

No. 821,422.

PATENTED MAY 22, 1906.

D McR. LIVINGSTON.  
COOLING APPARATUS.  
APPLICATION FILED AUG. 12, 1904.

2 SHEETS—SHEET 1.

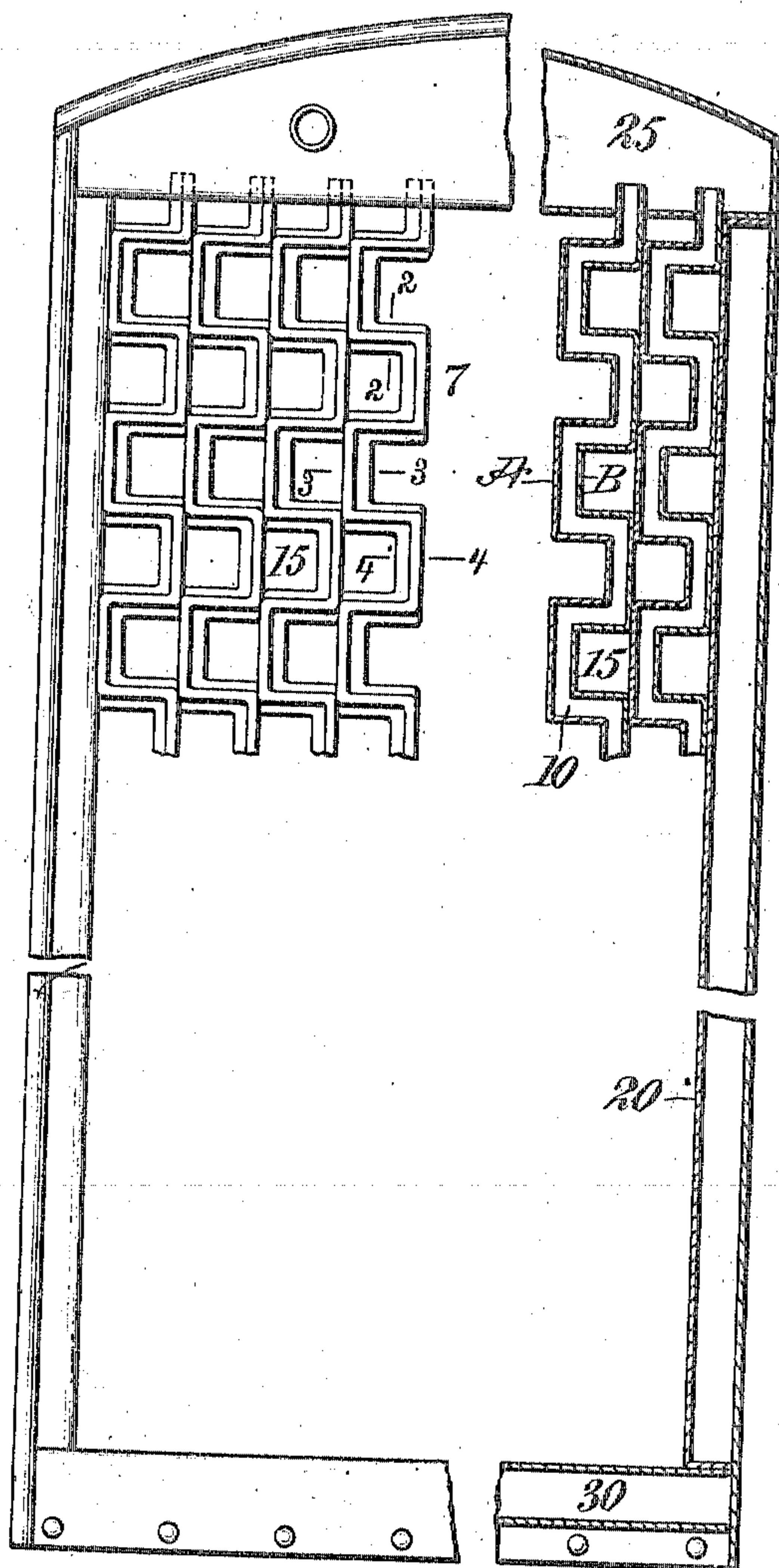
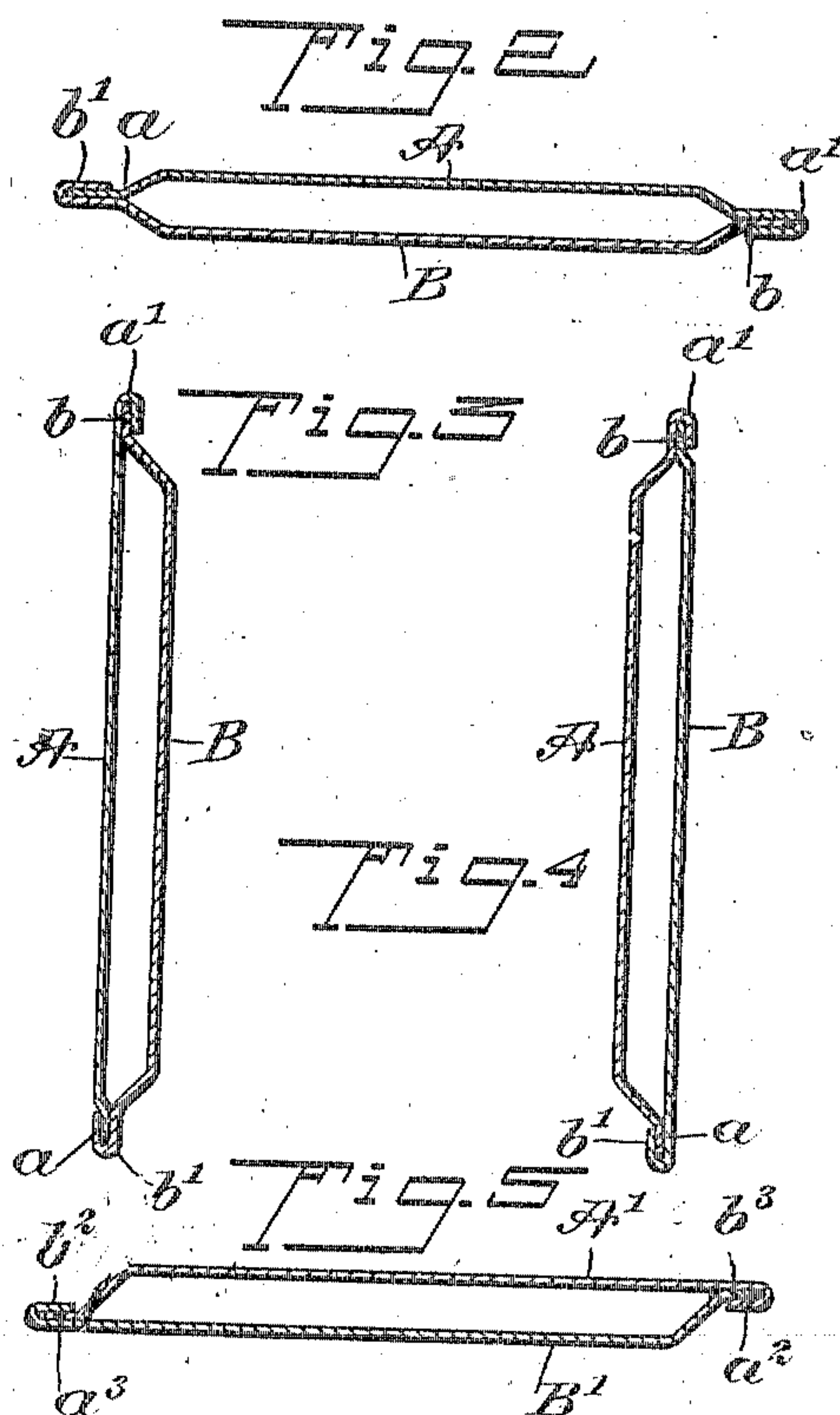


Fig. 1



WITNESSES:

J. A. Propoy  
J. R. W. Culiff

INVENTOR

D McRa Livingston

BY

Wm. M. S.  
ATTORNEYS

No. 821,422.

PATENTED MAY 22, 1906.

D McR. LIVINGSTON.  
COOLING APPARATUS.  
APPLICATION FILED AUG. 12, 1904.

2 SHEETS—SHEET 2.

Fig 6

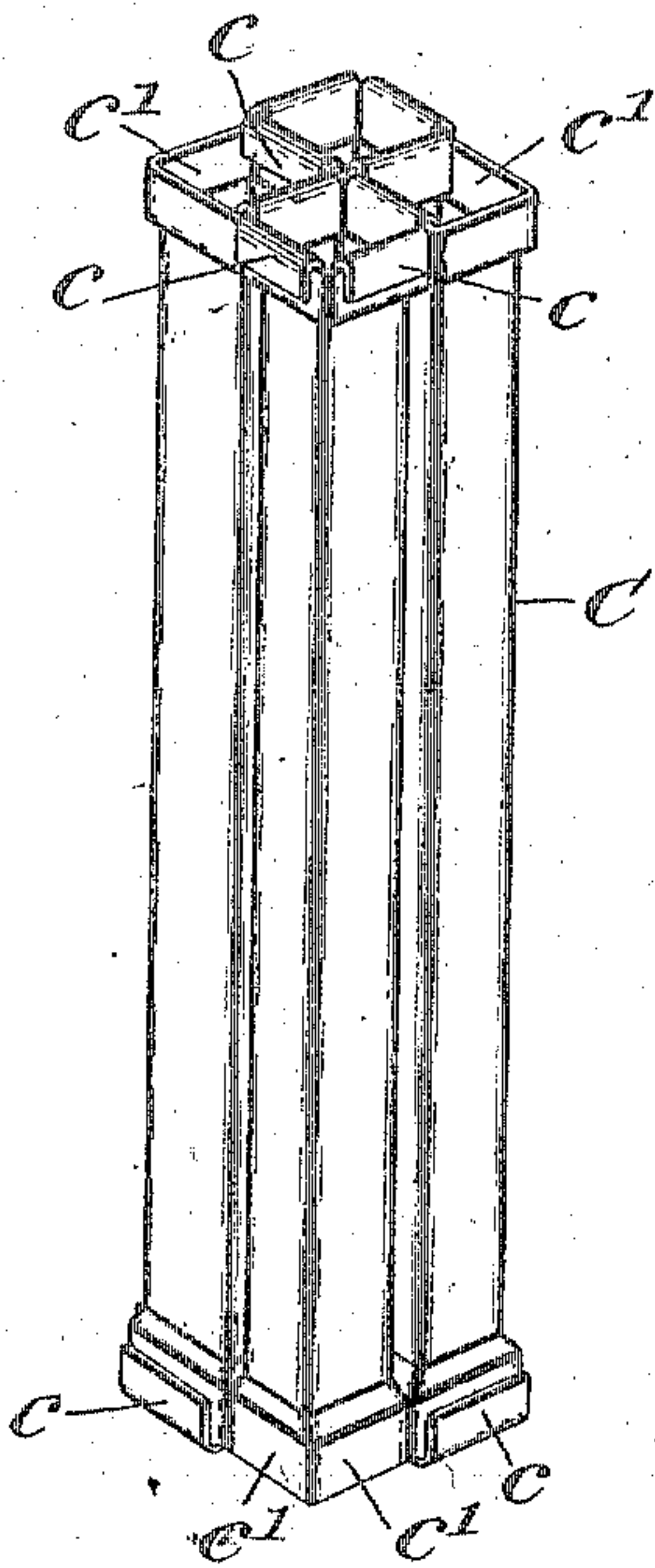
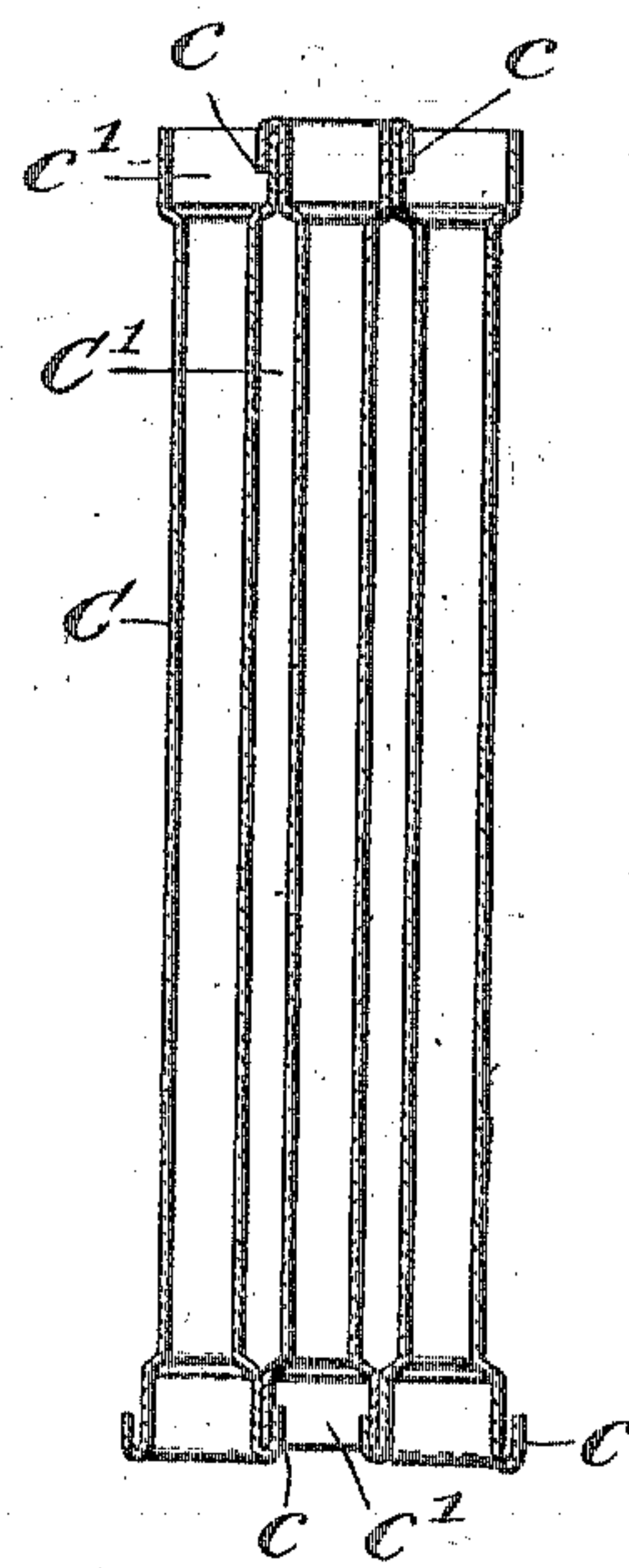


Fig 7



WITNESSES:

J. A. Propoy  
J. L. McCallister

INVENTOR

D McR. Livingston

BY

Mumford  
ATTORNEYS



# UNITED STATES PATENT OFFICE.

D McRA LIVINGSTON, OF NEW YORK, N. Y.

## COOLING APPARATUS.

No. 821,422.

Specification of Letters Patent.

Patented May 22, 1906.

Application filed August 12, 1904. Serial No. 220,505.

*To all whom it may concern:*

Be it known that I, D McRA LIVINGSTON, a citizen of the United States, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Cooling or Condensing Apparatus, of which the following is a full, clear, and exact description.

My invention relates more particularly to the cooling apparatus employed in connection with motor-vehicles propelled by explosive-engines. It will be understood, however, that the invention has a wider field of usefulness and may be embodied in a condenser or in a heating apparatus. In coolers of this character walls are provided having such a conformation and such a relation to each other as to produce when assembled conduits for the passage of the water or other fluid to be cooled and passages at approximately right angles to the conduits for the passage of atmospheric air or other cooling fluid.

In the manufacture of coolers for the stated purpose the walls referred to are in practice usually united by solder alone at their end edges because the walls have an irregular shape and their relation to each other is such as to make entirely impracticable the formation of such a joint as a lock-joint. The very severe strains to which the cooler is subjected by the jarring of the vehicle produces a separation of the walls, and leakage of the fluid results.

The object of my invention is to provide walls of such a form as to enable them to be assembled and interengaged with each other at the joints.

The invention will be particularly described hereinafter and then defined in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar reference characters indicate corresponding parts in all the figures.

Figure 1 is an elevation, partly in section and with part broken away, of a cooling or condensing apparatus constructed in accordance with my invention. Fig. 2 is an enlarged cross-section taken on the line 2 2 of Fig. 1. Fig. 3 represents an enlarged detail section taken on the line 3 3 of Fig. 1. Fig. 4 represents an enlarged detail section taken on line 4 4 of Fig. 1. Fig. 5 is a cross-sectional view similar to the section shown in Figs. 3

and 4, but illustrating a slight modification. Fig. 6 is a perspective view of a portion of a cooler of a different form and showing the application of my invention thereto, and Fig. 7 is a longitudinal sectional view of the form of cooler shown in Fig. 6.

Referring more particularly to Fig. 1, walls A B are provided, forming the conduits 10 for the fluid to be cooled and transverse passages 15 therebetween for the passage of air or the like, these walls being mounted in a frame 20 and the conduits communicating at their top and bottom in practice with connecting-chambers 25 and 30.

The detail construction of the cooler shown in Fig. 1 is more particularly described in Letters Patent granted to me August 16, 1904, No. 767,903.

It will be observed that the walls are corrugated and at the edges the juxtaposed walls of two adjacent conduits extend in close relation to each other, as indicated at the left of Fig. 1. In describing the construction shown in Fig. 1 I will refer to the walls as "plates," since they are formed by plates as distinguished from complete tubes. It is evident that with two adjacent plates forming the walls and serving to produce the conduits and passages referred to if the assemblage of the plates takes place before the plates are corrugated the conduit could not subsequently be corrugated, since the opposing plates would crush together. Therefore it is the custom to corrugate the plates before assembling; but the irregular formation of the plates by ordinary methods precludes the production of an interengagement or a locking of the plates with each other after the same have been corrugated. Hence the meeting edges of the two adjacent plates forming a conduit are simply soldered in practice.

By my present invention I am enabled to produce an interlocking of the plates notwithstanding the latter are corrugated. Thus, referring to Figs. 2, 3, and 4, it will be observed that a plate A has at one end a plane edge *a* and at the opposite end a hook or return-bend *a'*. Similarly a plate B has a plane edge *b* and at the opposite end a return-bend or hook *b'*, and the hook on the plate A receives the plane edge on the plate B, and vice versa. Hence notwithstanding that the plates are corrugated the two may be imposed one upon the other and brought together by a laterally-sliding movement until



the hook portions and plane edges engage as shown, thereby forming a double lap-joint at the side edges.

Each corrugation forms three sides of a square, said sides being represented, respectively, by Figs. 2, 3, and 4. As Fig. 2 represents that side of a conduit which does not contact with an adjacent conduit, but is the intermediate portion, the plates A and B are brought together at the median line of the conduit. The portions represented by Figs. 3 and 4, however, being the portions that contact when the respective conduits are assembled, are not brought together on the median line, but substantially in line with one side of the conduit. Thus in the section Fig. 3 the plate A extends to the edge and is directly returned to form the hook portion  $a'$ , the opposite edge  $a$  being plane. The plate B, on the contrary, is offset at its body portion, so that the hook portion  $b'$  and the plane edge  $b$  lie pronouncedly at one side of the body portion, thus bringing the joint between the plates A B close to the general plane of the plate A as distinguished from the plate B at this point.

In the section shown in Fig. 4, on the contrary, it will be observed that the reverse formation occurs, since the plate B is now the one that will contact with an adjacent conduit. Hence the plate B is directly returned to form the hook portion  $b'$ , while the body of the plate A is pronouncedly offset at its body portion, so that the hook portion  $a'$  and the plane edge  $a$  lie pronouncedly at one side of the body portion, thus bringing the joint between the plates A B close to the general plane of the plate B as distinguished from the plate A at this point.

It will further be observed in connection with the section shown in Fig. 3 that at the edge where the hook on the plate B engages the plane edge of the plate A it will be desirable that the return member of said hook lie substantially in the plane with the plate A, so that when placed against the adjacent conduit both the said hook portion and the said plate A will contact with said adjacent conduit, since the engagement between adjacent conduits is effected by soldering. To bring about the necessary close contact, the plane edge  $a$  is depressed or set in very slightly, so as to permit the return portion of the hook  $b'$  to lie about in the plane with the outer surface of the body of the plate A. In the section shown in Fig. 4 the opposite is true, the plate B having its plane edge  $b$  slightly depressed or set in to bring the hook portion  $a'$  about in line with the plane of the outer surface of the body of the plate B.

The possibility of the separation of a joint between two conduits is rather immaterial, since it will not result in leakage, as would a separation of the joint between the walls of a conduit.

In the form shown in Fig. 5 the conduits are

formed of two plates of similar formation placed in reversed position. Each plate A' B' is at one end directly returned on itself to form a hook portion  $a^2 b^2$ , while the opposite end of each plate is bent twice to produce the outwardly-projecting plane edge portions  $a^3 b^3$  at a point offset from the body. In assembling the plates they are simply slid together in the longitudinal direction of the corrugations, as in the case of the previous construction, so that the hook portion of one engages the plane edge portion of the other, as indicated in said Fig. 5.

In forming plates in accordance with my invention I take essentially flat plates and by suitable dies turn over the hook portions, and in order that said hook portions may not be flattened against the body of the plate there is placed a spacing-strip equal to the thickness of the plate at such a distance from the edge as will enable the extreme edge to be returned to form the hook. The plate may then be corrugated to give it the required conformation to form the wall of a conduit, whereupon the spacing-strip is removed and the plates are then brought together in the position shown in Figs. 2 to 5.

In Figs. 6 and 7 I have shown the application of my invention to a cooler in which the walls are formed of tubes—that is to say, the walls forming the four sides of an air-passage are integral—and these tubes are given a reduced size in their body portion, as at C, while their relatively enlarged or expanded ends contact with each other, as shown clearly in Fig. 7, to produce between the contracted body portions the conduits C' for the liquid. It will be understood that these figures are given to illustrate a well-known form of cooler and that the invention is applicable to coolers formed of tubular members regardless of the special conformation given them to produce air-passages and liquid-conduits. On one end of each tube I form on each of the four walls return-bends or hook portions  $c$ , and the opposite edges extend in plane form, as at  $c'$ . In assembling these the tubes are reversed, so that a plane edge on one will be engaged by a hooked portion on an adjacent tube, as will be clearly understood from Figs. 6 and 7. In all forms of my invention after the hook members and plane edges are properly engaged the joint is completed by soldering.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A cooler or like apparatus having walls forming conduits for one fluid and passages for another fluid at about right angles to the conduits, adjacent walls forming a conduit having their edges united by joints comprising an inwardly-disposed hook member on one wall and an outwardly-disposed member on the companion wall, the relative posi-



tions of the hook members and the members engaged thereby being reversed at the opposite edges.

2. A cooler, having walls forming conduits for one fluid and passages for another fluid at about right angles to the conduits, adjacent walls forming a conduit having their edges united by joints comprising a hook member on one wall and a plane edge on the companion wall, the said plane edge being engaged by the said hook member, the hook being at one edge of one wall and at the opposite edge on the companion wall.

3. In a cooler or like apparatus, pairs of walls having right-angular corrugations forming three sides of a square and united at edges thereof by a double lap-joint following the lines of the corrugations at the said edges, the edge portions being offset, the spaces forming the conduit being unobstructed and the jointed edges constituting the sole support between the walls of each conduit.

4. In a cooler or like apparatus, pairs of walls having corrugations, a wall of a pair

having a return-bend or hook portion ranging along an edge of the wall in a direction at right angles to the longitudinal direction of the corrugations, and at the opposite edge of the wall a plane edge portion, the plane portion of one wall being engaged by the hook portion of the companion wall.

5. In a cooler or like apparatus, pairs of walls having corrugations, a wall of a pair having a return-bend or hook portion ranging along an edge of the wall in a direction at right angles to the longitudinal direction of the corrugations and at the opposite edge of the wall a plane edge portion, the plane portion of one wall being engaged by the hook portion of the companion wall, and said engaging edge portions being soldered.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

D McRA LIVINGSTON.

Witnesses:

J. L. McAULIFFE,  
JNO. M. RITTER.