C. S. SAGE.

RADIATOR.

APPLICATION FILED APR. 22, 1911.

1,012,716.

Patented Dec. 26, 1911.

2 SHEETS—SHEET 1.

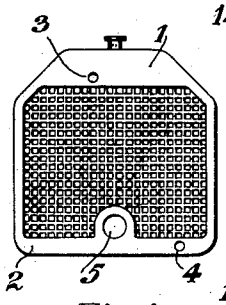

Fig. 1

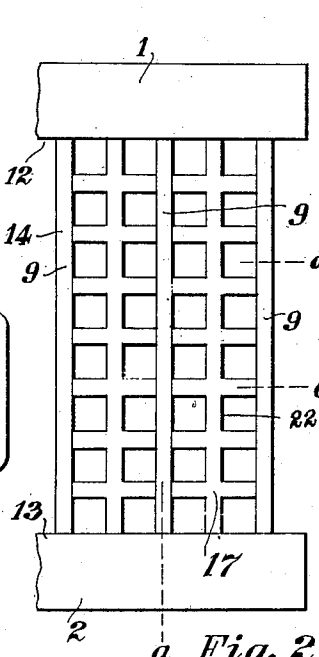

Fig. 2

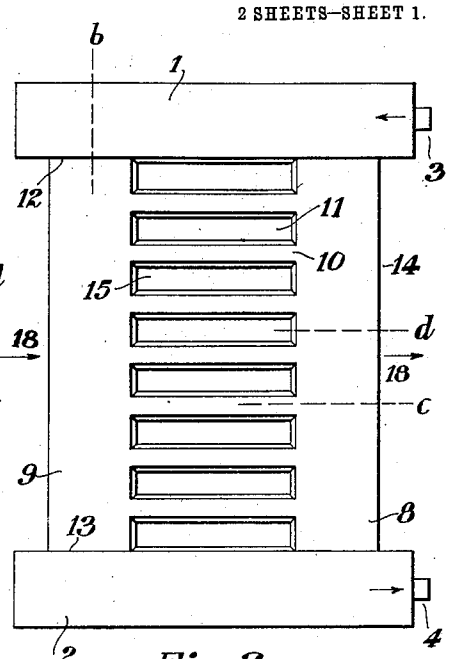

Fig. 3

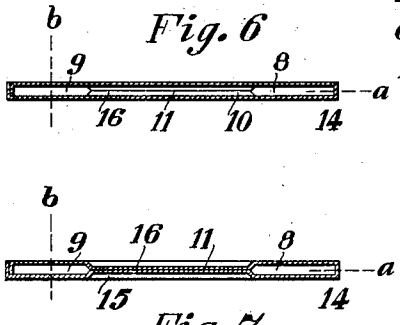

Fig. 6

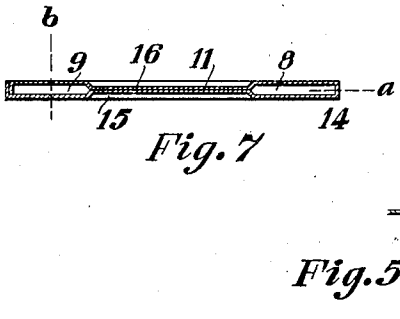

Fig. 7

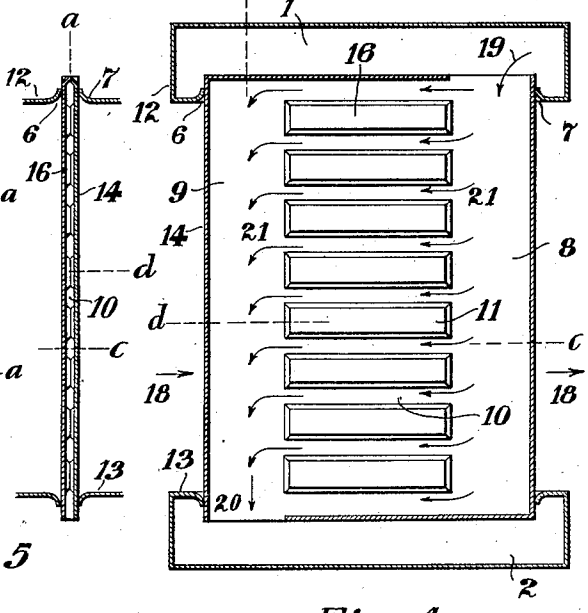

Fig. 5

Fig. 4

Witnesses

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2 SHEETS—SHEET 2.

Fig. 8

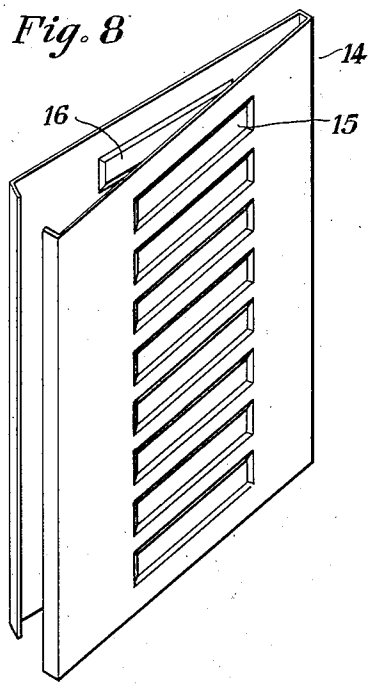
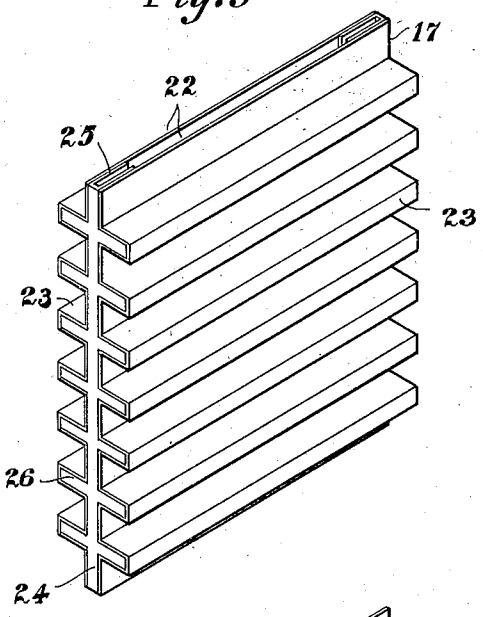


Fig. 9



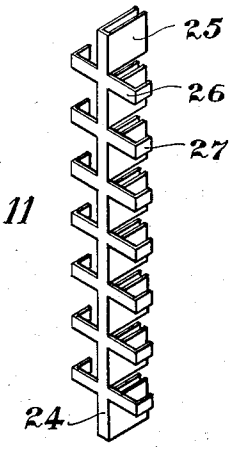


Fig. 11

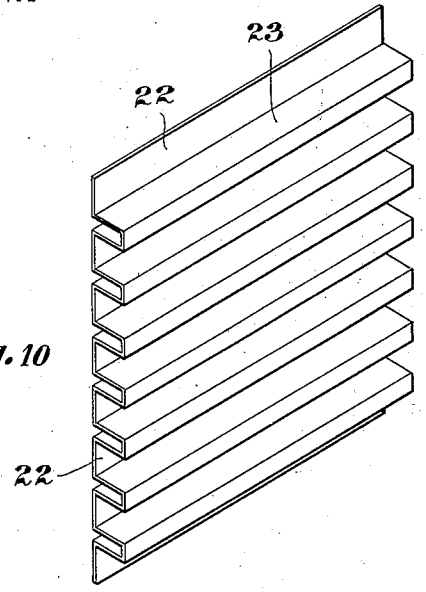


Fig. 10

Witnesses

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RADIATOR.

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To all whom it may concern:

Be it known that I, CHARLES SAMUEL SAGE, a citizen of the United States, residing at Rome, Oneida county, New York, have invented certain new and useful Improvements in Radiators, of which the following is a specification.

This invention relates to a system applicable, in its main features, to devices generally for the transfer of heat from one flowing body to another, and the construction herein particularly set forth as exemplifying the invention, has been designed with special reference to the use of the invention in radiators employed in automobiles for the purpose of abstracting heat from the water employed in cooling the engine.

In automobile radiators as usually constructed there is a tank receiving the hot water from the engine, a second tank to receive the water after being cooled by the radiator and prior to the return of the water to the engine, an air-exposed cooling conduit through which the water passes on its way from the first tank to the second tank and devices, generally termed fins, connected with the conduit to serve in increasing the area of conduit-metal, exposed to the cooling influence of the air. The conduit is generally of a multiple character. Assume such a radiator with its conduit system arranged vertically and with the cooling air blowing past its finned conduit horizontally. The hot water enters the top of the conduit and moves downward and becomes cooler in its descent, owing to the cooling influence of the air. Air sweeping by the conduit at a given level quickly reaches the temperature of the conduit at that level and passes onward. Air passing the conduit at a lower level acts in the same manner and passes away with most of its cooling capacity unutilized, for while it has taken up some heat from the conduit it is still cool enough to be capable of abstracting heat from the conduit at some higher level if it could be so utilized. It follows that air thus sweeping by the conduit at right angles to the path of movement of the water in the conduit is not acting in a fairly efficient manner in abstracting the heat. It is not feasible in a radiator of the character described to cause the air to act in succession on portions of the conduit having increased temperatures.

My invention is designed in recognition of the above facts and aims to so arrange the conduit system that while the general flow of water is at right angles to the current of the cooling air the water will nevertheless flow in paths parallel to that of the cooling air but in an opposite direction, and in such manner that the air in passing through the radiator encounters conduit temperatures which are always higher than the temperatures which the air could have possibly acquired previously from the radiator.

The invention will be readily understood from the following description taken in connection with the accompanying drawing in which:—

Figure 1 is a front elevation of an automobile radiator exemplifying my invention: Fig. 2 a front elevation of a portion of the radiator, very much reduced in height as compared to the height practically employed in an automobile radiator. Fig. 3 a side view of the same: Fig. 4 a vertical transverse section of the radiator in the plane of lines *a:* Fig. 5 a vertical longitudinal section of a radiator unit in the plane of lines *b:* Fig. 6 a horizontal section through one of the radiator units in the plane of lines *c:* Fig. 7 a horizontal section of one of the radiator units in the plane of lines *d:* Fig. 8 a perspective view of a tube-structure in incomplete form: Fig. 9 a perspective view of one of the fins; Fig. 10 a perspective view of one of the side-members of a fin: and Fig. 11 a perspective view of one of the end-members of a fin.

In the drawing:—1, indicates the first tank, the one receiving the hot water from the engine: 2, the second tank from which the cooled water is to be delivered back to the engine: 3, the hot water inlet to the first tank: 4, the cooled water outlet from the second tank: 5, the usual eye formed through automobile radiators for the projection of the engine shaft, to facilitate cranking the engine: 6, a series of slots in the floor of the upper tank and the roof of the lower tank, these slots extending from near the front to near the rear of the tanks: 7, lips margining these slots, these lips extending up from the floor of the first tank and down from the roof of the second tank: 8, a tube, of generally rectangular cross-section having its upper end disposed in the rear end of a slot in the floor of the upper tank and having its lower end disposed in the rear end of a slot

in the roof of the lower tank, there being one of these tubes for each of said slots, the lower ends of these tubes being closed: 9, a similar tube disposed at the forward end of each pair of slots, the upper ends of these tubes being closed, the two tubes of each pair being integrally formed, as will be later explained: 10, a vertical series of horizontal tubes or water passages connecting the two tubes of each pair: 11, the horizontal partitions separating the horizontal tubes and forming part of the fin system: 12, the floor of the upper tank: 13, the roof of the lower tank: 14, one of the radiator units, this unit comprising the two vertical tubes of a pair, together with the horizontal tubes connecting them, and the partitions separating the horizontal tubes: 15, horizontal recesses struck inwardly in the side-walls of the radiator unit at points between the horizontal tubes: 16, bosses formed on the inner surfaces of these sidewalls by the striking up of the recesses, these bosses making contact with each other and forming the partitions 11 between the horizontal tubes: 17, metallic fins consisting each of a vertical member with side projections stretching between the radiator-units, there being one of these fins between each pair of radiator-units, each fin being provided with a side projection at each horizontal tube, the fins extending from front to rear of the radiator-units, whereby there is produced the "square tube effect" at present much desired in automobile radiators: 18, arrows indicating the direction of flow of cooling air through the radiator: 19, an arrow indicating the direction of flow of water from the hot water tank into the upper ends of tubes 8: 20, an arrow indicating the direction of flow of the water into the cooled water tank from the tubes 9: 21, arrows indicating the direction of flow of water from tubes 8 through the horizontal tubes 10 and into tubes 9: 22, the side-walls of the fins: 23, horizontal corrugations in the side-walls of the fins, illustrated as rectangular in cross-section: 24, the end-walls of the fins, adapted to fit between the side-walls: 25, inner flanges on the end-walls, adapted to engage against the inner surfaces of the side-walls: 26, prongs projecting sidewise from the end-wall and adapted to fit within the corrugations of the side-walls: and 27, inwardly projecting flanges on the ends of the prongs to engage the inner surfaces of the corrugations of the side-walls.

An inspection of Fig. 4 will show that the hot water from tube 8 flows horizontally to the left while the air passing through the radiator flows in the opposite direction, whereby it follows that any particle of air passing through the radiator moves constantly past conduit surfaces having a constantly higher temperature, thus vastly increasing the efficiency of the air in cooling the water, in other words, after air has passed any given point in the radiator it becomes effective on a radiator point of higher temperature, and so on, until the air has passed entirely through the radiator. The fins, in the form illustrated, serve to increase the exposure of surface to the air passing through the radiator. In Fig. 2 but three radiator units are illustrated, the fins being disposed between each pair. These fins are merely illustrative of various forms of fin structures with which the radiator units may be provided.

The general dimensions of my improved radiator as applied to automobiles may be about as usual as regards height and width and fore and aft thickness, and the radiator units themselves I prefer to make about an eighth of an inch in thickness, which dimension I also prefer for the members of the fins.

In constructing the radiator units the first step is to take a strip of thin sheet metal somewhat over twice the total width of a radiator unit, the strip being as long, if desired, as the metal is obtainable. This sheet of metal is then struck up to form the bosses 16, after which the strip is doubled upon itself and given a lap joint at one edge of the unit, as indicated in Figs. 6, 7 and 8. The radiator units thus formed are then sheared off to desired length and the upper ends of the front tubes closed, as by pinching the metal together, the lower ends of the rear tubes being similarly closed. The radiator units are then assembled in the slots of the tank-portions. Fins of selected form are then to be inserted in the spaces between the radiator units. In constructing fins of the particular form illustrated, the corrugated sidewalls and end-walls are formed of thin metal and assembled, the vertical members of the end-walls closing the space between the side-walls while the prongs of the end-walls close the ends of the corrugations of the side-walls, the flanges 25 and 27 providing good bearings for the parts. These fins are then to be placed in the spaces between the radiator units, thus completing the assemblage of the radiator structure. The whole may then be rendered integral and tight by being dipped in solder.

The portions 1 and 2 of the radiator have been termed "tanks" but they are tanks only in the sense that they are larger than the conduits connecting them, for they are in reality merely conduit-portions of header character connected with the radiator units, and the term tank, as employed herein, is therefore to be understood in the conduit sense.

While the preference is, in any use of the new radiator, to dispose the radiator units vertically and to admit the hot water at the

top and remove it from the bottom of the units, such disposition is not essential, and where the terms upper and lower and vertical and horizontal are employed, the terms are to be considered as merely relative, or as being descriptive without being limiting as regards the invention, and the particular construction described is to be taken as a mere exemplification. I simply explain the principle of my invention and have set forth the best manner in which I at present contemplate applying that principle.

I claim:—

1. A radiator comprising, a vertical tube having an inlet at its upper end and closed at its lower end, a vertical tube having an outlet at its lower end and closed at its upper end, and a series of horizontal tubes connecting the two vertical tubes, the sides of the tube-structure thus formed being adapted for exposure to a current of cooling air flowing horizontally in a direction from the second mentioned vertical tube to the first mentioned vertical tube, combined substantially as set forth.

2. A radiator comprising, an upper tank, a lower tank, a series of vertical rear tubes arranged side by side and rigidly connected to the two tanks and open to the upper tank only, a vertical front tube disposed in front of each of the rear tubes and rigidly connected with the two tanks and open to the lower tank only, and a series of horizontal tubes connecting the two vertical tubes of a pair, the sides of the tube-structures being adapted for exposure to a current of cooling air flowing horizontally in a direction from the front to the rear tubes, combined substantially as set forth.

3. A radiator comprising, an upper tank, a lower tank, a series of vertical rear tubes arranged side by side and rigidly connected to the two tanks and open to the upper tank only, a vertical front tube disposed in front of each of the rear tubes and rigidly connected with the two tanks and open to the lower tank only, a series of horizontal tubes connecting the two vertical tubes of a pair, the sides of the tube-structures being adapted for exposure to a current of cooling air flowing horizontally in a direction from the front to the rear tubes, and fins disposed between each pair of vertical tube-structures, combined substantially as set forth.

4. A radiator comprising, an upper tank, a lower tank, a series of vertical rear tubes arranged side by side and rigidly connected to the two tanks and open to the upper tank only, a vertical front tube disposed in front of each of the rear tubes and rigidly connected with the two tanks and open to the lower tank only, a series of horizontal tubes connecting the two vertical tubes of a pair, the sides of the tube-structures being adapted for exposure to a current of cooling air flowing horizontally in a direction from the front to the rear tubes, vertical fin-members disposed between each pair of tube-structures, and fin-members extending horizontally from the vertical fin-members to the vertical tube-structures, whereby the radiator is provided with a multiplicity of square air openings extending through it, combined substantially as set forth.

5. A radiator comprising, an upper tank, a lower tank, a series of vertical rear tubes arranged side by side and rigidly connected to the two tanks and open to the upper tank only, a vertical front tube disposed in front of each of the rear tubes and rigidly connected with the two tanks and open to the lower tank only, a series of horizontal tubes connecting the two vertical tubes of a pair, the sides of the tube-structures being adapted for exposure to a current of cooling air flowing horizontally in a direction from the front to the rear tubes, and fin-members disposed between each pair of vertical tube-structures and connected with the sides thereof, combined substantially as set forth.

6. A radiator unit comprising, a strip of metal doubled upon itself and joined at its edges to form a longitudinal passageway, a longitudinal series of partitions disposed in said passageway, each partition extending from near one edge-wall to near the other edge-wall of the vertical passageway, whereby there is formed a longitudinal tube at each edge of the unit, one end of one longitudinal tube and the opposite end of the other longitudinal tube being closed, combined substantially as set forth.

7. A radiator unit comprising, a flat tube of sheet metal having a longitudinal series of recesses struck into its sides to produce inwardly projecting bosses forming partitions at right angles to the length of the general structure, whereby the unit becomes provided with a longitudinal tube at each edge and with transverse tubes connecting the longitudinal tubes, combined substantially as set forth.

8. A radiator unit comprising, a flat tube of sheet metal having a longitudinal series of recesses struck into its sides to produce inwardly projecting bosses forming partitions at right angles to the length of the general structure, whereby the unit becomes provided with a longitudinal tube at each edge and with transverse tubes connecting the longitudinal tubes, the unit being open only at one end of one of said longitudinal tubes and the opposite end of the other longitudinal tube, combined substantially as set forth.

9. A radiator comprising, a series of flat tubes disposed side by side and spaced apart, transversely corrugated fin-side-walls disposed against the flat surfaces of the tubes

and spaced apart from each other, and fin-end-walls closing the spaces between the fin-side-walls and having prongs closing the ends of the corrugations in the fin-side-walls, combined substantially as set forth.

10. A radiator comprising, a series of flat tubes disposed side by side and spaced apart, transversely corrugated fin-side-walls disposed against the flat surfaces of the tubes and spaced apart from each other, fin-end-walls closing the spaces between the fin-side-walls and having prongs closing the ends of the corrugations in the fin-side-walls, and flanges projecting inwardly from the fin-end-walls and their prongs, combined substantially as set forth.

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Witnesses:
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