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CIRCULATION FOR ELECTRODEPOSIT SYSTEMS.

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1,411,657. Patented Apr. 4, 1922.

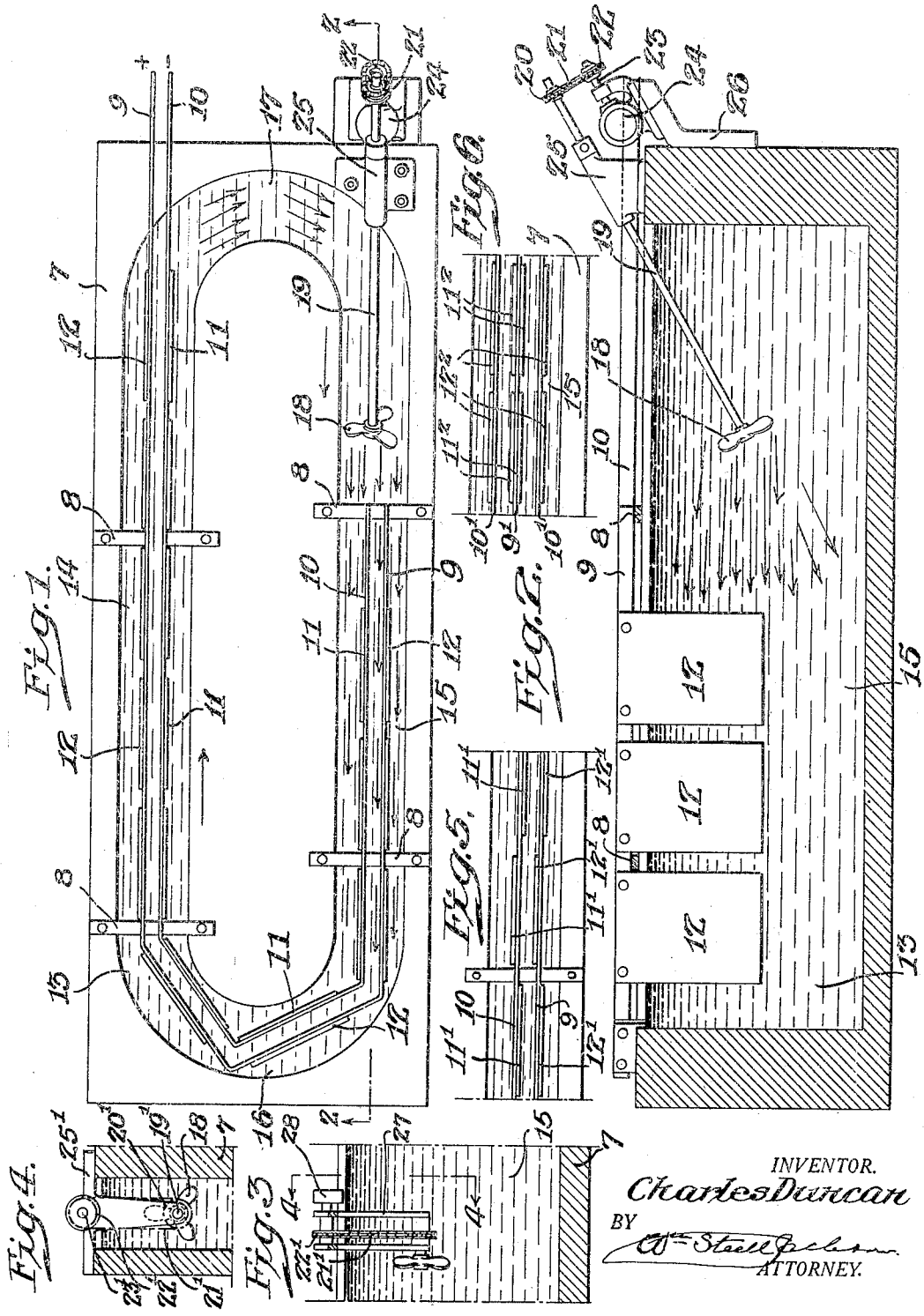


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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CIRCULATION FOR ELECTRODEPOSIT SYSTEMS.

1,411,657 Specification of Letters Patent **Patented Apr. 4, 1922.**

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To all whom it may concern:

Be it known that I, CHARLES DUNCAN, a citizen of the United States, residing at 6157 Lebanon Ave., Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Circulation for Electrodeposit Systems, of which the following is a specification.

My invention relates to baths for electrotyping and for similar processes in which a plurality of cathodes and anodes are used in the same bath. It is particularly suited to work where the cathodes and anodes are approximately plane surfaces or planes as in electrotyping.

The main purpose of my invention is to secure circulation of the bath solution so as to make possible the use of higher voltages without "burning" the deposit and to speed up the depositing operation. For this purpose I arrange the electrodes longitudinally of the bath in what might be called fluid series so that the fluid circulation of the electrolyte provided between the plates of one set (i. e., one cathode and one anode) shall continue through successive sets of electrodes, preferably throughout a course, likened herein to a raceway or track, and forming a closed circuit.

More specifically, by my invention I arrange the bath in the form of a track or path, preferably flattened on the sides and curved at the ends, so that the liquids of the bath may circulate throughout to the best advantage, and I provide mechanism for forcing the liquid of the bath lengthwise of the raceway or path.

My invention relates both to the methods disclosed and to the apparatus by which the methods may be carried out.

Further purpose will appear in the specification and in the claims.

Figure 1 is a top plan view of one form of my invention.

Figure 2 is a section of Figure 1, taken upon line 2—2 thereof.

Figure 3 is a fragmentary section corresponding in position to a portion of Figure 2, showing a modified form.

Figure 4 is a section upon line 4—4 of the structure seen in Figure 3.

Figures 5 and 6 are fragmentary top plan views of modified forms.

In the drawings similar numerals indicate like parts.

I have preferred to illustrate my invention by several structures of the same general type but differing slightly in the means of providing circulation and the placing of the electrodes only, among the various forms in which my invention might be practiced, selecting this type because it is practical, efficient and inexpensive, and at the same time well illustrates the principles of my invention.

In the electrotype shell the final printing surface is that surface of the cathode farthest removed from the anode. This is made up of lines, points and relatively small surfaces which constitute the bottoms of grooves, holes and recesses in the face upon which the coating is deposited. Deposition of metal upon the "high spots" of this face is easy and relatively rapid because they are exposed to good contact and the lines of flow to them are of low resistance; but they do not form the printing surfaces.

On the other hand, the lines represented by thin rules and the depressions for type faces are quite deep and the lines of flow to them are high resistance lines.

The deposit follows most readily the lines of low resistance flow, where least needed, and the solution available for the recesses is impoverished by reason of this and because of the free movement of solution to the high spots as compared with the sluggish turn over of solution in the recesses.

Where the solution is impoverished by deposit of its metallic content there is immediate need for a supply of fresh ions for deposition. The general need of stirring the solution to assist in deposit has been recognized and various efforts have been made to accomplish it, as by air bubbles let loose in the bottom of the tank or bath and by forced circulation between the electrodes. However, where attempt was made to cause circulation between the electrode pairs, both the anodes and the cathodes have been placed with their planes extending across from one side to the other of a generally rectangular vat or tank and it has been necessary to agitate the liquid separately at the "inlet" side of each pair without the directing assistance of partitioning off this part of the tank to form a raceway or fluid track. Not only has most of the agitation caused been poorly applied, but, in the case of bubbles, an excessive number of agitating bubbles has been required, and the mechanical agitation has

set up irregular lines of flow with undesirable counter-currents. This is due in the case cited to the quick turn of the circulating liquid required at the side of the bath because the circulation is directly reversed in the short spaces between the pairs or sets and the side of the tank.

I have attempted to secure smooth and easy circulation giving a maximum of fluid flow with a minimum of side flow or counter-currents and at a minimum of expense of tank space taken up and of energy required. In addition to this, the circulation mechanism is not in the way and is easily accessible.

In the illustration the tank is shown at 8, the feeders at 9 and 10 and the plates at 11, 12. It does not matter, for my invention which of these plates are anodes and which cathodes; nor is my invention confined to a single cathode and a single anode in the width of the tank within which they lie.

The fluid space for the bath within the tank is formed in an annular path or track 13, flattened at the side portions 14 and 15 and curved at the ends of 16 and 17 so as to provide a continuous path for the flow of the liquid. Screens at intervals are desirable to remove solid particles from the solution and to collect sludge from it.

As is well known, the liquids used in the bath are heavier than water and there is a tendency of the acid solution to settle, increasing in density toward the bottom.

Active swirling of the solution is necessary to a maximum density of current flow. By my invention I am able to maintain a current density of at least 500 amperes to 600 amperes per square foot of cathode. This is considered a very high density at the present time.

Because of the tendency of the bath to greater density at the bottom, the propeller 18 shown in my preferred form is downwardly directed by means of its shaft 19 so as to stir up the liquid at the same time that it gives circulation to the entire bath in the direction of the arrows in Figure 1. As a result the liquid of the bath flows through the successive sets (here pairs) of electrodes parallel to the faces of the cathodes and anodes in the direction of the arrows, brushing away any bubbles that may have collected upon the surface, mixing the liquid and bringing all of the liquid successively in contact with the different electrodes.

The electrodes can be placed out of alignment, even when parallel in adjoining pairs, as shown in Figure 5, so as to break up settled lines of liquid flow within the bath, and multiple paths may be provided by the use of three or more electrodes abreast (a single electrode at the center with surfaces oppositely facing to pair with different electrodes, if desired) as in Figure 6.

The shaft 12 is shown as driven through sprockets 13 and 14 and chain 15, from the shaft 16, and any suitable motor or pulley intended to be typified by a motor 17.

In Figures 1 and 2 the mechanism is supported by means of brackets 18 and 19 and may be permanently placed.

The shafts and blades may be made of copper, bronze, brass or other metal which will be but little affected by the bath.

In Figure 3 and 4, the driving mechanism is shown as comprising propeller 18 upon a shaft 19′, supported in a frame 27 and driven through a chain 21′, sprockets 20′, 22′, shaft 23′ and pulley 28. Though the propeller blades are shown as much higher in the bath in this figure, it will be obvious that any depth of propeller and angle of shaft may be provided for that is desired, and that the mechanism shown in these figures has the advantage of occupying very little space longitudinally of the bath and that it can be located quickly and easily by means of a bracket 25′ fastened at any point along the path of the liquid.

In Figure 5, the adjacent cathodes and anodes, arranged at intervals along the path of the liquid are placed differently for the purpose of ensuring more use of the liquid which in Figure 1 might flow outside and inside of the plates.

In Figure 6, I have shown two anodes as placed back-to-back with the cathodes on the outside, giving parallel paths between and increasing the capacity for any given width of path.

Where desired the plates can be turned at an angle to the length of the liquid travel to ensure fresh liquid without setting up objectionable cross-currents or stopping the liquid travel.

The various changes shown are recognized by me as minor to the main invention, are intended chiefly to indicate that my invention is not limited to the detail shown, and have advantage only in so far as they cooperate to secure better results in the use of my broad invention.

It will be evident that my invention may be applied either for the purpose of permitting the use of high voltages with consequent large increase in the permissible density of current flow and speed of depositing the required metal; or in obtaining a firmer, denser and more effective deposit within the same time; and that these two advantages may both be secured to varying degrees within the judgment of the designer.

I recognize that the needs of installations and the preference of the individual will produce many variations from what I have shown herein, but which will suggest themselves to the minds of those skilled in the art as a result of my disclosure, and I desire to cover all of these changes which come

within the reasonable spirit and scope of my invention.

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

1. The method of facilitating the circulation of the liquid in a bath through the spaces lying between the electrodes which consists in arranging successive pairs of electrodes with their faces substantially parallel in fluid series and giving the bath circulation between them in a diagonal downward direction.

2. The method of securing circulation of electro-depositing material between the cathodes and anodes within a bath which consists in arranging the cathode and anode pairs in fluid series longitudinally of the bath and in causing the liquid to flow between successive pairs and at the same time stirring up the bath by projecting the liquid diagonally downwardly at one point for a number of pairs.

3. The method of securing circulation of electro-depositing material between the plates of anode and cathode pairs within a bath, which consists in arranging the bath in a relatively narrow annular circuit, in placing the pairs in fluid series in successive positions along the length of the circuit and in causing the fluid to flow about the circuit to secure circulation between the pairs and to avoid cross currents of liquid.

4. The method of securing circulation of electro-depositing material between the plates of a plurality of pairs of cathodes and anodes, which consists in arranging a closed track or path of flow for the liquid, distributing the pairs at intervals along the length of the bath, and driving the liquid throughout the bath by propelling means located well down below the surface of the bath.

5. The method of rendering more effective circulation of electro-depositing material between the plates of a plurality of pairs of cathodes and anodes, which consists in arranging a closed track or path of flow for the liquid, distributing the pairs at intervals along the length of the bath, and driving the liquid throughout the bath by propelling means located well down below the surface of the bath and directed diagonally downwardly.

6. In an electro-deposit system, an annular bath in combination with electrodes located at intervals along the length of the bath, and means for moving the bath about the annulus.

7. In an electrotype system, an annular receptacle, an electro-deposit bath therein, leads providing electric current for electro-deposit along the length of the bath, cathodes and anodes arranged in pairs to receive the current, located at intervals along the length of the bath and driving mechanism for moving the bath about the annulus.

8. In an electrotype system, an annular receptacle, an electro-deposit bath therein, leads providing electric current for electro-deposit along the length of the bath, cathodes and anodes arranged in pairs to receive the current, located at intervals along the length of the bath and driving mechanism for moving the bath about the annulus and for stirring up the bottom of the bath.

9. In an electrotype system, an annular receptacle, a bath therein, cathode and anode pairs of plates arranged in series along the annulus, propeller agitating mechanism within the bath and directing the propeller drive generally lengthwise of the bath and driving means outside the bath for the said propeller.

10. In an electrotype system, an annular receptacle, a bath therein, cathode and anode pairs of electrodes arranged in series along the annulus, a propeller, a shaft therefor extending into the bath and directing the propeller drive generally lengthwise of the bath and downwardly to stir up the bottom of the bath and driving means outside the bath for the said propeller shaft.

11. In an electrotype mechanism, an annular bath therein, a propelling mechanism effective to drive diagonally below the bath level, and driving mechanism outside of the bath, adapted to be dipped into the bath at any point along the length of the bath.

CHARLES DUNCAN.