Feb. 6, 1951 J. D. BEEBE 2,540,805

ELECTROLYTIC APPARATUS FOR MAKING RADIATOR CORES

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Fig. 2.

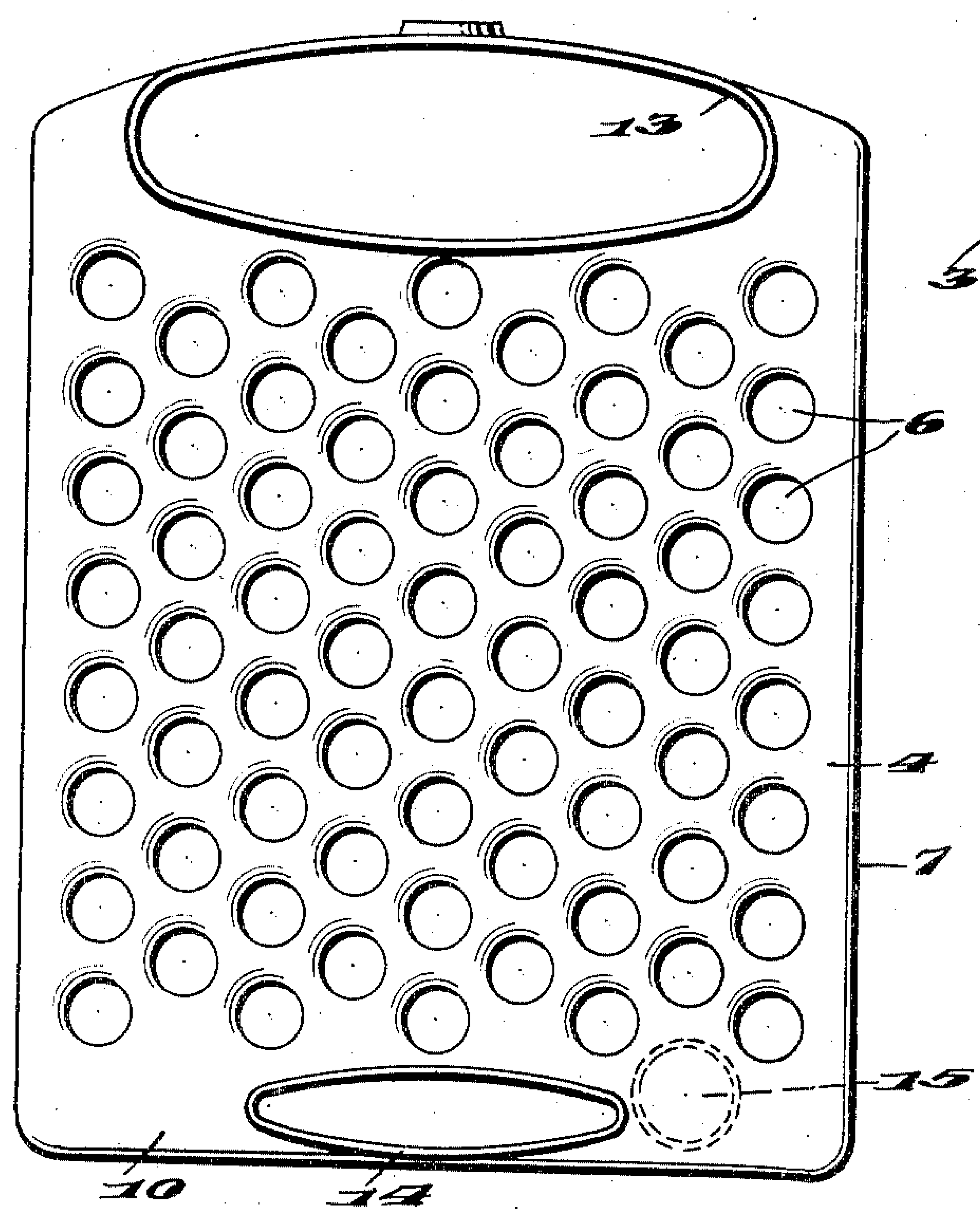


Fig. 1.

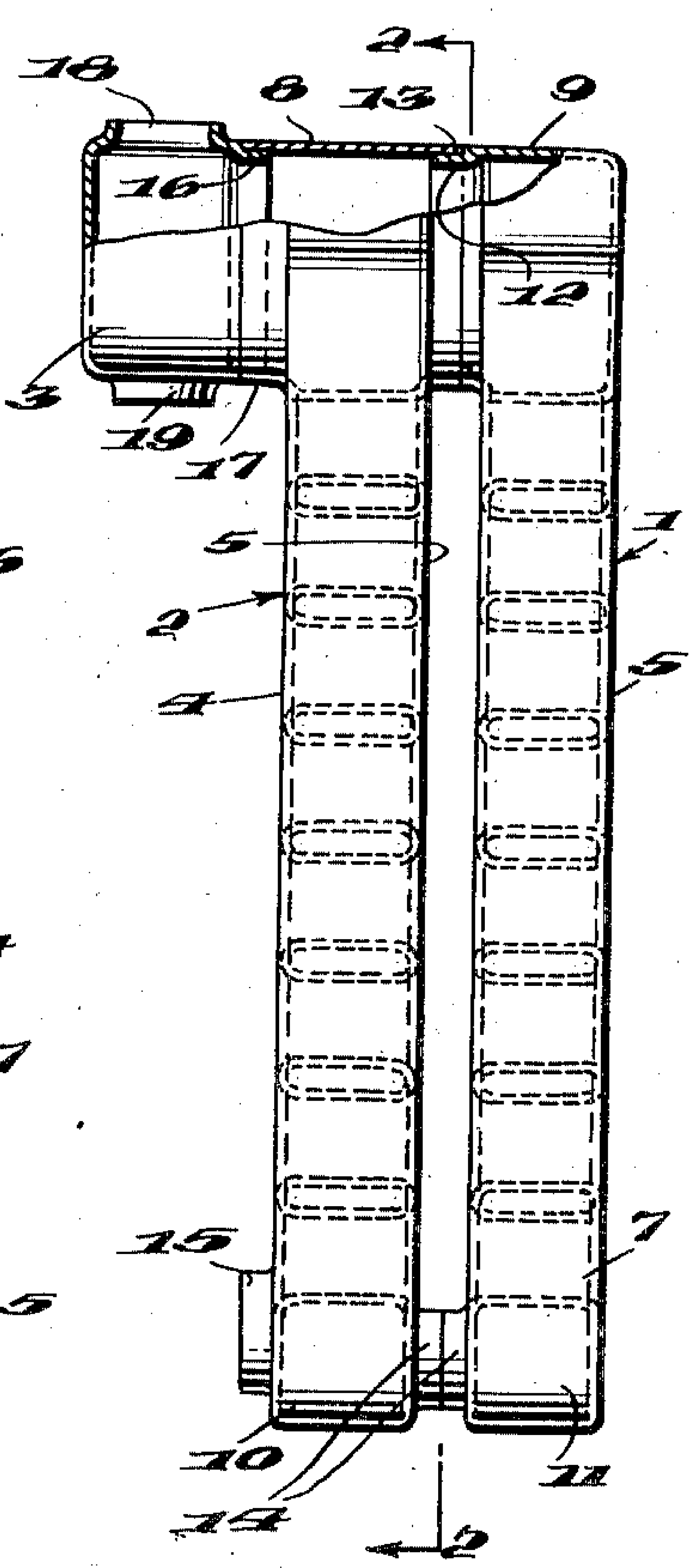
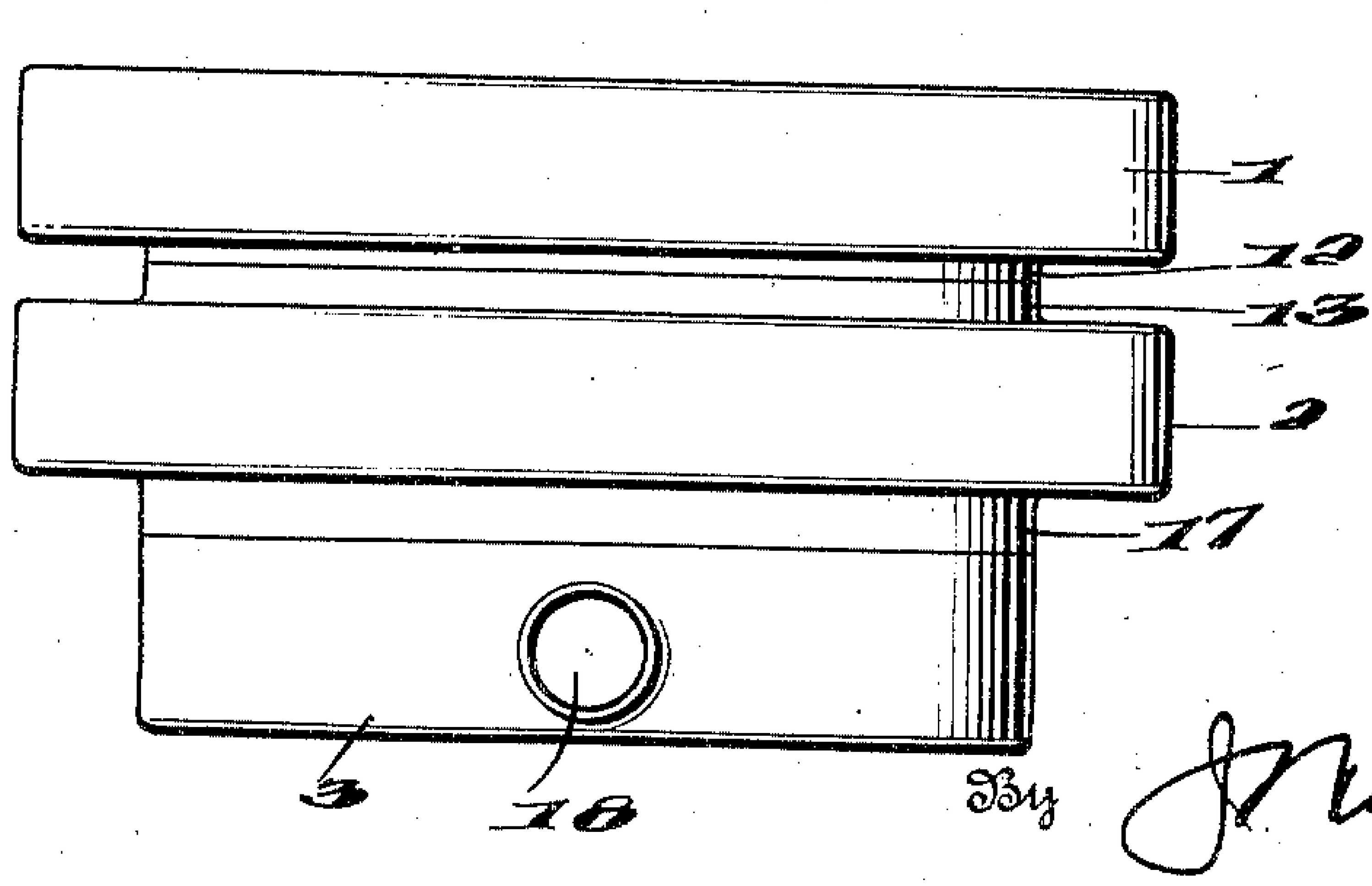


Fig. 3.



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ELECTROLYTIC APPARATUS FOR MAKING RADIATOR CORES

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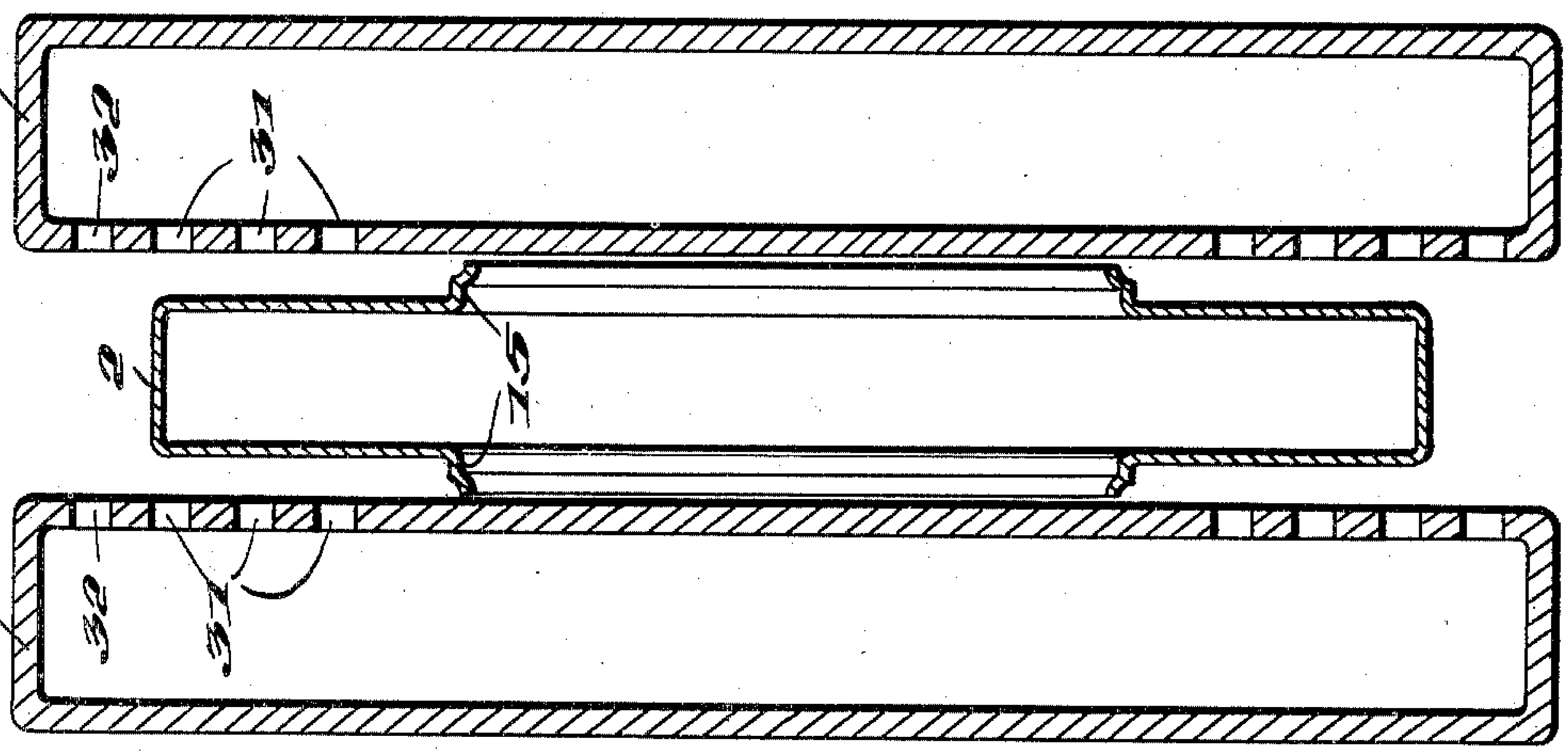

Fig. 7.

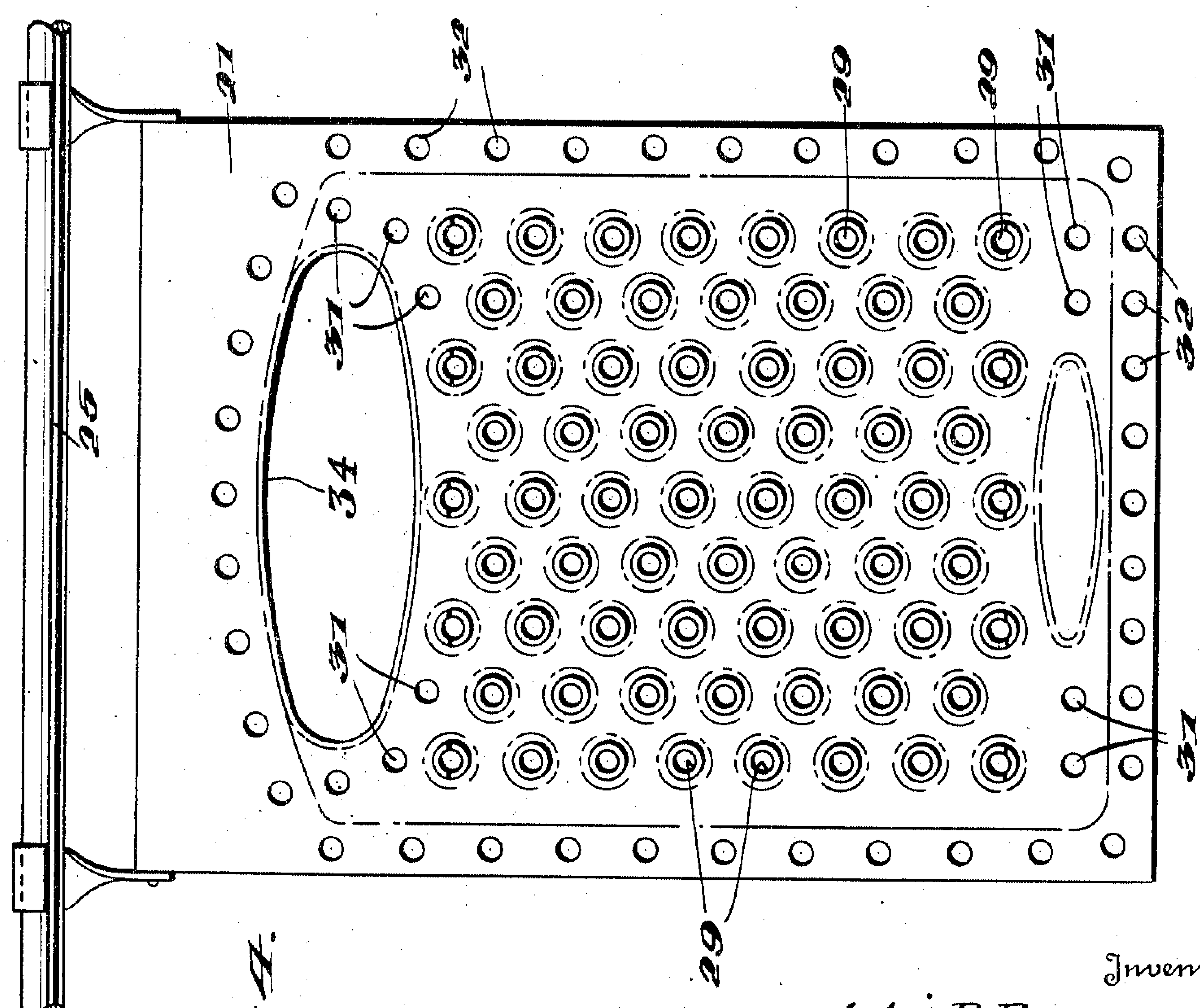

Fig. 4.

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ELECTROLYTIC APPARATUS FOR MAKING RADIATOR CORES

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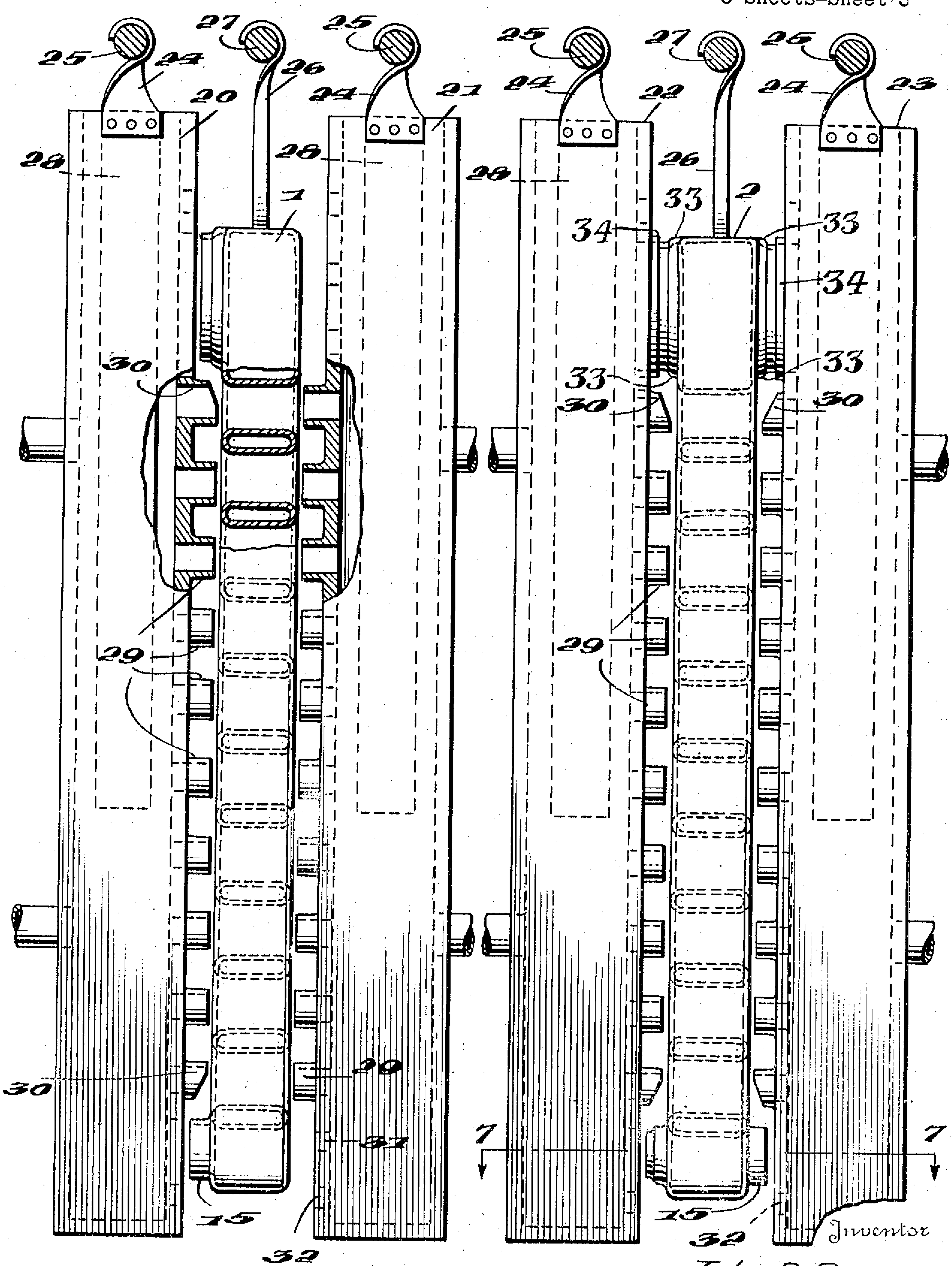

Fig. 5. Fig. 6.

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ELECTROLYTIC APPARATUS FOR MAKING RADIATOR CORES

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Application April 30, 1946, Serial No. 666,137

4 Claims. (Cl. 204—242)

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This invention relates to radiator cores and has for its object to teach the method and to provide an apparatus by which such cores may be made electrolytically.

I am aware that various attempts have been made to make radiator cores electrolytically, however, so far as I am aware, no previous attempt has been entirely successful. The main difficulties have been that the finished product was inevitably porous, that there was lack of uniformity of thickness in the sections supposed to be of uniform thickness, that the walls of the air openings therethrough varied in thickness and in quality of copper upon which strength depends, and that the metal forming the header and connecting portions for sister cores were lacking in proper strength because of the inability to vary the thickness of deposit where a thicker section is needed.

The principal object of this invention is to provide an apparatus by which cores can be made and which will overcome all of these difficulties rendering it possible to make a core which will be free of pin holes, which will have greater strength with less weight of metal than present conventional cores, which can be made from scrap copper or other scrap electrolytic material, which will have a high rating of heat dissipation, which can be made economically and which lends itself to production in quantity.

The general principles of essential parts of the process and apparatus which I employ are fully described and claimed in my co-pending applications Serial Number 640,090 filed January 9, 1946, now abandoned, and Serial Number 640,091 filed January 9, 1946. In those applications it is explained, contrary to the conception of the action of an electrolytic bath by many who have worked in the art, an electrolytic deposit is not picked up out of solution by the cathode but that the ions which leave the anode deposit directly upon the cathode and that the direction of those ions may be controlled. It is further set forth that the control depends upon the provision of an anode constructed with attention to provision for an adequate flow of electrolyte thereover, with provision for the proportioning of the areas of the anode to the cathode depending upon the grade of metal to be deposited, upon proper concentration of the acid in the electrolyte and to the other factors of the bath therein described. The theory and practice set forth in those pending applications is retained in full in this process, the only difference being that this process is the application of that original process to a special complicated case which presents additional problems.

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More specifically it is the object of this invention to teach the deposit of electrolytic metal by different paths of varied length from an anode to a cathode, to teach the control of each of these paths in order to obtain deposition over the areas desired and to teach the control of each of these paths for thickness of deposit so that the cathode, in one immersion, may be coated to completion with metal which varies in thickness over the areas selected but which will have uniform thickness in any given area.

Other objects and advantages will become hereinafter more fully apparent as reference is had to the accompanying drawings wherein my invention is illustrated by way of example and in which

Figure 1 is a side elevation of a complete radiator core made according to my improved process,

Figure 2 is a front view of one section of the core of Figure 1, as seen along the line 2—2 of Figure 1,

Figure 3 is a top plan view of the core,

Figure 4 is a front view of an anode employed to electrodeposit the section in Figure 2,

Figure 5 is a side elevation of the main right hand section of Figure 2 in the process of electroformation,

Figure 6 is a side elevation of the left hand section of Figure 2 in the process of electroformation, and

Figure 7 is a horizontal section taken along the line 7—7 of Figure 6.

More particularly, Figure 1 shows a complete radiator core which is composed of two main sections 1 and 2 together with an additional header section 3. The sections 1 and 2 are composed essentially of a front face 4 and a rear face 5 connected by a multiplicity of walled openings 6, borders 7, header portions 8 and 9 respectively, and of lower solid sections 10 and 11. The sections 1 and 2 are joined at their header sections 8 and 9 by collars 12 and 13, and at their lower sections 10 and 11 by the collars 14. The section 2 has a cylindrical outlet 15 for attachment to the collar 17 of the section 2. This section 3 is also provided with a filler opening 18 and a water inlet 19.

In order to electroform the three sections 1, 2 and 3, I provide a matrix which may be made of some material such as plumbago or wax coated with graphite or other conductive material upon which deposition can be made. The essential is that the material be uniformly conductive so that there will be a uniform beginning of plating over its entire surface, that it hold its exact molded shape at the operating temperature of the vat, which is about 90° F., and that it be capable of being melted out at temperatures below that which might have any noticeable effect on the section from which it is to be removed. The matrix, in each instance, is moulded solidly in the exact shape of the section to be formed.

The matrices are suspended individually in a vat filled with a suitable electrolyte, Figure 5 showing a matrix in process of being coated in the formation of the section 1 and Figure 6 showing a matrix in process of being coated in the formation of the section 2. The matrix of the section 1 is suspended between two anode baskets 20 and 21 and the matrix of the section 2 is suspended between two anode baskets 22 and 23, each having a multiplicity of openings therethrough, as will be described, and the electrolyte must be deep enough in the vat to cover all of the openings generously. This will also amply cover the matrices with electrolyte.

The anode baskets are each composed of some material of poor conductive properties, such as hard rubber, or of metal which is fully coated with such material so that the metal will be fully insulated against electrolytic action and against deterioration by the acid of the electrolyte.

The baskets each have hangers 24 of good electrical conductivity, such as copper, for support of the baskets and for establishment of a path of current flow from positive bus bars 25. The matrices are supported by conductive hangers 26 from negative bus bars 27.

The anode baskets are filled with particles of electrolytic material, such as copper. Copper shot or pellets or copper trimmings and scrap, etc., may be used. In order to maintain electrical contact between the hangers 24 and this material I provide conductive strips 28 which are attached to the hangers at their upper ends and which hang freely in the baskets to a considerable depth.

The concentration of acid and copper sulphate in the electrolyte is important and should be maintained at a constant value insofar as possible. I recommend seven ounces of sulphuric acid per gallon of water to which I add 34 ounces of copper sulphate, the radiator cores being, preferably, of very soft copper.

The baskets are provided with a multiplicity of openings of various types depending upon the area and the shape of the area of the matrix upon which each one must direct a stream of ions. The total area of the openings in the baskets should equal approximately one-fifth the area of matrix upon which deposition is to be made and this ratio applies to each individual opening with respect to the area of matrix assigned to it. If the ratio is less than one-fifth, the rate of deposit will be slower, but if the ratio is increased the copper deposited will become harder. This will assure uniformity of hardness of the deposited metal.

Now, in order to assure uniformity of thickness, or a predetermined differential in thickness of deposit, it is explained in my previous application Serial #640,090 that the ionic flow may be directed and that diffusion of the stream will depend, in large measure, upon the distance of the point of release of the flow from the surface upon which deposit is made. The baskets are therefore provided with hollow tubular extensions 29 each of which projects toward an opening through the matrix, each of which is a projector for an ionic stream and each of which is at a uniform small distance from a face of the matrix which is to form a face 4 or 5 of the core sections. There is one extension 29 from each anode basket for each opening in each matrix which is to form an air opening 6 in the core sections 1 and 2. Each extension 29 is therefore expected to emit a flow of ions sufficient to cover the interior of one-half the sidewalls in the matrix and likewise to coat a portion of the face of the matrix equal to one-half the distance to the area to be coated by the adjacent extensions 29 in forming the walls of the adjacent openings 6 together with a portion of the faces 4 or 5. If the extensions 29 terminate too close to the matrix too great a proportion of the deposit will take place within the openings and if too far away too great a proportion will occur on the faces at the expense of the thickness of the sidewalls. If a current density approximately equal to forty amperes per square foot at 4 to 5 volts, a concentration of solution as indicated and a ratio of area of each area of each extension 29 to its assigned area are all properly maintained then the thickness of deposit within the holes and on the faces will be found without difficulty by a few trials after which the position of the baskets with respect to the matrices can be fixed by properly spacing the positive negative bus bars or by adjusting the shape or position of the hangers 24.

In addition to the extensions or projectors 29, I provide other projectors 30 which are similar to projectors 29 but which terminate in inclined surfaces. These projectors 30 are adjacent that portion of the matrix upon which the collars 12, 13, 14, 15, 16 and 17 are to be formed so that the area of deposit assigned to each of them is one-half the depth of an opening to form the holes 6 and a portion of the area of a face 4 or 5 and a portion of the area of a collar. By cutting away one side of the projector as illustrated, there will be a greater diffusion of the ionic flow and the deposit will occur where desired.

In forming the large water connection 13 I provide extensions 33 on the matrix upon which deposit is to be made (Figure 6, upper end). The extensions 33 are, of course, solid and no deposit is to be made except on the side walls thereof. I, therefore, provide a ring-like extension 34 opposite the solid surface of the extensions 33, the inside surfaces of the ring-like extensions being shaped similarly to the extensions 33 but slightly larger in peripheral size than the outer ends of the extensions 33 so that the deposition will be limited to the desired area.

Where the deposit is to be made on the flat surfaces such as on the face of the matrices to form the headers 8, 9 and 10, I provide a series of openings 31 in the baskets. And I provide a further series of openings 32 as a complete border for the other openings in the baskets, as best seen in Figure 4 in which a frontal view of the basket 23 is shown. These latter openings will form the rims 7. Since the diffusion from these openings 31 and 32 are assigned areas and since the diffusion therefrom must not be so great as to fail to cover these areas as desired, it is obvious that the desired distance of these openings from the faces of the matrix will determine the length of the projectors 29 and 30.

Where no deposit is desired, as in the space on the matrices interiorly of the surfaces upon which the collars are to be formed, no openings are provided in the baskets.

The header section 3 may be similarly formed by following the principles herein set forth, by providing anode baskets made for the purpose.

What I claim is:

1. An electrolytic apparatus for making a radiator core comprising a matrix formed in the shape of the core and having a plurality of openings therethrough, and an anode on each side of said matrix, said anodes each being containers for bits of electrolytic metal and having a plurality of openings through the side walls thereof, one of said openings being opposite each of said openings in said matrix and closely adjacent thereto for directing a flow of ions into said openings, said containers each having additional openings through the sidewalls generally encircling the first named openings for directing a flow of ions onto the remaining surfaces of said matrix, the outlets of the last named openings being spaced a greater distance from said matrix than the first named openings whereby there is increased diffusion of the ions from said last named openings, said anodes and said matrix being relatively stationary when said apparatus is in operation.

2. An electrolytic apparatus for making a radiator core comprising a matrix formed in the shape of the core and having a plurality of openings transversely therethrough, said matrix being adapted to serve as a cathode, and an anode on each side of said matrix, said anodes each being containers for bits of electrolytic metal, said containers each having a multiplicity of hollow tubular projections each of which resides immediately opposite one of said openings, said anodes each having additional openings therethrough through which ions may flow for deposition on the rim and border of the matrix, said tubular projections terminating substantially closer to said matrix than the walls around said additional openings, said anodes and said matrix being relatively stationary when said apparatus is in operation.

3. An electrolytic apparatus for making a radiator core comprising a matrix formed in the shape of the core, and having a plurality of openings transversely therethrough, said core serving as a cathode when immersed in an electrolyte, and an anode residing alongside of each side of said matrix each of said anodes being a container for electrolytic metal and each having a multiplicity of tubular projections extending outwardly therefrom each of which terminates immediately opposite one of said openings, certain of the tubular projections of the two anodes being of different length and terminating at equal distances from said matrix, said anodes each having additional openings for outletting a flow of ions toward the rim and border of the matrix, the sidewalls of the last named openings being at greater distances from said matrix than the ends of said tubular projections whereby said apparatus forms a complete core in one operation.

4. An electrolytic apparatus for making a radiator core comprising a matrix formed in the shape of the core, having a plurality of openings transversely therethrough and having solid projections extending outwardly therefrom in replication of the hollow water connections of the core, said matrix serving as a cathode when immersed in an electrolyte, and an anode residing alongside each side of said matrix, each of the anodes being a container for electrolytic metal and each having a multiplicity of hollow tubular projections extending laterally therefrom, each of said extensions terminating immediately opposite one of said openings, said anodes each having a multiplicity of additional openings through the walls thereof through which a flow of ions may flow for deposit on the boundary surfaces of said matrix, said anodes each presenting a solid surface opposite said solid projections of the matrix and each having a ring-like extension thereon the inside surface of which is similar to and slightly larger than the periphery of the outer end of the adjacent solid connection, said ring-like projections residing closely adjacent said solid projections, said anodes each having a multiplicity of openings through the walls thereof together encircling said ringlike extensions whereby a flow of ions therethrough will form a deposition on the exposed surfaces of said solid projections simultaneously with the formation of the remainder of the core.

JOHN D. BEEBE.

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