

May 26, 1931.

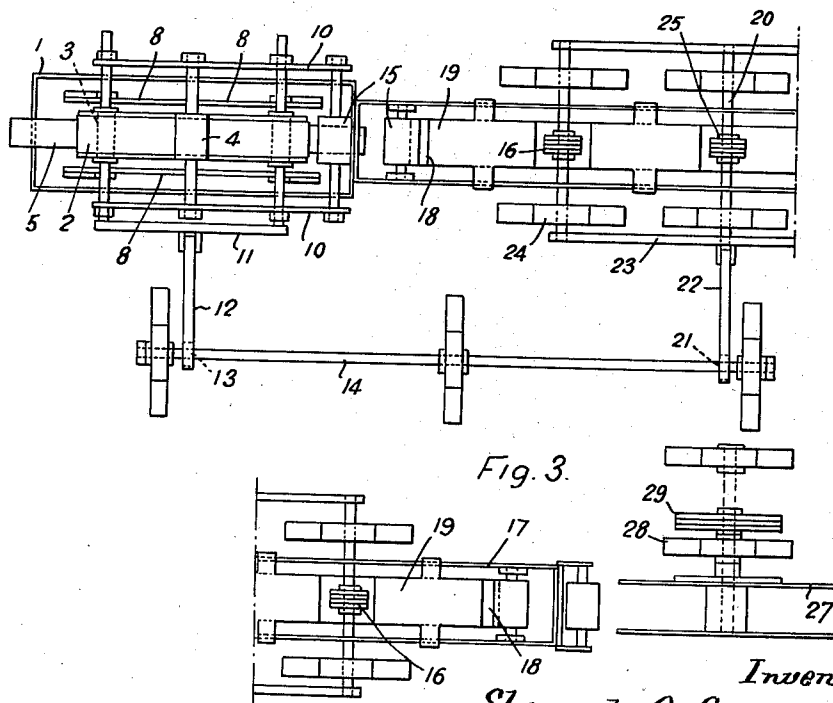
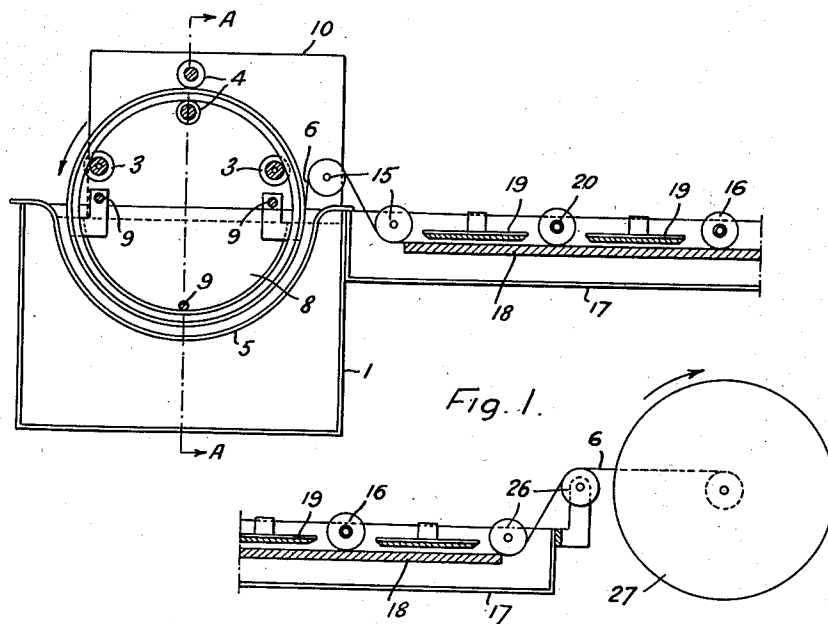
S. O. COWPER-COLES

1,806,587

MANUFACTURE OF METALLIC SHEET, STRIP, OR WIRE

Filed Jan. 3, 1931

2 Sheets-Sheet 1



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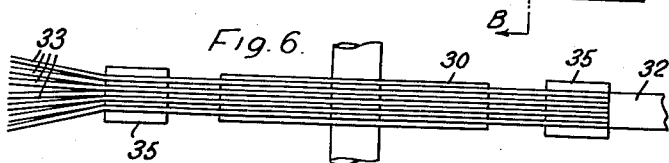
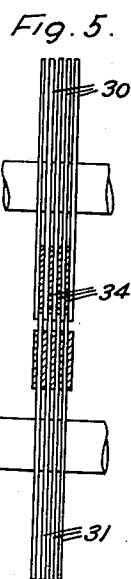
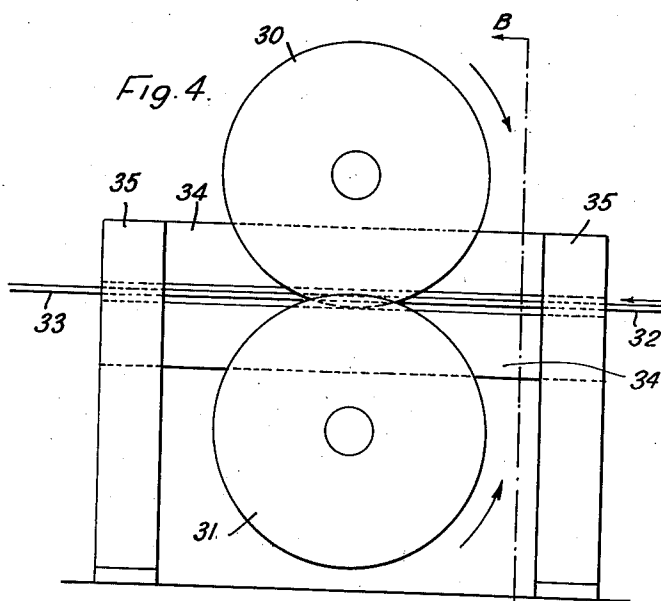
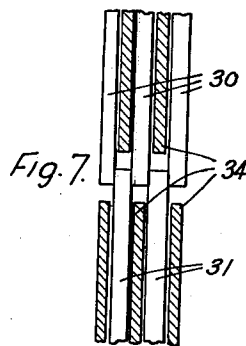
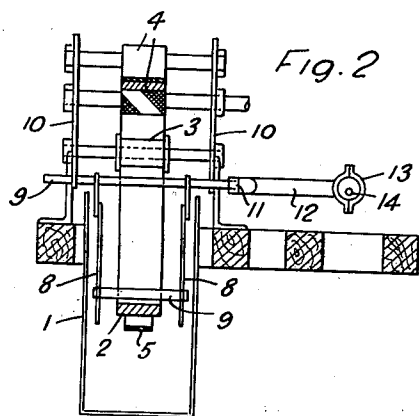
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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MANUFACTURE OF METALLIC SHEET, STRIP OR WIRE

Application filed January 3, 1931, Serial No. 506,469, and in Great Britain May 16, 1929.

My invention has for its object the production of metallic sheet, strip or wire in continuous lengths by the process of electro-deposition. Such a process forms the subject of my prior British specification No. 150,063 according to which a drum or disc mounted in the depositing tank with its axis horizontal is adapted to be revolved in the electrolyte, in which it is only partially immersed, at a speed slow enough to allow the desired thickness of deposit to take place for the formation of a sheet or strip, which is detached from the drum or disc at some point in the course of its revolution before it enters the electrolyte and thereafter can be continuously stripped off from the drum or disc as a sheet or strip of any required length. I have found, however, that, in sheet or strip produced by this process it is difficult to attain sufficient thickness for many purposes and there is a tendency to softness and porosity and it is one of the chief objects of the present invention to overcome these drawbacks. To make it possible to increase the thickness it has been proposed to pass the sheet or strip after stripping it from the rotating cathode for a further period through the electrolyte, and the present invention contemplates a process involving a similar additional thickening while providing means whereby the structure and surface of the metal is improved.

According to the invention a sheet or strip produced by electro-deposition on a slowly rotating cathode is passed through a further depositing bath for the purpose of increasing its thickness, and in this further process of deposition it is subjected to the consolidating and smoothing action of rollers or discs free to revolve and also capable of limited motion in the direction of travel of the sheet or strip; the rollers or discs are also preferably given a reciprocatory movement across the sheet or strip. Similar action by means of a nonrotary burnisher, or even by a roller, has been proposed, but in the latter case freedom of movement in the direction of travel was not allowed for and the roller was kept in contact with the metal under substantial pressure instead of, as preferred in the present instance, being allowed to rest thereon simply by its own weight. I find it advantageous to employ a high current density, for example 200 amperes or more per square foot, and in some cases desirable to arrange that the rollers or discs shall bear on the sheet or strip during their transverse movement in one direction only in a manner analogous to that described in the specification of my co-pending British patent application No. 15144 of 1929. By such a process I am able to produce metal sheet or strip of indefinite length having the unique properties mentioned in that specification.

In order further to improve the structure of the metal deposited on the rotating drum or disc I may provide baffles in proximity thereto adapted to be continuously maintained in motion for the purpose of agitating the electrolyte, causing it to flow rapidly over the surface of the deposited metal and preventing the formation, on the drum or disc or on the metal already deposited, of bubbles of gas which to a large degree constitute the cause of the above mentioned porosity experienced in carrying out deposition of metals on a drum or disc rotating comparatively slowly on a horizontal axis. If the drum or disc be of a width corresponding to that of the sheet or strip I desire ultimately to obtain, such sheet or strip, on emerging from the tank in which the further deposit has been effected, may be wound directly on a bobbin or otherwise disposed of with a view to storage or transport. If, however, a strip or wire narrower than that actually deposited, as represented by the width of the disc or drum, be required, I may, as a part of the continuous process, split the deposited sheet or strip into strips or wire of

the desired size; or the deposited sheet may be split into strips which may be wound on bobbins and subsequently divided into smaller sections of the desired size approximately to the finished wire.

5 The invention is not limited to the use of a single supplementary bath wherein metal may be deposited on a sheet or strip unwound from a rotating cathode, but two or more such
10 supplementary baths, each with a set of rollers or discs, may be employed in series, thus enabling, if desired, a sheet or strip composed of two or more metals to be produced.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawings which illustrate by way of example apparatus more especially applicable for the production of
15 strip or wire, and in which:—

20 Figs. 1, 2 and 3 are respectively a longitudinal section, a sectional end view on the line A—A of Fig. 1 and a plan view of electrolytic apparatus wherein the metallic strip is initially deposited on a rotating cathode and is built up to its final thickness by further electro-deposition and

25 Figs. 4 to 7 illustrate respectively in side view, section on the line B—B of Fig. 4, plan view and enlarged sectional view, apparatus adapted to be combined with electrolytic plant for the production of sheet or strip whereby the latter may be split into strip or wire of a narrower width than that originally deposited.

35 Referring to Figs. 1 to 3, there is located within a vat or the like 1, adapted to contain a suitable electrolyte, a drum or disc 2 in the form of a ring supported on guide rollers 3 and adapted to be rotated in the direction indicated by driving rollers 4, one of which is revolved at a suitable speed by power driven means. Electrical supply to the drum or disc 2, which constitutes the cathode, is effected through any or all of the rollers 3 and 4
40 and the anode of the electrolytic bath is constituted by a sheet, strip, casting or series of bars 5 of the metal which it is desired to deposit, this anode being preferably, as indicated, in the form of an arc of a cylinder embracing the lower immersed portion of the drum or disc 2. Rotation of the cathode is effected at a rate sufficiently slow to ensure that the deposit of metal made thereon during the time that any point on the drum is immersed, that is to say, approximately half
45 a revolution, is thick enough to be detached in the form of a strip 6 as the cathode leaves the electrolyte.

50 For the purpose of maintaining the electrolyte in agitation, baffles comprising approximately semi-circular plates 8 may be provided on each side of the drum or disc 2, these baffles being connected together by rods 9 so as to constitute a frame-work capable

of being oscillated as a whole within the vat 1. To this end the upper rods 9 are mounted within a stationary framework 10, which also serves as a bearing member for the rollers 3 and 4, in such a manner that they can slide in their axial direction thereby oscillating the baffles 8 in a direction transverse to their own plane. To produce this oscillatory motion the rods 9 are connected together by a cross-head 11 to which there is jointed the connecting rod 12 of an eccentric 13 mounted on a spindle 14 adapted to be continuously rotated by any suitable means.

The metal strip 6, on detachment from the drum or disc 2, is led over guide rollers 15 and then under a series of rollers or discs 16 whereby it is maintained immersed in the electrolyte contained in a second vat 17. A plate 18 of electrically non-conducting material, such for example as plate glass, is supported within the vat 17 and the strip 6 is, by means of the rollers or discs 16, kept in contact with this plate. At intervals between the rollers or discs 16 there are arranged anodes 19 of the metal of which the strip is composed or of some other metal should it be desired to produce a composite strip. These anodes 19 and the strip 6 are respectively connected to opposite poles of the source of electrical supply. The rollers or discs 16 preferably bear on the strip 6 solely by their own weight and are floating rollers, that is to say, are capable of a certain amount of bodily motion in the direction of travel of the strip. For this purpose the central apertures in the rollers or discs are made substantially larger than the spindles 20 on which the rollers or discs are mounted, so that the latter are free to execute the above mentioned motion. Further, they are given an oscillatory motion transverse of the strip, this being produced by the oscillation of the spindles 20 from a second eccentric 21 mounted on the spindle 14 and operating through a connecting rod 22 and cross-head 23 to which the spindles 20 are attached. To permit of their oscillatory motion the spindles are mounted in suitable bearings 24 and are provided with collars 25 whereby the rollers or discs 16, while being free to revolve, are constrained to follow the transverse movements of the spindles 20. If desired, auxiliary mechanism may be provided, analogous to that described in the specification of co-pending British application No. 15144 of 1929, for ensuring that the rollers or discs 16 make contact with the strip 6 during transverse motion in one direction only.

Instead of the anodes 19 being made of the metal it is desired to deposit, they may be of lead, carbon, ferro-silicon, or other electrochemically inert material, the metal to be deposited being contributed by one of its compounds held in solution or suspension in the electrolyte. By this means it is found

possible, for example, to deposit a metal directly from its ore provided that the latter is in a form capable of constituting or being contained in an electrolyte as above mentioned.

After treatment in the vat 17, the strip 6 is led over guide rollers 26 to a bobbin 27 mounted in bearings 28 and adapted to be rotated by means of a pulley 29 at such a speed that, having regard to the current density employed, temperature, nature of the electrolyte and other controlling factors, sufficient metal has been deposited to produce a strip of the desired thickness. The pulley 29 is arranged to rotate at a varying speed by any of the well known methods so as to wind the strip at a fixed rate of travel.

It will be realized that the width of the strip or sheet will depend upon that of the surface of the drum or disc 2 and should this width be greater than that desired for the strip or wire in its final form the splitting device depicted in Figs. 4 to 7 may be combined with the depositing apparatus as above described in such a manner that the sheet or strip, on leaving the vat 17, is passed through the former for division into strip or wire of the desired width.

This splitting device comprises essentially two series of cutting or shearing discs 30 and 31 mounted to rotate about parallel axes. The discs in each series are spaced apart on their respective spindles a distance equal to the width of a single disc, this being determined by the width of the strip or wire into which the sheet or strip is to be split. As indicated, one series of discs overlaps the other, the individual discs being suitably staggered for this purpose so that, as the tape 32 is fed in between the discs from right to left as seen in Fig. 4, shearing action takes place and a number of strips or wires 33, depending on the total number of discs employed and the width of the sheet or strip 32, results. In order to prevent the bending of these strips or wires, which would occur due to the shearing action, a series of stationary plates 34 is provided, being supported from uprights 35 and spaced so as to lie between the discs as most clearly indicated in Figs. 5 and 7. The strips or wires 33 after the shearing operation are thus prevented from being carried round by the cutting discs and constrained to remain substantially straight.

The invention has been particularly evolved for the production of sheet, strip or wire in copper, but it is also applicable to the electro-deposition of other metals such, for example, as zinc, nickel, copper or silver. Further, although as a rule the electrolyte will be constituted by a solution of a salt of the metal it is desired to deposit, it is possible to substitute a compound of the metal held in suspension in the liquid, thus allowing of the direct deposition of the metal from its ore in

the manner set forth in the specification of co-pending British patent application No. 15144 of 1929.

I claim:

1. Apparatus for the production of metallic sheet, strip or wire comprising in combination, an electrolytic bath, a cathode therein, an anode therein, means for slowly rotating the cathode, means for stripping the deposited metal from the cathode in the form of a sheet, a second electrolytic bath in proximity to the first bath into which the sheet is passed, an anode therein, electrically non-conducting means for supporting the sheet in said second bath, and members bearing on said sheet in said second bath, said members being free to revolve and capable of motion in the direction of travel of the sheet through the bath, said motion being imparted to said members by inequalities in the sheet.

2. Apparatus for the production of metallic sheet, strip or wire comprising in combination, an electrolytic bath, a cathode therein, an anode therein, means for slowly rotating the cathode, means for stripping the deposited metal from the cathode in the form of a sheet, a second electrolytic bath in proximity to the first bath into which the sheet is passed, an anode therein, electrically non-conducting means for supporting the sheet in said second bath, members bearing on said sheet in said second bath, said members being free to revolve and capable of motion in the direction of travel of the sheet through the bath, said motion being imparted to said members by inequalities in the sheet, and means for reciprocating said members across the sheet.

3. Apparatus for the production of metallic sheet strip or wire comprising in combination an electrolytic bath, a cathode therein, an anode therein, means for slowly rotating the cathode, a baffle in proximity to the cathode, and means for moving the baffle continuously in a direction parallel to the axis of the cathode.

4. Apparatus for the production of metallic sheet, strip or wire comprising in combination, an electrolytic bath, a cathode therein, an anode therein, means for slowly rotating the cathode, means for stripping the deposited metal from the cathode in the form of a sheet, a second electrolytic bath in proximity to the first bath into which the sheet is passed, an anode therein, electrically non-conducting means for supporting the sheet in said second bath, a series of spindles and a roller freely mounted on each spindle and bearing on the sheet, each roller having an aperture of substantially larger diameter than that of the spindle on which it is mounted.

5. Apparatus for the production of metallic sheet, strip or wire comprising in combination, an electrolytic bath, a cathode therein, an anode therein, means for slowly rotating the cathode, means for stripping the deposited

metal from the cathode in the form of a sheet,
a second electrolytic bath in proximity to the
first bath into which the sheet is passed, an
anode therein, electrically non-conducting
6 means for supporting the sheet in said second
bath, a series of spindles and a roller freely
mounted on each spindle and bearing on the
sheet, each roller having an aperture of sub-
stantially larger diameter than that of the
10 spindle on which it is mounted, and means
for reciprocating said rollers across the sheet.

In testimony whereof I have signed my
name to this specification.

SHERARD OSBORN COWPER-COLES.

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