

Dec. 28, 1926.

1,611,894

N. DIAMANT

RADIATOR -

Filed Dec. 3, 1923

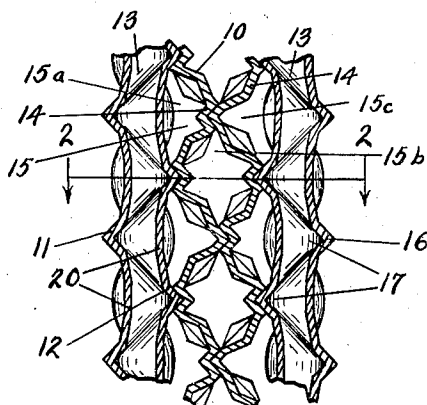


FIG. 1

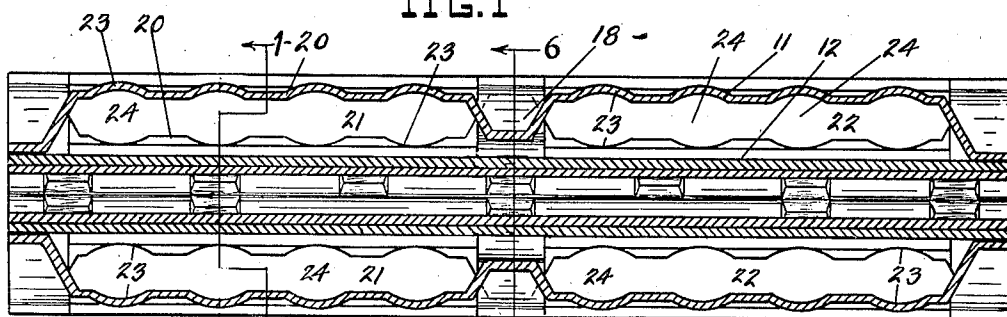


FIG. 2

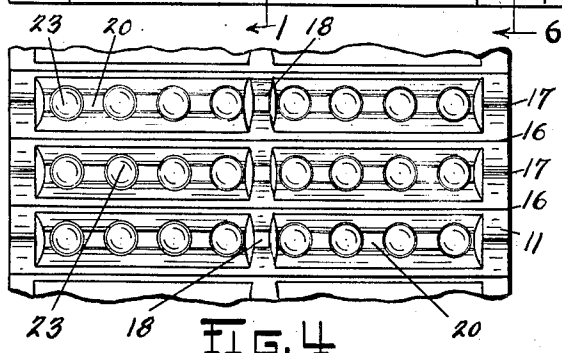
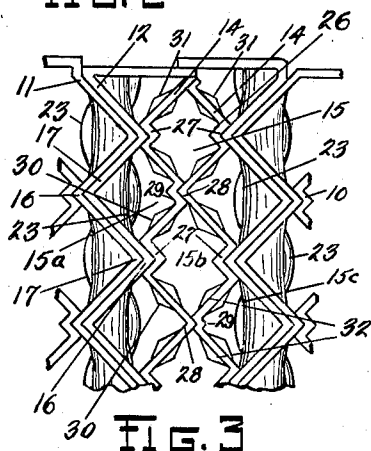


FIG. 3

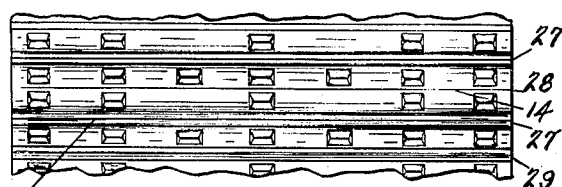


FIG. 5

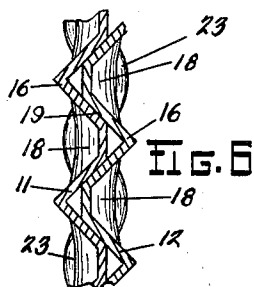


FIG. 6

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## UNITED STATES PATENT OFFICE.

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## RADIATOR.

Application filed December 3, 1923. Serial No. 678,107.

This invention relates to an improvement in radiators or coolers, and more particularly to radiators of the ribbon type commonly used in automobiles, trucks, tractors or other automotive vehicles for cooling the engine therein, which radiators are provided with vertical water conduits and horizontal air conduits, the air which passes through the latter acting to cool the water in the former.

The primary object of this invention is to provide a radiator of this type in which the various elements affecting and influencing the exchange of heat between the air and the water are so manipulated and arranged that the cooling capacity per unit surface of the radiator is greatly increased while the cost of manufacturing and assembling the different units is reduced, whereby it is possible to produce a smaller radiator having the same cooling capacity as a larger radiator of the type now known and used.

Another object of this invention is to provide in a radiator of this type a water conduit which permits the circulation of the water through the radiator at high speed, and at the same time creates turbulence in the flow of water or other cooling medium, and also in the flow for the air.

A further object of this invention is to provide in a radiator of this type a core which can be quickly and easily assembled and will rigidly withstand strains which may be applied to it in any direction.

Other objects will appear from a consideration of the following specification and of the drawings which form a part thereof, and in which

Fig. 1 is a transverse section of a portion of a radiator embodying this invention taken along the line 1—1 of Fig. 2;

Fig. 2 is a horizontal section taken along the line 2—2 of Fig. 1;

Fig. 3 is a front elevation of a portion of a radiator embodying this invention;

Fig. 4 is a side elevation of one type of wall strip that might be employed as one of the elements of this radiator;

Fig. 5 is a similar view of one of the separator strips that might be employed; and

Fig. 6 is a section of a water conduit taken along the line 6—6 of Fig. 2.

It is well known that the efficiency of a radiator of this type depends upon the speed

of circulation and turbulence of the water and the velocity and turbulence of the air. This efficiency increases up to a certain point, beyond which it is not materially affected by the increase in the rate of circulation or turbulence of the water, or the velocity and turbulence of the air, since the creation of the turbulence requires an expenditure of energy and the advantage resulting therefrom will eventually be more than counteracted by the amount of energy expended. A mere increase in the rate of circulation only of the water is not in itself sufficient to provide an efficient radiator, and it is essential that the water be given a certain amount of turbulence.

Also for a given mass flow of air a certain amount of turbulence therein is essential for the greatest efficiency of the radiator.

Thus we are presented with the problem of providing air and water conduits having as high a permeability or as low a resistance as possible, but at the same time having the proper amount of turbulence in both, so that the maximum capacity of heat exchange can be secured.

Referring to the drawings, the reference numeral 10 is employed to designate one form of radiator core embodying this invention. This radiator comprises pairs of vertical wall strips 11—12 forming vertical water conduits 13 and separator strips 14 suitably arranged between the water conduits to provide a plurality of horizontal air conduits 15. In the present instance, two sets of separator plates 14 are provided between each pair of water courses, and these strips are of such formation that they provide three vertically arranged tiers of air conduits 15<sup>a</sup>, 15<sup>b</sup> and 15<sup>c</sup>.

The wall strips 11 and 12 are the same in construction and are formed of corrugated metal of a zigzag conformation having a series of parallel transverse equally spaced angles 16, extending from one edge to the other. Midway between each pair of angles 16 are formed along each edge angular offsets 17 faced in the opposite direction so that when the radiator core is viewed from either front or rear, it has a true zig-zag appearance. (See Fig. 3.)

Between each pair of angles 16 and intermediate and in alinement with the offsets 17

are formed vertically alined spacers or supports 18. The spacers 18 are preferably semi-octagonal in cross section as shown in Fig. 6, and face in the same direction as the offsets 17.

When the strips 11 and 12 are assembled to form the water conduits, the offsets 17 of each piece rest in the angles 16 of the other piece and the spacers 18 of one strip lie between the spacers 18 of the other strip with the inclined sides 19 in surface contact, as shown in Fig. 6. The offsets 17 and the spacers 18 determine the distance between the strips 11 and 12 and the depressed portions 20 of the strips between the offsets 17 and the spacers 18 are opposite the angles 16 to form the courses 21, 22 in the conduit 13.

These intermediate supports 18 not only act to separate the water courses 21 and 22, but also act to prevent the wall strips from collapsing and interfering with the water flow, functioning by reason of their interengagement, as shown in Fig. 6, to stiffen the core and withstand any strains that might be set up by weaving or impact. When a shallow core is used, the supports 18 may be omitted because the wall strips will be stiff enough for all practical purposes and because the provision of the supports will too much reduce the effective width of the water conduits. Hence while the supports 18 are set forth in the drawing, it will be understood that they may, where conditions permit, be omitted.

Since the portions 20 in the wall strips of each pair are in alternate horizontal planes, (see Fig. 1), the courses 21, 22 are sinuous and consequently turbulence will be set up. This, however, will reduce somewhat the speed of circulation and in order to overcome this reduction in speed due to the sinuous form of the water courses and at the same time to increase the turbulence of the water, equally spaced, rounded indentations 23 are formed in the depressed portions 20 of the wall strips. These indentations define in the courses 21, 22 a plurality of water passages 24. In the drawing four such passages are formed in each water course, in vertical alinement but obviously the number and arrangement can be varied as desired. For example, the turbulence may further be increased by arranging the indentations 23 in sinuous or alternate vertical rows instead of in alinement as shown in Fig. 4.

The indentations 23 preferably have well defined edges 25 so that the passages 24 widen and narrow, and consequently set up further turbulence in the water flow by the well known principle of expansion and contraction. Thus turbulence results from the irregular sinuous path of the water through the courses and the widening and narrowing of the passages 24, although the conduits 13 are sufficiently direct and the passages 24 are

sufficiently large and numerous to reduce the resistance to the flow of the water.

The separator strips 14 are preferably interchangeable and approximately of zig-zag conformation. The transverse angles 26 (Figs. 3 and 5) along one side of each separator strip are provided with small or re-entrant bends 27 and the alternate transverse angles 28 along the other side are provided with similar small or re-entrant bends 29, the purpose of which will appear hereinafter. On the flat portions between the angles are formed indentations or bosses 30 some of which project in one direction while others project in the opposite direction. In the drawings the numerals 31 are employed to designate the bosses projecting toward the adjacent wall strip and the numerals 32 to designate the bosses projecting toward the adjacent separator strip.

The separator strips are assembled as shown in Fig. 1, with the angles 16 of the wall strips nested in the small bends 27 of the separator strips and the alternate angles 28 of the separator strips nested in the alternate small bends 29. The wall and separator strips are thus firmly united throughout their transverse length and will resist positively any tendency of the core to weave or shift in position.

Referring to Fig. 3 of the drawing, it will be noted that in every instance the adjacent strips join along contacting angles facing in the same direction.

Each separator strip and its adjacent wall strip form horizontal air conduits 15<sup>a</sup> and 15<sup>b</sup> while the adjacent separator strips form horizontal air conduits 15<sup>b</sup>. Since the adjoining portions of separator and wall strips are in each case closely nested into contact, the heat of the water in the conduits 13 will readily travel from each wall strip to its adjacent separator strip and be dissipated by the air passing through the conduits 15.

The rounded indentations 23 in the wall strips project into the conduits 15<sup>a</sup> and 15<sup>b</sup> and coact with the bosses 31 in the separator strips to interrupt the free passage of the air therethrough and set up turbulence therein. The bosses 32 in the separator strips similarly project into the air conduits 15<sup>b</sup> and set up turbulence in the air flowing therethrough. The particular form and arrangement of the bosses 30 may be varied as desired but the form here shown has been determined by use to result in a peculiarly efficient radiator core and is consequently preferred.

While one embodiment of this invention has been shown and described, I am not to be limited thereto since it is obvious that others may be made without departing from the spirit and scope of the invention as set forth in the following claims.

Having thus set forth my invention what

I claim as new and for which I desire protection by Letters Patent is:

1. A radiator including in combination a plurality of water conduits each composed of two wall strips of zigzag conformation, each strip having on one face parallel transverse angles extending from one side to the other and on the other face at each side of the strip angular offsets equally spaced between said angles and facing in the opposite direction thereto and a plurality of horizontal air conduits each composed of separator strips of zigzag conformation and said wall strips, the face of said separator strips adjacent said wall strips having parallel transverse angles extending from one side to the other in which angles are formed return bends which receive the angles of said wall strips.

2. A radiator including in combination a plurality of water conduits each composed of two wall strips of zigzag conformation, each having on one face parallel transverse angles extending from one side to the other and on the other face at each side of the strip angular offsets equally spaced between said angles and facing in the opposite direction thereto, said strips being assembled with the offsets of one nested in the angles of the other and a plurality of horizontal air conduits each composed of separator strips of zigzag conformation and said wall strips, the face of said separator strips adjacent said wall strips having parallel transverse angles extending from one side to the other in which angles are formed return bends which receive the angles of said wall strips.

3. A radiator including a plurality of water conduits each composed of two wall strips of zigzag conformation the outer faces of each pair of strips having parallel transverse angles extending from one side to the other and rounded depressions arranged in vertical and horizontal rows to form uninterrupted channels to reduce the resistance to the flow of water due to the zigzag conformation of the strips and a plurality of air conduits formed adjacent each water conduit by a plurality of separator strips each separator strip being in contact with the adjacent wall strip from one side to the other along the parallel transverse angles, said separator strips having bosses which project into said air conduits and increase

the turbulence of the air passing there-through.

4. A radiator including in combination a plurality of water conduits each composed of two strips of zigzag conformation, each strip having on one face parallel transverse angles and on the other face angular offsets equally spaced between said angles and facing in the opposite direction thereto, and spacers intermediate said offsets, the portions of said strips between said spacers and offsets being provided with rounded depressions arranged to form uninterrupted channels which reduce the resistance to the flow of water through the conduits.

5. A radiator including in combination a plurality of water conduits each composed of two strips of zigzag conformation each having on one face parallel transverse angles and on the other face angular offsets equally spaced between said angles and facing in the opposite direction thereto, and spacers intermediate said offsets, the portions of said strips between said spacers and offsets being provided with rounded depressions arranged to form uninterrupted channels which reduce the resistance to the flow of water through the conduits, and separator strips forming with said first named strips a plurality of air conduits into which said depressions extend.

6. A radiator including in combination a plurality of water conduits each composed of two strips of zigzag conformation each having on one face parallel transverse angles and on the other face angular offsets equally spaced between said angles and facing in the opposite direction thereto, and spacers intermediate said offsets, the portions of said strips between said spacers and offsets being provided with rounded depressions arranged to form direct uninterrupted channels which reduce the resistance to the flow of water through the conduits, separator strips forming with said first named strips a plurality of air conduits into which said depressions extend, and bosses on said separator strips projecting into said air conduits to coact with said depressions and increase the turbulence of the air passing therethrough.

In testimony whereof I have affixed my signature.

NICHOLAS DIAMANT.