No. 679,357. Patented July 30, 1901.

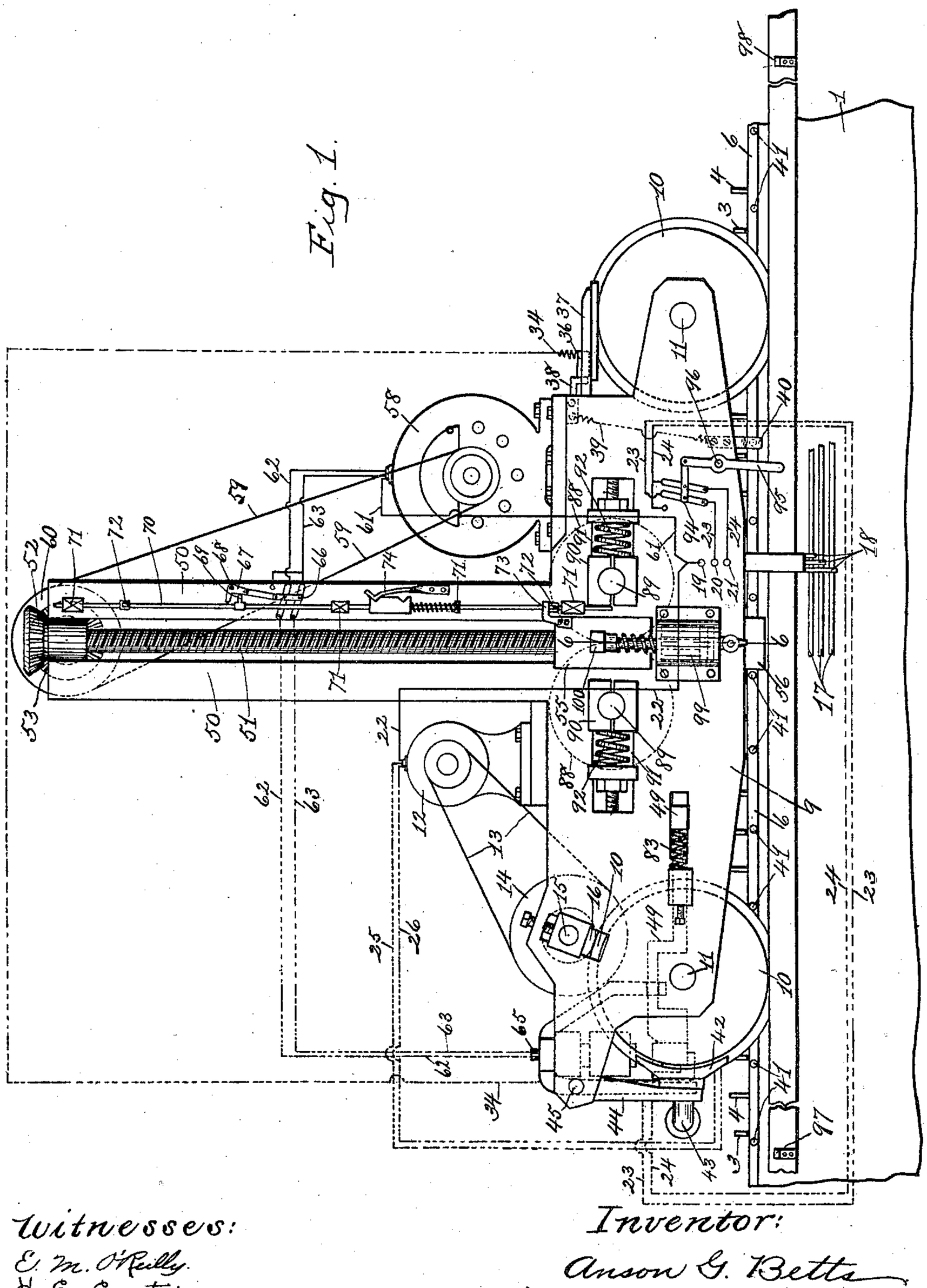
A. G. BETTS.

APPARATUS FOR TREATING METALS BY ELECTROLYSIS.

(Application filed Mar. 18, 1901.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



Witnesses:
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H. E. Curtis.

Inventor:
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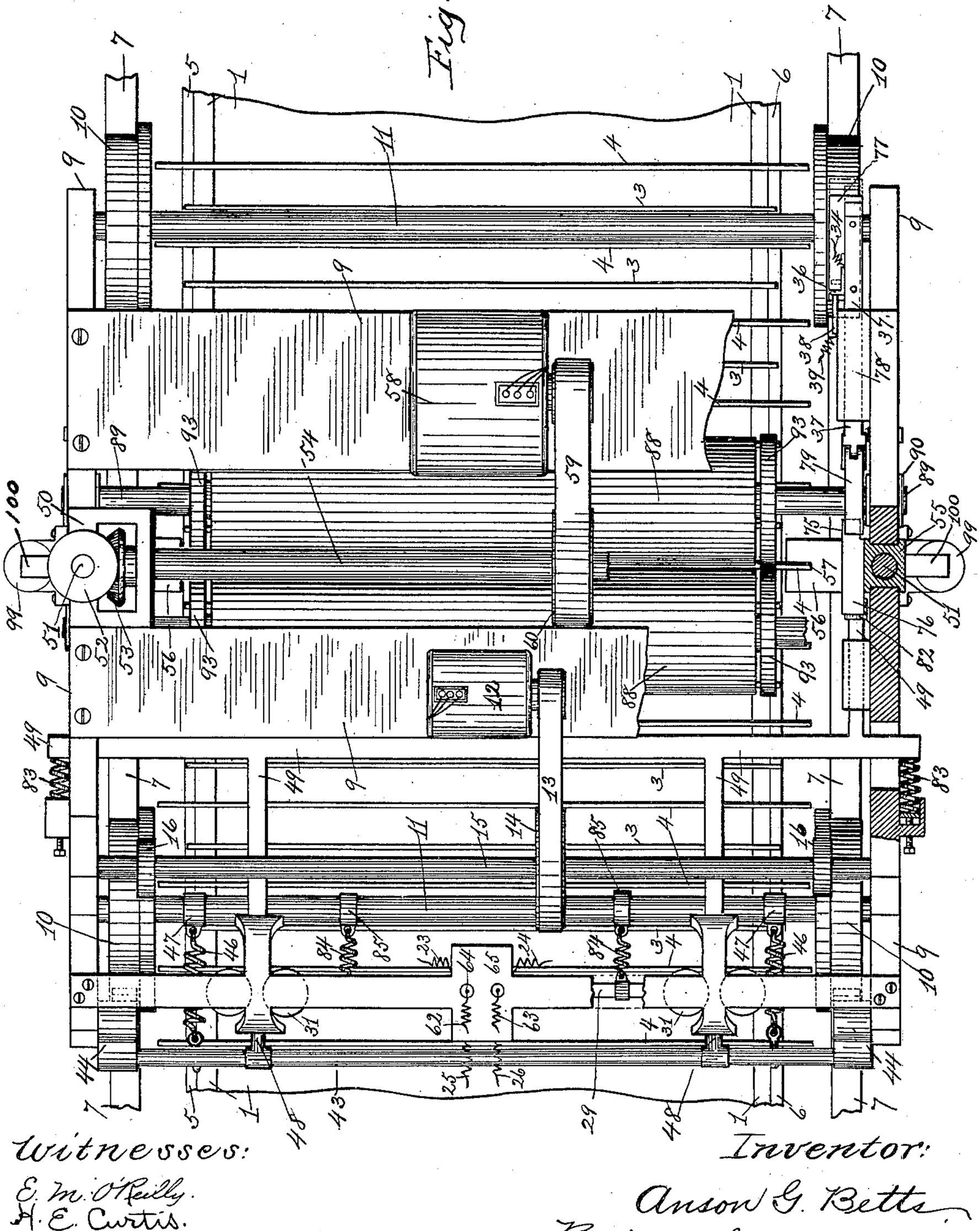
(No Model.) 4 Sheets—Sheet 2.

Fig 2.



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(No Model.) 4 Sheets—Sheet 3.

Fig. 4.

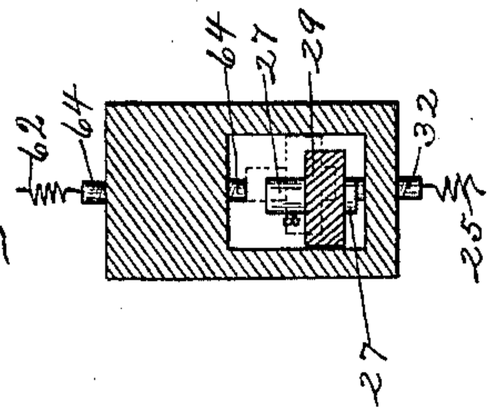

Fig. 3.

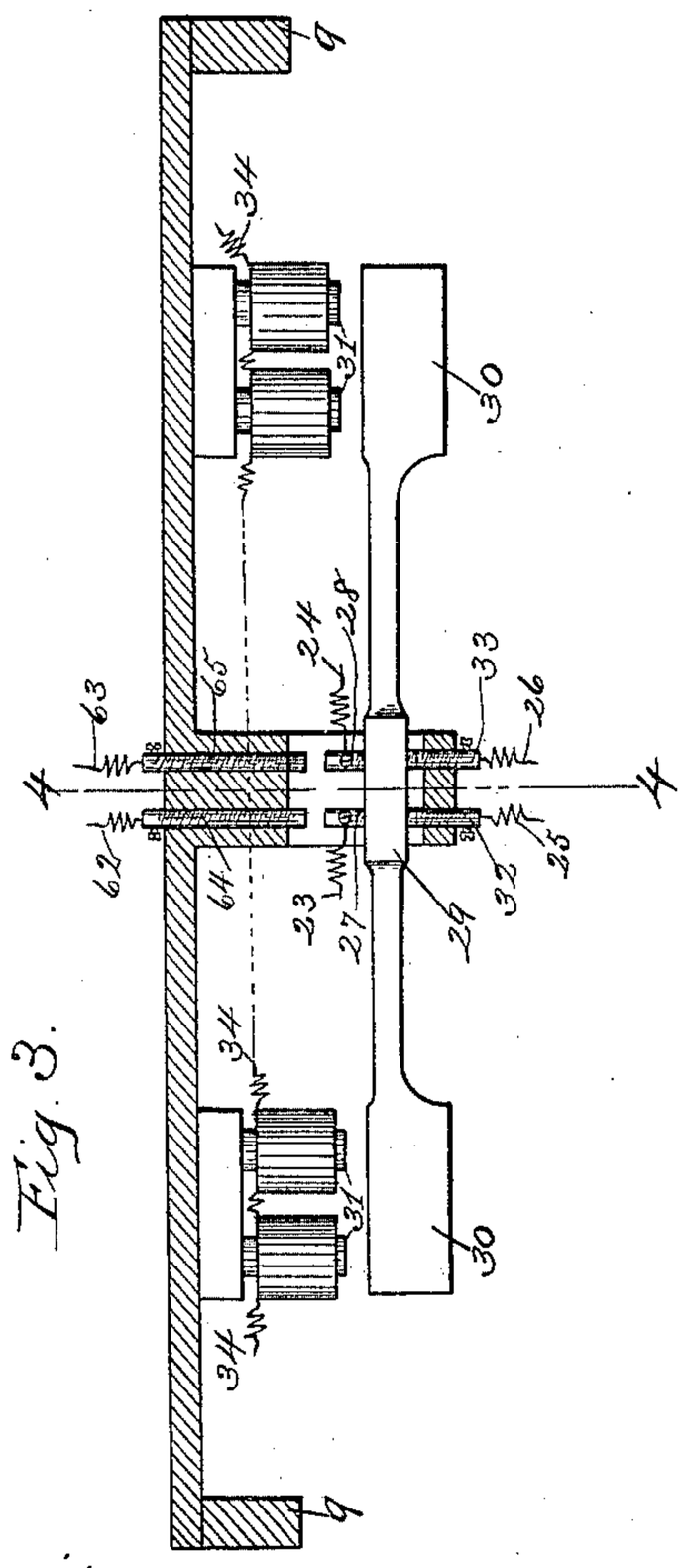

Fig. 5.

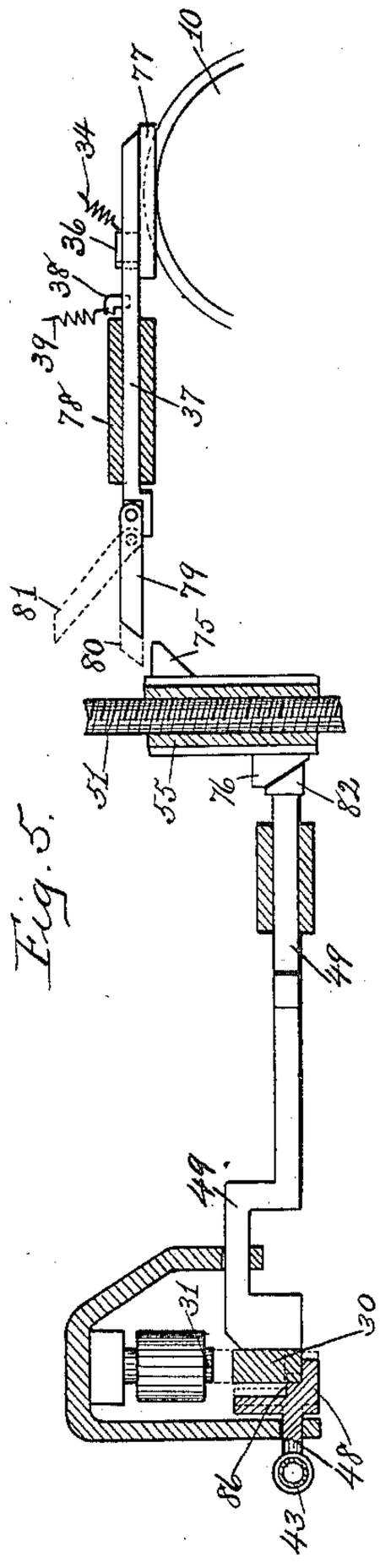

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Fig. 7.

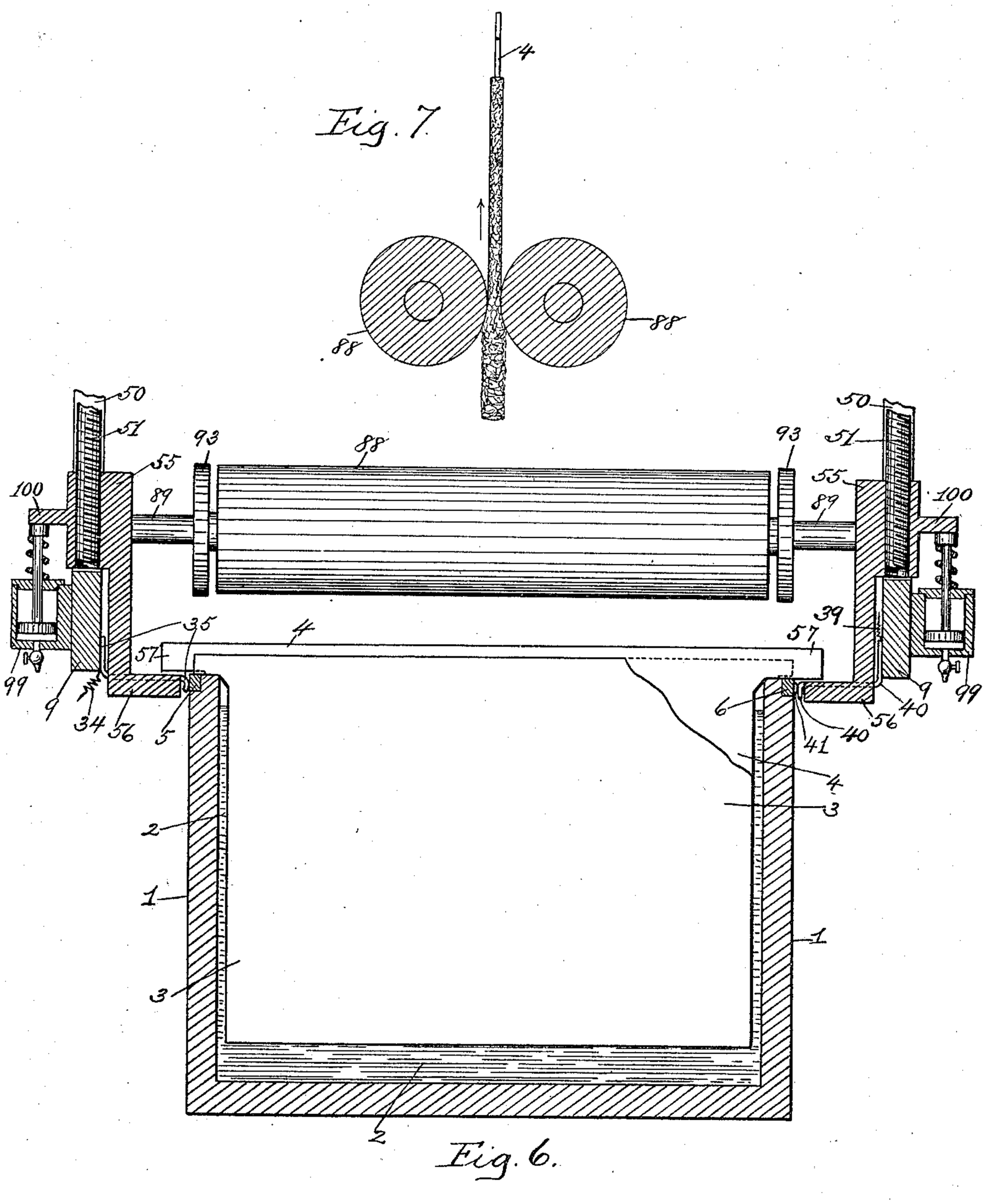

Fig. 6.

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UNITED STATES PATENT OFFICE.

ANSON G. BETTS, OF UPPER TROY, NEW YORK.

APPARATUS FOR TREATING METALS BY ELECTROLYSIS.

SPECIFICATION forming part of Letters Patent No. 679,357, dated July 30, 1901.

Application filed March 18, 1901. Serial No. 51,578. (No model.)

To all whom it may concern:

Be it known that I, ANSON G. BETTS, a citizen of the United States, residing at Upper Troy, county of Rensselaer, and State of New York, have invented certain new and useful Improvements in Apparatus for Treating Metals by Electrolysis, of which the following is a specification.

The invention relates to such improvements; and it consists of the novel construction and combination of parts hereinafter described and substantially claimed.

Reference may be had to the accompanying drawings, and the reference characters marked thereon, which form a part of this specification.

Similar characters refer to similar parts in the several figures.

Figure 1 of the drawings is a view in side elevation of my improved apparatus for refining metals by electrolysis. Fig. 2 is a view, partly in top plan and partly in horizontal section, of the same. Fig. 3 is a view, partly in vertical section and partly in side elevation, of the brake mechanism and automatic switch mechanism.. Fig. 4 is a cross-section of the same, taken on the broken line 4 4 in Fig. 3. Fig. 5 is a view, partly in vertical longitudinal section and partly in side elevation, of the brake-releasing mechanism and the automatic circuit breaker and closer. Fig. 6 is a view in vertical cross-section of a portion of the apparatus, taken on the broken line 6 6 in Fig. 1. Fig. 7 is a cross-section of the pressure-rollers, showing one of the electrodes with its electrodeposit undergoing the compacting operation.

My invention relates to apparatus for treating metals by electrolysis, wherein an electrodeposit of refined metal is formed upon electrodes supported in a vat containing the electrolyte.

Considerable time is usually required for the formation of a sufficient quantity of electrodeposit to necessitate its removal from the electrodes, during which time it is usually desirable, if not necessary, to mechanically treat the electrodes with their formation of electrodeposit.

The object of my invention is to provide for and facilitate the mechanical treatment of the electrodes in carrying on such a process of treating metals.

My apparatus is adapted with obvious modifications to be used for various kinds of mechanical treatment of the electrodes.

I have shown in the drawings my apparatus in the form adapted for compacting upon the cathode the metallic electrodeposit from time to time. This compacting operation I preferably perform by passing the cathodes between pressure-rollers, and I have shown my apparatus adapted for such purpose.

1 represents a vat containing electrolyte 2 and a series of anodes 3 and cathodes 4, supported therein. The anodes are supported in the vat in contact with the conductor 5, connected with the positive element of an electrical energizer, and the cathodes are supported in contact with a conductor 6, connected with the negative element of such energizer, the energizer, which may be of any known form, being omitted from the drawings. Adjacent to and extending longitudinally of the vat is a track formed by the rails 7, which may be supported in fixed relation to the vat in any known manner. The mechanism for mechanically treating the cathodes is supported upon a carriage movable along said track above the vat. The body of this carriage comprises a truck-frame 9, mounted upon the wheels 10, adapted to run upon said track-rails, said wheels being provided with axles 11, having bearings in the truck-frame. This carriage is capable of an intermittent or step-by-step movement along the track from one cathode to another, and I have shown means for automatically imparting thereto such a movement, as well as means for mechanically treating the cathodes during the intervals between successive movements of the carriage. As a means for moving the carriage I have shown a three-phase electric motor 12, mounted upon the truck-frame and connected by belt 13 with a pulley 14, fixed upon the cross-shaft 15, having bearings in the truck-frame, which shaft 15 is provided with friction-wheels 16, adapted to engage the periphery of one of the truck-wheels and frictionally drive the same. The electrical supply for this motor is obtained from the three conductors 17, which run parallel with

the track on which the carriage travels, the carriage supporting contact mechanism having the contact-fingers 18 adapted to contact with the respective conductors 17, as shown in Fig. 1, said contact-fingers being connected with the respective posts 19, 20, and 21. The post 19 is connected by a direct wire 22 with said motor, and the posts 20 and 21 are connected therewith by the wires 23 and 24 and connecting-wires 25 and 26 through a switch mechanism (illustrated in Fig. 3) and comprising contact-posts 27 and 28, with which the wires 23 and 24 are respectively connected, which posts are mounted in a switch-bar 29, provided at its opposite ends with armatures 30 in proximity to the respective electromagnets 31. When the armatures are unaffected by the magnets, the bar rests by gravity with the lower ends of the posts 27 and 28 in contact with the contact-posts 32 and 33, with which are connected the respective wires 25 and 26, which lead to said motor 12. When the electromagnets 31 are energized, they draw the respective armatures 30 upwardly, thereby carrying the bar 29 upwardly and destroying the contact of the posts 23 and 24 with the posts 32 and 33, thereby disconnecting said motor 12 from its source of electrical supply. It will thus be seen that by alternately energizing and deënergizing said electromagnets intermittent movements will be imparted to said motor and transmitted to the carriage to move the same along its track.

The electromagnets 31 are energized by a supply of electricity obtained by forming a shunt connection between the conductors 5 and 6, the coils of the magnets being included in such shunt-circuit. The conductor-wire 34, which forms the coils of the electromagnets, is connected at one end with a contact-plate 35, fixed upon the carriage and adapted to engage the conductor 5 on the vat. The other end of this wire 34 is connected with a contact-plate 36, mounted upon a slide-bar 37 and adapted to be brought by the movement of said slide-bar into contact with a contact-plate 38, fixed upon the carriage and connected by conductor 39 with a contact-plate 40 on the carriage, adapted to engage offsets 41, formed at intervals on the conductor 6. The parts are so arranged that as the carriage travels along the track the contact-plate 40 will engage the offsets 41 successively, but will not engage the conductor 6 in the intervals between said offsets. It will thus be seen that a shunt-circuit is formed to energize the electromagnets only when the contact-plate 40 engages one of the offsets 41. Prior to the engagement of the contact-plate 40 and offset 41 the carriage is in motion upon the track, being operated by the motor 12, which is energized in the manner above described, the switch-bar 29 being in its lowermost position, causing a contact of the posts 27 and 28 with the posts 32 and 33. Upon the contact-plate 40 engaging an offset 41 the shunt-circuit is completed, which energizes the magnets 31, causing the armatures 30 to be drawn upwardly, carrying with them the switch-bar 29 and destroying the connection with the motor 12 by separating the posts 27 and 28 from the posts 32 and 33. The motor 12 being thus deënergized, the carriage will come to a position of rest upon the track. As a means for accurately determining the position in which the carriage will stop upon the track when the motor 12 is thus deënergized, I provide brake mechanism adapted to be actuated by the same movement of the armatures and switch-bar which breaks the supply-circuit of said motor. The brake-shoes 42 are mounted upon the brake-beam 43, suspended from the truck-frame by the swinging links 44, pivoted at 45 and adapted to engage the adjacent truck-wheels. Coil-springs 46, which connect said brake-beam with a sleeve 47 on the neighboring axle 11, tend to force the brake-shoes against the respective truck-wheels. While the motor 12 is energized the brake-shoes are held out of contact with the truck-wheels against the force of the springs 46 by means of the armature-blocks 30, which are interposed between an abutment on an arm 48 on the brake-beam and the frame 49, which is maintained in a fixed position upon the carriage while the carriage is in motion. When the armature-blocks are drawn upwardly by the force of the electromagnets, they are lifted above the abutting portions of the arms 48, permitting the arms to pass beneath the armatures as the springs 46 draw the brake-beam toward the axle 11 and force the brake-shoes against the truck-wheels. It will thus be seen that at the same instant the supply-circuit of the motor 12 is broken by the movement of the switch-bar the brakes are automatically applied to overcome the inertia of the moving parts and cause the motion of the carriage to be instantly arrested.

I have shown mechanism adapted to automatically remove the brake-shoes from engagement with the truck-wheels and to restore the supply-circuit of the motor 12, which mechanism is intimately associated with and will be described in connection with that for the mechanical treatment of the cathodes during intervals between successive intermittent movements of the carriage.

Erected from the truck-frame on opposite sides of the carriage are a pair of uprights 50, each containing a slideway and each provided with a vertical screw-shaft 51, provided at its upper end with a bevel-gear 52, adapted to mesh with a similar bevel-gear 53, fixed upon the horizontal cross-shaft 54, having bearings at opposite ends in said uprights. Mounted upon each of the screw-shafts 51 is a nut 55, in the form of a slide-block adapted to fit the neighboring slideway in the upright 50 and be moved up and down therein by rotary movements of said screw-shaft. These slide-blocks are provided with inwardly-projecting hook-offsets 56,

adapted as the carriage is moved along the track to pass beneath the outwardly-projecting offsets or lugs 57 on the respective cathodes. The contact-plate 40 and offsets 41 on the conductor 6 are so arranged that each time the movement of the carriage is arrested in the manner above described by the engagement of said contact-plate 40 with one of the offsets 41 these hook-offsets will be in a position directly beneath the oppositely-projecting lugs 57 on one of the cathodes in position to engage said lugs and lift the cathode from the vat as the slide-blocks are forced upwardly in their respective slideways by the rotation of the respective screw-shafts 51. The cathodes thus lifted from the vat may be mechanically treated in any known manner to facilitate the operation or improve the product of the process.

As a means for rotating the screw-shaft 51 I have shown a three-phase electric motor 58, connected by belt 59 with a belt-pulley 60 on the horizontal shaft 54. This motor is supplied from the conductors 17, through the contact-fingers 18, the wire 61 extending from the post 19 directly to said motor, while the wires 62 and 63, connecting with said motor, are adapted to be connected with the wires 23 and 24 at certain times by the operation of the switch-bar 29. These wires 62 and 63 connect, respectively, with contact-posts 64 and 65, supported in position to be engaged by the upper ends of the posts 27 and 28 when the switch-bar 29 is moved upwardly by the upward movement of the armatures when the electromagnets are energized. It will thus be seen that the two motors 12 and 58 are operated alternately and that the motor 58 can operate only when the carriage is at rest.

The wires 62 and 63 are of opposite polarity and connect with a pole-changer 66, adapted to be operated by an angle-lever 67, fulcrumed at 68 upon one of the uprights 50 and adapted to be engaged and operated by an offset 69, fixed upon the slide-rod 70, capable of vertical reciprocatory movements in slideway-bearings 71, mounted upon the upright 50. This slide-rod is provided near its opposite ends with offsets 72, adapted to be engaged by a finger 73, fixed upon the slide-block 55. The parts are so arranged that the finger 73 will engage the upper offset 72 when the slide-block 55 reaches the upper portion of its slideway, such engagement forcing the slide-rod upwardly in its bearings and causing the pole-changer to be operated to reverse the polarity of the wires 62 and 63, and thereby cause a reverse operation of the motor 58, cross-shaft 54, and screw-shaft 51 with a resultant descending movement of the slide-block 55, which upon reaching the lower portion of its slideway causes the polarity of the wires 62 and 63 to be again reversed by a movement of the slide-rod 70, caused by engagement of the finger 73 with the lower offset 72. A spring-stop 74 serves to prevent accidental operation of the pole-changer by yieldingly supporting the slide-rod in either a raised or lowered position. The slide-block 55 is provided with a pair of wedge-shaped offsets 75 and 76, the former being adapted to operate the slide-bar 37 in one direction and the latter to operate and control the frame 49, forming part of the brake apparatus. The slide-bar 37 is provided with a friction-plate 77, adapted to engage the periphery of one of the truck-wheels as the carriage is moved along the track from right to left, as viewed in Fig. 1. The movement of the truck-wheel will, by frictional engagement with the plate 77, force the slide-bar 37 along its slideway 78, and maintain the same with the contact-plates 36 and 38 in engagement with each other, as shown in Fig. 1, in which position the vertically-swinging arm 79, hinged upon the inner end of said slide-bar, will overlie the wedge 75 in a position to be engaged thereby as the slide-block 55 is raised in its slideway. This arm 79 is so hinged that it yields readily to an upward thrust, but tends to resist a downward thrust upon its swinging end. The carriage having come to a position of rest with the slide-bar 37 in such a position that the contact-plates 36 and 38 are in engagement with each other, such engagement will be maintained to continuously energize the electromagnets as the slide-block 55 is moved upwardly in its slideway, moving the hinged arm 79 from the dotted position 80 to the dotted position 81, said arm resuming the dotted position 80 after the slide-block has passed upwardly out of engagement therewith, and such engagement of the contact-plates 36 and 38 will thereafter continue until the reversal of the motor 58 has caused the slide-block to again descend until the wedge 75 engages the arm 79, which being not free to yield in a downward direction causes the slide-bar 37 to be forced outwardly in its slideway to separate the contact-plates 36 and 38 from each other, the friction-plate 77 sliding upon the periphery of the truck-wheel. The shunt-circuit is thus broken by the separation of the contact-plates 36 and 38, causing the magnets to be deënergized as the slide-block 55 is returned to its lowered position. The other wedge 76 is adapted to engage a wedge 82 on the frame 49 to maintain the frame relatively fixed in the position shown in Fig. 5, so long as the slide-block 55 is in its lowermost position, and to thus maintain said frame against the force of the coil-springs 83, which tend to force said frame inwardly when released by the upward movement of the wedge 76 as the slide-block is raised in its slideway. The coil-springs 84, connecting the switch-bar with sleeves 85 on the adjacent axle 11, tend to hold the switch-bar with its armature-blocks in engagement with the frame 49, so that when said frame is raised by the upward movement of the wedge 76 the armature-blocks which are held in a raised position by the magnets are caused by

the springs 84 to accompany said frame in its inward movement. The armatures are thus brought in their raised position over a depressed portion of the brake-beam arm 48, and when the magnets are deënergized said armatures are forced by gravity into said depressed portion of the brake-beam arm and between the abutment 86 thereon and the frame 49.

From an inspection of Fig. 5 it will be seen that as the slide-block 55 descends in its slideway the wedge 75 will operate the slide-bar 37 to cause the shunt-circuit to be broken to deënergize the magnets and release the armature-blocks before the wedge 76 engages the frame 49 and that immediately thereafter the wedge 76 by engaging the wedge 82 on the frame 49 will force said frame outwardly or to the left, and the armatures being at this time interposed between said frame and the abutment 86 on the brake-beam arm the brake-beam will be forced outwardly or to the left, thereby forcing the brake-shoes out of contact with the truck-wheels and releasing the brake. Immediately upon the breaking of the shunt-circuit of the electromagnets, the downward movement of the armatures and switch-bar 29 breaks the supply-circuit of the motor 58, but the force of gravity and the inertia of the moving parts will be sufficient to complete the downward movement of the slide-blocks 55. The downward movement of the switch-bar 29, which breaks the supply-circuit of the motor 58, again connects the motor 12 with its supply, causing the carriage to be again moved along the track. A slight movement only of the carriage is required to force the slide-bar 37 to the left to bring the plates 36 and 38 into contact with each other, whereupon the several operations above described will be automatically and successively performed upon the engagement of the contact-plate 40 with the next offset 41 on the conductor 6. I have shown the carriage provided with a pair of pressure-rollers 88 88, having trunnions 89 rotatively mounted in bearing-boxes 90, movable toward and from each other in horizontal slideways 91 in the truck-frame, the coil-springs 92 tending to force said bearing-boxes toward each other to cause the rollers to compress between them each cathode as the same is drawn upwardly between the rollers by the slide-blocks 55, as above described, the hook-offsets 56 being located midway between the axial lines of said rollers. In refining various metals by electrolysis it is found that the electrodeposit is formed upon the cathode in a porous or spongy form, which is objectionable for many reasons. By thus passing the cathodes between the pressure-rollers from time to time the electrodeposit will be compacted upon the cathode in a comparatively solid form. These pressure-rollers are preferably made of glass, porcelain, or other material which will not deteriorate upon contact of the electrolyte. When the rollers are so made of frangible material, I preferably provide them at opposite ends with guard-disks 93 of slightly larger diameter than the respective rollers, said disks on the respective rollers being adapted to contact with each other to prevent the roll-surfaces proper from engagement with each other. These disks may be made of metal or other durable material and may be protected from the action of the electrolyte by placing them upon the trunnions at a short distance from the ends of the respective rollers, leaving a clear space between said disks and rollers, as shown in Fig. 2. As the cathode passes down between and below said rollers said disks will receive the shock of concussion due to the forcing of the rollers toward each other by the springs 92, thus relieving the rollers from the force of such concussion. It will thus be seen that it is only necessary to locate the contact-offsets 41 the proper distance apart, which is the distance between successive cathodes, and to arrange said offsets in the proper position upon the conductor 6 in order to insure the intermittent movement of the carriage from one electrode to another of the series and in the intervals between the successive movements of the carriage to raise from the vat, pass between the pressure-rollers, and return to the vat the respective cathodes, all of which operations are successively and automatically performed.

I have shown the wires 23 and 24 connected with a pole-changer 94, adapted to be operated by a lever 95, pivoted at 96 upon the truck-frame and having its lower end adapted to engage the respective stops 97 and 98 at opposite ends of the track to automatically cause the operation of said pole-changer and the reversal of the motor 12 at each end of the desired path of movement of the carriage. Thus when the carriage reaches the end of its desired movement toward the left, as shown in Fig. 1, the engagement of the lever 95 with the stop 97 will operate the pole-changer 94, and by thus reversing the motor 12 will cause the carriage to return along the track, moving toward the right. When the carriage moves in this direction—that is, from left to right—the engagement of the truck-wheel with the friction-plate 77 forces the slide-bar 37 toward the right to separate the contact-plates 36 and 38, and the slide-bar will be maintained in this position so long as the carriage continues to move in that direction. The contact-plates 36 and 38 being thus maintained out of engagement with each other, the shunt-circuit will not be formed as the contact-plate 40 engages the respective offsets 41 during this return movement of the carriage, which movement will be continuous until the lever 95 engages the stop 98 at the opposite end of the track to again operate the pole-changer and reverse the motor 12 and induce a movement of the carriage to the left. As soon as the carriage again begins to move toward the left the slide-bar 37 is forced toward

the left to bring the plates 36 and 38 into contact with each other, thus permitting the shunt-circuit to be formed by the contact of the plate 40 with the offset 41, whereupon the several mechanisms will be caused to operate successively, as above described. The apparatus is thus adapted to continue in operation indefinitely.

I have shown electric motors for causing the various movements of the apparatus; but I do not wish to be limited to the same, as any known form of motor may be employed which is capable of producing the desired result.

For convenience of illustration the several conductor-wires are shown or indicated partly by dotted lines extending more or less directly from one point of connection to another. It will be of course understood that such wires are preferably extended along the framework of the carriage and more or less concealed in practice. The downward movement of the slide-blocks 55 and cathode carried thereby may be gradually arrested by means of a dash-pot 99, the plunger of which is adapted to be engaged by an offset 100 on the slide-block.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; and mechanism supported by said carriage for mechanically treating the electrodeposits on the several electrodes.

2. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; and mechanism supported by said carriage for raising from the vat, and lowering into the vat, the several electrodes and mechanism supported by said carriage for mechanically treating the electrodeposits on the several electrodes.

3. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; means for intermittently moving said carriage along said track; means adapted to operate during the intervals between successive intermittent movements of the carriage, for mechanically treating the several electrodes and means for automatically inducing the alternate operation of said carriage-moving mechanism, and said mechanism for mechanically treating the electrodes.

4. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; an intermittent motor for automatically imparting to said carriage intermittent movements along said track; mechanism for raising from the vat, mechanically treating, and lowering into the vat, the several electrodes and means for automatically inducing alternately intermittent action of the carriage-operating mechanism, and electrode raising, lowering and treating mechanism.

5. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; pressure-rollers mounted upon said carriage; and mechanism supported by said carriage for raising the several electrodes from the vat, passing them between said pressure-rollers, and lowering them into the vat.

6. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; pressure-rollers mounted upon said carriage; electrode raising and lowering mechanism on said carriage; a motor for moving said carriage along said track; and means for operating said electrode raising and lowering mechanism.

7. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track located adjacent to said vat; a carriage adapted to be moved along said track above said vat; pressure-rollers mounted upon said carriage; an intermittent motor for automatically imparting to said carriage intermittent movements along said track; and mechanism adapted to operate automatically during the intervals between successive movements of said carriage for raising the several electrodes from the vat, passing them between said rollers, and lowering them into the vat, substantially as described.

8. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track located adjacent to said vat; a carriage adapted to be moved along said track above said vat; pressure-rollers mounted upon said carriage; mechanism for raising the several electrodes from the vat, passing them between said rollers and lowering them into the vat; and a pair of intermittent motors, one adapted to intermittently move said carriage along said track and the other adapted to operate said electrode raising and lowering mechanism; and means for automatically inducing said motors to operate alternately.

9. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track adjacent to said vat; a carriage adapted to move back and forth along said track; a reversible motor for moving the carriage; an automatic switch for reversing said motor at either end of the path of movement of the carriage; means for automatically

causing said motor to operate intermittently to move the carriage in one direction; electrode raising and lowering mechanism on said carriage; means for automatically operating said electrode raising and lowering mechanism during the intervals between successive intermittent movements of the carriage; and a pair of pressure-rollers mounted on the carriage in the path of the raised and lowered electrodes.

10. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; pressure-rollers mounted upon said carriage; a frame capable of vertical, reciprocating movements on said carriage and adapted to engage, raise and lower the several electrodes; and means for alternately operating said carriage and frame, substantially as described.

11. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat, and electrodes contained therein; of a track adjacent to said vat; a carriage movable along said track; a pair of pressure-rollers mounted thereon; a pair of screws mounted upon said carriage; a frame adapted to engage, raise and lower, the several electrodes, and provided with a pair of nuts fitting said screws respectively; means for moving said carriage; and means for rotating said screws to raise and lower said frame, substantially as described.

12. In an apparatus for refining metals by electrolysis, the combination with a carriage movable from one to another of a series of electrodes; a movable frame adapted to engage, raise and lower the electrodes severally; and pressure-rollers mounted on the carriage in the path of the raised or lowered electrodes; a reversible motor for raising and lowering said frame; a switch for reversing said motor; and switch-operating mechanism carried by said frame.

13. In an apparatus for refining metals by electrolysis, the combination with a carriage movable along a track from one to another of a series of electrodes; and a movable brake for preventing movement of the carriage; of a movable frame adapted to engage, raise and lower the several electrodes; means for raising and lowering said frame; and brake-releasing mechanism actuated by the final descending movement of said frame.

14. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat; of a series of electrodes severally provided on their upper ends with oppositely-projecting lugs; and electrode raising and lowering frame, having hooks adapted to pass beneath and engage said lugs; means for moving said frame from one to another of said electrodes; and means for raising and lowering said frame.

15. In an apparatus for refining metals by electrolysis, the combination with an electrolytic vat; of a series of electrodes contained in said vat and severally provided on their upper ends with oppositely-projecting lugs; a track adjacent to said vat; a carriage movable along said track; a frame movably supported on said carriage and movable therewith from one to another of said electrodes; projections on said frame adapted to pass beneath said lugs on the electrodes; and means for raising and lowering said frame to cause said frame projections to engage, raise and lower the several electrodes, substantially as described.

In testimony whereof I have hereunto set my hand this 15th day of March, 1901.

ANSON G. BETTS.

Witnesses:

FRANK C. CURTIS,

E. M. O'REILLY.