J. E. WHITBECK.

RADIATOR.

APPLICATION FILED MAR. 3, 1919.

1,346,577. Patented July 13, 1920.

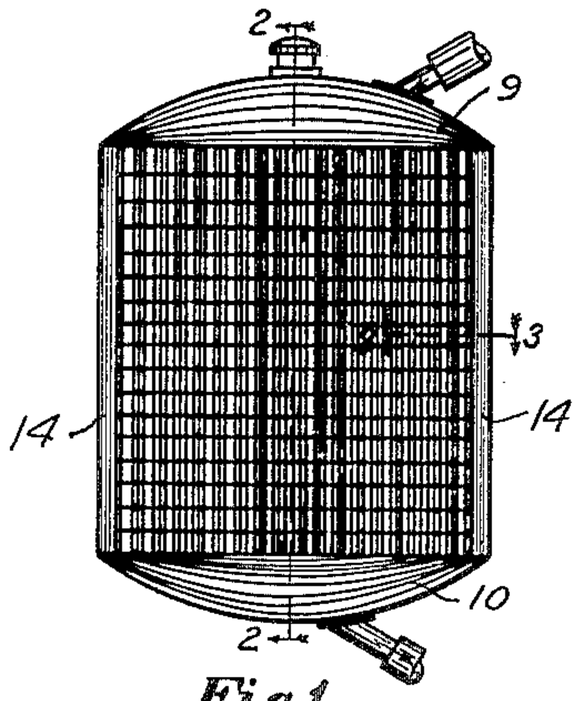

Fig.1

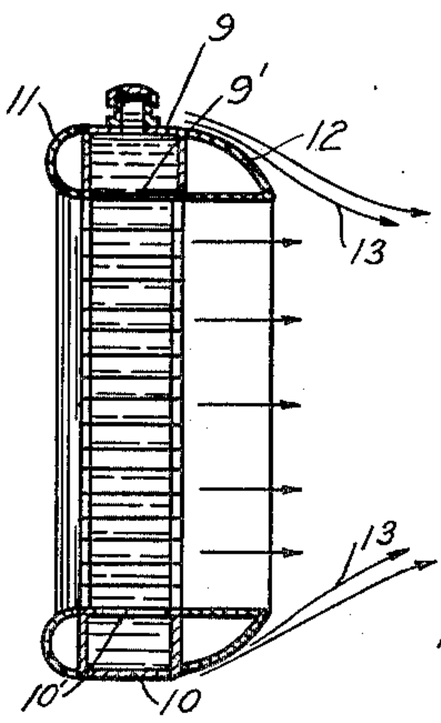

Fig.2

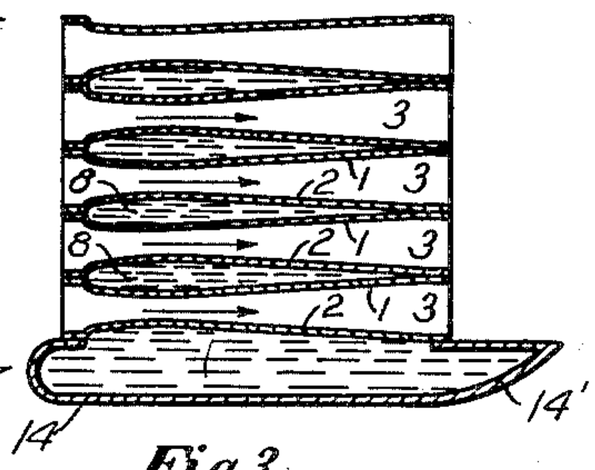

Fig.3

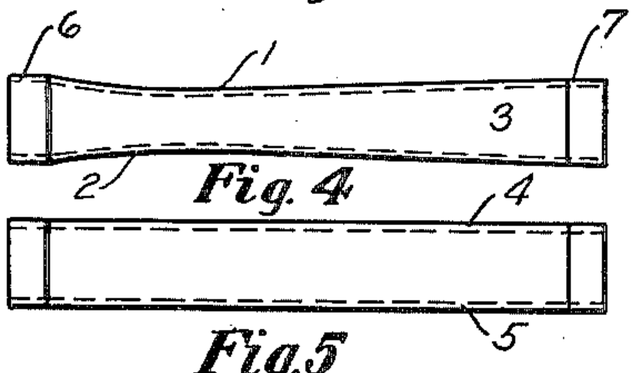

Fig. 4

Fig.5

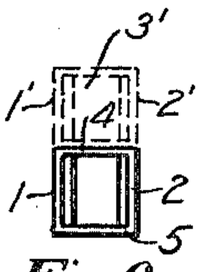

Fig.6

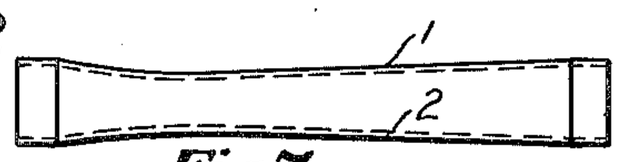

Fig.7

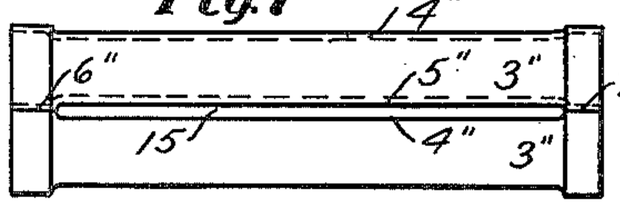

Fig.8

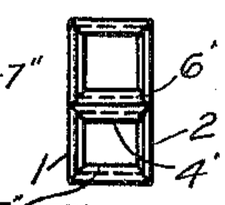

Fig.9

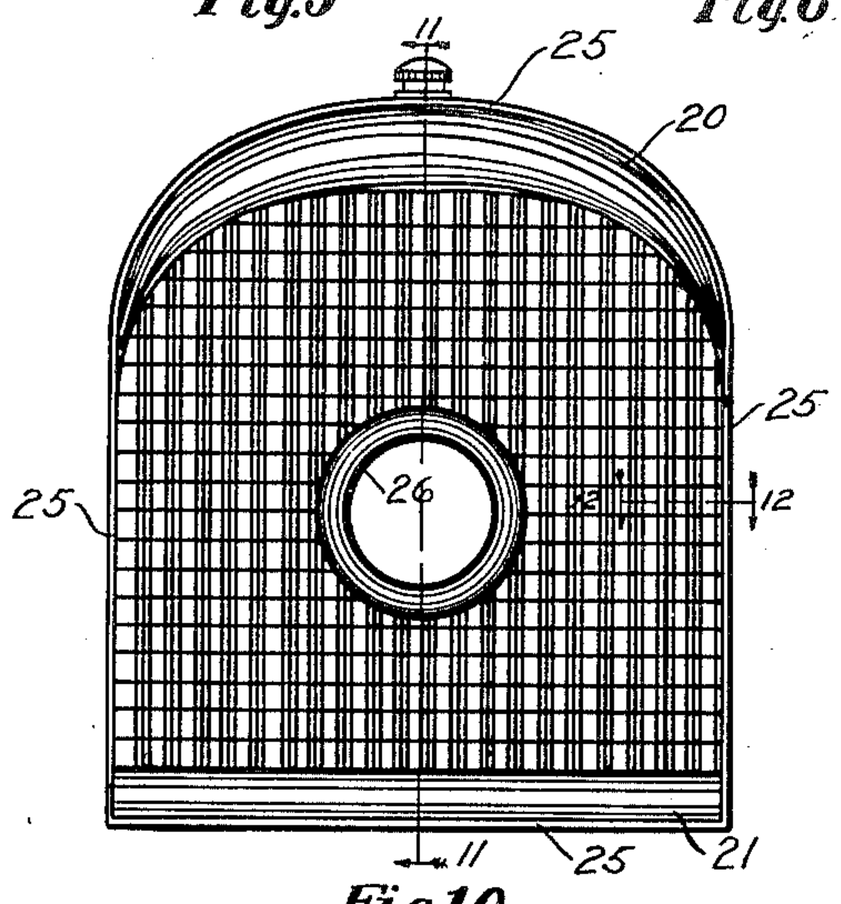

Fig.10

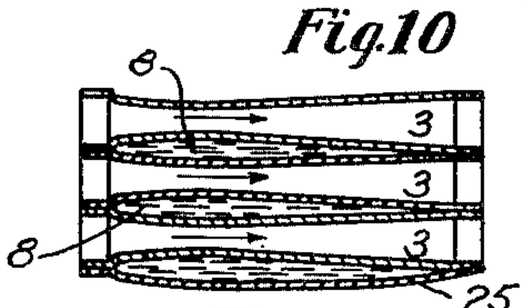

Fig.12

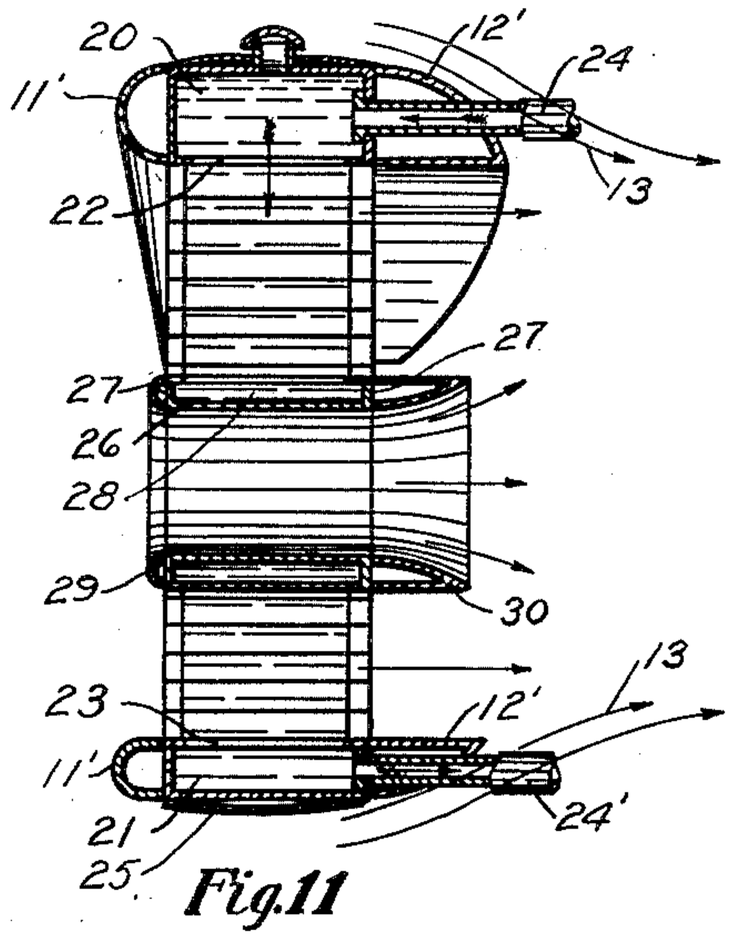

Fig.11

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RADIATOR.

1,346,577. Specification of Letters Patent. Patented July 13, 1920.

Application filed March 3, 1919. Serial No. 280,359.

To all whom it may concern:

Be it known that I, JOHN E. WHITBECK, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Radiators, (Case B,) of which the following is a specification.

This invention relates to radiator core construction and radiator header construction for use on vehicles intended to travel through the air at high speed, such as airplanes.

The principal object of this invention is to minimize the head resistance or drag ordinarily presented by the present day radiator. This object is attained by the use of a radiator core in which the tubes forming the same are of venturi-like construction, these tubes being assembled one above the other so that they define between them water passages which are of stream line form.

The head resistance or drag imposed by the air is further minimized by providing the inlet header and outlet header of the radiator with fairing elements so shaped as to bring the whole to as nearly a stream line shape as possible.

It is a further object of this invention to provide a radiator in which a series of water passages which are straight and unobstructed are provided, whereby the water flows in substantially a straight and free passage directly from the inlet header to the outlet header.

It has been found that the venturi shape is particularly efficient in giving a very rapid flow of air through the radiator core. This fact together with the fact that the rapid water flow made possible by the straight water passages, obviously will give very high thermal efficiency.

It is a further object of this invention to provide a radiator header in which the air flowing over the outside of the header will be directed toward and into the stream of air flowing from the radiator core. This tends to prevent eddying behind the radiator core and further, the two converging streams of air flowing past the header have a venturi like action in sucking air through the radiator core.

Other objects and advantages will appear as the description proceeds.

In the drawings illustrating certain embodiments of my invention, Figure 1 is a front view of my improved radiator; Fig. 2 is a section of the same on the line 2—2 of Fig. 1; Fig. 3 is a horizontal section, on an enlarged scale, taken on the line 3—3 of Fig. 1; Figs. 4, 5 and 6 show a plan, elevation and end view, respectively of one of the tubes used to build up the radiator core; Figs. 7, 8 and 9 are similar views of a modified tube; Fig. 10 is a view of a modification; Fig. 11 is a sectional elevation taken on the line 11—11 of Fig. 10; and Fig. 12 is a horizontal section, on an enlarged scale taken on the line 12—12 of Fig. 10.

At this point it may be stated that a radiator embodying somewhat similar principles of theory and construction is shown in my copending case, Serial No. 280358 filed March 3, 1919.

Referring now to Figs. 4, 5 and 6 showing one of the radiator core elements, a substantially four sided tube is shown, the vertical walls 1 and 2 of which are curved in toward the axis of the tube so as to provide a tube of varying cross sectional area from front to rear. The cross sectional area of this tube becomes a minimum at a point located between the front and middle thereof, the cross sectional area increasing gradually both toward the front and toward the rear from this minimum point or throat. Or in other words looking at the tube, designated in its entirety by the reference character 3, in plan, a venturi form is shown.

The top and bottom walls of the tube 3, designated 4 and 5 respectively are substantially flat. The radiator core is built up by assembling the tubes 3 in columns directly above one another as shown in Fig. 6. That is to say the vertical walls 1′ and 2′ of a super-posed tube 3′ are substantially vertical continuations of the vertical walls 1 and 2 of the tube directly beneath it. It will be understood that the tubes are also assembled in horizontally disposed rows as is usual to build up the radiator core. The ends 6 and 7 of the several tubes 3 are suitably bent so that they will fit together tightly and so that they may be brazed or soldered to make a water tight joint.

Referring now to Fig. 3, it will be seen that there is defined, between adjacent walls 2 and 1 of different tubes 3 a water space 8, which water space 8 is of substantially stream line form. By stream line form is meant a shape of gradually varying cross

sectional area from front to rear. There are as is well known, many possible stream line shapes. The typical stream line shape however resembles a very much elongated oval, being rounded off at the front, then increasing in cross sectional area to a maximum at a point between the front and middle thereof and from there gradually decreasing in cross sectional area to a rather sharp edge at the rear.

The coöperation and relationship existing between the venturi-like air tubes and the stream lined water spaces defined therebetween is a very important feature of this invention. Both of the mentioned water and air spaces vary in cross sectional area from front to rear, but in an inverse sense, the one attaining its maximum at substantially the same point that the other attains its minimum, and vice versa.

The use of a Venturi tube for the passage of air presents the following advantages. The flaring mouth of the venturi takes in a comparatively large volume of cold air at the front of the water space 8 where the water is hottest, and so a rapid interchange of heat takes place at that point. The air as it passes along the venturi becomes more and more heated and tends to expand and bank up in the tube. The expanding rear part of the venturi however, provides a space into which the heated air can and does expand. This provision for the expansion of the air not only prevents banking up of the air in the tube but it tends to increase its velocity and to suck air through the constricted throat of the venturi.

The use of a stream line shape for the water passage defining means will, it is obvious, reduce the head resistance to a minimum. The present tendency of modern airplane design is to stream line all parts that can be stream lined. It will be noted that the bulk of the water is toward the front of the air passages where the air is colder and that there is very little water toward the rear where the cooling effect is smaller due to the fact that the air in the rear part has been already considerably heated.

The several columns and rows of tubes 3 are mounted between an inlet header 9 and an outlet header 10. These two headers are provided with apertures 9′ and 10′ respectively that open into the top and bottom, respectively of the several water passages 8. The water passages 8, it should be noted are substantially vertical and provide a free and unobstructed passage for the flow of water from one header to the other. The rapid flow of water thereby gained, together with the rapid flow of air gained by the use of the Venturi tubes makes for high thermal efficiency.

In order to further minimize the air resistance or drag, the two headers 9 and 10 may be provided with front fairing elements 11 and rear fairing elements 12, shaped as shown. It should be noted that the rear fairing elements 12 are so shaped as to direct the air passing thereover into and toward the air stream passing through the radiator core proper, as indicated by the arrows 13. In addition to aiding in preventing eddying behind the radiator core, the two converging streams of air have a venturi-like action in sucking air through the radiator core, thus aiding in producing a rapid and desirable air flow.

The side walls 14 of the radiator may be substantially stream lined as shown and may at their rear portions 14′, be shaped so as to direct the air passing thereover into and toward the air stream leaving the radiator core. These two lateral air streams cooperate with the upper and lower air streams passing over the upper and lower headers to aid in obtaining the advantages already fully set forth. These side walls 14 may, as indicated, act as water passages.

Referring now to Figs. 7, 8 and 9 a modified form of core tube is shown in which the vertical walls are curved to provide a substantially venturi-like tube as in Fig. 4. The upper and lower walls 4″ and 5″ however instead of being flat are slightly offset at the front and rear as indicated at 6″ and 7″, so that the adjacent walls 5″ and 4″ of adjacent tubes 3″ are slightly spaced apart to define a lateral water passage 15, which water passages 15 extend at right angles to the several water passages 8. This modification is intended to be used where a rather high cooling effect is necessary, the additional cooling being obviously due to the fact that the air tubes have a film of water on the top and bottom thereof, as well as on the sides. The tubes 3″ are assembled in vertical columns to define the usual water passages 8.

Referring now to the modified construction shown in Figs. 10, 11 and 12, 20 indicates a curved inlet header and 21 an outlet header. A core consisting of a series of Venturi tubes 3 assembled as already described in vertical columns and horizontal rows to define water spaces 8, is mounted between these two headers. The headers 20 and 21 are respectively provided with a series of apertures 22 and 23 which register respectively, with the upper and lower ends of the several water passages 8. 24 and 24′ indicate inlet and outlet pipes respectively.

Fairing elements 11′ and 12′ are associated with the two headers and function in the same manner as the already described fairing elements 11 and 12. Additional fairing elements 25 may be carried by the two headers in order to complete a substantially stream line form.

The side elements 25 extending between

the headers 20 and 21 on each side coöperate with the two extreme lateral columns of Venturi tubes to define the two water columns 8′, one on each side.

In order to permit the passage of the shaft of an airplane propeller through the radiator the center part of the core is cut away and there is mounted in the space thus obtained an annual collar 26, with which collar there coöperate fore and aft annular rings 27 to define an annular water space 28, which water space is in communication with the series of water spaces 8 directly above and below the same. Fairing elements 29 and 30 are provided at the front and rear respectively of the water containing collar 26 to complete a substantially stream line form. The rear fairing element 30 is shaped to guide the air flowing thereover toward and into the stream of air leaving the radiator core.

While I have illustrated my radiator core as applied to a nose type radiator, it should be understood that the core may be and is intended to be used in a radiator mounted on the side of the fuselage, or in the wing of the airplane, or elsewhere.

It should be further understood that my invention is not limited to the details shown by way of illustration but may be carried out in other ways, as defined within the scope of the following claims.

I claim:—

1. A radiator for a vehicle, comprising a core, upper and lower headers, and side walls, said headers and said side walls being shaped so as to direct air passing thereover toward and into the air stream leaving the radiator core, to form converging air streams to aid in drawing air through the radiator core.

2. The combination as claimed in claim 1, said side walls further acting as water-carrying passages.

3. An airplane radiator, comprising a core, upper and lower headers shaped so as to direct air passing thereover into and toward the air stream leaving the radiator core, said core being provided with an opening for the passage of a propeller shaft, and a collar set in said opening and shaped so as to direct the air passing through said opening outwardly into the air stream leaving the radiator core.

In testimony whereof I affix my signature.

JOHN E. WHITBECK.