No. 879,243. PATENTED FEB. 18, 1908.

P. M. BUSH.

REFRIGERATING APPARATUS.

APPLICATION FILED SEPT. 22, 1906.

2 SHEETS—SHEET 1.

Fig 1.

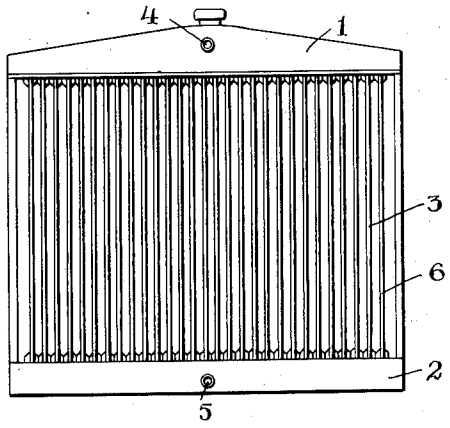


Fig. 2.

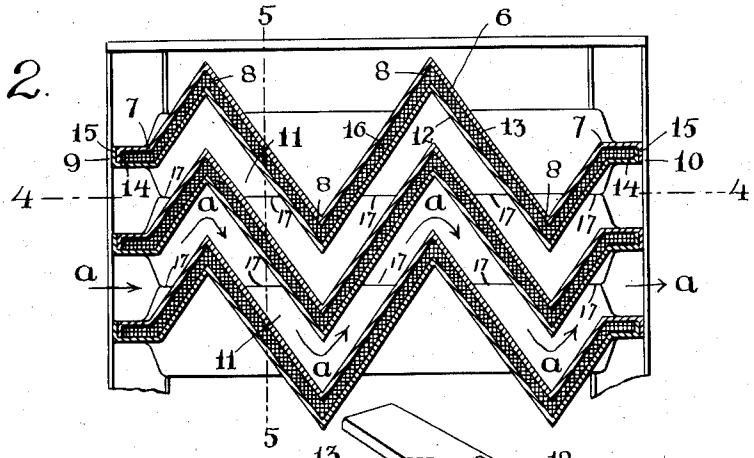
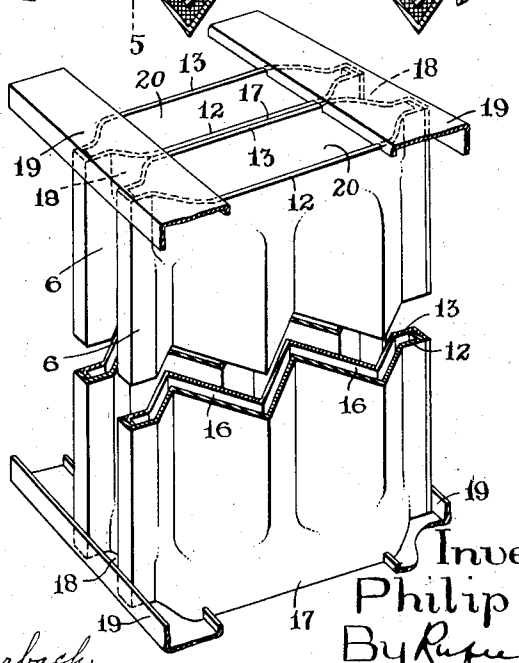


Fig. 3.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 4.

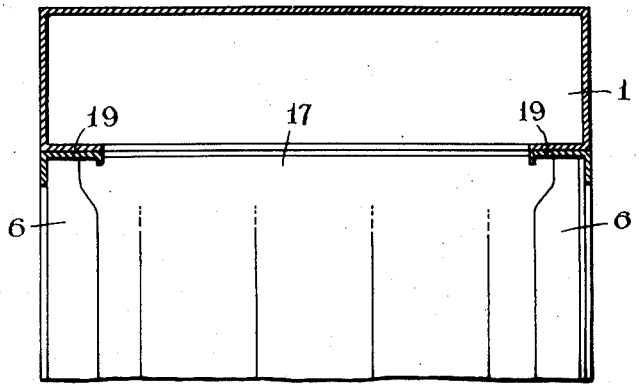
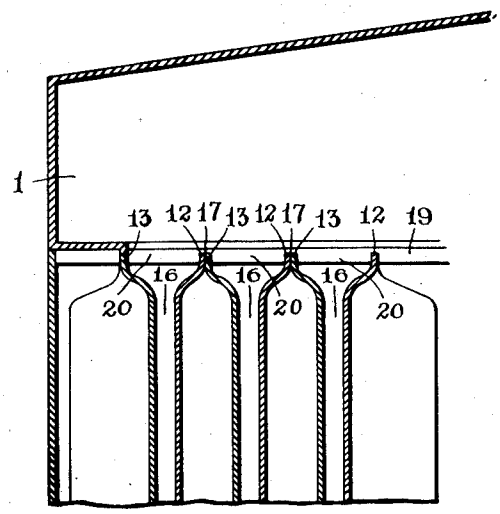


Fig. 5.



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UNITED STATES PATENT OFFICE.

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REFRIGERATING APPARATUS.

No. 879,243. Specification of Letters Patent. Patented Feb. 18, 1908.

Application filed September 22, 1906. Serial No. 335,766.

To all whom it may concern:

Be it known that I, PHILIP M. BUSH, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented a new and useful Improvement in a Refrigerating Apparatus, of which the following is a specification, accompanied by drawings forming a part of the same, in which—

Figure 1 represents a front view of a water cooler for automobiles embodying my invention. Fig. 2 is a top view on a larger scale of a portion of an automobile cooler shown in transverse sectional view. Fig. 3 is a perspective view of two of the refrigerating pipes or tubes detached from the water chambers. Fig. 4 represents the upper water chamber in transverse vertical section, and the upper portion of one of the pipes in side view. Fig. 5 represents a portion of the upper part of the apparatus shown in vertical longitudinal sectional view on the plane of the broken line 5—5, Fig. 2.

Similar reference letters and figures refer to similar parts in the different views.

My present invention relates to a refrigerating apparatus especially adapted for use in connection with an explosive engine for the purpose of cooling water which has become heated by its contact with the explosion cylinders of the engine, and in the accompanying drawings I have shown my invention as embodied in a water cooling apparatus such as is commonly used in automobiles which are propelled by gasolene or other explosives.

The object of my invention is to simplify the construction, to reduce the number of joints and consequent liability to leakage, and to increase the cooling efficiency of the apparatus, and I accomplish these results by the construction and arrangement of parts as hereinafter described and pointed out in the annexed claims.

Referring to the accompanying drawings, Fig. 1 represents a front view of an automobile cooler comprising, as is usual in devices of this class, water chambers 1 and 2 connected by a refrigerating apparatus 3. The water chamber 1 is placed vertically above the chamber 2, the water passing by gravity from the chamber 1 to the chamber 2 through the refrigerating section 3. The upper chamber 1 is provided with an inlet pipe 4, and the lower chamber 2 is provided with an outlet pipe 5, which communicates in the usual manner with the jacket and chamber surrounding the cylinder. Water which has been heated by this contact with the cylinder passes through the inlet pipe 4 to chamber 1, and passing downward through the refrigerating section 3 is received into the chamber 2, from which it is returned through the outlet pipe 5 to the cylinder, thereby completing a circulatory system through which water is made to flow, usually, by means of a pump.

My present invention relates particularly to the refrigerating section by which the heated water is cooled during its passage through a section by the contact of cooler air with the exterior of the refrigerating section.

In cooling apparatus of the class referred to, it has been customary to conduct the water from the upper to the lower chamber through a series of pipes between which a current of air was made to pass, either by the movement of the vehicle or by the action of a rotary fan placed behind the refrigerating section, so that the contact of the air with the outside of the pipes would abstract the heat that had been imparted by the passage through them to the heated air.

In order to increase the cooling efficiency of this class of apparatus, various expedients have been adopted, such, for example, as the flattening of pipes, increasing the surface in contact with the water relatively with its volume, providing flanges upon the outside of the pipes to increase the contact of the metal with the air current, arranging the pipes in over-lapping spiral coils in order to increase the length of pipe between the upper and lower chambers, and the zigzagging of pipes between the upper and lower chambers for the same purpose. The primary object of these expedients has been to increase the contact between the metal and the current of water relatively to its volume in order that the heated water might impart a maximum amount of heat to the metal of the pipes and increase the contact between the pipes and the air in order to abstract a maximum amount of heat from the pipes, the metal of the pipes serving as a medium for transferring heat from the water to the air.

In my improved refrigerating apparatus I

connect the upper and lower water chambers 1 and 2 by a series of thin sheet metal pipes 6. Each pipe connects at its upper end with the upper water chamber 1, and its lower end with the lower water chamber 2, and extends from the front to the back of the water chambers. The pipes 6 are corrugated longitudinally or bent into a zigzag form between their front and rear edges, as shown in cross section in Fig. 2, in which pipe 6 is shown as bent near its front and rear edges at an oblique angle at 7, 7, and again at sharper angles at 8, forming a zigzag line between the front edge 9 of the pipe and the rear edge 10. The several pipes 6 are placed sufficiently near together so that the projecting angle of each pipe will extend into the corresponding reëntering angle of the next adjacent pipe in order to provide a series of zigzag air passages 11, extending transversely across the apparatus through which air passes in the direction of the arrows *a*. Each of the pipes 6 are formed of longitudinal strips 12 and 13, provided at their edges with overlapping flanges 14 and 15, and are soldered together to inclose a water space 16, connecting at its upper end with the upper chamber 1, and at its lower end with its lower chamber 2.

The strips 12 and 13 are formed from straight plates of metal which are drawn by suitable dies into the form shown in Fig. 3. Each end of the strip is bent outwardly as shown in Fig. 5, in order to provide a space of increased width for the entrance of the water, and to contact with a plate in the neighboring pipe, as at 17, Fig. 5. Each sheet between the bent portions is then drawn into zigzag form, as shown in Figs. 2 and 3. The contacting ends of the plates are soldered together at 17, thereby forming longitudinal zigzag air passages between the plates. The transverse passage for water is formed by the pipes 6 which are provided with a wide mouth 20, a narrow passage 16 leading directly to a similar wide mouth 20, but arranged zigzag transversely to said water passage between the wide mouths 20 and 20.

The space 18 between the edges of the pipes and the expanded central sections are covered by plates 19, which are soldered to the ends of the pipes, closing a portion of each pipe at its front and rear edges, and leaving a larger open space 20 communicating with the water chambers.

I claim,

1. In an apparatus of the class described, the combination with a pair of water chambers placed one above the other, of an interposed refrigerating section comprising a series of vertical pipes placed side by side and communicating with said water chambers, said pipes having a series of corresponding vertical longitudinal bends or corrugations, and inclosing between them a series of zigzag air spaces extending transversely across said pipes.

2. In an apparatus of the class described, the combination with a pair of water chambers placed one above the other, of an interposed series of vertical water passages communicating with said water chambers, each of said water passages being inclosed by a pair of sheet metal plates attached at their edges and having a series of vertical longitudinal bends or corrugations, with a vertical air space between each of said water passages and extending transversely in a zigzag direction across said water passages.

3. In an apparatus of the class described, the combination with a pair of water chambers one placed above the other, of an interposed refrigerating section comprising a series of vertical water pipes communicating with said chambers, and having vertical longitudinal corrugations with spaces between said water pipes open to the air at the front and rear edges of said pipes.

4. In an apparatus of the class described, the combination of a pair of water chambers, a refrigerating section placed between said water chambers and comprising a series of thin sheet metal pipes communicating at their ends with said water chambers, said pipes having a series of corresponding longitudinal bends or corrugations, and having spaces between said pipes open at the front and rear edges for the pipes to free passages of air therethrough in a zigzag path.

5. In an apparatus of the class described, the combination of a pair of water chambers, a series of thin sheet metal refrigerating pipes connecting said chambers, said pipes having longitudinal bends or corrugations and having between said pipes open air spaces extending transversely across said pipes, and said pipes having their ends expanded to provide transverse contacting surfaces.

6. In an apparatus of the class described, a refrigerating section consisting of a series of parallel thin sheet metal pipes having longitudinal bends or corrugations, and placed side by side to inclose air spaces extending in a zigzag line transversely across said pipes, said pipes having their ends expanded to form transverse contacting surfaces.

7. In an apparatus of the class described, the combination of a series of parallel thin sheet metal pipes formed of plates having longitudinal flanged edges soldered together, and a series of longitudinal bends or corrugations, with the ends of said pipes expanded to form attached contacting surfaces, whereby said pipes are held side by side and with interposed open air spaces extending in a zigzag direction transversely across said pipes.

8. In an apparatus of the class described, the combination of a series of thin sheet metal

water pipes having longitudinal bends or corrugations, and having their ends expanded to form attached contacting surfaces whereby said pipes are held side by side with interposed air spaces extending transversely across said pipes, and water chambers attached to the expanded opposite ends of said pipes and communicating therewith.

Dated this 18th day of Sept. 1906.

PHILIP M. BUSH.

Witnesses:
EDWIN H. TUCKER,
EDWARD D. REDFIELD.