C. G. BOECK.

AUTOMOBILE RADIATOR.

APPLICATION FILED JAN. 7, 1910.

970,297.

Patented Sept. 13, 1910.

4 SHEETS—SHEET 1.

Fig. 1.

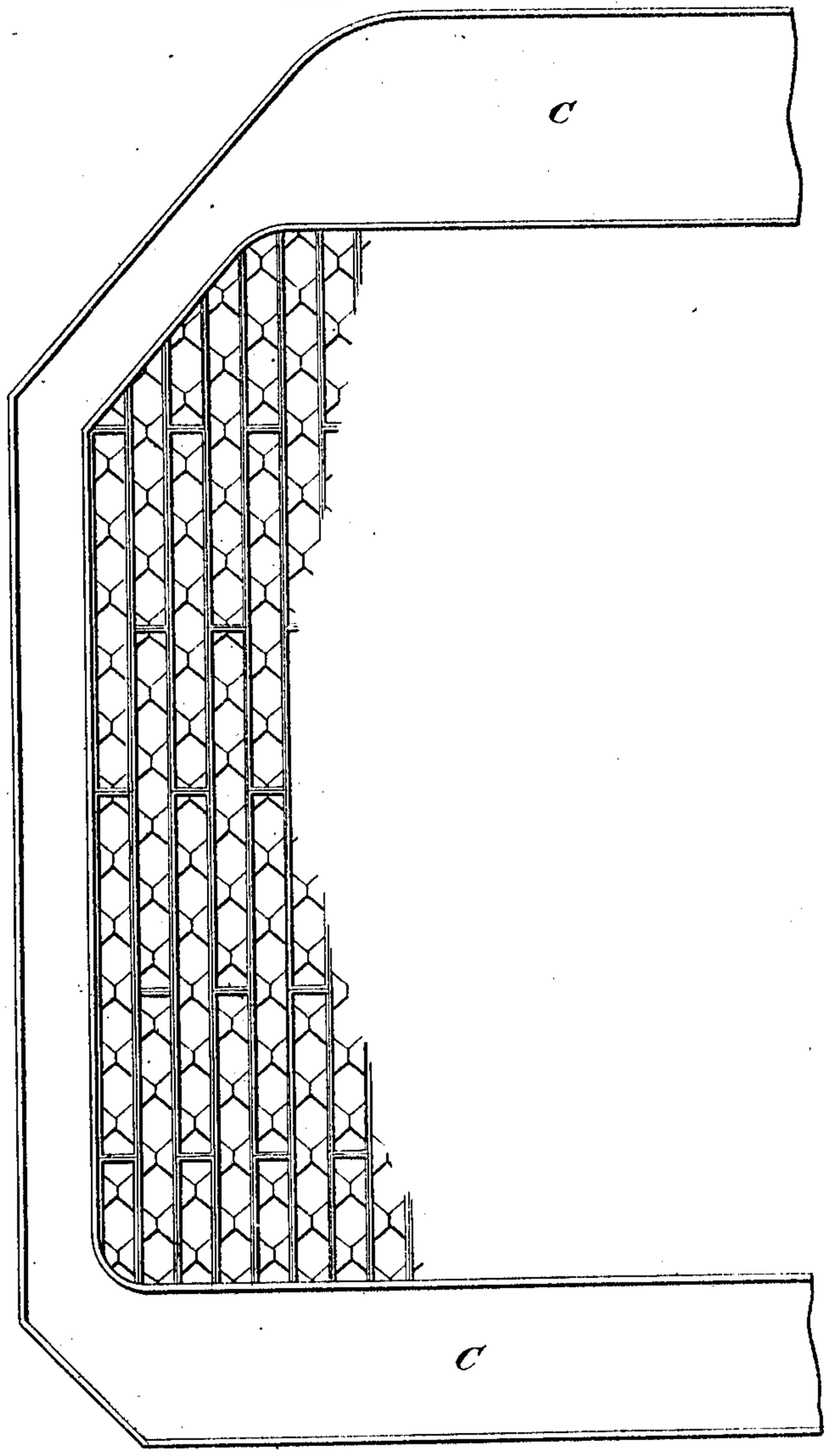
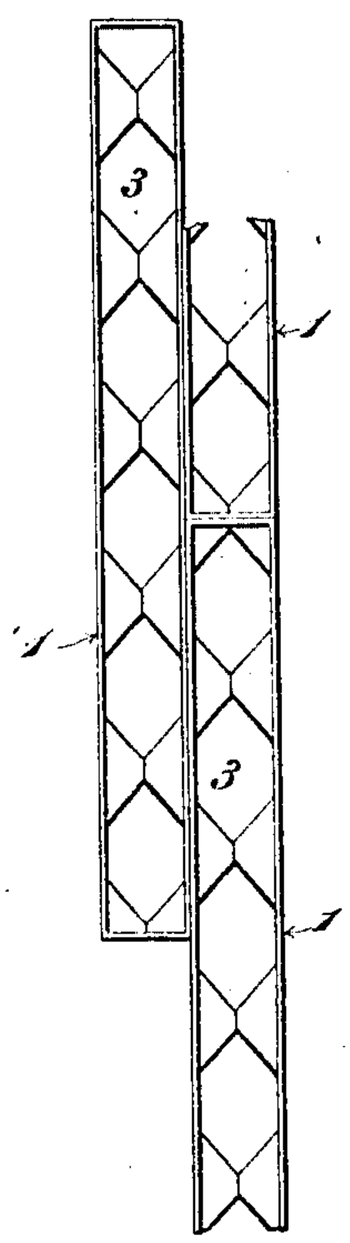


Fig. 2



WITNESSES

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4 SHEETS—SHEET 2.

Fig. 2.

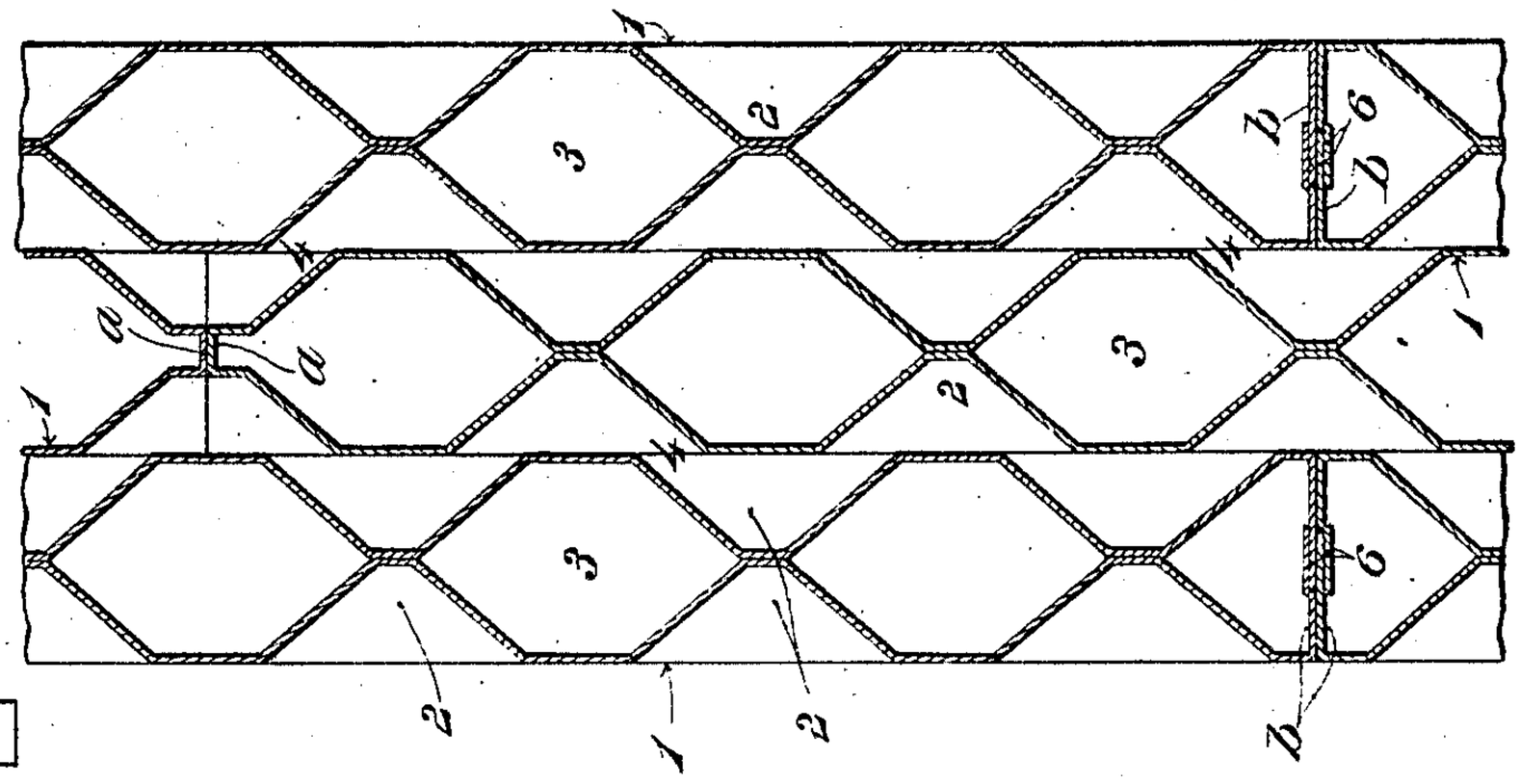


Fig. 3.

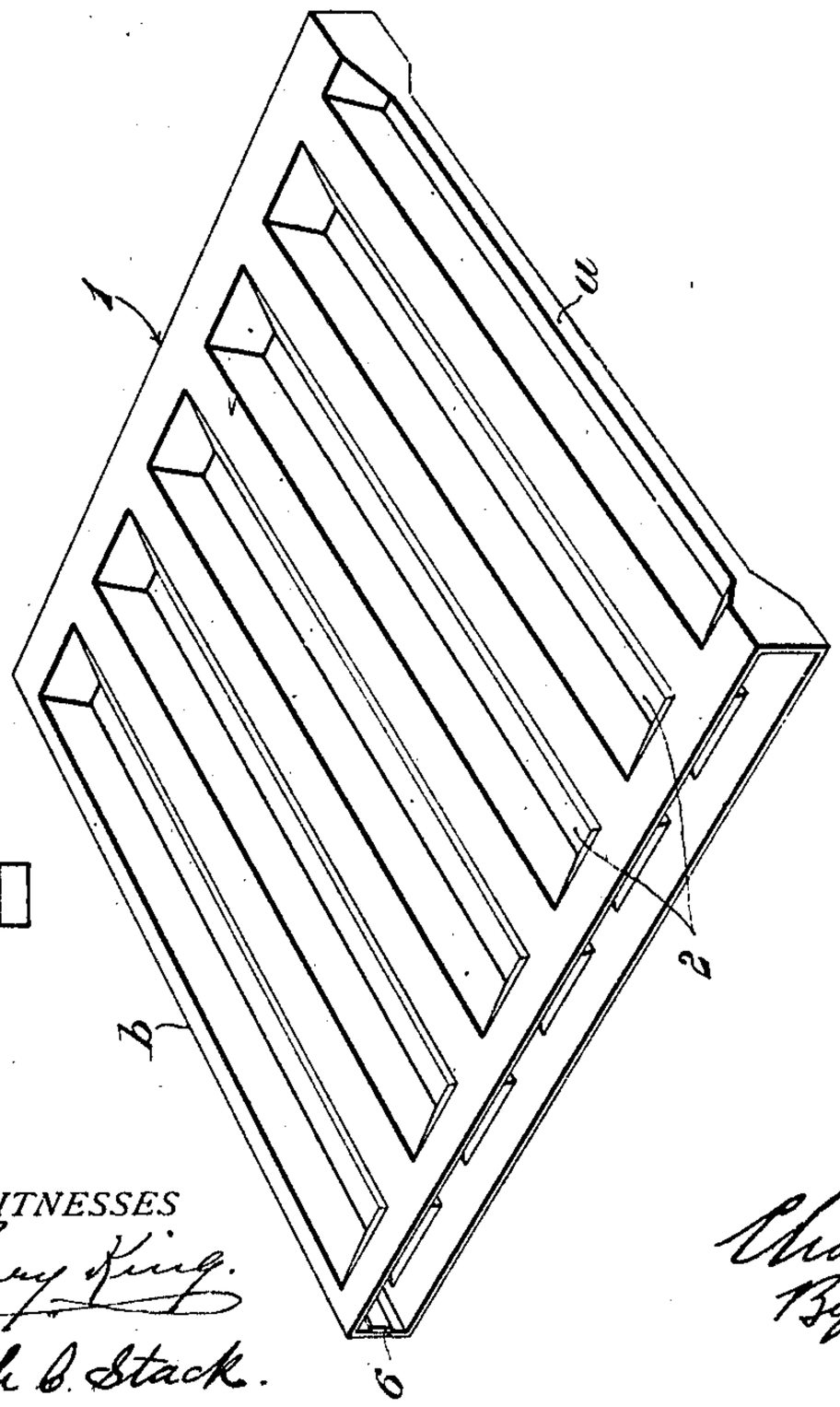


Fig. 4.

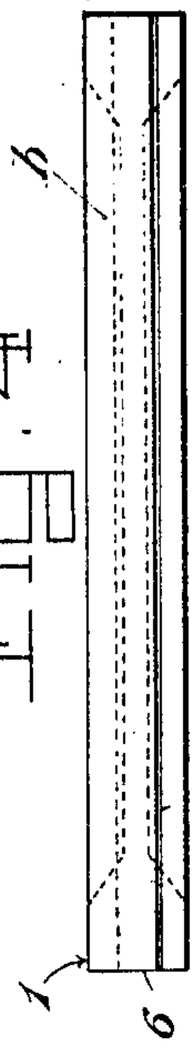
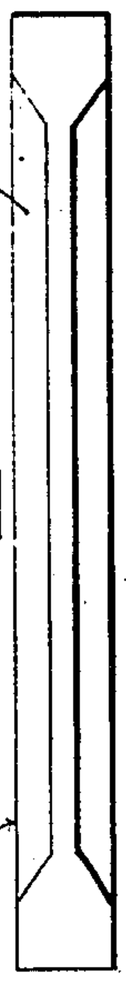


Fig. 5.



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4 SHEETS—SHEET 3.

Fig. 7

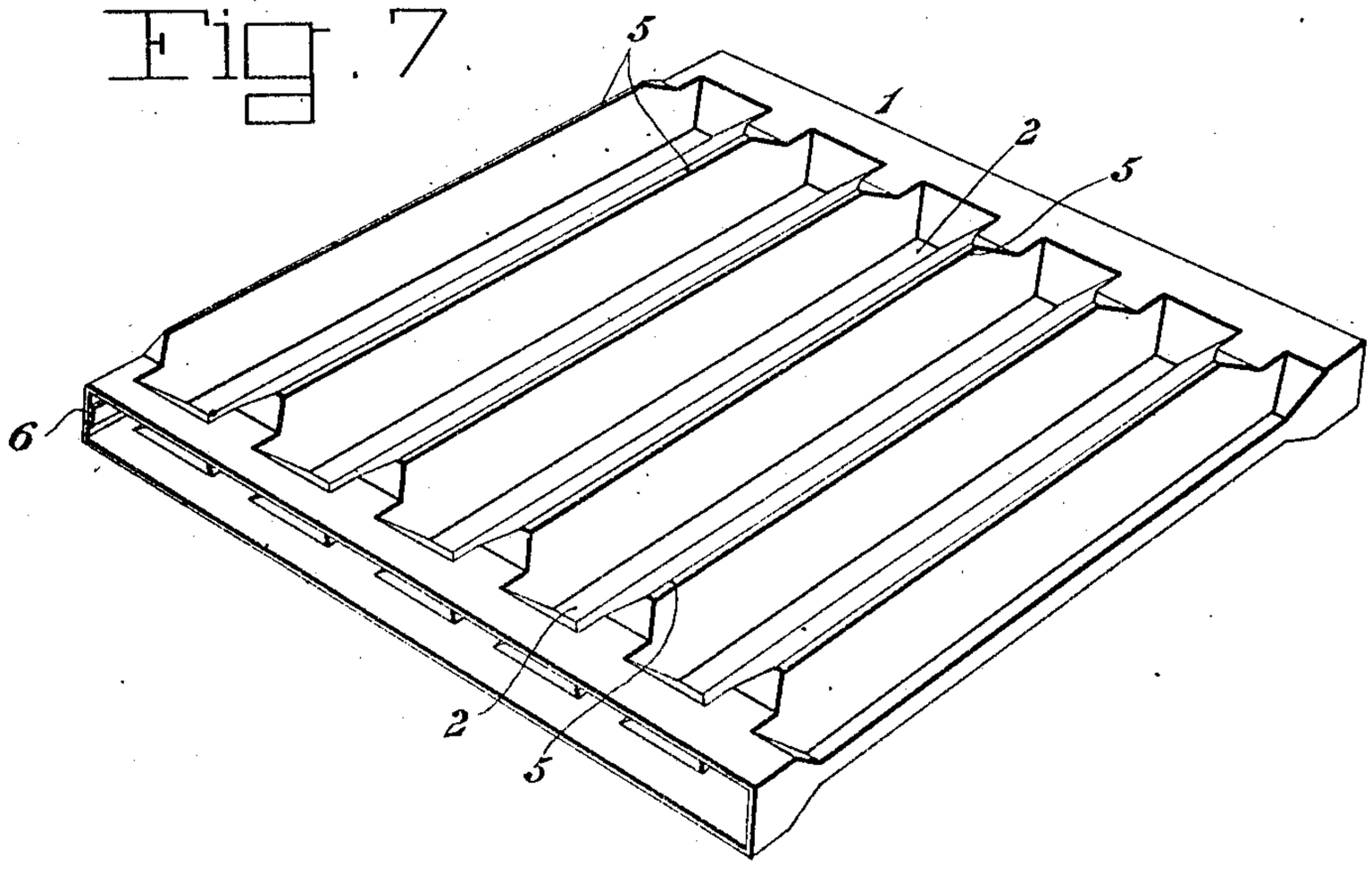


Fig. 8.

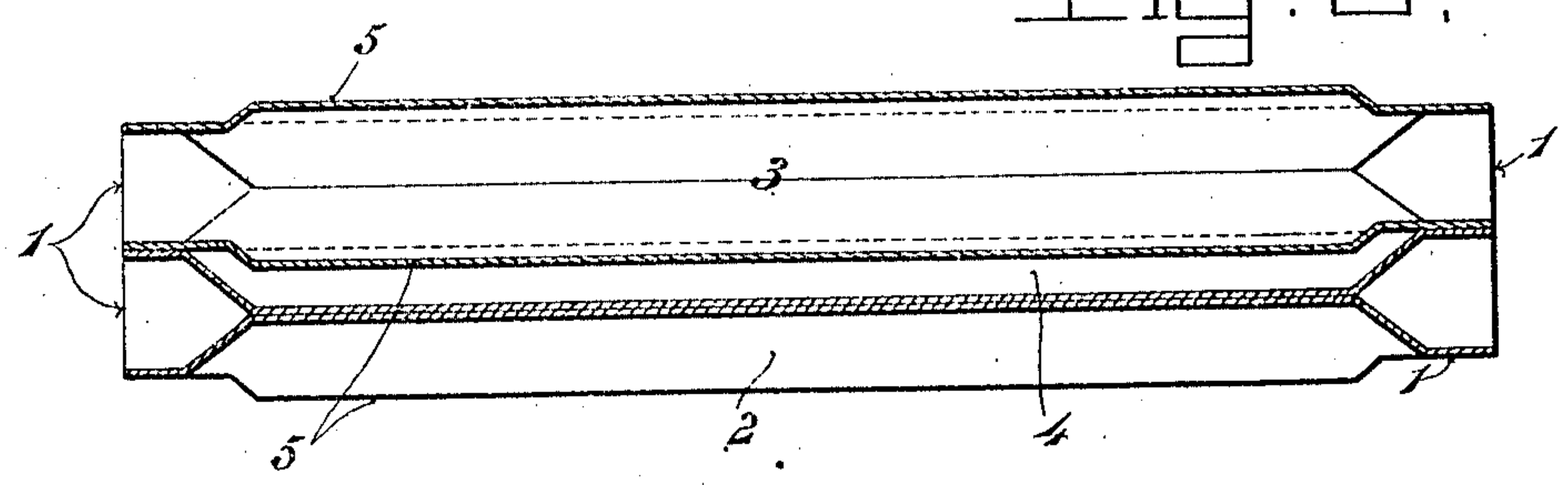
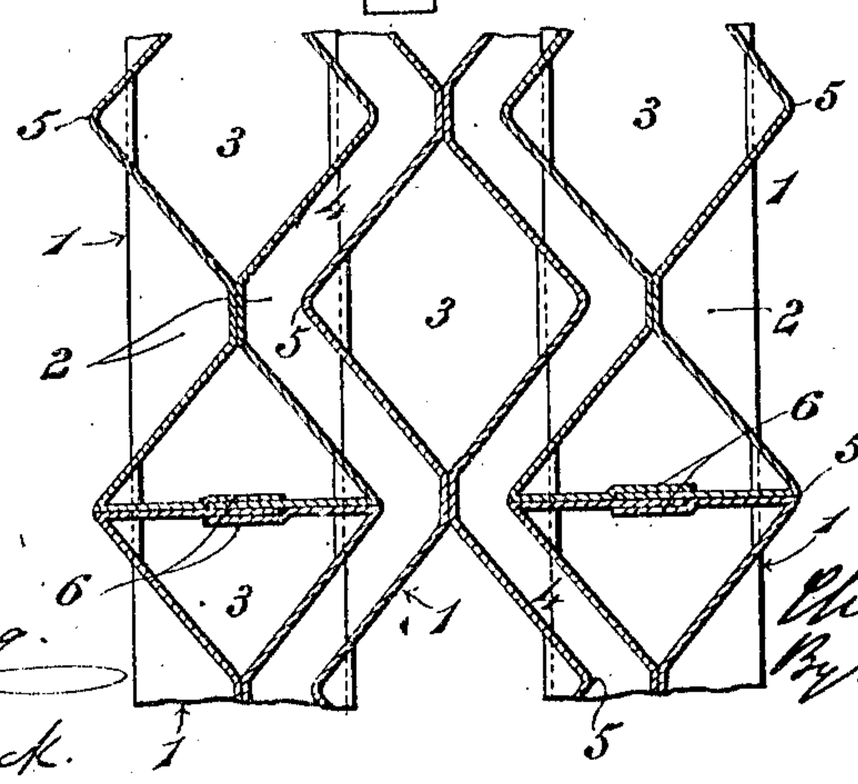


Fig. 9



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4 SHEETS—SHEET 4.

Fig. 11.

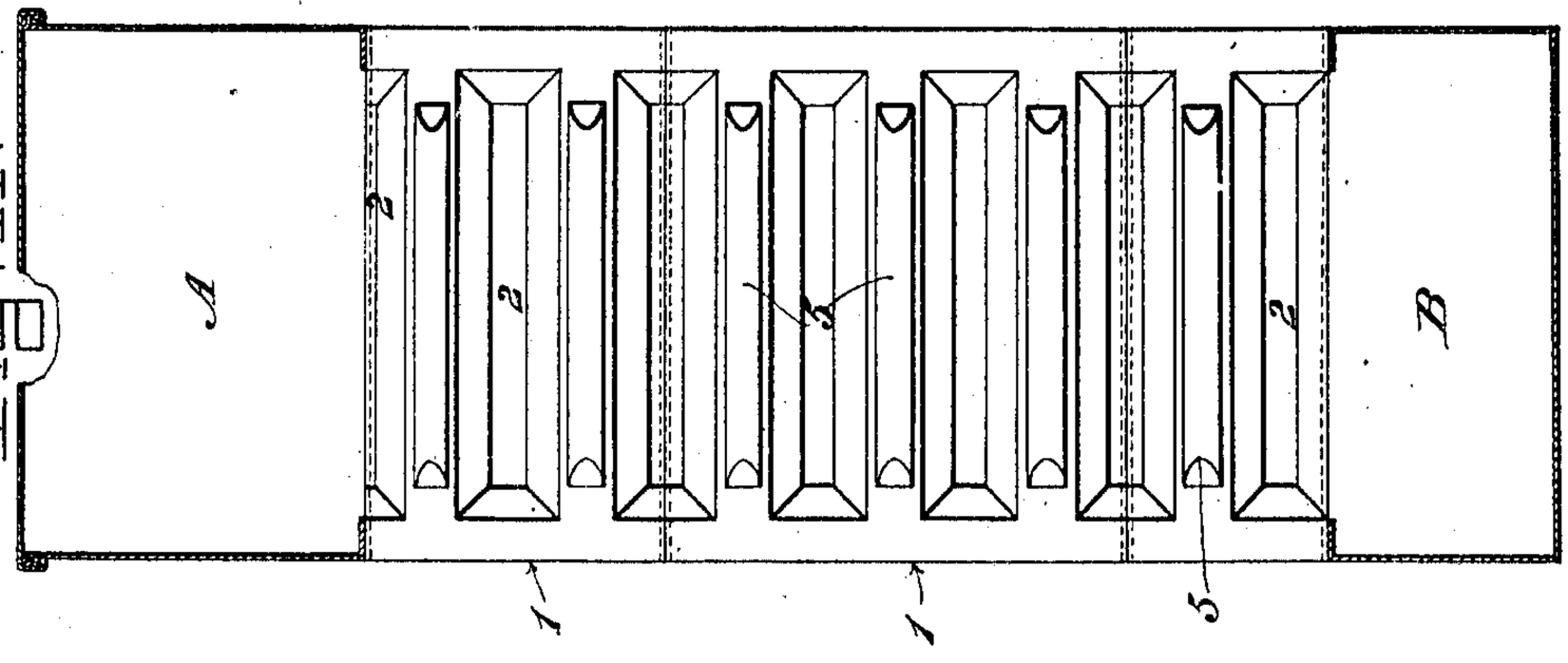

Fig. 10

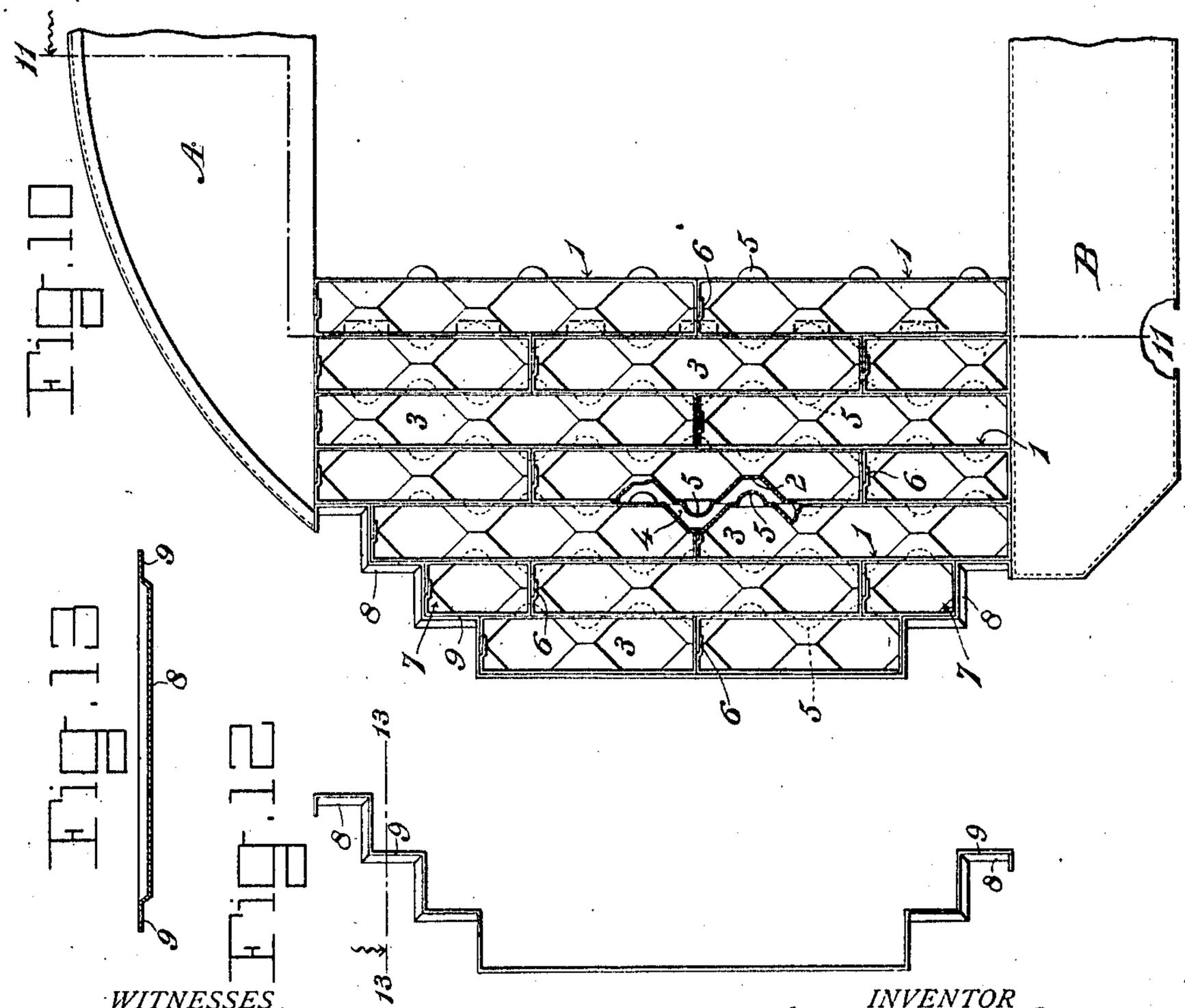

Fig. 13

Fig. 12

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UNITED STATES PATENT OFFICE.

CHARLES G. BOECK, OF JACKSON, MICHIGAN, ASSIGNOR TO NOVELTY MANUFACTURING COMPANY, OF JACKSON, MICHIGAN, A CORPORATION OF MICHIGAN.

AUTOMOBILE-RADIATOR.

970,297. Specification of Letters Patent. Patented Sept. 13, 1910.

Application filed January 7, 1910. Serial No. 536,923.

To all whom it may concern:

Be it known that I, CHARLES G. BOECK, a citizen of the United States, residing at Jackson, in the county of Jackson and State of Michigan, have invented certain new and useful Improvements in Automobile-Radiators, of which the following is a specification.

My invention relates to radiators such as are commonly employed on motor-vehicles for air-cooling the circulating fluid used for jacketing the engine-cylinders.

The invention pertains more particularly to the so-called cellular type of radiator, comprising an assemblage of open air-flues with intervening sealed restricted water-passages; approved structures of this character being usually of sheet-metal.

In the construction of such radiators, the principal desideratum is to provide as much radiating surface as possible within a given area, while restricting the stream of water flowing in contact with such surface, so as to promote rapid and efficient interchange of heat.

Another desideratum, scarcely less important, is to provide sufficient flexure in the walls of the cellular structure to minimize, or to obviate if possible, the liability of rupture and leakage from freezing; considerable difficulty having heretofore been experienced from this cause. Also, the structure of the radiator should be such as to conveniently permit the making of repairs, by soldering the joints in the event of rupture.

Still a further important consideration is to provide a mechanically and commercially practical and economical form of manufacture.

These several objects are quite satisfactorily attained by my invention, which provides a very practicable and efficient construction of radiator of the type referred to.

The invention will hereinafter be first fully described with reference to the accompanying drawings, which form a part of this specification, and then more particularly pointed out in the claims following the description.

In said drawings: Figure 1 is a front elevation of an automobile radiator embodying my invention; a part of the frame or casing being broken away, and only a portion of the flue-sections or elements composing the radiator being shown. Fig. 2 is a larger front view of a fragment of the radiator, showing the relative arrangement of flue sections to provide the intervening water-passages as hereinafter described. Fig. 3 is a perspective view of a flue section. Figs. 4 and 5 are elevations showing the upper and lower ends of a flue section. Fig. 6 is a vertical cross-section on a larger scale through a portion of the radiator. Fig. 7 is a perspective view of a flue section of another form. Fig. 8 is a horizontal cross-section through two adjacent flue-sections like Fig. 7. Fig. 9 is a vertical cross-section through a portion of the radiator composed of flue-sections like Fig. 7. Fig. 10 is a front view of a radiator embodying the invention in a form slightly modified from that shown in Fig. 1. In this view the frame or outside casing is omitted, thus revealing the upper and lower water-chambers between which the radiator is placed, as well understood in the art. Fig. 11 is a vertical section on line 11—11 of Fig. 10. Fig. 12 is a front elevation of caps for sealing the flue sections at the sides of the radiator. Fig. 13 is a cross-section of a cap.

As shown in the drawings, the illustrated radiator embodying my invention comprises an assemblage of flat or flattish tubular elements 1 of sheet-metal, which may be said to have the general form of thin quadrangular prisms. The opposite walls or lateral faces of said elements are stamped or formed with longitudinal depressions 2, making internal confronting projections which divide the elements interiorly into a number of parallel open-ended air flues 3. Said longitudinal depressions do not extend to the ends of the elements, the front and rear portions of which are thus left flat-sided as shown. These flattish sheet-metal elements or flue-sections, which in the illustrated radiator are arranged vertically and in tiers, are placed immediately adjacent one another, side by side, and joined at their ends preferably by the well-known method of soldering. Adjacent elements or flue-sections have their longitudinal depressions 2 arranged in staggered relation, so that they overlap one another, thus providing restricted serpentine water-passages 4 between the flue-sections, as seen more clearly in Fig. 6. Said water-passages extend of course transversely of the air-flues and are sealed at the front and back of the radiator by the join-

ing of the flat-sided ends of the flue-sections together as aforesaid.

The foregoing explains the general construction as exemplified in Figs. 1 to 6 inclusive of the drawings, but I prefer also to stamp or form longitudinal external projections or raised portions 5, as seen in Figs. 7 to 11, upon those parts of the sides of the flue-sections that lie between the longitudinal depressions or indentations 2. These external projections 5 on each flue-section extend into the recesses or depressions 2 of the adjacent flue-sections and thereby restrict the water-passages at their bends and check the rapid flow at those points; and the effect is also to somewhat enlarge the air-flues interiorly intermediate their end-portions as seen in Fig. 8. In Figs. 7 to 9 the said external projections 5 are represented as continuous with the inclined walls of the recesses or depressions 2; while in Figs. 10 and 11 they are shown as distinct corrugations. I consider at present the construction shown in Figs. 10 and 11 to be a preferred form of the invention.

The individual elements or flue-sections are preferably made each from a continuous strip of sheet-metal, the ends thereof being joined by a soldered lap-joint 6 or other suitable seam; and they may be formed to provide the longitudinal depressions or alternating depressions and projections on their sides by the known or any appropriate methods of working sheet-metal, as by stamping or pressing with dies. Heretofore I have formed the sheet-metal strip into a rectangular or flattish tube, slipped same over a mandrel and finished in a press. Alternatively, a sheet-metal strip of the required dimensions may be first stamped with two corresponding series of depressions or corrugations at opposite sides of a median line, and then folded or doubled and bent into the flattish form of a thin quadrangular prism as shown, so that the indentations in the metal made by the depressions come opposite one another inside the prism to form the plural air-flues.

In Figs. 1 to 9, the lateral depressions stamped in the flue sections are so spaced that the tops and bottoms of the flue-sections intermediate their flat-sided end portions, are of different form, as will be seen in Figs. 3 to 6 wherein, to facilitate the explanation, the tops and bottoms are designated by the symbols *a* and *b*. Either *a* or *b* may be the top or the bottom of an element. The mating or adjoining of like parts *a* of two superimposed elements or flue-sections makes one complete depression 2, the top and bottom of such elements each forming only the one-half part of such depression. Adjoined like parts *b* of two such superimposed elements makes one full spacing between depressions. The manner in which this arrangement is or may be carried out in an entire radiator structure will be clear from Figs. 1 and 6. It is not necessary, however, that the several elements or flue-sections should be thus differently formed at their tops and bottoms, for both tops and bottoms of all or some of the flue-sections may be formed like *a* or like *b*. Thus in Figs. 10 and 11, which as aforesaid represents a preferred construction, most of the elements or flue-sections have both their tops and bottoms alike, and similar to the part *a* in Fig. 3.

In the practical construction of my radiator, it will generally be desirable to employ elements some of which have lesser heights than others, as shown in Figs. 1 and 10; and in many instances to completely fill the space or area of the radiator it will be necessary to insert relatively small elements; and in carrying out the general principle of the invention these lesser elements may not have a plurality of lateral depressions; for instance, the elements 7 in Fig. 10 have neither of them a full depression but are formed at their tops and bottoms with half-depressions like *a* in Fig. 3. Elements of such character are of course to be included within the scope of my invention; it being noted, in fact, that each vertical row of superimposed elements may be considered as making up a composite vertical flue-section within the terms of the first paragraph of this description.

The overlapping of the longitudinal recesses 2 on the faces or sides of the laterally-adjacent elements or flue-sections, to provide the intervening water-passages, is obtained by assembling the elements so that the recesses or depressions in one flue-section alternate with those in the laterally-adjacent sections; but it is not necessary that the elements of one vertical tier should be actually displaced relative to those of the tiers beside it, as is illustrated in the drawings, for it is entirely practicable to construct the radiator with a single horizontal row of vertical elements of equal heights. For example, if a number of elements like that shown in Fig. 3 be placed together side by side, arranging alternate elements with the parts *a* at the top and the intermediate ones with the parts *b* at the top, it is obvious that the recesses of adjacent elements will overlap and thus provide the water-passages as aforesaid.

To construct the radiator, the several elements or flue sections are properly assembled in a suitable form and tightly clamped together, after which the edges are preferably immersed in acid and then in a vat of molten solder. It takes but a moment to do this, and the entire face of the radiator is sealed and the separate elements joined together at front and back, leaving the water-passages open at top and bottom. Where

the sides of the radiator are irregular or stepped, as in Fig. 10, they may be sealed by caps 8, shown in Figs. 12 and 13. The cap 8 is or may be a strip of sheet-metal of the same transverse width as the length of the flue-sections, and shaped to fit over the steps or irregular top and bottom of the sides of the radiator. The cap has a channeled form with flat margins or flanges 9 corresponding to the flat end-portions of the flue-sections, and in constructing the radiator the caps may be clamped in with the assembled flue-sections and the edges of the cap soldered to the edges of the outside flue-sections in the same operation just described. These caps provide water-passages around the steps or irregularly arranged tops and bottoms of the flue-sections at the sides. There may be separate caps at top and bottom, or they may be formed in one piece; that is, the top and bottom caps may be formed at the opposite ends of one sheet-metal strip, instead of separately.

Figs. 10 and 11 show the radiator in place between upper and lower water-chambers as usual in such constructions; the upper chamber A and lower chamber B being parts of a water-circulating system including the engine-jacket or jackets (not shown) and suitable pipes or ducts. As seen more clearly in Fig. 11, the two chambers are in communication through the vertical water-passages 4, so that the fluid may circulate in thin streams or columns between the vertical tiers of flue-sections.

In Fig. 1 the water-chambers are not shown, being concealed behind and within the usual frame or outside casing C which incloses the radiator.

While I have shown and described the radiator with its elements arranged in vertical tiers, to permit the flow of water around the air cells between water-chambers placed at the top and bottom, as is now considered the preferred construction, it should be understood, however, that I do not confine myself to the arrangement illustrated, for the elements may be disposed horizontally or otherwise to conduct the water across the radiator or from side to side where the water-chambers are located laterally, as in some constructions. I also reserve the right to such changes in the details of form and arrangement, as well as such other embodiments of the invention herein contained, as may be made within the scope of the claims following this description.

It will be noted, among other advantages, that the problem of spacing the elements or flue-sections to provide the intervening water-passages is obviated by my improvement. The elements composing the structure being substantially flat-sided prisms, stamped with the depressions or corrugations in an intermediate area of the side of the prism, and adjacent such elements being disposed to present their depressions in staggered relation, the water-passages are provided by the overlapping of and intercommunication between the depressions or recesses, so that there is no necessity for employing spacing means; and the flat-sided ends of the adjacent elements or flue-sections are placed side by side and make close, tight, straight joints, insuring a perfect seal of the water-passages. The undulating formation of the sides of the flue-sections is such as to render the walls of the water-passages sufficiently flexible or yielding to obviate the danger of rupture from freezing, and any stress in the structure is not liable to separate the sealed joints or seams at the ends of the flue-sections, since the latter are flat-sided and placed and held tightly together so that there can be no tendency to break the soldered seams. Moreover, these straight seams at the front and back of the radiator could be very easily repaired by solder in the event of any possible rupture. It will be further noted that the structure presents practically a maximum of radiating surface for contact with the thin flowing columns of water, and in this connection the depressions 2 are preferably of substantially a form as shown to make prismatic air-flues 3, though I do not restrict myself to such form. By reason of the rectangular form of the flue-sections they can also be very easily assembled, and in the completed structure the radiator has a flat top and bottom which adapts it to fit between the water-chambers and to be easily sealed above and below. When the tubes are set up in a form, clamped together and soldered in the manner stated, they rest firmly together as will be clearly understood.

While my invention is primarily designed as an automobile radiator, being so shown and described herein, it should be understood however that I claim the invention as a cellular air-passaged cooler or heat-interchanger for whatever purpose it may be adaptable.

I claim as my invention and desire to secure by Letters Patent:

1. A radiator comprising an assemblage of prismatic tubular air-flue sections having open rectangular ends, the same being placed immediately adjacent one another and joined at their ends, the lateral faces of said elements being formed intermediately of their flat-sided end portions with longitudinal recesses, and the opposed faces of adjacent elements having their said recesses staggered for intercommunication, thereby providing intervening sealed water-passages extending transversely of the air-flues.

2. A radiator comprising an assemblage of prismatic tubular air-flue sections having open rectangular ends, the same being placed immediately adjacent one another and joined

at their ends, the lateral faces of said elements being formed intermediately of their flat-sided end portions with longitudinal recesses and alternating longitudinal projections, and adjacent elements being disposed so that the recesses in the faces of one overlap with the recesses in the faces of the others, while said projections on one element extend into the recesses in adjacent elements, thereby providing intervening serpentine water-passages restricted by said projections in the bends of said passages.

3. A radiator comprising an assemblage of prismatic air flue sections of sheet metal having open rectangular ends, the lateral faces thereof being flat at their end-portions and formed intermediately with longitudinal indentations which provide exterior recesses and interior projections increasing the radiating surface within the air-flues, such elements being arranged and secured together with the flat end portions of the faces of adjacent elements in contact and with the exterior recesses of such adjacent elements staggered for intercommunication, thereby providing intervening sealed water-passages.

4. A radiator comprising a plurality of flattish tubular elements or flue-sections having the form of thin quadrangular prisms, arranged immediately adjacent one another and joined at their ends, the opposite walls of said flue-sections being formed intermediately of their flat-sided end portions with longitudinal indentations making exterior recesses and interior projections which latter divide the flue-sections into a number of open-ended air-flues, and laterally adjacent flue-sections having their said recesses arranged in staggered relation to overlap, thereby providing sealed water-passages between the flue-sections and transversely of the air-flues.

5. A radiator comprising an assemblage of sheet-metal flue-sections arranged immediately adjacent one another and joined at their ends, said flue-sections having the form of thin quadrangular prisms the opposite sides of which are stamped intermediately of their flat-sided end portions with longitudinal depressions or recesses and alternating projections, said depressions making confronting inside projections which divide the flue-sections interiorly into a number of open-ended air-flues, and laterally adjacent flue-sections having their depressions overlapping, while the exterior projections on one flue-section extend into the depressions in the adjacent ones, thereby providing between the flue-sections serpentine water-passages which are restricted in the bends thereof by said projections.

6. For a sheet-metal radiator structure of the character described, a flue-section or element constructed from a continuous strip of sheet metal in the form of a thin quadrangular prism the opposite walls of which are stamped with longitudinal indentations forming exterior recesses and interior projections dividing the flue-section interiorly into a number of open-ended air-spaces, said indentations not extending to the front and rear ends of the flue-section which are left flat-sided, for the purpose described.

7. In a cellular radiator, the combination with an assemblage of tubular elements providing open-ended air-flues and intervening sealed restricted water-passages extending transversely of the air-flues, said elements being arranged to provide irregular sides, of stepped caps fitting over and sealing the stepped portions at the sides, said caps being formed to provide water-passages around said stepped portions.

In testimony whereof I affix my signature, in presence of two witnesses.

CHARLES G. BOECK.

Witnesses:

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G. D. HAWKINS.