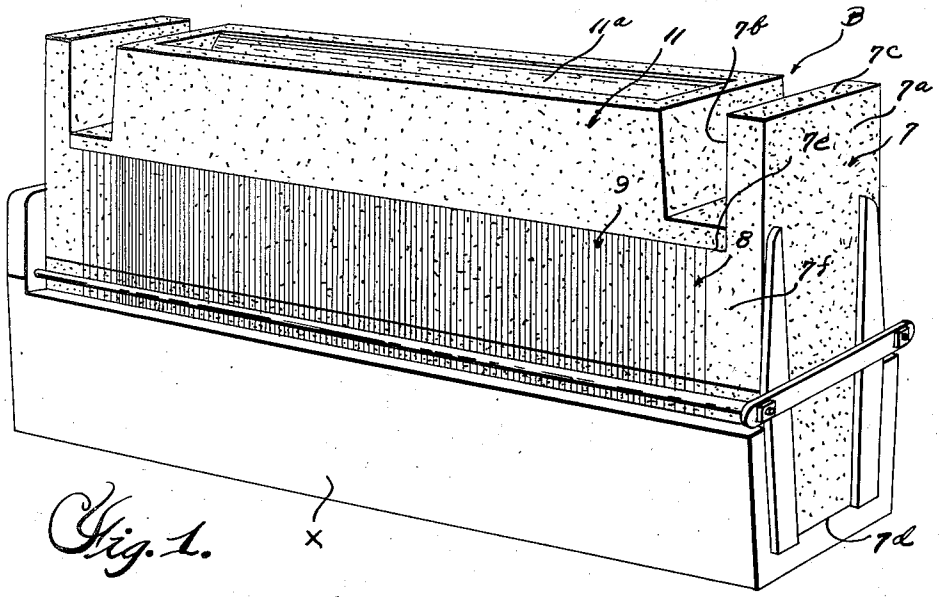


Fig. 1.

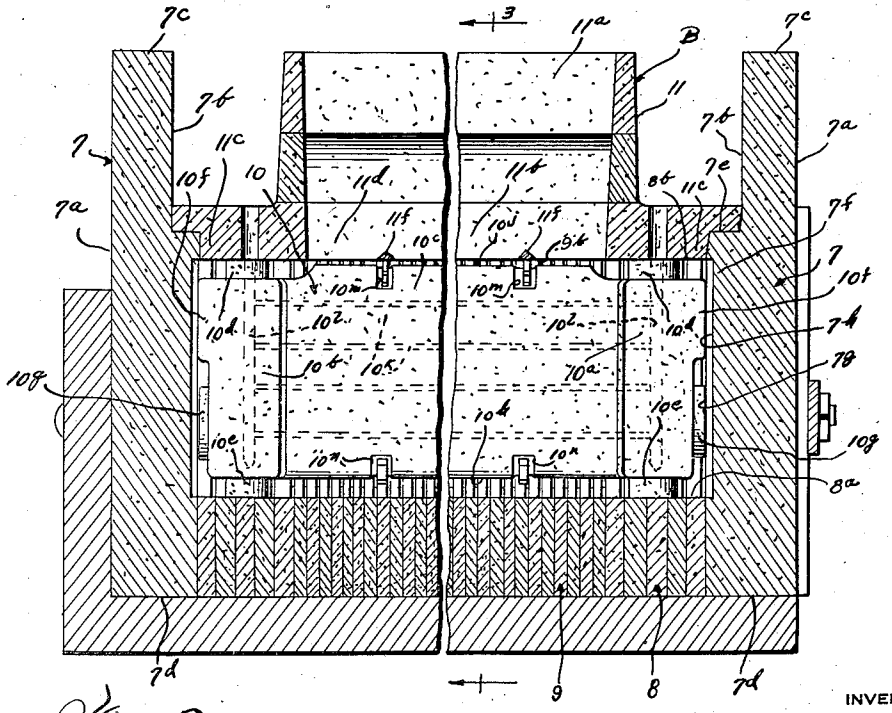


Fig. 2.

INVENTOR

James F. McIntire

BY

Whittemore, Hulbert & Whittemore & Belknap

ATTORNEYS

May 28, 1935. J. F. McINTIRE 2,002,904

APPARATUS FOR MAKING RADIATORS

Original Filed Aug. 15, 1932 4 Sheets-Sheet 2

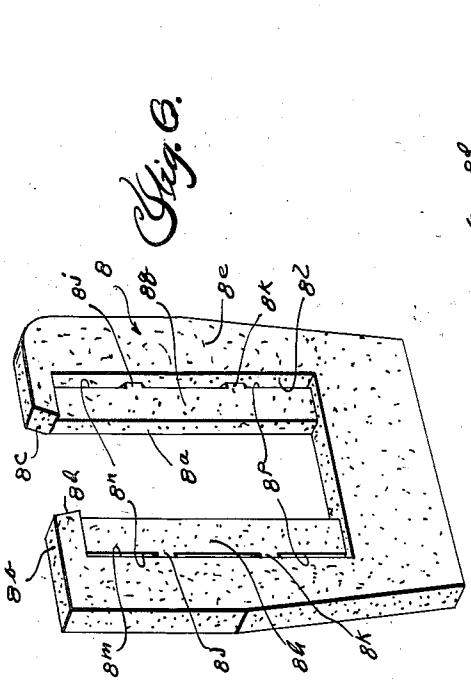


Fig. 6.

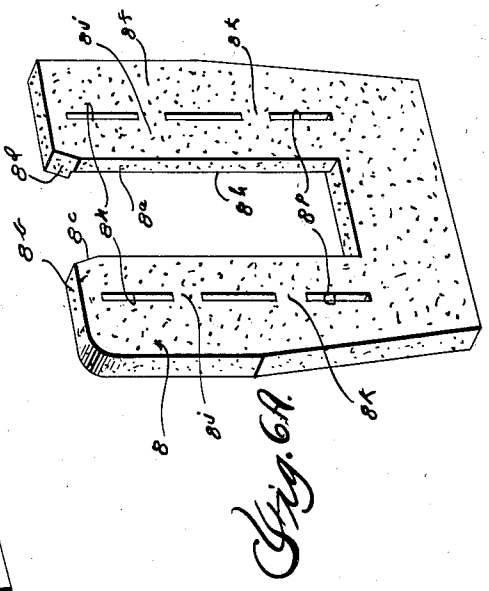


Fig. 6A.

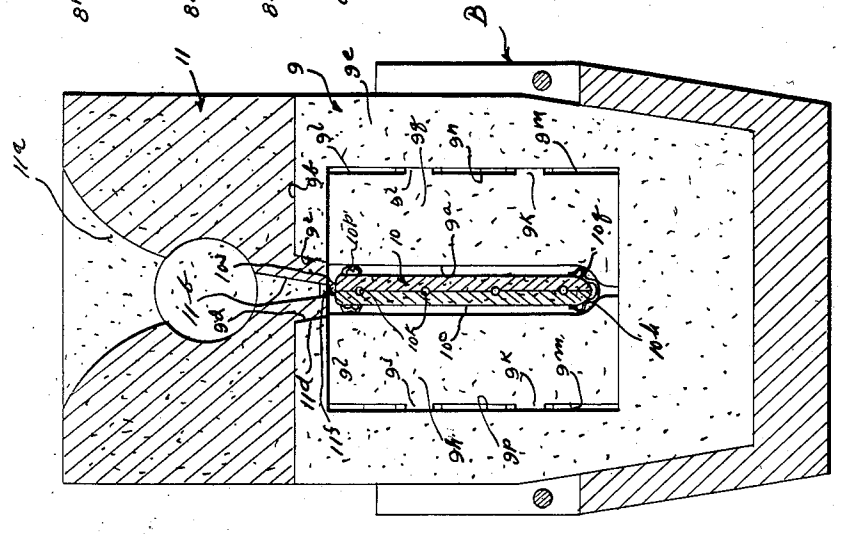


Fig. 3.

INVENTOR
James F. McIntire

BY
Whittemore, Hulbert & Whittemore & Belknap
ATTORNEYS

May 28, 1935. J. F. McINTIRE 2,002,904

APPARATUS FOR MAKING RADIATORS

Original Filed Aug. 15, 1932 4 Sheets-Sheet 3

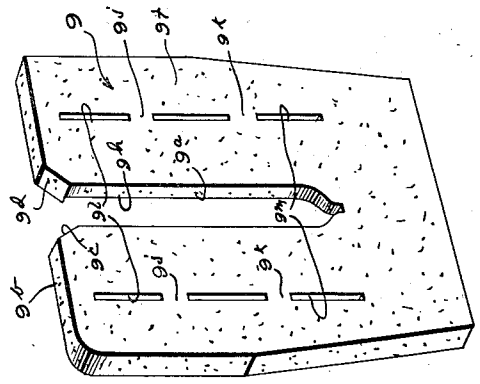


Fig. 7A.

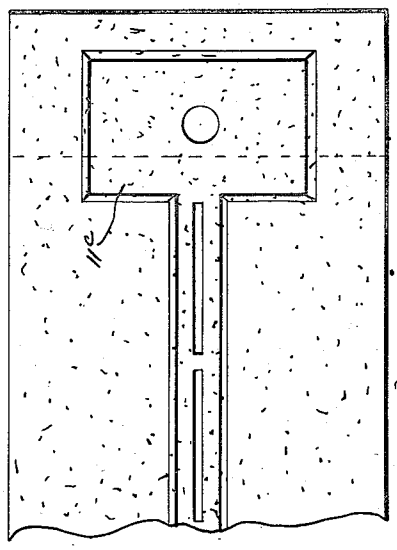


Fig. 8.

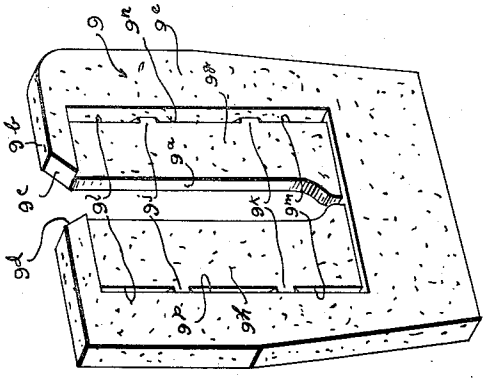
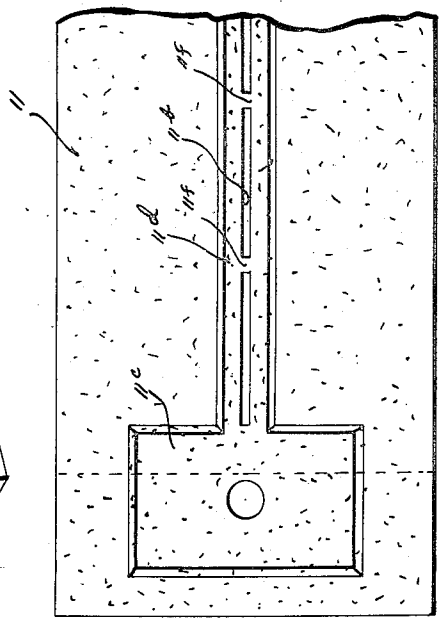


Fig. 7.



INVENTOR
James F. McIntire

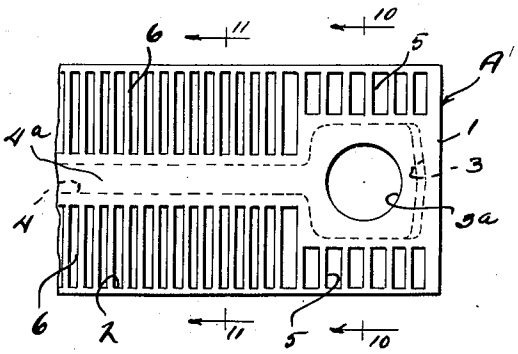
BY
Whittemore Hubbell & Whittemore & Belknap
ATTORNEYS

May 28, 1935. J. F. McINTIRE 2,002,904

APPARATUS FOR MAKING RADIATORS

Original Filed Aug. 15, 1932 4 Sheets-Sheet 4

Fig. 8.



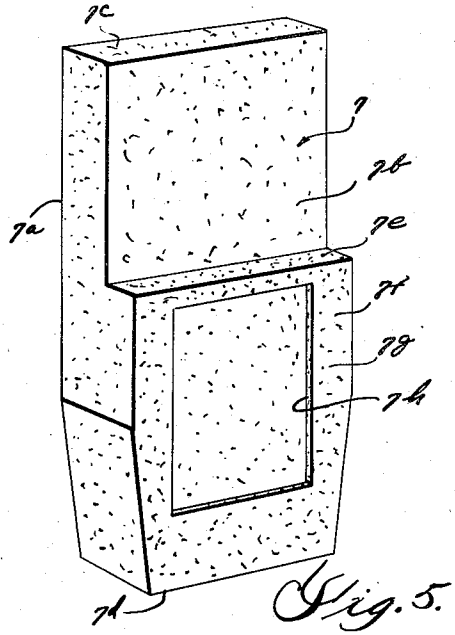
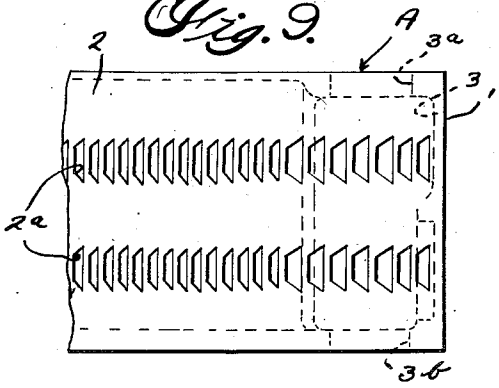


Fig. 5.

Fig. 9.



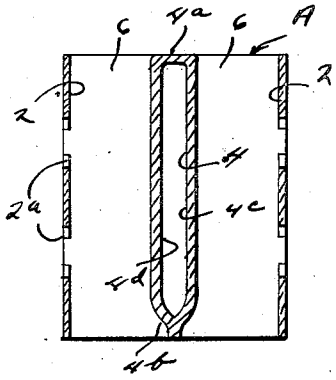
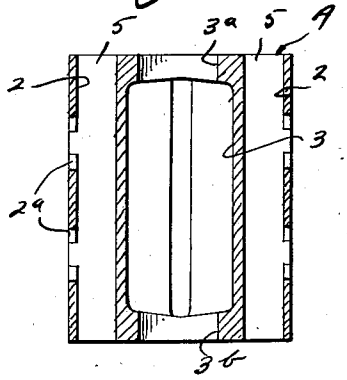


Fig. 11.

Fig. 10.



INVENTOR
James F. McIntire

BY
Whittemore, Hulbert & Whittemore & Belknap

ATTORNEYS

Patented May 28, 1935

2,002,904

UNITED STATES PATENT OFFICE

2,002,904

APPARATUS FOR MAKING RADIATORS

James F. McIntire, Detroit, Mich., assignor to United States Radiator Corporation, Detroit, Mich., a corporation of New York

Original application August 15, 1932, Serial No. 628,950. Divided and this application March 19, 1934, Serial No. 716,421

11 Claims. (Cl. 22—131)

This invention relates generally to the manufacture of radiators and constitutes a division of my application filed August 15, 1932, bearing Serial No. 628,950.

In the accompanying drawings:

Figure 1 is a perspective view of apparatus embodying my invention;

Figure 2 is a fragmentary vertical longitudinal sectional view through the construction illustrated in Figure 1;

Figure 3 is a vertical transverse sectional view taken substantially on the line 3—3 of Figure 2;

Figure 4 is a fragmentary bottom plan view of the cover core illustrated in Figures 2 and 3;

Figure 5 is a perspective view of one of the end cores;

Figures 6 and 6a are perspective views of opposite sides of one of the header cores;

Figures 7 and 7a are perspective views of opposite sides of one of the fin cores;

Figure 8 is a fragmentary top plan view of a radiator formed in the apparatus illustrated in Figures 1 to 7a, inclusive;

Figure 9 is a side elevation of the radiator illustrated in Figure 8;

Figure 10 is a sectional view taken on the line 10—10 of Figure 8;

Figure 11 is a sectional view taken on the line 11—11 of Figure 8.

Referring now to the drawings, A is a radiator of the single fluidway type and B designates generally the apparatus in which such a radiator may be formed. As shown, the radiator A has end walls 1, side walls 2, headers 3, a fluidway 4, and fins 5 and 6 respectively. Preferably the parts are integrally united and form a radiator that has a uniform cross sectional area throughout its length. The end walls 1 are flat and are relatively thick. The side walls 2 are thinner than the end walls and are terminally secured thereto at the outer upright edges thereof. Preferably such side walls 2 are provided at spaced points thereof with openings 2a. The headers 3 are substantially rectangular in shape and are vertically disposed upon the inner sides of the end walls 1 in spaced relation to the side walls 2. Preferably openings 3a and 3b respectively are provided in the headers 3 for the reception of suitable piping (not shown). The fluidway 4 extends between the headers 3 and is disposed substantially midway between and in substantially parallel relation to the side walls 2. The top wall 4a of the fluidway is flat, while the bottom wall 4b thereof is substantially Y-shape in cross section. The side walls 4c and 4d respectively of the fluidway are parallel to each other and to the side walls 2. The fins 6 are located between the headers 3 and project laterally from the sides 4c and 4d of the fluidway to the side walls 2, while the fins 5 are located upon and project laterally from opposite sides of the headers 3 to the side walls 2. Preferably the fins 5 and 6 are relatively thin and are closely spaced in parallel relation to the end walls 1. In this connection it will be noted that the fins are upon opposite sides of the openings 2a and that the latter are arranged in vertically spaced rows extending longitudinally of the radiator. It will also be noted that the upper edges of the end wall 1, side walls 2, fins 5 and 6, top wall 4a of the fluidway and the upper ends of the headers 3 are substantially flush and that the lower edges, walls and ends of said parts are also substantially flush. Thus a very compact and uniform construction is provided.

Preferably end, header, fin, fluidway, and cover dry sand cores 7, 8, 9, 10 and 11, respectively, are employed in the process of manufacturing the radiator just described. As shown, there are two end cores 7 and each preferably comprises a relatively thick upright body or slab having flat outer and stepped inner walls 7a and 7b respectively and flat upper and lower ends 7c and 7d respectively. The steps 7e are flat and constitute the upper edges of plate-like portions 7f of the slabs 7. As shown, each of these portions 7f has a flat face 7g in which substantially square recesses 7h corresponding in shape to the end walls 11 of the radiator are provided for receiving molten metal.

The header cores 8 are arranged in two series, one upon the inner side of each end core 7. As shown, each of the header cores 8 comprises a plate that substantially corresponds in area to the plate-like portions 7f of the end cores. Preferably each core 8 has a vertical substantially rectangular-shaped opening 8a which extends through the upper edge 8b of the core and is provided at its upper ends with flaring edge portions 8c and 8d respectively. The faces 8e and 8f respectively of each core 8 are flat, however, each face 8e is preferably provided upon opposite sides of the opening 8a with recesses 8g and 8h respectively corresponding in area to the fins 6. Webs 8j and 8k corresponding in area to the openings 2a are provided at spaced points of the upright edges 8l and 8m respectively of the recesses 8g and 8h, and slots 8n and 8p respectively corresponding in area to the cross section of the

side walls 2 are provided along said edges 8^l and 8^m above and below the webs 8^j and 8^k.

The fin cores 9 are arranged in series between the two series aforesaid of header cores 8, and each preferably comprises a plate that corresponds in area to a header core 8. As shown, each fin core 9 has a vertical elongated opening 9^a which extends through the upper edges 9^b of each core and is provided at its upper ends with flaring edge portions 9^c and 9^d respectively. The faces 9^e and 9^f respectively of each core plate 9 are flat, however, each face 9^e being preferably provided upon opposite sides of the opening 9^a with recesses 9^g and 9^h respectively corresponding in area to the fins 5. Webs 9^j and 9^k corresponding to the webs 8^j and 8^k, and slots 9^l and 9^m respectively corresponding to the slots 8^n and 8^p are provided along the upright edges 9^n and 9^p respectively of the recesses 9^g and 9^h.

The fluidway core 10 extends between the end cores 7 and preferably has a pair of header portions 10^a and 10^b respectively and an intermediate web portion 10^c. As shown, the header portions 10^a and 10^b are substantially rectangular in configuration and have substantially cylinder prints 10^d and 10^e respectively projecting vertically from the upper and lower ends thereof. These header portions 10^a and 10^b are also provided upon their outer sides with vertically spaced, substantially square and substantially cylinder portions 10^f and 10^g respectively. The web 10^c is relatively thin and merges into the inner sides of the header portions 10^a and 10^b at the centers thereof. The lower edge 10^h of the web 10^c is rounded or substantially U-shape in cross section and is in line with the lower ends of the header portions 10^a and 10^b, while the upper edge 10^j of the web is substantially flat and is located above the upper ends of the header portions. Suitable horizontal and vertical passages 10^k and 10^l respectively are provided in the core 10 to permit the escape of core gases. Adjacent the header portions 10^a and 10^b the web 10^c is provided at the upper and lower edges thereof with recesses 10^m and 10^n respectively which are adapted to receive the spring arms of suitable chaplets 10^p and 10^q.

The cover core 11 is provided longitudinally thereof with a sprue 11^a and a gate 11^b through which the molten metal may flow from the top to the fin, header, fluidway and end cores 9, 8, 10 and 7, respectively. In this instance, the cover core 11 rests upon the steps 7^e of the end cores and upon the upper edges of the fin and header cores 9 and 8. Projecting downwardly from the body of the core 11 at opposite ends thereof are substantially square-shaped portions 11^c that fit within the openings 8^a in the header cores 8, while projecting downwardly from the body of the cover core 11 intermediate said portions 11^c is a rib 11^d that fits within the openings 9^a in the fin cores 9. As shown, the sprue 11^a is in the body of the core 11, while the gate 11^b is in the rib 11^d. Preferably webs 11^f extend across the gate at spaced points thereof for engagement by the chaplets 10^p.

In use, the cores 7, 8 and 9 are assembled and clamped in a suitable rack such as X (see Figure 1). The fluidway core 10 is then placed in the openings 8^a and 9^a respectively in the header and fin cores, and finally the cover core 11 is placed upon the steps 7^e of the end cores and upon the upper edges of the header and fin cores. In this connection, it will be noted that the lower end and opposite sides of certain of the openings 9^a are engaged by the chaplet 10^q, while the opposite sides of certain of the openings 9^a and the lower face of the rib 11^d are engaged by the chaplet 10^p. Thus, the fluidway core 10 is effectively held in position for the pouring of molten metal.

After the parts have been assembled as described, molten metal may be poured into the sprue 11^a and will flow through the gate 11^b into the openings 8^a and 9^a, recesses 7^h, 8^g, 8^h, 9^g and 9^h, and slots 8^n, 8^p, 9^l and 9^m to form the radiator. Thus, it will be apparent that the end walls 1 will be formed in the recesses 7^h in the end cores 7, the side walls 2 will be formed in the slots 8^n, 8^p, 9^l and 9^m in the header and fin cores 8 and 9, the headers 3 and fluidway 4 will be formed in the openings 8^a and 9^a respectively in the header and fin cores, and the fins 5 and 6 will be formed in the recesses 9^g, 9^h, 8^g and 8^h respectively, in the fin and header cores. The cover core 11 cooperates with the end, header and fin cores 7, 8 and 9 respectively, to form the upper ends of the headers 3 and the top wall 4^a of the fluidway.

What I claim as my invention is:

1. A mold for forming a radiator having end and side walls, headers upon the end walls, a fluidway extending between said headers, fins projecting laterally from opposite sides of the fluidway to said side walls, and fins projecting laterally from the headers to said side walls, comprising a longitudinally extending dry sand core having a relatively thin elongated body for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed fin cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said elongated body, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent fin cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, and a cover core extending over the vertical portions of said fin and header cores between said slabs and having depending portions that extend between the vertical portions of the header and fin cores, said cover core having a sprue for molten metal, and one of said depending portions having an opening therein communicating with the sprue and with the space between the vertical portions of said fin cores and forming a gate for the reception of molten metal, the slabs being provided in their inner faces with recesses into which metal may flow to form the end walls aforesaid, the fin cores being provided in horizontal alignment with the recesses just mentioned with recesses into which metal may flow to form the first mentioned fins, the header cores being provided in horizontal alignment with the recesses aforesaid with recesses into which metal may flow to form the last mentioned fins, the bases of the recesses in the fin and header cores being provided at their outer upright edges with aligned slots into which metal may flow to form the side walls aforesaid.

2. A mold for forming a radiator having end and side walls, headers upon the end walls, a fluidway extending between said headers, and

fins projecting laterally from opposite sides of the fluidway to said side walls, comprising a longitudinally extending dry sand core having a relatively thin elongated body for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed fin cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said elongated body, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent fin cores and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided above the fin and header cores with steps, and a cover core extending over the vertical portions of said fin and header cores and resting on said steps, said cover core being provided between the steps with depending portions that extend between the vertical portions of the header and fin cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said fin and header cores and forming a gate for the reception of molten metal, the slabs being provided in their inner faces with recesses into which metal may flow to form the end walls aforesaid, the fin cores being provided in horizontal alignment with said recesses with recesses into which metal may flow to form the fins of the radiator, the bases of the recesses in the fin cores and the header cores being provided substantially in alignment with the outer upright edges of the recesses with aligned slots into which metal may flow to form the side walls of the radiator.

3. A mold for forming a radiator having end and side walls, headers upon the end walls, a fluidway extending between the headers, and fins projecting laterally from the outer sides of the headers to said side walls, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to said enlargements, vertically disposed fin cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent fin cores and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided above the fin and header cores with steps, and a cover core extending over the vertical portions of said fin and header cores and resting on said steps, said cover core being provided between said steps with depending portions that extend between the vertical portions of the header and fin cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said fin and header cores and forming a gate for the reception of molten metal, the slabs being provided in their inner faces with recesses into which metal may flow to form the end walls aforesaid, the header cores being provided in horizontal alignment with the recesses aforesaid with recesses into which metal may flow to form the fins of the radiator, the fin cores and the bases of the recesses in the header cores being provided substantially in alignment with the outer upright edges of the recesses in the slabs with aligned slots into which metal may flow to form the side walls of the radiator.

4. A mold for forming a radiator having end and side walls, headers upon the end walls, a fluidway extending between said headers, fins projecting laterally from opposite sides of the fluidway to said side walls, and fins projecting laterally from the headers to said side walls, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed fin cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent fin cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided above the fin and header cores with steps, and a cover core extending over the vertical portions of said fin and header cores and resting on said steps, said cover core being provided between said steps with depending portions that extend between the vertical portions of the header and fin cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said fin cores and forming a gate for the reception of molten metal, the slabs being provided in their inner faces below said steps with recesses into which metal may flow to form the end walls of the radiator, the fin cores being provided in horizontal alignment with the recesses just mentioned with recesses into which metal may flow to form the first mentioned fins, the header cores being provided in horizontal alignment with the recesses aforesaid with recesses into which metal may flow to form the last mentioned fins, the bases of the recesses in the fin and header cores being provided at their outer upright edges with aligned slots into which metal may flow to form the side walls of the radiator.

5. A mold for forming a radiator having side walls, headers between said side walls at opposite ends thereof, and a fluidway extending between said headers, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed plate-like cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent plate-

like cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided above the fin and header cores with steps, and a cover core extending over the vertical portions of said plate-like and header cores and resting on said steps, said cover core being provided between said steps with depending portions that extend between the vertical portions of the header and plate-like cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said plate-like cores and forming a gate for the reception of molten metal, the plate-like cores and header cores being provided with substantially horizontally aligned slots into which metal may flow to form the side walls of the radiator.

6. A mold for forming a radiator having side walls, headers between said side walls at opposite ends thereof, a fluidway extending between said headers, and fins projecting laterally from opposite sides of said fluidway to said side walls, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed fin cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent fin cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided above the fin and header cores with steps, and a cover core extending over the vertical portions of said fin and header cores and resting on said steps, said cover core being provided between said steps with depending portions that extend between the vertical portions of the header and fin cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said fin cores and forming a gate for the reception of molten metal, the fin cores being provided upon opposite sides of the longitudinally extending core with substantially horizontally aligned recesses into which metal may flow to form the fins of the radiator, the fin cores and header cores being provided with substantially horizontally aligned slots into which metal may flow to form the side walls of the radiator.

7. A mold for forming a radiator having side walls, headers between said side walls at opposite ends thereof, a fluidway extending between said headers, fins projecting laterally from opposite sides of the fluidway to said side walls, and fins projecting laterally from the headers to said side walls, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed fin cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent fin cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided above the fin and header cores with steps, and a cover core extending over the vertical portions of said fin and header cores and resting on said steps, said cover core being provided between the steps with depending portions that extend between the vertical portions of the header and fin cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said fin cores and forming a gate for the reception of molten metal, the fin cores being provided upon opposite sides of the longitudinally extending core with substantially horizontally aligned recesses into which metal may flow to form the first mentioned fins, the header cores being provided in horizontal alignment with the recesses just mentioned with recesses into which metal may flow to form the last mentioned fins, the bases of the recesses in the fin and header cores being provided with aligned slots into which metal may flow to form the side walls of the radiator.

8. A mold for forming a radiator having end and side walls, headers upon the end walls, and a fluidway extending between said headers, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed plate-like cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent plate-like cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided with steps, and a cover core extending over the vertical portions of said plate-like and header cores and resting on said steps, said cover core being provided between said steps with depending portions that extend between the vertical portions of the header and plate-like cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said plate-like cores and forming a gate for the reception of molten metal, the slabs being provided in their inner faces below said steps with recesses into which metal may flow to form the end walls of the radiator, the plate-like cores and header cores being provided with substantially horizontally aligned slots into which metal may flow to form the side walls of the radiator.

9. A mold for forming a radiator having end and side walls, headers upon the end walls, and a fluidway extending between said headers, comprising a longitudinally extending dry sand core for forming the fluidway and having en-

largements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to said enlargements, vertically disposed plate-like cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent plate-like cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, and a cover core extending over the vertical portions of said plate-like and header cores and having depending portions that extend between the vertical portions of the header and plate-like cores, said cover core and one of said depending portions having openings therein communicating with the space between the vertical portions of said plate-like cores and forming a gate for the reception of molten metal, the slabs being provided in their inner faces with recesses into which metal may flow to form the end walls of the radiator, the plate-like cores and header cores being provided with substantially horizontally aligned slots into which metal may flow to form the side walls of the radiator.

10. A mold for forming a radiator having end and side walls, headers upon the end walls, a fluidway extending between said headers, fins projecting laterally from opposite sides of the fluidway to said side walls, and fins projecting laterally from the headers to said side walls, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to the enlargements, vertically disposed fin cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent fin cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, and a cover core extending over the vertical portions of said fin and header cores, said cover core having depending portions that extend between the vertical portions of the header and fin cores, said cover core having a longitudinally extending upwardly opening sprue for molten metal and one of the depending portions of said cover core having a gate for conducting molten metal from the sprue to the space between the vertical portions of said fin cores, the slabs being provided in their inner faces below said steps with recesses into which metal may flow to form the end walls of the radiator, the fin cores being provided in horizontal alignment with the recesses just mentioned with recesses into which metal may flow to form the first mentioned fins, the header cores being provided in horizontal alignment with the recesses aforesaid with recesses into which metal may flow to form the last mentioned fins, the bases of the recesses in the fin and header cores being provided with aligned slots into which metal may flow to form the side walls of the radiator.

11. A mold for forming a radiator having end and side walls, headers upon the end walls, and a fluidway extending between said headers, comprising a longitudinally extending dry sand core for forming the fluidway and having enlargements at opposite ends thereof for forming the headers, and a casing for said core comprising slabs at opposite ends of said core in spaced relation to said enlargements, vertically disposed plate-like cores arranged one against the other in a row between said enlargements and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said longitudinally extending core, vertically disposed header cores arranged one against the other in rows between the slabs and the adjacent plate-like cores aforesaid and having substantially horizontal and vertical portions respectively spaced beneath and upon opposite sides of said enlargements, said slabs being provided with steps, and a cover core extending over the vertical portions of said plate-like and header cores and resting on said steps, said cover core being provided between said steps with depending portions that extend between the vertical portions of the header and plate-like cores and being provided longitudinally thereof with an upwardly opening sprue and a downwardly opening gate through which molten metal may flow into said casing about the longitudinally extending dry sand core aforesaid, the slabs being provided in their inner faces below said steps with recesses into which metal may flow to form the end walls of the radiator, the plate-like cores and header cores being provided with substantially horizontally aligned slots into which metal may flow to form the side walls of the radiator.

JAMES F. McINTIRE.