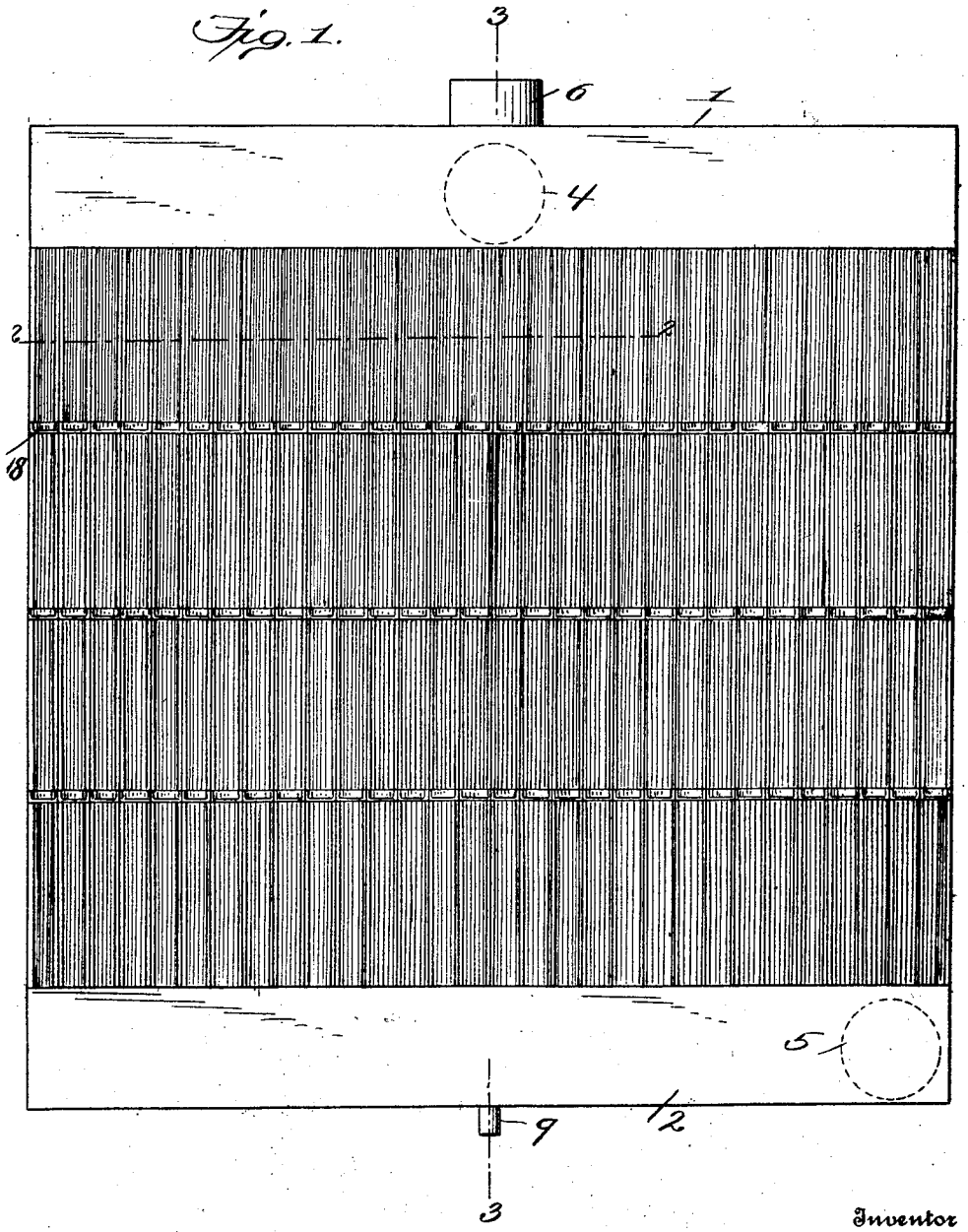
June 8, 1926. 1,588,348

G. C. FARRIS

RADIATOR FOR INTERNAL COMBUSTION ENGINES

Filed Feb. 7, 1923 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

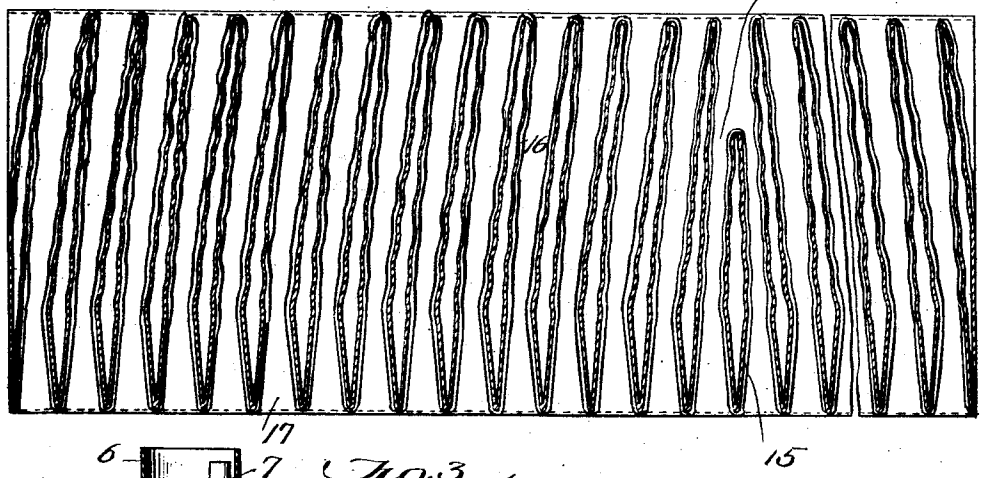


Fig. 3.

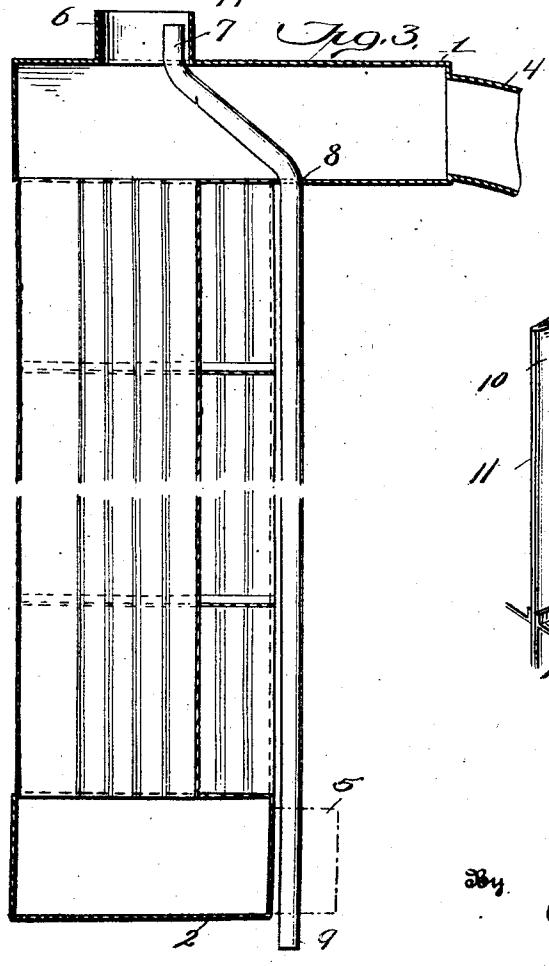
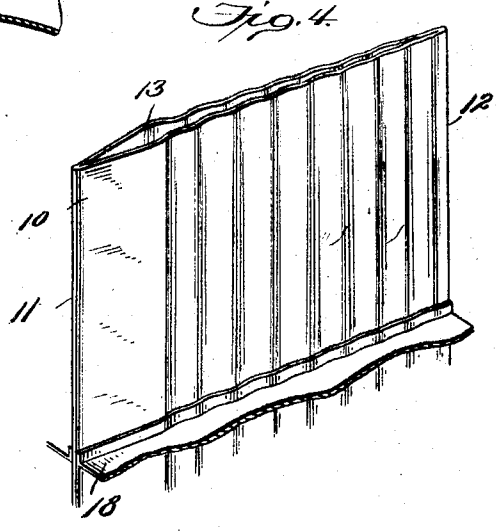


Fig. 4.



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UNITED STATES PATENT OFFICE.

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RADIATOR FOR INTERNAL-COMBUSTION ENGINES.

Application filed February 7, 1923. Serial No. 617,595.

This invention relates to radiators for internal combustion engines and proposes a novel core construction which is designed to improve the structural characteristics of the radiator as well as to enhance its efficiency as a heat dissipating unit.

One of the objects of the invention is the provision of water tubes arranged in adjacency and formed to encompass the maximum amount of air at the forward end of the radiator and to deflect it against the internal combustion engine at the rear.

Another object of the invention is the provision of water tubes so constructed and arranged as to form air passages presenting flaring ends in the direction of the natural draft created by the movement of the vehicle upon which the radiator is mounted.

Still another object of the invention is the construction of a water tube tapering forwardly and rearwardly from an intermediate wide portion, said portion being positioned forwardly where the cooling draft is of relatively low temperature, the tube narrowing toward the rear proportionately as the air becomes warmer so that the thickness of the film of circulating liquid to be cooled is directly proportioned at any point to the rate of heat exchange.

A further object of the invention is the provision of a core comprising vertical tubes each extending in a width direction substantially the full thickness of the core, the front of said tube being formed as an edge in order to oppose minimum resistance to the air and to permit a maximum quantity of air to pass through said radiator, the walls of said tube toward the rear being corrugated to provide for expansion should the cooling liquid therein contained become frozen.

A still further object of the invention is the relative arrangement of adjacent tubes to form an air conduit diverging from an intermediate point both forwardly and rearwardly and having the rear walls thereof provided with means for deflecting the current of air flowing through said conduit in a zigzag direction from one side to the other to ensure complete and continuous renewal of the air along the surfaces of said tubes.

With the above and other objects in view, my invention consists in the improved radiator illustrated in the accompanying drawings, described in the following specification, and particularly claimed, and in such variations and modifications thereof as will be obvious to those skilled in the art to which my invention relates.

In the drawings accompanying and forming a part of this specification, and wherein the preferred embodiment of my invention is illustrated:

Figure 1 is a front elevation of my improved radiator.

Figure 2 is a cross section of a portion thereof, on an enlarged scale, taken along the line 2—2 of Figure 1.

Figure 3 is a side sectional view taken along the line 3—3 of Figure 1.

Figure 4 is a perspective view of a portion of one of the tubes and the spacers associated therewith.

Referring now in detail to the several figures, the numerals 1 and 2 represent, respectively, the upper and lower headers of the radiator, the former being a tank of considerable capacity, as shown in Figure 3. Conduits 4 and 5 lead respectively, from the upper and lower headers of the radiator to the cylinder jacket of the internal combustion engine, not shown. The upper header is provided with a filling opening 6, and an overflow pipe 7 originates in said opening and passes in a water-tight manner through an aperture in the header 1, as shown at 8, and downwardly closely adjacent the rear face of the core, the lower end of said overflow pipe terminating below the radiator. The features thus far enumerated are conventional and, in themselves form part of the present invention only broadly in combination with the structure now to be described. The upper and lower headers are joined to the opposite ends of a series of vertical tubes 10, with which they are in communication. These tubes are soldered to the adjacent faces of the upper and lower headers in a usual manner. Each of the tubes comprises a hollow body formed in cross section like a double wedge, said body consisting preferably of sheet metal folded upon itself to produce a substantial front edge 11 and rear edge 12, with an intermediate portion which is widest in cross section at a point adjacent the front of the tube as shown at 13. That portion of the

walls of said tube which lies forwardly of the widest part 13 is smooth while that portion to the rear of the widest part is formed with vertical corrugations. The tubes are arranged in parallelism between the upper and lower headers, as shown in Figure 2, from which figure it will be noted that the rear portions of the tubes are disposed angularly to the forward portions so that air entering between adjacent tubes longitudinally of the direction of motion of the vehicle upon which the radiator is mounted, is deflected inwardly toward the median line of the radiator and is concentrated upon an internal combustion engine located behind said radiator. The tubes on opposite sides of a vertical plane passing through the longitudinal center the radiator incline toward each other so that a central space 14 is necessarily formed, the same being preferably filled in by a tube 15 of less width than the other tube. The rear portions of the tubes 10 are formed with corrugated walls 16.

Each of the spaces 17 which lies between adjacent tubes take a shape which is incident to the shape of the tubes, being widest at the front of the radiator and converging to a narrow passage which lies adjacent the widest part of the tubes, from which point the space again widens as it approaches the rear of the radiator.

The wedge-like fronts of the tubes permit a volume of air to enter the radiator which is substantially of the same area as the front face of the radiator itself. This air is directed into narrow streams of great velocity at the point where the air spaces 17 are narrowest, and then passes to the rear. On account of the constriction of the jets of air at the narrowest parts of the spaces between adjacent tubes the velocity of said jets will be greater in the midst of the air currents passing rearwardly between the tubes than adjacent the surfaces of the rearward portions. This ordinarily would permit films of undisturbed air to reside closely adjacent the walls of the rearward portions of the tubes 10. One of the objects in corrugating the walls of the tubes is to provide baffle means whereby the air impinging upon one baffle will be thrown to the opposite side of the air passage, there to meet another baffle and be thrown back and so on in its course through radiator ensuring complete and continuous renewal of the air in contact with the walls of the radiator. Another function of the corrugations is to provide for the expansion of the tubes without injuring them, should the circulating liquid within the radiator become frozen.

In order to give rigidity to the core of the radiator the tubes are braced at their sides by spacing elements 18 (Fig. 4), the side edges of which are shaped to fit the side walls of the tubes 10.

By this construction of core it will be observed that the widest parts of the water tubes 10 are arranged as closely as practicable to the front of said tubes in order that those parts of the tubes which contain the greater volume of cooling fluid may receive the greatest cooling effect, while the tubes narrow gradually toward the rear as the cooling draft increases in temperature, the rate of heat exchange thus being preserved uniform through the extent of the tube. By providing single tubes instead of a plurality of conduits extending in banks in a width direction the skin friction within said tubes is reduced to a minimum which prevents the radiator becoming materially less efficient through age, due to deposits on the walls thereof on account of sluggish movement of the circulating fluid. Moreover, the shape of the tubes is such as to reduce head resistance of the incoming air, which is a factor of importance particularly when the radiator is used in aeronautic installations, and the general assemblage of parts forms a strong and rigid structural unit.

It is obvious that the specific details of construction and configuration of parts described herein may be modified in various ways without sacrificing the advantages of the invention or departing from the scope thereof as defined in the appended claims.

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

1. A radiator including a core comprising a series of water tubes forming walls for a series of alternating air spaces, the walls of adjacent tubes flaring forwardly and rearwardly from an intermediate point and being corrugated rearwardly of said intermediate point.

2. A radiator including a core comprising a series of water tubes forming walls for a series of alternating air spaces, the walls of adjacent tubes flaring forwardly and rearwardly from an intermediate point and being corrugated rearwardly of said point transversely of the direction of the draft entering said radiator.

3. A radiator including a core comprising a series of water tubes forming walls for a series of alternating air spaces, the walls of adjacent tubes flaring forwardly from an intermediate point, the forward parts of said tubes lying longitudinally of the direction of draft entering said radiator and the rear parts being inclined with respect to said direction.

4. A radiator including a core comprising a series of water tubes forming walls for a series of alternating air spaces, said walls flaring forwardly and rearwardly from an intermediate point, the forward parts of adjacent walls lying symmetrically with re-

spect to vertical planes parallel to the direction of draft entering said radiator and the rear parts being assymmetric to said planes.

5. A radiator including a core comprising a series of water tubes forming walls for a series of alternating air spaces, the walls of adjacent tubes flaring forwardly and rearwardly from an intermediate point, the forward parts of said tubes lying longitudinally of the direction of draft entering said radiator and the rear parts on one side of the core being convergently inclined with respect to the rear parts on the other side thereof, said tubes being corrugated rearwardly of said intermediate point.

6. A radiator including a core comprising a series of water tubes forming walls for a series of alternating air spaces, the walls of adjacent tubes flaring forwardly and rearwardly from an intermediate point, the forward parts of said tubes lying longitudinally of the direction of draft entering said radiator and the rear parts being inwardly inclined thereto, said tubes being corrugated rearwardly of said intermediate point transversely of the path of the draft through said radiator.

7. A radiator including a core comprising a series of water tubes forming walls for a series of alternating air spaces, the walls of adjacent tubes flaring forwardly and rearwardly from an intermediate point which lies relatively close to the front face of the radiator, the forward parts of said tubes lying longitudinally of the direction of draft entering said radiator and the rear parts on one side of the core being convergently inclined with respect to the rear parts on the other side thereof.

8. A water tube for radiators comprising a hollow body having the cross sectional shape of a double wedge, the apices being directed respectively forwardly and rearwardly, the widest part of said tube being relatively close to the forward apex, said tube being corrugated rearwardly of its widest part.

In testimony whereof I affix my signature.

GROVER C. FARRIS.