June 9, 1936. J. L. YOUNG 2,043,823

ANODE

Filed Nov. 1, 1934

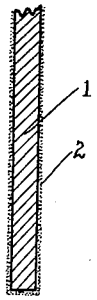


Fig. I

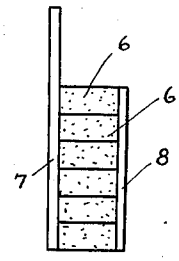


Fig. III

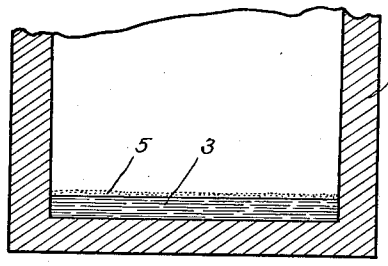


Fig. II

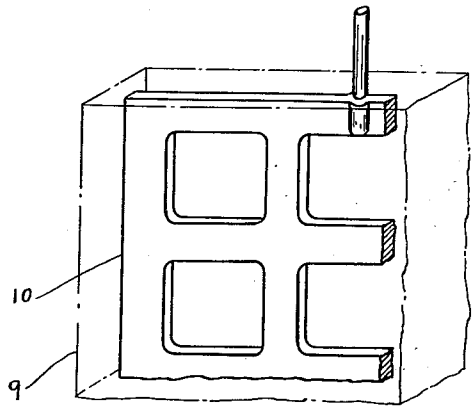


Fig. IV

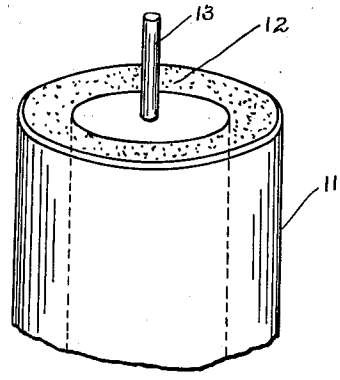


Fig. V

INVENTOR
John L. Young
BY
Christy and Wharton
ATTORNEYS

Patented June 9, 1936 2,043,823

UNITED STATES PATENT OFFICE

2,043,823

ANODE

John L. Young, Pittsburgh, Pa., assignor to National Radiator Corporation, a corporation of Maryland

Application November 1, 1934, Serial No. 750,929

2 Claims. (Cl. 204—4)

This invention relates to electrolytic cells for the deposit of metals. I have developed it in making deposit of iron, and in that particular application I shall describe it.

In the accompanying drawing Fig. I is a diagrammatic view in section of an anode of my present invention in one of its practicable forms; Fig. II is a view in section of a portion of the walls of an electrolytic cell, and of the anode of my invention in another permissible form; and Figs. III, IV, and V are views in elevation of the anode of the invention in yet other forms.

It has heretofore been proposed to make electrolytic deposit of iron from a solution of a ferrous salt, typically ferrous ammonium sulphate, as an electrolyte, using an iron anode; but the proposal has been attended with practical difficulties not heretofore successfully overcome. As the operation progresses the electrolyte tends to become increasingly acid in character, with the conversion of the dissolved ferrous ammonium sulphate to ferric salt, and the iron deposit upon the cathode tends to become so brittle as to be useless. The proposal has been made to correct this tendency by maintaining iron sponge in suspension in the electrolyte; but the proposal leads to other difficulties. The bulk of the sponge iron is lost in an undesired precipitate of ferrous hydroxide, and the deposit on the cathode tends to become rough, and in that respect of impaired utility. And it has not been found practically possible so to maintain the pH value of the bath within the limited range essential to practical success.

I have discovered that if iron sponge be employed, not as a substance suspended in and distributed through the body of electrolyte, but as the anode itself, the pH value of the electrolyte may be maintained within the requisite range, and a successful and practical deposit obtained.

While I do not wish to limit my invention by theoretical considerations, I have reason to believe that my practical success, in contrast to the impracticability of prior proposals, is due to the fact that, whereas the substance of the iron anode as heretofore employed has been accessible to the electrolyte over surface areas that were small relatively to the mass of metal consumed, with an anode of iron sponge the substance of the anode is accessible over surface areas that are large relatively to the mass consumed. I, therefore, find the essential character of the anode of my invention to be the finely divided condition of the iron of which it is constituted.

There are various ways in which the anode may be formed, to possess the characteristic that it shall consist essentially of iron in finely divided condition. In one embodiment of the invention a supporting core of magnetic character may carry, magnetically secured, a surface coating of finely divided iron, and in such case, as in the progress of the electrolytic operation, it is consumed, the coating may be renewed and built up again by sprinkling fresh supplies of finely divided iron into the electrolyte. Such material so sprinkled in will at once be attracted magnetically to and will constitute renewal of the coating upon the core. The core may be permanently magnetic, or it may be rendered magnetic by means of an electric current. In Fig. I an anode is shown, consisting of a core 1 and a coating 2 of finely divided iron, and it may be understood that the core is magnetized, and that the coating is held magnetically to it.

Again, advantage may be taken of the fact that certain metals in molten state have the characteristic of wetting iron, in order to form an anode of the character indicated. This is illustrated in Fig. II. A body 3 of mercury, for example, suitably disposed within the cell 4 (spread as a bath upon the bottom of the cell) may carry a skim or coating 5 of finely divided iron sprinkled upon it. And in this case also the coating may be renewed by sprinkling fresh supplies of finely divided iron into the cell, while the operation is in progress; for the sprinkled-in iron will sink through the electrolyte and rest upon the surface of the bath of mercury.

I have found that iron sponge compressed sufficiently to form a coherent mass of permanent shape will still retain its finely divided character to sufficient extent, and will be found effective in the electrolytic operation. Accordingly, another way of forming a practicable electrode is to compress iron sponge to suitable shape and size and to mount the compressed body or bodies (for, conveniently, a plurality of smaller units will thus be built together) upon a carrier that is at once a conductor and is more inert than is the body of compressed sponge to the corrosive action of the electrolyte. In Fig. III a plurality of discs or blocks 6 are shown, which may be understood to be bodies of iron sponge compressed sufficiently to give coherence, but not sufficiently to destroy the characteristic of finely divided material, large surface area relatively to mass. These bodies 6 are shown to be combined and formed into a unitary anode structure by means of strips 7 and 8 of another metal or alloy cast in situ upon them

and establishing electrical continuity. These uniting strips are formed of a metal or alloy that is inert to the corrosive action of the electrolyte, or substantially so. They are inert, relatively to the bodies of iron sponge, both by virtue of the material of which they are composed and by virtue of the condition of the material: while the bodies 6 are of spongy condition, the strips 7 and 8 are dense. Although it is not requisite, it is advantageous that the metal or alloy of which the strips 7 and 8 are formed be such as to possess when in molten state the characteristic of wetting iron. Such a metal is lead. In operation the strips of relatively inert metal or alloy persist, while the compressed iron sponge is gradually eaten away by the corrosive action of electrolysis. In the use of the anode in this embodiment, manifestly, there must be replacement of the worn anode.

Again, the iron sponge may be compressed upon a supporting grid or carrier of another metal, the compression being sufficient to effect mechanical union and integration and electrical continuity, but insufficient to destroy the characteristic advantage of iron sponge described above. This is illustrated in Fig. IV, in which in dotted lines a body 9 of iron sponge is shown to be shaped and compressed upon a grid 10, that may be understood to be formed of denser iron.

The iron sponge may be given coherence by compression within a thin cylinder of a metal that is soluble in the electrolyte, and in such case the sponge will be exposed for electrolytic action immediately on the disappearance of the shell—a disappearance that will occur when the cell goes into operation. In Fig. V such a shell is illustrated at 11, and within it is shown a body 12 that may be understood to be a body of compressed iron sponge. Within the body 12, in turn, is incorporated a supporting and electrically conducting carrier 13.

Proceeding with an anode of finely divided iron, the electrolyte will as operation progresses be found to have a relatively constant pH value; the pH value will be found to range from 6 to 7. And within that range electrolysis progresses successfully and the deposit is such in character as to be useful. A deposited sheet, for example, may be successfully removed from a stripping cathode, and brought by annealing to serviceable condition.

I claim as my invention:

1. A soluble anode for metallic electro-deposition consisting of finely divided metal resting upon the surface of a supporting body of another metal in liquid state.

2. An anode for an electrolytic cell consisting of finely divided iron held magnetically upon the surface of a supporting body of magnetic character.

JOHN L. YOUNG.