Feb. 18, 1936. A. H. HANNON 2,030,984

AUTOMATIC ELECTROPLATING MACHINE

Filed March 7, 1933 6 Sheets-Sheet 1

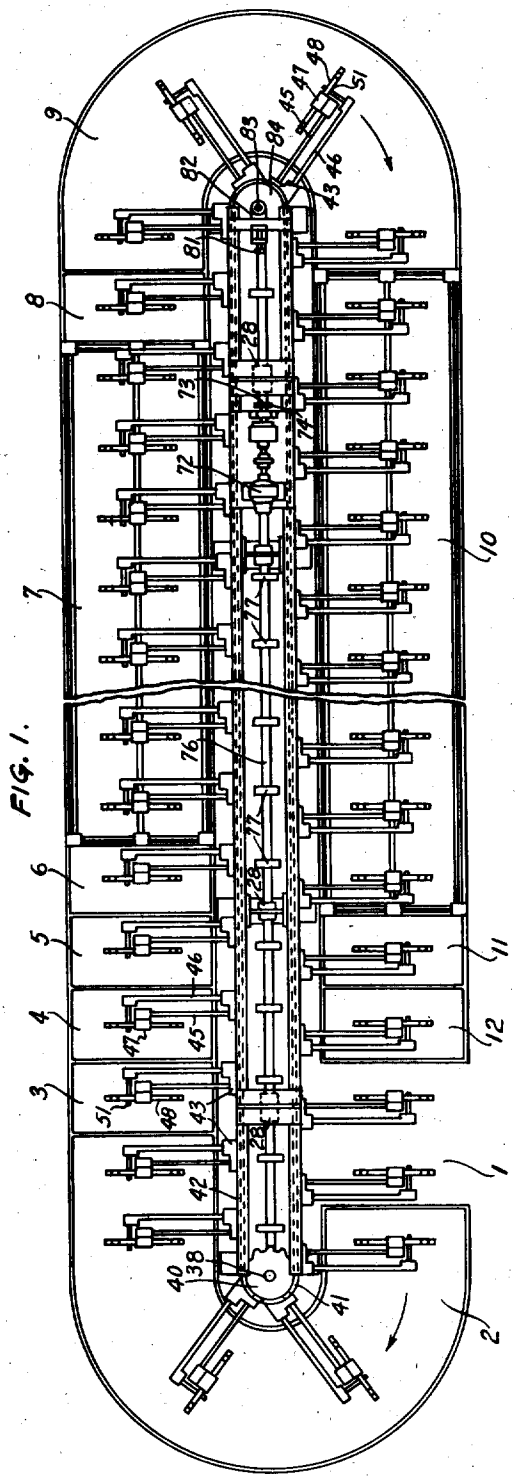


FIG. 1.

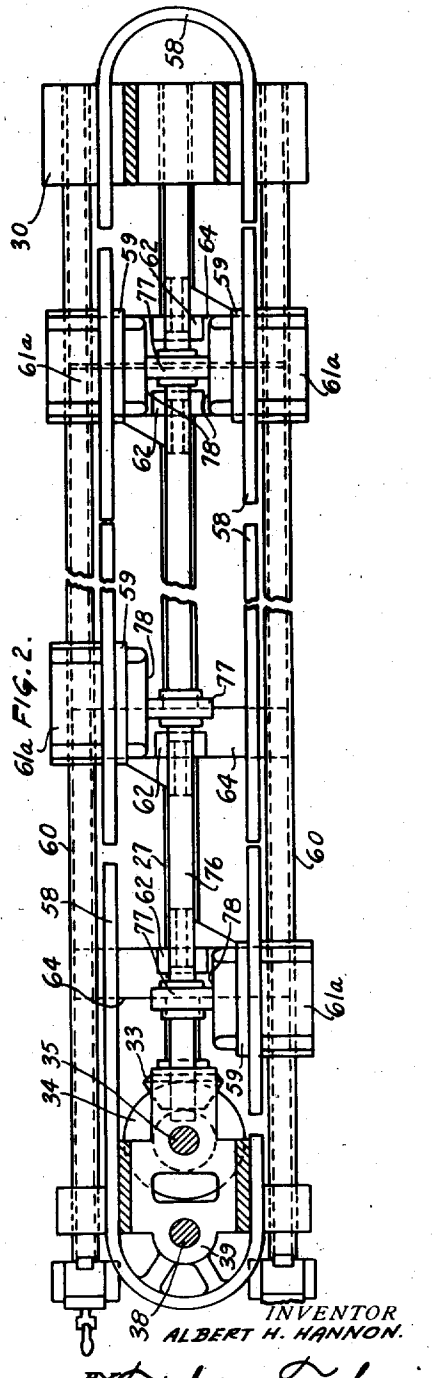


FIG. 2.

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FIG. 3.

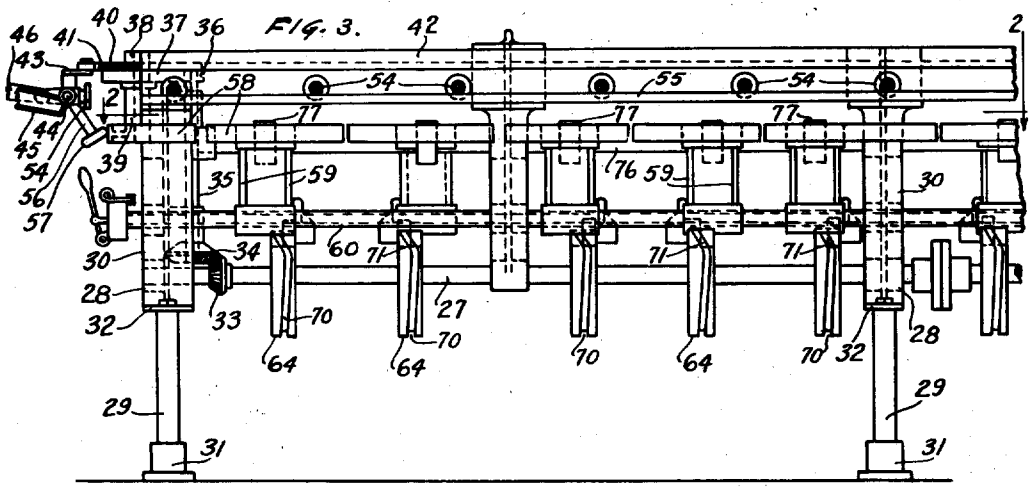
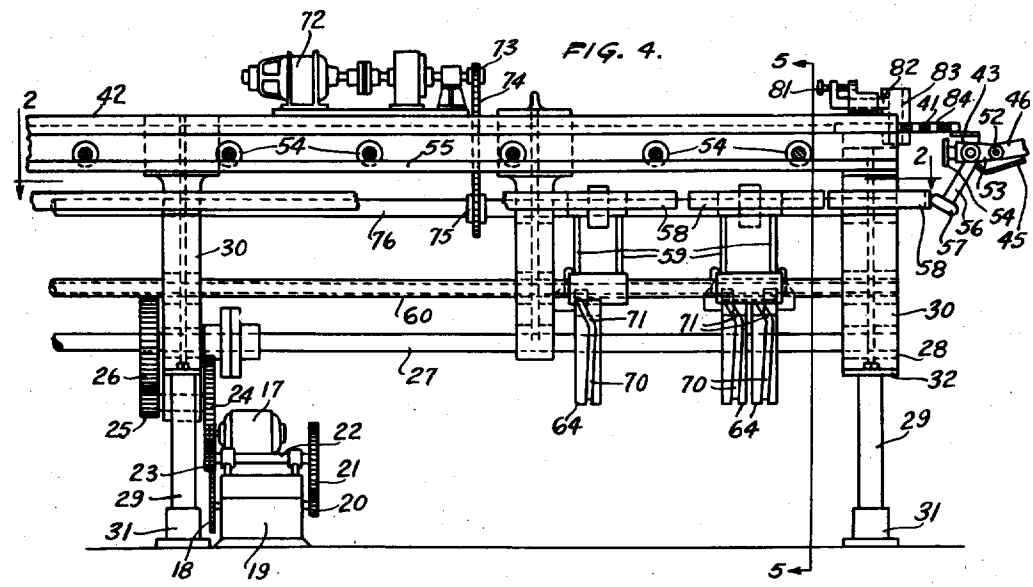


FIG. 4.



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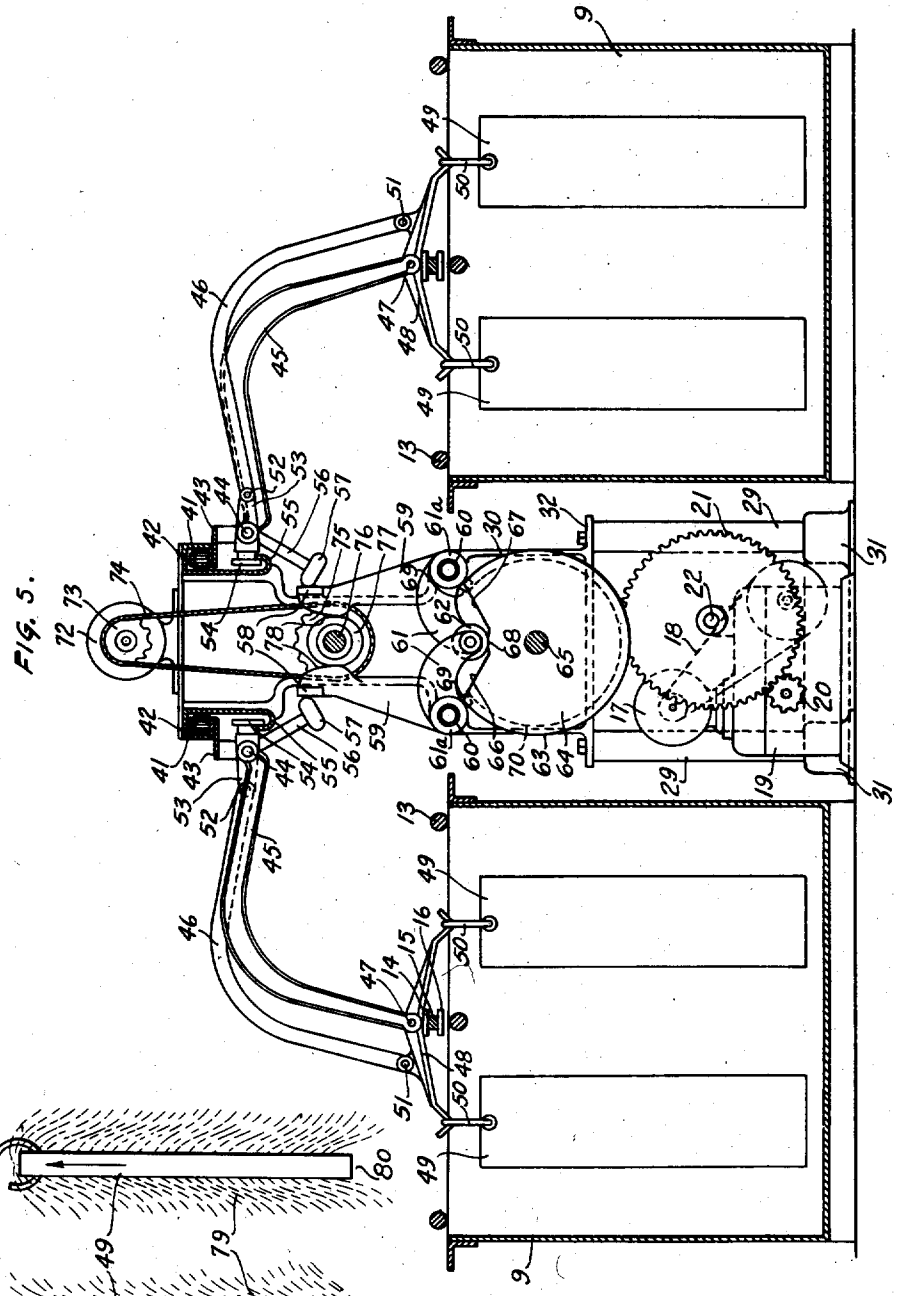


Fig. 5.

Fig. 7. Fig. 8.

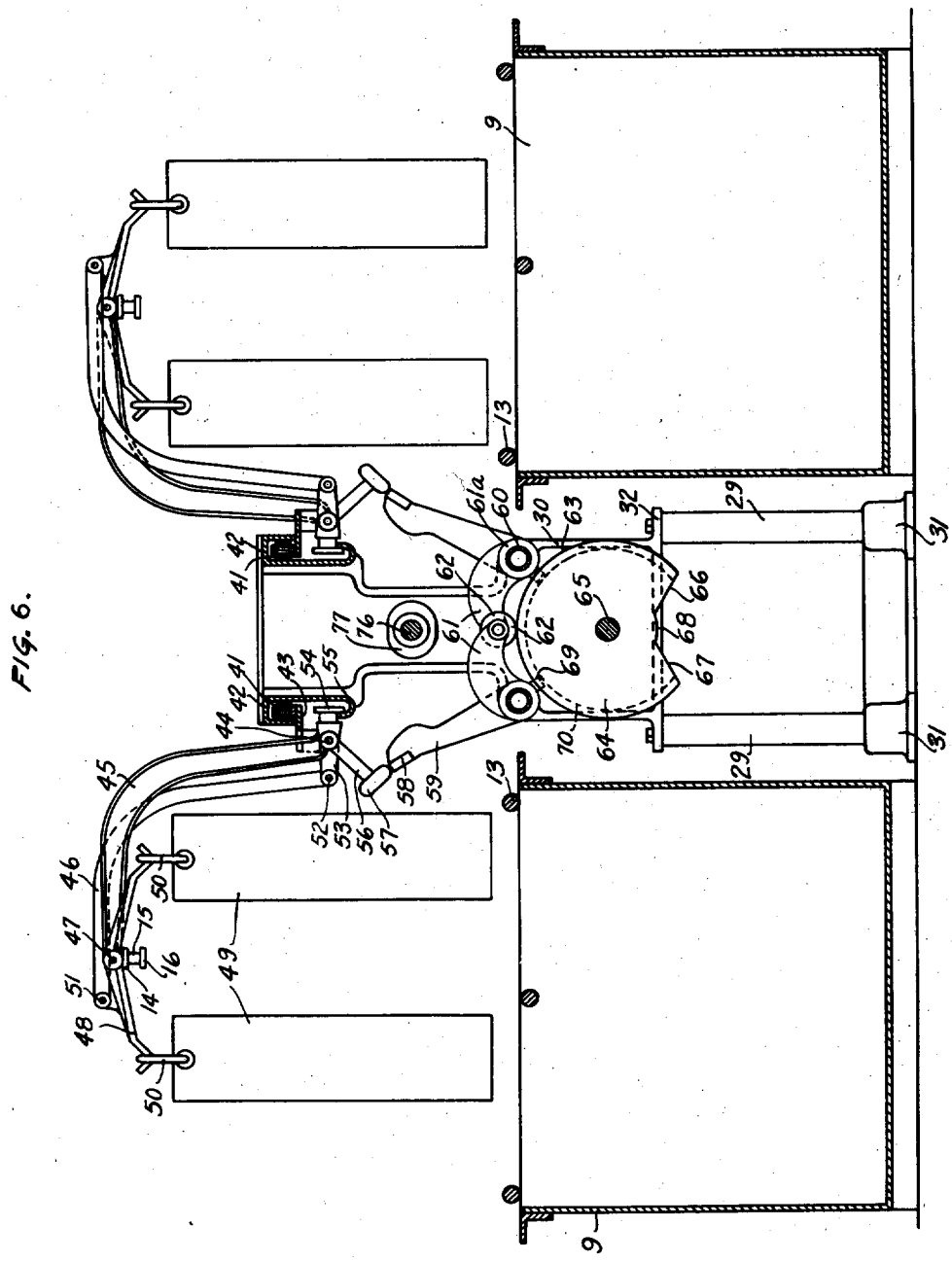
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FIG. 6.



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Fig. 9.

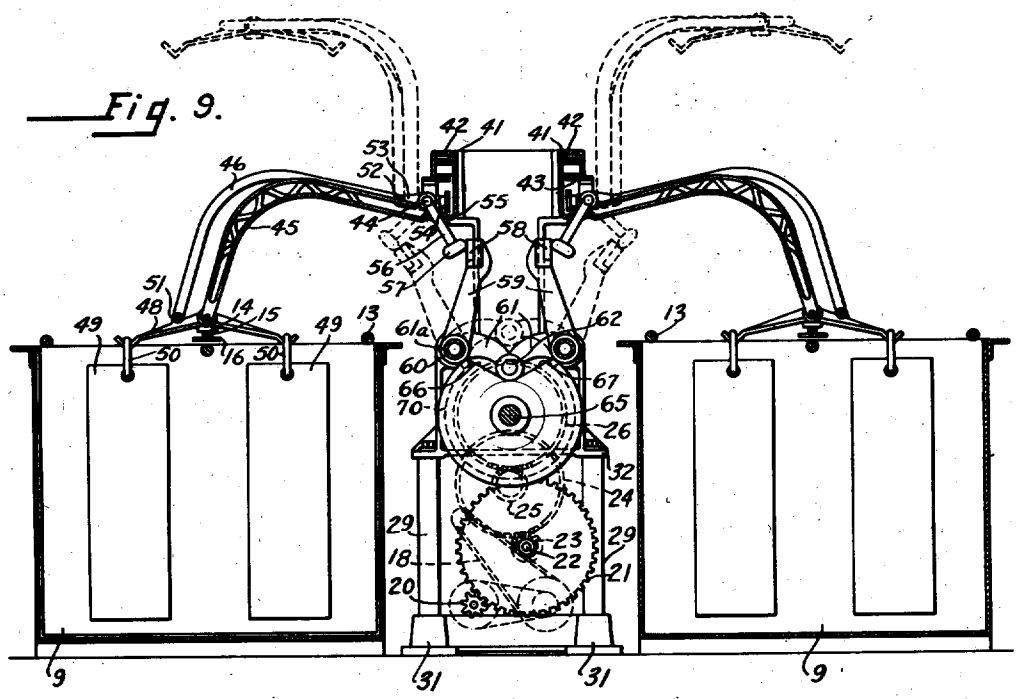
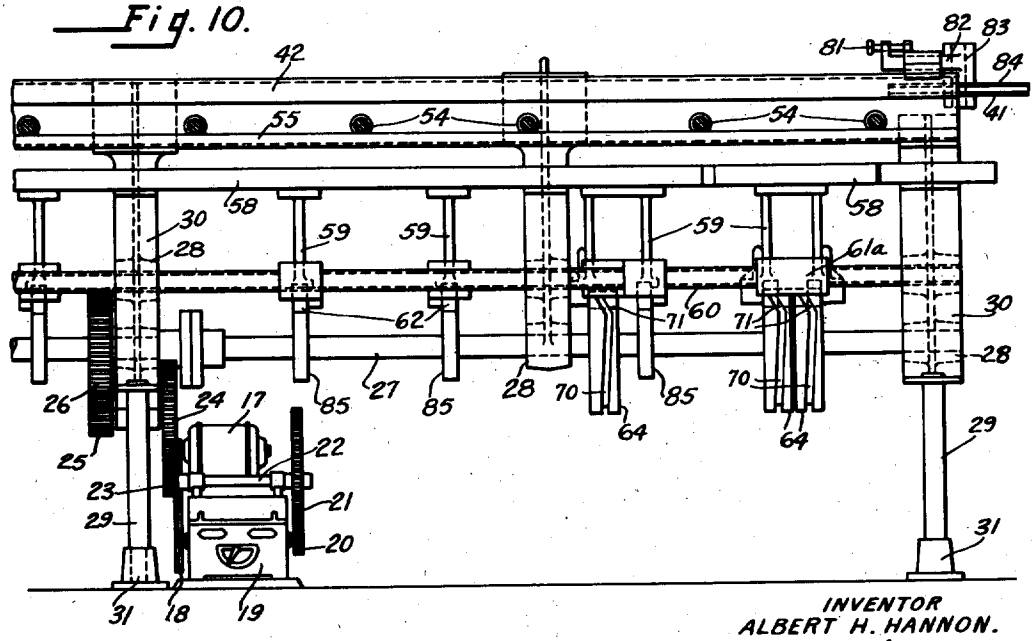


Fig. 10.



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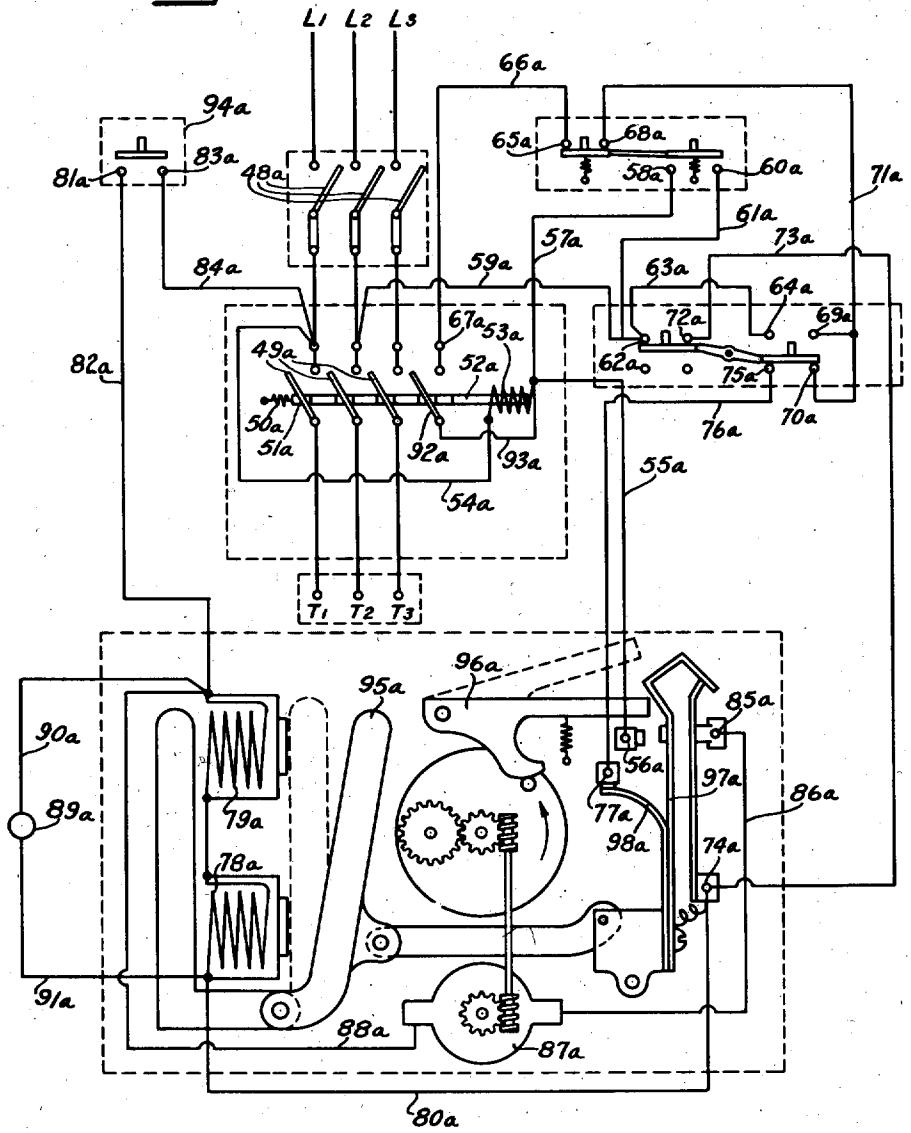
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Fig. 11.



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UNITED STATES PATENT OFFICE

2,030,984

AUTOMATIC ELECTROPLATING MACHINE

Albert H. Hannon, Springfield, Ohio

Application March 7, 1933, Serial No. 659,933

26 Claims. (Cl. 204—5)

It is the object of my invention to provide an automatic electroplating machine and a method of operation thereof.

It is my object to provide for either a continuously operating or intermittently operating machine in which the movement of the articles is both horizontal in a continuous or intermittent manner while in the baths; and also has a minor vertical movement while in the baths to prevent the accumulation of hydrogen bubbles and the like upon the articles being plated.

It is a further object to provide a novel means and method of applying cathodic contact by locating the cathode rail within the limits of the plating and cleaning tanks.

It is my object to avoid idle movements of the lifter mechanism and to provide a lifter mechanism in which there is no idle movement.

It is my object to provide a method and apparatus by which the articles being plated have the compound motion of a bodily horizontal movement and, at the same time, a minor up and down movement.

It is a further object to provide mechanism for imparting this minor movement synchronously with the lifting and lowering of the articles from tank to tank and synchronously with the horizontal movement of the articles.

It is a further object to provide a common operating means to move the articles continuously horizontally and while in the baths to impart to them minor vertical movements.

It is an object to provide means for moving the articles to and from the baths and also move them through the baths but to permit them to remain at rest in the baths at intervals and, while so at rest, so far as the horizontal movement is concerned, to impart to them minor vertical movement to prevent the accumulation of hydrogen bubbles on the surface thereof.

It is a further object to provide a lifter to raise an article carrying arm out of one tank and to hold the arm out of the tank in the air until it is advanced forwardly a sufficient distance to move it over the end of the tank and let it down into a succeeding tank and to then retract the lifter laterally so as to clear the mechanism of the arm to permit of an index into registry with the incoming mechanism of an incoming arm to repeat the operation.

With my machine and method, I obtain a quick transfer from tank to tank, especially between the cleaning and plating operations, to eliminate oxidation because a film of oxide on the surface of the work to be plated prevents good plating. After having effected the introduction of the work into the plating solution in a clean state, I then minimize the formation of hydrogen on the surface of the work by causing the raising and lowering of the articles to be plated in the solution to gain a washing action.

I also move the work horizontally through the solution intermittently to accentuate this washing action. Heretofore, when the work has been conveyed continuously, an air pocket is formed behind the portions of the work where gases multiply and are not completely washed away.

By the use of the intermittent operation, the forward portion of the work gets the washing action when the work stops momentarily, the direction of the solution being in the same direction as the movement of the work, upon stopping the work the inertia in the solution causes it to wash against the rear portion of the work, thereby causing a uniform washing action. This is true whether the movement of the work is vertical or horizontal. In this machine I provide for both movements.

It is my object to provide for both electrical and mechanical means for indexing the machine to permit of the intermittent carrier arm movement.

Referring to the drawings;

Figure 1 is a top plan view of the machine;

Figure 2 is a section on the line 2—2 of Figures 3 and 4;

Figure 3 is a side elevation with the carrier arms in section of the operating mechanism showing the left hand end of the machine;

Figure 4 is a similar view showing the right hand end of the machine;

Figure 5 is a section on the line 5—5 of Figure 4 looking in the direction of the arrows showing a machine in which there is a main drive for the carrier arms to impart intermittent, horizontal, lifting and lowering movement and a supplementary drive for imparting minor vertical movements while the articles are suspended in the solution tanks;

Figure 6 is a similar view showing the articles lifted out of the tanks;

Figure 7 is a diagrammatic view showing an article being moved downwardly on a minor movement;

Figure 8 is a similar view showing an article being moved upwardly;

Figure 9 is a transverse section showing the arrangement of the machine with the common drive for continuous operation, which also operates to give minor vertical movement to the work

being plated during the time the articles are in their lowered position in the solution tanks, both of the movements being effected from a common source of power;

Figure 10 is a side elevation of the actuating mechanism of the machine when the arrangement as illustrated in Figure 9 is employed;

Figure 11 is a diagrammatic view of the electrical and mechanical mechanism for indexing the machine for intermittent movement.

Tank mechanism

Referring to the drawings in detail, 1 indicates the loading and unloading area, the loading taking place on the left hand and the unloading on the right hand as the carrier arms move in the direction of the arrow. Upon being loaded, the articles are lifted and then lowered to be inserted within the electrolytic cleaning fluid in tank 2, such fluid being an alkali. The articles are then moved into a cold water tank 3, then the acid tank 4, cold water tank 5, cold water tank 6, copper plating tank 7, cold water tank 8, cold water tank 9 and nickel tank 10 and finally through the cold water tank 11 and then into the hot water tank 12, and then to the unloading station.

It will be noted that in the arrangement of these tanks, I provide an anode contact at 13 and a cathodic contact consisting of a sliding supporting plate 14 resting upon an insulation bar 15 which, in turn, rests upon a plate 16 over the middle of the tank.

Carrier arm driving mechanism

17 is a driving motor driving through the belts 18 to operate a speed reducing unit 19 which, in turn, operates the pinion 20, the gear 21, shaft 22, pinion 23, gear 24, pinion 25 and gear 26 mounted on the main operating shaft 27. This shaft is carried in bearings 28 at intervals by upright columns 29 in frame members 30. These columns 29 are arranged in spaced pairs and are connected by transverse foot pieces 31 and cap members 32 forming the base of the frame members 30. The shaft 27 carries a beveled pinion 33 which meshes with a beveled pinion 34 on a vertical jack shaft 35, which terminates in the pinion 36 that drives the gear 37 carried on the shaft 38 journaled in the frame 39. This shaft carries the sprocket 40 that drives the chain 41. This chain is guided in an inverted U-shaped track 42. Depending from the chain and extending laterally thereof is a bracket arm 43 which carries on a transverse pivot 44 the bifurcated carrier arm comprising the carrier arm 45 and the guide arm 46. The carrier arm 45 is pivoted at 47 to the laterally extending yoke 48 which carries the work pieces 49 on loops or hooks 50. This yoke is pivotally connected at 51 to the outer or lower end of the guide arm 46 whose inner end is pivoted at 52 to the arm 53 on the bracket 43. The inner end of the bracket 43 has a roller 54 traveling in a U-shaped track 55. The carrier arm 45 is connected to the bell crank arm 56 carrying the roller 57 that engages with the successive lifter plates 58.

Lifter mechanism

In order to lift the arms 45 and 46 to move the work pieces 49 quickly from one tank to the other, I provide the lifter plates 58 on the lifter arms 59 which are pivotally mounted on the tubes 60 carried in the frame members. These lifter arms 59 are provided with bell crank arms 61 terminating in cam rollers 62 which ride upon the cam surface 63 of the cam 64 that are driven by the cam shaft 65. Each of these cams is provided with a cut away dwell portion having sloping walls 66 and 67 and a bottom dwell portion 68. The juncture of the arms 59 and 61 has a sleeve 61*a* carrying a cam pin 69 operating in the cam groove 70 in the cam 64. This cam groove has a sharp lateral bend as at 71 in order to have a prompt shifting of the lifter plate 58 after it has accomplished the lifting and lowering of one roller 57 and its associated mechanism, and must be moved back into position to receive the next succeeding roller which is being presented by the chain.

In operation, when the carrier arms have been moved opposite one of the lifter plates 58 adjacent the end of one tank and the entry to another tank, the lifter cam 64 engages the roller 62 lifting the arms and their work pieces 49 which are then conveyed rapidly by the chain into the next succeeding tank position and lowered by the movement of the roller 62 down the incline 66. After this has been performed, the cam grooves 70 and 71 engaging the pin 69 shifts the lifter plate 58 back to its initial position as it is no longer carrying the load of the roller 57 and associated mechanism. During the interval of rest as the chain is brought to rest by reason of the intermittent moving mechanism hereinafter explained, the arms are given minor movements up and down to keep the accumulation of hydrogen from the work pieces, as indicated in Figures 7 and 8. For this purpose, the motor 72 operating a sprocket 73 and chain 74 drives a sprocket 75 on the shaft 76 carrying the oscillating cams 77. These cams engage the inner cam faces 78 of the lifter arms 59. As these arms are in engagement with the rollers 57, the whole carrier arm structure is oscillated with the work pieces 49 moving them upwardly and downwardly in a minor movement. The cams 77 are so timed to perform this movement when there is no horizontal movement taking place in the carrier arms and their work pieces.

As will be seen in Figures 7 and 8, the downward movement of the work piece causes the current of the solution 79 to clean off the lower end and sides of the work piece from any accumulation of hydrogen, and the reverse movement performs the same function. The inertia of the moving liquid will sweep over the work piece after the work piece comes to rest and thoroughly clean it eliminating the accumulation of hydrogen due to a pocket of air being formed behind the moving work piece as at 80.

Chain adjusting mechanism

The chain 41 is maintained in a taut condition by the adjusting screw 81 operating on the block 82 carrying the shaft 83 which, in turn, carries the end sprocket 84 supporting the chain 41.

Intermittent movement control

Referring to Figure 11, there will be seen a typical form of intermittent control so that the chain will be at rest when the articles are submerged in the tanks and will be moved when the articles are lifted and moved from one tank to the other. This form of mechanism is employed when the intermittent movement of the chain is desired and when the mechanism is such as that shown in Figures 1, 2, 3, 4, 5, and 6.

In order to obtain this intermittent movement I have elected to use an electrical time relay.

However, the same effect can be obtained by mechanical indexing mechanisn. By referreing to Figure 11, it will be seen that the power lines L1, L2, and L3 are connected through cutout switches 48a and the automatic switches 49a to the respective motor terminals T1, T2, and T3. The switches 49a are normally open by the action of the spring 50a upon the connecting member 51a which is connected to each of the switch arms. The member 51a includes a solenoid plunger 52a which is attracted by a magnet 53a for closing the switches against the action of the spring 50a when the magnet is energized. One terminal of the magnet 53a is connected by the wire 54a with L1, the opposite terminal by wire 55a to contact 56a. This coil 53a is also connected by the wire 57a with the start switch contact 58a and by the wire 59a with L2. The start switch contact 60a is connected by the wire 61a to the hand switch contact 62a and the hand switch contact is also connected by the wire 63a to the automatic switch contact 64a. The stop switch contact 65a is connected by the wire 66a to the automatic switch contact 67a. The stop switch contact 68a is connected with the automatic switch contact 69a and 70a by the wire 71a. The hand switch contact 72a is connected through the wire 73a with the timing switch contact 74a. The automatic switch contact 75a is connected by the wire 76a with the timing switch contact 77a. The time switch contact 74a is also connected with coils 78a and 79a through the wire 80a. The coils 78a and 79a are connected with the limit switch contact 81a through the wire 82a. The limit switch contact 83a is connected through the wire 84a to L1. The time switch contact 85a is connected through the wire 86a to the time switch motor 87a. This motor is, of course, a synchronous motor. The time switch motor 87a is also connected through the wire 88a to the coils 79a. The time coils are also connected to the pilot light 89a through the wire 90a. The pilot light 89a is also connected through the wire 91a to the coils 78a. The switch 92a is connected with the coil 53a by the wire 93a.

Hand operation of the machine for the purpose of setting up and for running the machine continuously, if desired, is obtained by depressing the switch marked "Hand" which opens the contacts 62a, 72a, 70a, 75a and closes the contacts 64a and 69a. This operation disconnects the automatic timing switch from the circuit and the machine can then be started by pressing the start switch 46a, closing the contacts 58a and 60a. The circuit then is completed as follows: L1 by the wire 54a through the solenoid 53a, wire 57a, start switch contacts 58a and 60a, wire 61a, hand switch contact 62a, wire 59a to L2, thereby energizing the coil 53a, closing switch 49a and thereby connecting L1, L2, and L3 with the motor terminals T1, T2, and T3 and also closing the switch 92a which locks up the coil 53a when starting button is released through the circuit L1, wire 54a, coil 53a, wire 93a, switch 92a, wire 66a, stop switch contacts 65a and 68a, wire 71a, automatic switches 69a and 64a, wire 63a, contact 62a and wire 59a to L2.

The motor is stopped by pressing the stop switch, thereby opening the contacts 65a and 68a, deenergizing the coil 53a and permitting the spring 50a to open the switches 49a and 92a.

Automatic operation is obtained by pressing the automatic side of the switch 47a which locks in either position and then starting the machine by pressing the start switch 46a. The circuit is then completed as follows: L1, by wire 54a through solenoid coil 53a, through wire 57a, start switch contacts 58a and 60a, wire 61a, contact 62a, wire 59a to L2, energizing the coil 53a and closing the switches 49a and 92a which connects L1, L2 and L3 through to the motor T1, T2, and T3. This circuit is locked up when the switch 92a is closed through the following circuit. L1, wire 54a, coil 53a, wire 93a, switch 92a, wire 66a, contacts 65a and 68a, wire 71a, contacts 70a and 75a, wire 76a, contact 77a, contact spring 98a, wire 73a, contacts 72a and 62a, wire 59a to L2.

After a predetermined travel of the conveyor chain 41, the limit switch 94a is mechanically engaged by a roller of the chain 36 setting down on the lever of the limit switch located at one point of the machine, closing the contacts 81a and 83a. The following circuit is then completed. L1, through wire 84a, contacts 83a and 81a, wire 82a, coils 79a and 78a, wire 80a to contact spring 74a, wire 73a, contacts 72a and 62a, wire 59a to L2, which energizes the coils 78a and 79a closing the armature 95a. The closing of this armature opens the contact 77a which interrupts the circuit described above and the deenergizing coil 53a, permitting the switches 49a and 92a to open thereby stopping the machine.

When the coils 78a and 79a are energized actuating the armature 95a while the contact 77a is open, the pawl 96a prevents the contact spring 97a from closing the contact 56a, although tension is applied to the spring 97a. The timing motor, being shunted around the coils 78a and 79a is also started by the closing of the limit switch contacts 81a and 83a. After a predetermined time the pawl 96a is operated by this timing motor and permits the flexed spring 97a to close the contact 56a, which again energizes the coil 53a and starts the motor through the following circuit: L1, through wire 54a, coil 53a, wire 55a, contact 56a, contact spring 97a, wire 73a, contacts 72a and 62a, wire 59a to L2. When the pawl 96a releases the spring 97a this spring also operates the spring 74a, opening the contact 85a and thereby stopping the timing motor 87a, circuit of which is previously described. When the machine starts, the limit switch 94a is mechanically actuated to open the contacts 81a and 83a by the roller 36a, being lifted off of the lever on the limit switch. This opens the circuit through the coils 78a and 79a, permitting the armature 95a to fall back, contacts 85a and 77a to close and contact to open. It is to be noted, however, that the contact 77a is permitted to close before the contact 56a opens as otherwise the holding circuit through the coil 53a would be momentarily interrupted and the switch 92a allowed to open before the contact 77a was again closed.

Continuous operation machine

Referring to Figure 9, it will be noted that the machine is similar to the machine heretofore described except being a continuous operation machine, the minor vertical movements for minor oscillation are carried out while the work pieces are being moved horizontally through the liquid in the tanks. For this purpose a cam 85 is provided on the shaft 65, the high points of the cam 86 being so arranged as to engage with the roller head 62 of the arms 61 to oscillate them while they are in the dwell between the walls 66 and 67 of the cam 64.

My machine is capable of continuous movement through the solutions in the tanks with coordi-

nated minor vertical movements of the articles being plated during the major horizontal continuous movement.

It is also capable of intermittent movement by which the articles being plated are brought to rest in the solution and, while at rest, have vertical minor movements to keep them from accumulating hydrogen bubbles.

My machine has the further advantage of having all the electrical apparatus which make the circuit contacts within the margins of the tank. The cathode rail is located over and between the side walls of the tank so that it is entirely removed from the operating mechanism carrying the carrier arms. This provides a reduction in not only the expense of installation but a marked reduction in the expense of operation.

It is a further object of my invention to provide for removal of hydrogen from all sides of the object by both vertical and horizontal movements, which are intermittently applied to the object. This insures equal plating on all sides of the object and produces an article of a quality not heretofore possible in the art.

Lubrication

It will be noted that the members **60** are tubular. By making them hollow, I am enabled to force lubricating grease in these tubes at one end and permit the grease to escape through ports where the bell crank lifter arms are located so as to lubricate all of these arms by a single act of lubrication. This confines the lubricant to the surfaces without the possibility of the lubricant getting into the contents of the tanks to contaminate the contents.

It will be understood that I desire to comprehend within my invention such modifications as may be necessary to adapt it to varying conditions and uses.

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

1. In combination, a tank, means for moving a plurality of suspended articles to and from the tank, means for quickly lowering and raising said articles with respect to said tank, and means acting on the lowering and raising means for intermittently moving said articles vertically while in the tank.

2. In combination, a tank, means for moving a plurality of suspended articles to and from the tank, means for quickly lowering and raising said articles with respect to said tank, means for intermittently moving said articles forward while in the tank, and means acting on the lowering and raising means for vertically moving said articles while in the tank.

3. In combination, a tank, means for continuously moving a plurality of articles with respect to said tank and simultaneously at intervals quickly raising and lowering said articles with respect to said tank, and means operating the first-named means during the continuous movement of the articles in the tank for moving them up and down without stopping their continuous horizontal movement through the tank.

4. In combination, a tank, carrier means to suspend, elevate, lower and transport horizontally articles to be immersed in the tank, elevating rotating cams, and elevating arms engaging said carrier means and operated by said cams, said cams having means to shift the elevating arms laterally.

5. In combination, a tank, carrier means to suspend, elevate, lower and transport horizontally articles to be immersed in the tank, an elevation cam, elevating arms engaging said carrier means on said cam, and means for vibrating said arms, carrier means and articles carried to vibrate the articles in a vertical plane while immersed.

6. In combination, a tank, carrier means for conveying articles to be immersed in the tank, supporting arms on said carrier means, bell crank lifting arms for said supporting arms, master rotating cams for actuating said lifting arms and shifting them laterally, and a common driving means for actuating said lifting cams to control the raising and lowering of the articles and for driving the carrier means to control the horizontal movement of the articles.

7. In combination, a tank, carrier means for conveying articles to be immersed in the tank, supporting arms on said carrier means, lifting arms for said supporting arms, master cams for actuating said lifting arms and shifting them laterally, a common driving means for actuating said lifting cams to control the raising and lowering of the articles and for driving the carrier means to control the horizontal movement of the articles, and means to intermittently move said carrier means.

8. In combination, a tank, carrier means for conveying articles to be immersed in the tank, supporting arms on said carrier means, lifting arms for said supporting arms, a master cam for actuating said lifting arms, a common driving means for actuating said lifting cam to control the raising and lowering of the articles and for driving the carrier means to control the horizontal movement of the articles, means to intermittently move said carrier means, and means while the carrier means is at rest for vibrating said arms and the articles carried thereby.

9. In combination, a tank, carrier means for conveying articles to be immersed in the tank, supporting arms on said carrier means, lifting arms for said supporting arms, a master cam for actuating said lifting arms, a common driving means for actuating said lifting cam to control the raising and lowering of the articles and for driving the carrier means to control the horizontal movement of the articles, means to intermittently move said carrier means, and means of shifting said elevating arms in synchronism with said cam whereby, as the arms are successively presented by the carrier, the lifter arms will be in position to engage with the carrier arms, travel with them a predetermined distance and return after having performed the lifting and lowering operation on the arms.

10. In combination, a tank, a carrier, arms pivoted on the carrier, articles suspended from the end of the arms, lifter arms for said carrier arms, a cam, means for actuating said lifter arms at intervals, and means for laterally shifting said lifter arms so that they will travel with the lifter arms during the lifting and lowering operations and then be returned to their initial positions for reengagement with a new arm.

11. In combination, a tank, a carrier, arms pivoted on the carrier, articles suspended from the end of the arms, lifter arms for said carrier arms, a cam, means for actuating said lifter arms at intervals, and means for laterally shifting said lifter arms so that they will travel with the lifter arms during the lifting and lowering operations and then be returned to their initial positions for reengagement with a new arm, and means for imparting minor vertical movements to the car-

rier arms and the articles carried while the lifter arms are inoperative.

12. In combination, a tank, a carrier, arms pivoted on the carrier, articles suspended from the end of the arms, lifter arms for said carrier arms, a cam, means for actuating said lifter arms at intervals, means for laterally shifting said lifter arms so that they will travel with the lifter arms during the lifting and lowering operations and then be returned to their initial positions for reengagement with a new arm, and means for imparting minor vertical movements to the carrier arms and the articles carried while the lifter arms are inoperative, said means being independently operated with respect to the operation of said lifting cam means.

13. In combination, a tank, a carrier, arms pivoted on the carrier, articles suspended from the end of the arms, lifter arms for said carrier arms, a cam, means on the cam for actuating said lifter arms at intervals, means for laterally shifting said lifter arms so that they will travel with the carrier arms during the lifting and lowering operations and then be returned to their initial positions for reengagement with a new arm, and means for imparting minor vertical movements to the carrier arms and the articles carried while the lifter arms are inoperative, said means being independently operated with respect to the operation of said lifting cam means, and means for bringing said lifting cam means and carrier means to rest while the carrier arms and articles carried thereby have minor movements vertically imparted to them.

14. In combination, a tank, continuously driving means, cam means driven thereby, lifter arms rocked by said cam means and shifted laterally thereby to travel with carrier arms, a carrier chain, carrier arms pivoted thereon engageable by said lifter arms and independently driven means for imparting minor vibratory movements to said lifter arms to vibrate the carrier arms and the articles carried thereby while immersed in a solution carried by the tank.

15. In combination, an intermittently operating driving means, cam means operated thereby, carrier lifter arms oscillated by said cam means and laterally shifted thereby, carrier arms, a carrier chain pivotally supporting said arms, and means for vibrating said lifter arms, carrier arms and articles carried thereby while the parts are at rest.

16. In combination, a continuously operating driving means, cam elevating means, cam lifter arms operated thereby for oscillation and lateral shifting, a carrier, carrier arms pivoted thereto engageable by said lifter arms, and means driven by said continuously driven operated means timed to vibrate said lifter arms, carrier arms and articles carried thereby while the articles are immersed in the tank.

17. In combination, a central frame having a longitudinally disposed main driving shaft, a chain on said frame driven thereby, an annular guide track on said frame adapted to guide said chain, carrier arms suspended from said chain, an annular guide track for said arms so suspended adapted to maintain said chain in its track, and means on the shaft for intermittently raising, lowering and shifting said arms laterally.

18. In combination, a central frame having a longitudinally disposed main driving shaft chain on said frame driven thereby, an annular guide track on said frame adapted to guide said chain, carrier arms suspended from said chain, an annular guide track for said arms so suspended adapted to maintain said chain in its track, means operated by said chain, driving means for intermittently raising and lowering said arms, and means associated with said frame for vibrating said arms while in their lowered position.

19. In combination, a frame, tanks associated with the side of said frame, a longitudinally disposed driving means in said frame, a chain over said driving means mounted on the frame in a track and driven by said driving means, arms pivoted on said chain, a corresponding track for supporting said arms and supporting the chain in its track, a plurality of lifter plates pivotally mounted on said frame adapted to successively engage said carrier arms and to travel with them while lifted a predetermined distance, and means on said driving means for actuating said lifter arms at intervals and shifting them laterally.

20. In combination, a frame, tanks associated with the side of said frame, a longitudinally disposed driving means in said frame, a chain over said driving means mounted on the frame in a track and driven by said driving means, arms pivoted on said chain, a corresponding track for supporting said arms and supporting the chain in its track, a plurality of lifter plates pivotally mounted on said frame adapted to successively engage said carrier arms and to travel with them while lifted a predetermined distance, means on said driving means for actuating said lifter arms at intervals and shifting them laterally, and means on said carrier arms comprising an arm and a roller adapted to engage with the face of said lifter plates.

21. In combination, a central frame, an annular series of tanks surrounding said frame, an annular chain traveling in a track on the top of said frame, a plurality of carrier arms mounted thereon having rollers, a second track for supporting said rollers and supporting the chain in its track, roller arms connected to said carrier arms, a plurality of spaced lifter plates and bell cranks supporting the plates adapted to engage with said rollers in succession, a driving shaft in said frame, cams in said driving shaft engageable with said bell cranks for oscillation and lateral shifting, and means for driving said driving means driving the cams and for synchronously driving the chain.

22. In combination, a central frame, an annular series of tanks surrounding said frame, an annular chain traveling in a track on the top of said frame, a plurality of carrier arms mounted thereon having rollers, a second track for supporting said rollers and supporting the chain in its track, roller arms connected to said carrier arms, a plurality of spaced lifter plates and bell cranks supporting the plates adapted to engage with said rollers in succession, a driving shaft in said frame, cams in said driving shaft engageable with said bell cranks for oscillation and lateral shifting, means for driving said driving means driving the cams and for synchronously driving the chain intermittently, and means during the intermittent rest periods while the driving means is at rest for vibrating the bell cranks, carrier arms and articles carried thereby when immersed in the tanks.

23. In combination, a frame, a driving means, a longitudinally disposed driven shaft, a plurality of spaced cams thereon, spaced supports adjacent said cams, bell crank lifter arms slidably and rotatably mounted on said supports and

engageable by said cams for oscillation and lateral shifting, a chain mounted on the top of said frame, carrier arms mounted on said chain, track means for supporting said chain and arms, means on said arms for engaging said bell crank lifter arms in succession, a motor mounted on top of said frame, a vibrating cam driven thereby located between pairs of said lifter arms and adapted to engage said lifter arms while they are engaged by the carrier arms and the carrier arms are in their lowered position with the articles supported thereby in the tank.

24. In combination, a frame, a driving means, a longitudinally disposed driven shaft, a plurality of spaced cams thereon, spaced supports adjacent said cams, bell crank lifter arms slidably and rotatably mounted on said supports and engageable by said cams for oscillation and lateral shifting, a chain mounted on the top of said frame, carrier arms mounted on said chain, track means for supporting said chain and arms, means on said arms for engaging said bell crank lifter arms in succession, a motor mounted on top of said frame, a vibrating cam driven thereby located between pairs of said lifter arms and adapted to engage said lifter arms while they are engaged by the carrier arms and the carrier arms are in their lowered position with the articles supported thereby in the tank, and means for bringing to rest said chain and carrier arms while they are being so vibrated.

25. In combination, a tank, means for moving a plurality of suspended articles to and from the tank, means for lowering and raising said articles with respect to said tank, and means acting on the lowering and raising means for intermittently moving said articles vertically while in the tank.

26. In combination, a tank, means for moving a plurality of suspended articles to and from the tank, means for lowering and raising said articles with respect to said tank, means for intermittently moving said articles forward while in the tank, and means acting on the lowering and raising means for vertically moving said articles while in the tanks.

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