

United States Patent

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[73]	Assignee	The Budd Company Philadelphia, Pa.

1,152,772	9/1915	Wheeler	204/283
3,434,938	3/1969	Van Sciver	204/216

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[54] APPARATUS FOR MAKING PERFORATED METAL FOIL

8 Claims, 9 Drawing Figs.

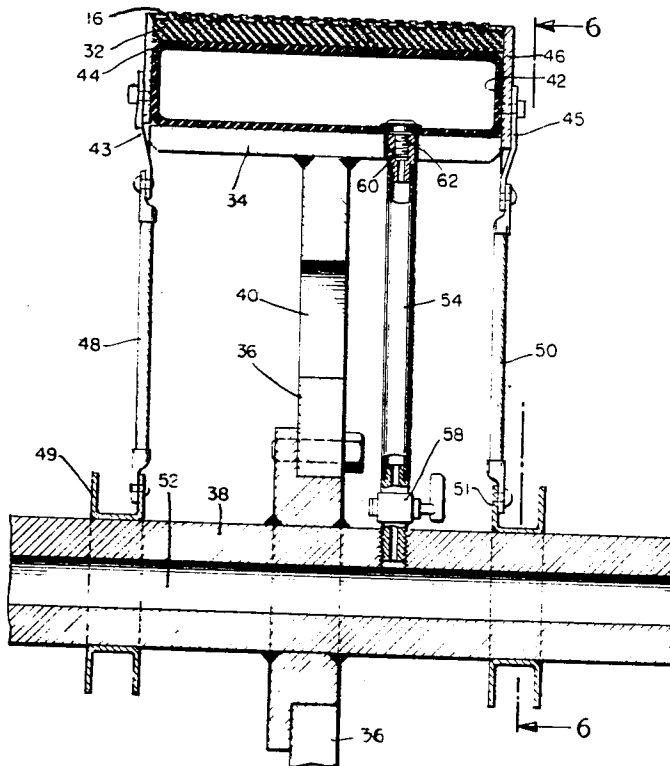
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[51] Int. Cl. B23p 1/12
[50] Field of Search 204/206,
208, 216, 283, 284

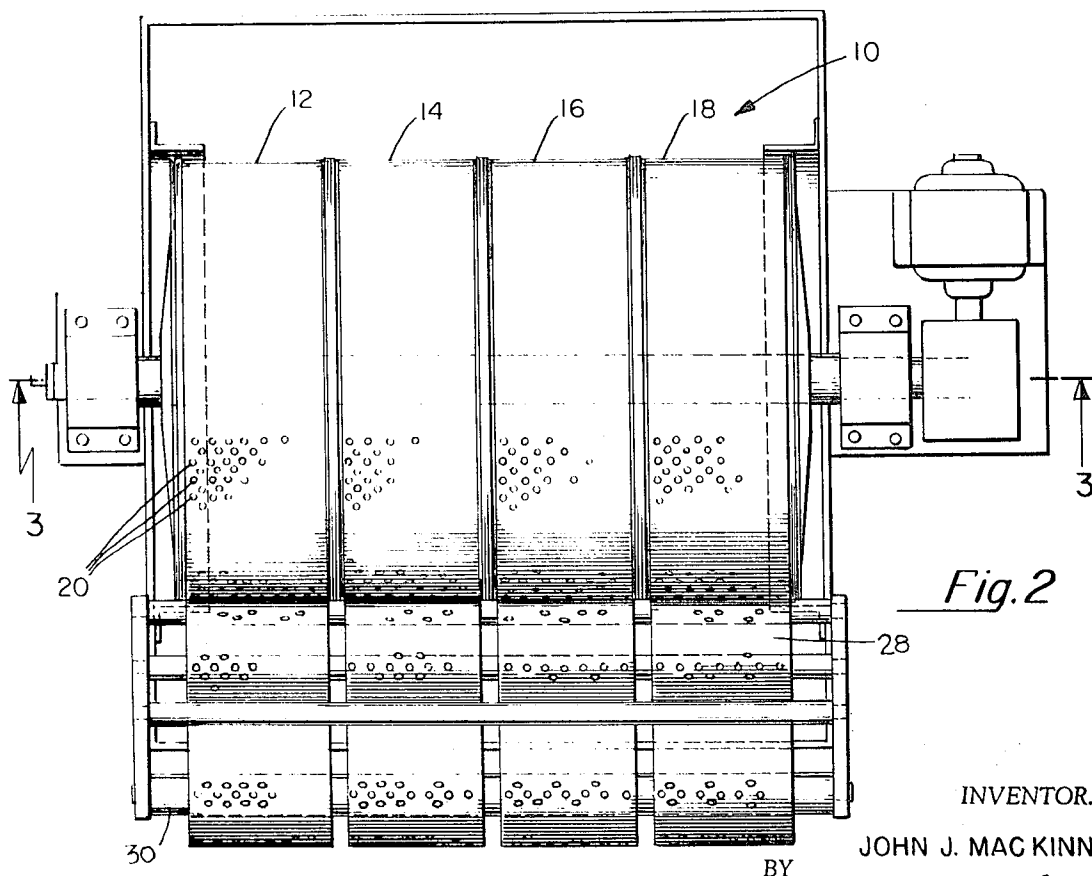
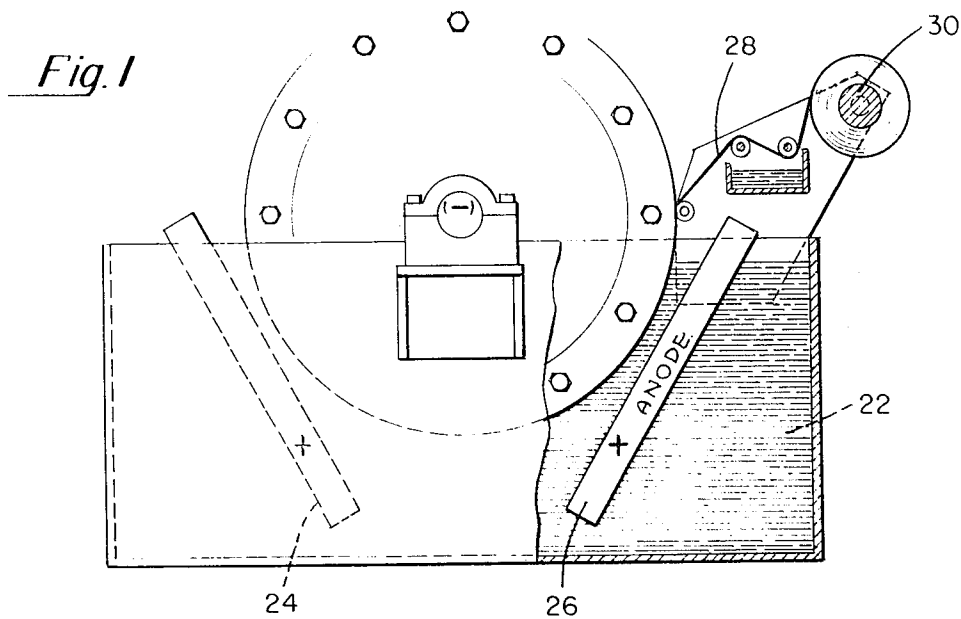
[56] References Cited

UNITED STATES PATENTS

533,596	2/1895	House	204/216
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ABSTRACT: Apparatus for making perforated metal foil includes a conductive cylindrical member having openings therein and adapted to receive electrodeposited metal to form the foil. A pliable insulated element is disposed within the cylindrical member. Means are provided for pressing the insulated element against the interior of the cylindrical member causing portions of the insulated element to protrude through the openings. Metal may then be deposited on the cylindrical member but not on the portions of the insulated element extending through the openings.





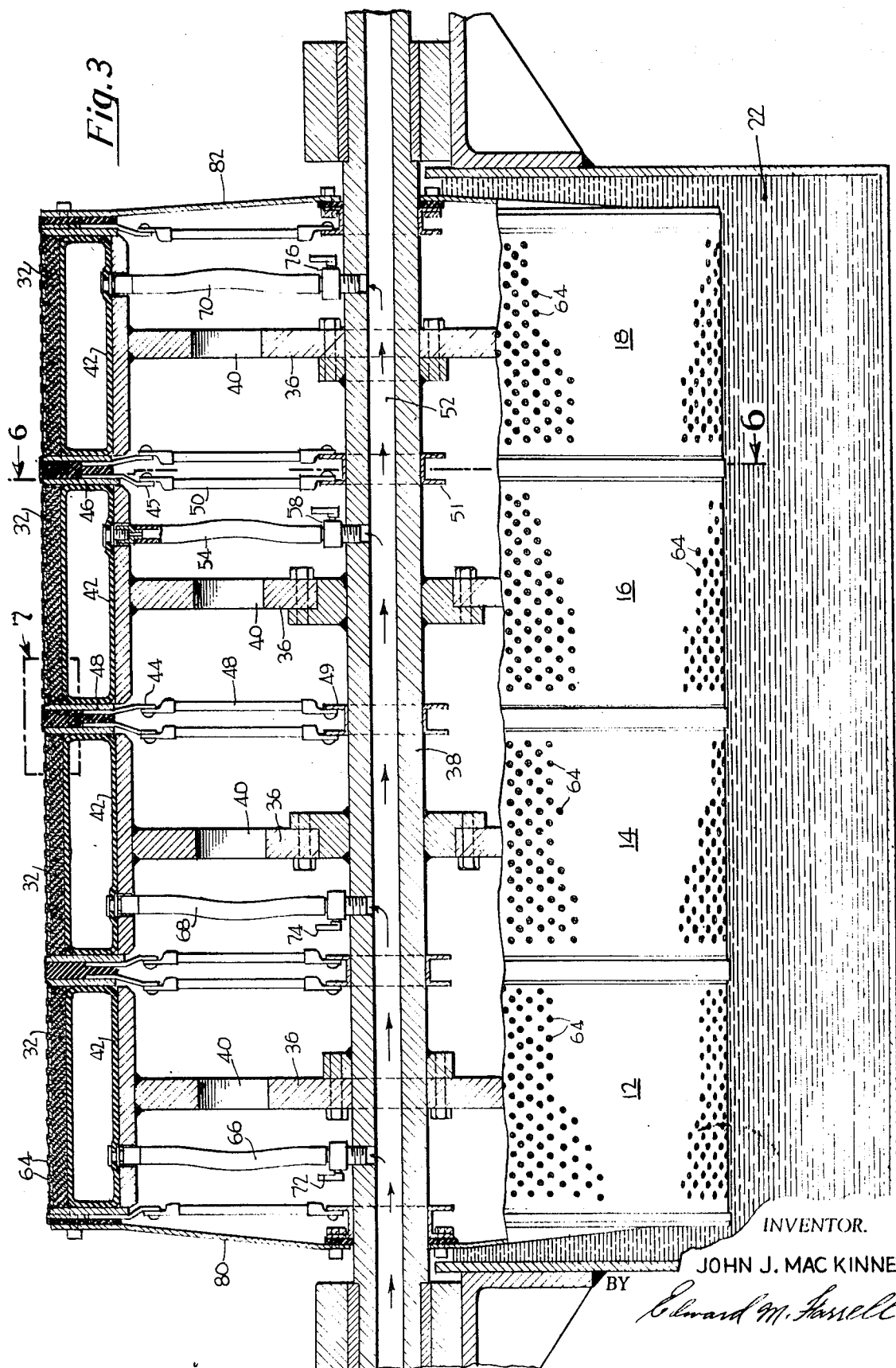
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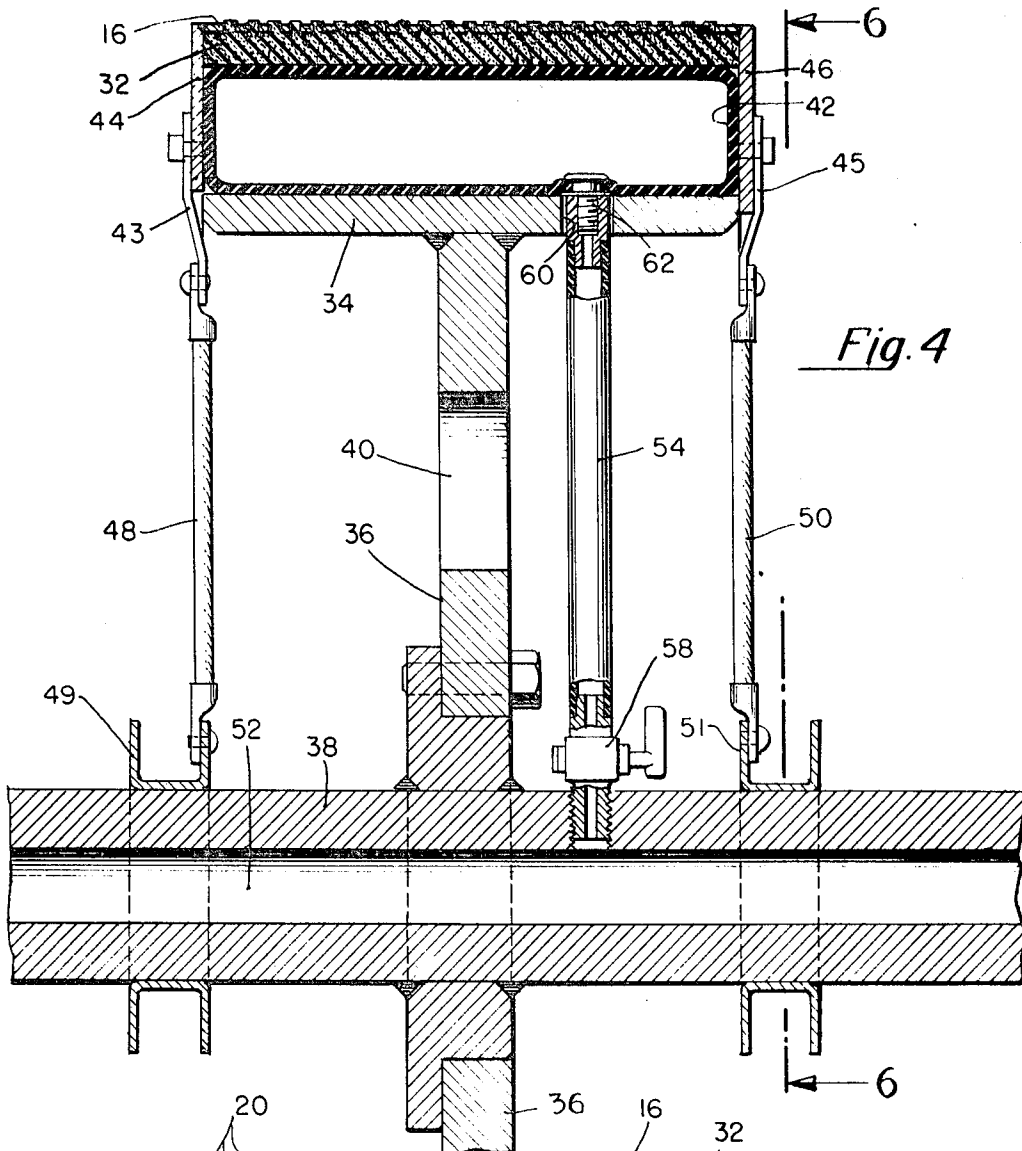


Fig. 4

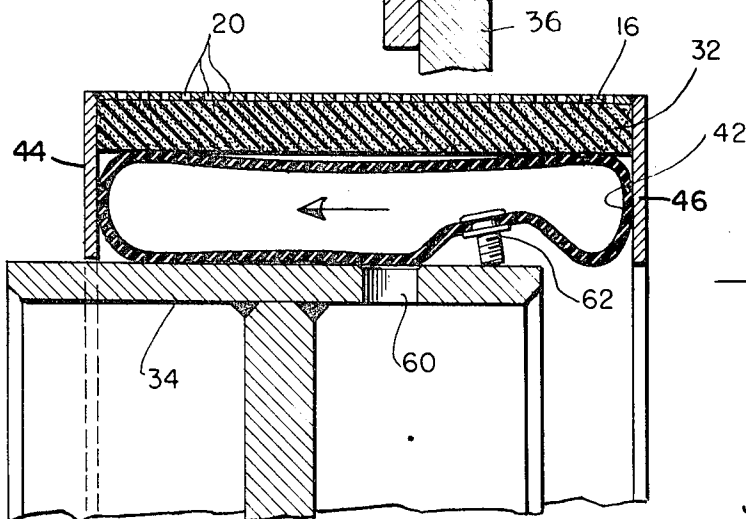


Fig. 5

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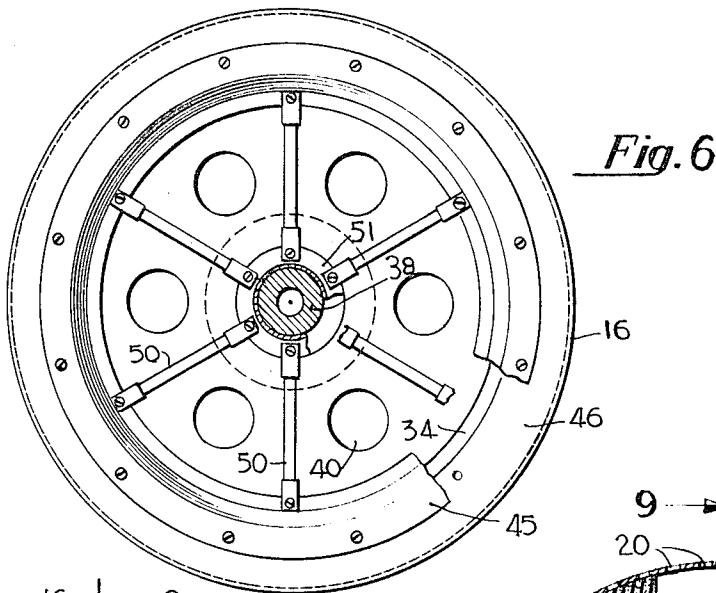


Fig. 6

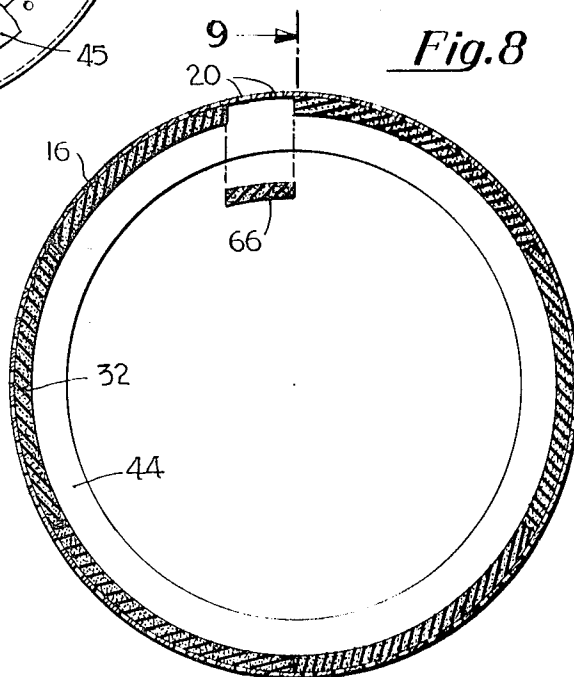


Fig. 8

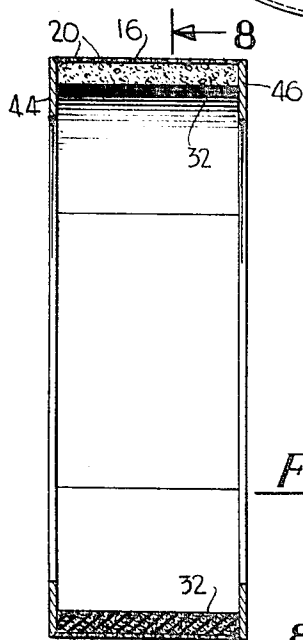


Fig. 9

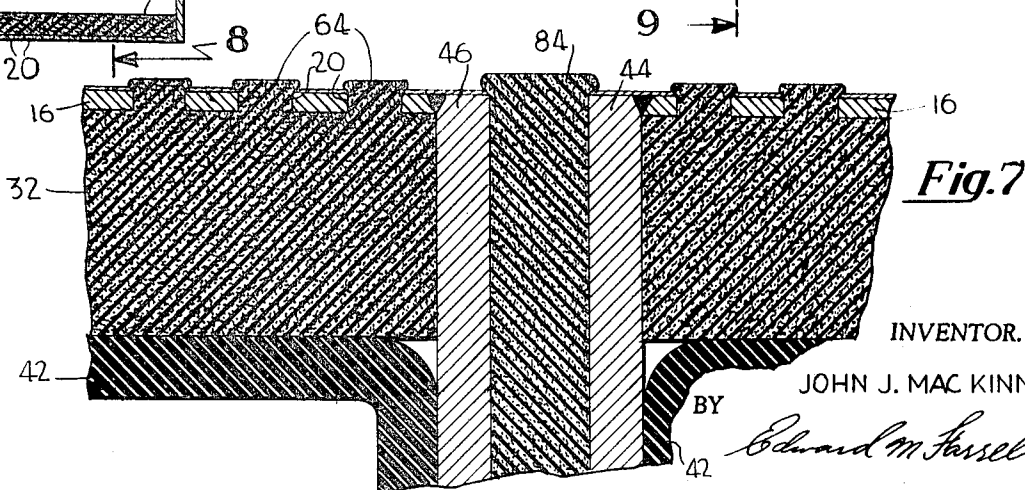


Fig. 7

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APPARATUS FOR MAKING PERFORATED METAL FOIL

Electroplating as a process for coating an article or for making thin foil is well known. A method for making such foil, for example, is described in U.S. Pat. No. 3,434,938 to Van Sciver issued on Mar. 25, 1969. In this application, a drum is submerged in an electrolyte bath and becomes the cathode in the electrolysis system. One or more anodes which act as the source of metal for forming the foil is disposed within the electrolyte. A suitable voltage is applied across the cathode and anode causing a current to pass through the electrolyte. This forms a coating of electrodeposited metal on the cathode or drum to the desired thickness. The metal employed may be silver, copper, iron, cadmium, nickel or one of a variety of other metals which can be deposited in an aqueous electrolyte.

The perforations in the drum may be formed by making portions of the drum nonconductive. This may be done by printing a pattern with ink on the portions where holes are to be formed, as described in the aforementioned patent, by inserting insulated plugs in the drum face or by other means.

One of the main problems involved in making perforated foil resides in the maintenance required periodically for satisfactory operation. For example, if ink is used as the insulating material, it will tend to wear away or require continuous replacement. If plugs or the like are inserted into the drum face to provide the insulated portions, they tend to become frayed by the removal of the deposited metal and must be cleaned or replaced. The maintenance of the apparatus is a costly factor in adding to the cost of the perforated foil manufactured.

Another problem encountered in making foil by electrodeposition involves overhauling the entire apparatus when only a portion of the apparatus requires maintenance.

It is an object of this invention to provide novel apparatus for making electrodeposited perforated foil.

It is a further object of this invention to provide novel apparatus for making perforated foil in which the maintenance of said apparatus is facilitated.

It is still a further object of this invention to provide novel apparatus for making foil which may be readily disassembled for maintenance and then reassembled.

In accordance with the present invention, apparatus for making perforated metal foil includes a conductive cylindrical member adapted to receive an electrodeposited metal to form the foil. The cylindrical member includes openings therein. A pliable insulated element is disposed within the cylindrical member. Inflatable means is disposed to press the insulated member against the interior of the cylindrical member to cause portion of the insulated element to protrude through the openings. When the apparatus is subjected to an electrodeposition process, foil is formed on the conductive portions of the cylindrical member with no metal being deposited on the portions of the insulated element extending through the openings. Consequently, a perforated metal foil may be produced.

Other objects and advantages of the present invention will be apparent and suggest themselves to those skilled in the art, from a reading of the following specification and claims, in conjunction with the accompanying drawings, in which:

FIG. 1 is an end view, partly cut away and in cross section, illustrating apparatus in accordance with the present invention;

FIG. 2 is a top view illustrating the apparatus of FIG. 1;

FIG. 3 is a cross-sectional view taken along lines 3-3 of FIG. 2;

FIG. 4 is a cross-sectional view, somewhat enlarged, of a portion of the apparatus illustrated in FIG. 3;

FIG. 5 is a cross-sectional view illustrating a method of assembly of the unit illustrated in FIG. 4;

FIG. 6 is a cross-sectional view taken along lines 6-6 of FIG. 3;

FIG. 7 is a cross-sectional view of the block 7 shown in FIG. 3;

FIG. 8 is a cross-sectional view taken along lines 9-9 of FIG. 9, and

FIG. 9 is a cross-sectional view illustrating one of the cylindrical members used to make up the apparatus of FIG. 1, in accordance with the present invention.

Referring particularly to FIGS. 1, 2 and 3, drum apparatus 10 comprises four cylindrical members 12, 14, 16 and 18. The cylindrical members may be made of a smooth steel and include a plurality of perforations 20 therein. The drum apparatus is disposed within an electrolyte 22. The electrolyte may comprise a nickel salt solution which may include nickel sulfamate, nickel chloride, boric acid and a suitable wetting agent. Such compositions are well known to those skilled in the art. The surfaces of the cylindrical members act as a cathode in operation. A plurality of anodes 24 and 26, which may be nickel, are also disposed within the electrolyte 22.

As the foil 28 is formed, it is stripped off the drum and rolled on a roller 30, as generally described in the aforementioned patent. The various means and compositions for making the foil and rolling in the manner illustrated are well known to those skilled in the art. Therefore, these details are not described in detail because they are only incidentally related to the subject invention.

The plurality of cylindrical members is provided so that strips of foil of predetermined width sizes may be formed. This eliminates the need for cutting the foil as would be the case if the foil were originally formed as a relatively large piece. In addition, the breaking down of the apparatus into sections or segments makes it possible to disassemble the apparatus and replace individual units without requiring that the entire apparatus be replaced or repaired. For example, in some cases during operation, only a small portion of the drum apparatus may become defective. Rather than replace the entire assembly, one unit may be taken out and replaced or repaired.

Considering cylindrical element 16 as a typical unit, and referring to FIGS. 4 and 9 of the drawing, a pliable member 32, which may be rubber or other suitable material is disposed within the cylindrical element 16. A mechanical support member 34 is provided and suitably connected to a bearing member 36 which is connected to the shaft 38. An opening 40 is provided in the bearing 36 to permit a person to reach through the bearing member 36 when the apparatus is being assembled or repaired.

The support element 34 is spaced from the pliable element 32 so as to provide room for an inflatable member 42 therebetween. Relatively heavy conductive rings 44 and 46 are suitably welded to the edges of the cylindrical element 16. Suitable electrical terminals 43 and 45 are provided on the conductive members 44 and 46 to permit cables 48 and 50 to be attached thereto. The cables 48 and 50 are connected to bracket elements 49 and 51 which may be welded to the shaft 38. The surface of the cylindrical member 16, which acts as a cathode, is electrically connected to the shaft 38. During the formation of foil, current will pass from the cylindrical surface 16, through the cables 48 and 50, through the shaft to the source of power (not illustrated).

In one embodiment of the present invention, the shaft 38 may be hollow to provide a pneumatic conduit 52. The air or gas from the conduit 52 may pass through a tubing 54 into the inflatable member 42. A connector element 62 on the inflatable member 42 extends through an opening 60 in the support member 34 to receive one end of the tubing 54. The other end of the tubing 54 includes a valve 58 and means extending through the shaft 38 to the pressure medium. On installation, each of the individual valves 58 may be closed to maintain the pressure within the inflatable member 42.

The assembly of the unit illustrated in FIG. 4 is relatively simple. Means are provided to have this unit cooperate with additional units to provide an overall assembly such as illustrated in FIG. 1.

FIG. 5 illustrates a method of assembling one of the units. A cylindrical member 16 with its associated conductive elements 44 and 46 and having the flexible member 32 contained therein is moved over the support member 34. The inflatable member 42 is in a deflated condition during assembly until after the entire assembly is moved into place. When the as-

sembly is in place, the threaded element 62 fits through the hole 60 and is adapted to be connected to the tube 54 which is illustrated in FIG. 4. The inflatable member 42 may then be inflated by any suitable means. The means for inflation may take a variety of forms other than that illustrated and this feature is only incidentally related to the present invention.

When the member 42 is inflated, the pliable member 32 is compressed causing portions of it to protrude through the openings 20 in the cylindrical element 16. This is illustrated in FIG. 7. The amount of pressure in the inflatable member 42 is such so as to cause the portions 64 of the pliable member 32 to extend beyond the cylindrical member and overlap very slightly the edges of the openings.

It is well known that as foil is built up on a surface that it will tend to concentrate on the edges. For this reason, the overlapping portions 64 provide a form of feathering of the foil 28 as it is deposited thereby preventing an excessive buildup around the edges.

FIG. 8 illustrates an embodiment of the invention wherein the pliable member 42 may include a cutout 66. This cutout 66 may be easily removed so as to permit the pliable member 32 to be removed from the cylindrical member between the conductive elements 44 and 46. In most cases, however, the pliable material will be sufficiently soft and pliable so as to not require a cutout portion 66.

In one embodiment of the present invention, air may be applied to the center of a hollow shaft through tubes 66, 68, 54 and 70. The valves 72, 74, 58 and 76 may be open to receive the air from the center of the shaft and lead it into the inflatable member.

Numerous arrangements for providing the air into the inflatable members may be provided and are well known to those skilled in the art. The means for inflating the inflatable members is not directly related to the present invention.

During operation, a source of power may be connected between the positive and negative terminal illustrated in FIG. 1. Current is caused to flow in the electrolyte 22 thus causing metal ions to deposit on the surfaces of the cylindrical members 12, 14, 16 and 20. The drum assembly 10 is slowly rotated at a speed dependent upon the desired thickness of the metal. After the foil is formed, it is stripped off the drum and rolled on rolls 30.

The current in the system flows from the positive anodes through the solution to the surfaces of the cylindrical members. The current flows from the cylindrical members through pairs of electrical conductors 48 and 50 to the shaft 38. The conductors are made relatively heavy to carry a relatively large amount of current. A relatively large number of conductors are provided so that the current-carrying capacity of the system may be enhanced.

The entire drum assembly may be enclosed by end plates 80 and 82.

The individual cylinders 12, 14, 16 and 18 may be readily assembled, one following the other. Between each of the cylinders is an insulated element 84 (FIG. 7). This insulated element 84 may be somewhat pliable and may be squeezed between adjacent conductors 44 and 46. The insulated element 84 separates the cylindrical members to provide relative-

ly independent action. It also makes possible a number of current paths which is necessary to carry relatively high current.

In operation, it may be necessary to replace only one of the cylindrical members. The present invention provides apparatus which may be easily disassembled with the spare part being repaired or replaced and then reassembled.

After a relatively long use, it is desirable to remove the pliable members 32. This involves disassembling the cylindrical members, deflating the inflatable member and removing the pliable members from the cylindrical members. The pliable members may be replaced or repaired. At the same time, the surface of the cylindrical members may be readily cleaned. Thus it is seen that the present invention has provided apparatus which is relatively easy to maintain. Also, because of the ease of assembly, replacement of the entire unit is not necessary.

Regarding the assembly and disassembly for ease of maintenance, it is apparent that the cylindrical members need not be perforated. In this case, only the inflatable members need be used between the support members and the interior of the cylindrical members.

What is claimed is:

1. Apparatus for making perforated metal foil comprising a conductive cylindrical member adapted to receive electrodeposited material to form said foil, said cylindrical member having openings therein, a pliable insulated element disposed within said cylindrical member, an inflatable member for pressing said insulated element against the interior of said cylindrical member causing portions of said insulated element to protrude through said openings, a rotatable shaft disposed inside of said cylindrical member, and support means secured to said rotatable shaft for supporting said inflatable member.

2. The invention as set forth in claim 1 wherein a plurality of cylindrical members and a plurality of inflatable members are provided in said apparatus.

3. The invention as set forth in claim 2 wherein said support means comprises a plurality of support members fixedly mounted to said shaft.

4. The invention as set forth in claim 3 wherein insulating elements are provided to separate said cylindrical members from each other.

5. Apparatus for making metal foil comprising a plurality of cylindrical members for receiving electrodeposited metal thereon, a rotatable shaft disposed inside of said cylindrical members, support means fixedly mounted to said shaft, and inflatable means disposed between said support means and said cylindrical members.

6. The invention as set forth in claim 5 wherein said inflatable means includes a plurality of inflatable members associated with said plurality of cylindrical members.

7. The invention as set forth in claim 6 wherein said support means includes a plurality of support members spaced from said plurality of cylindrical members to receive said plurality of inflatable members thereon.

8. The invention as set forth in claim 7 wherein insulating means are provided to separate said cylindrical members from each other.

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