Dec. 23, 1924. 1,520,676

H. K. KOPPIN

RIM PLATING MACHINE

Filed June 25, 1923 2 Sheets-Sheet 1

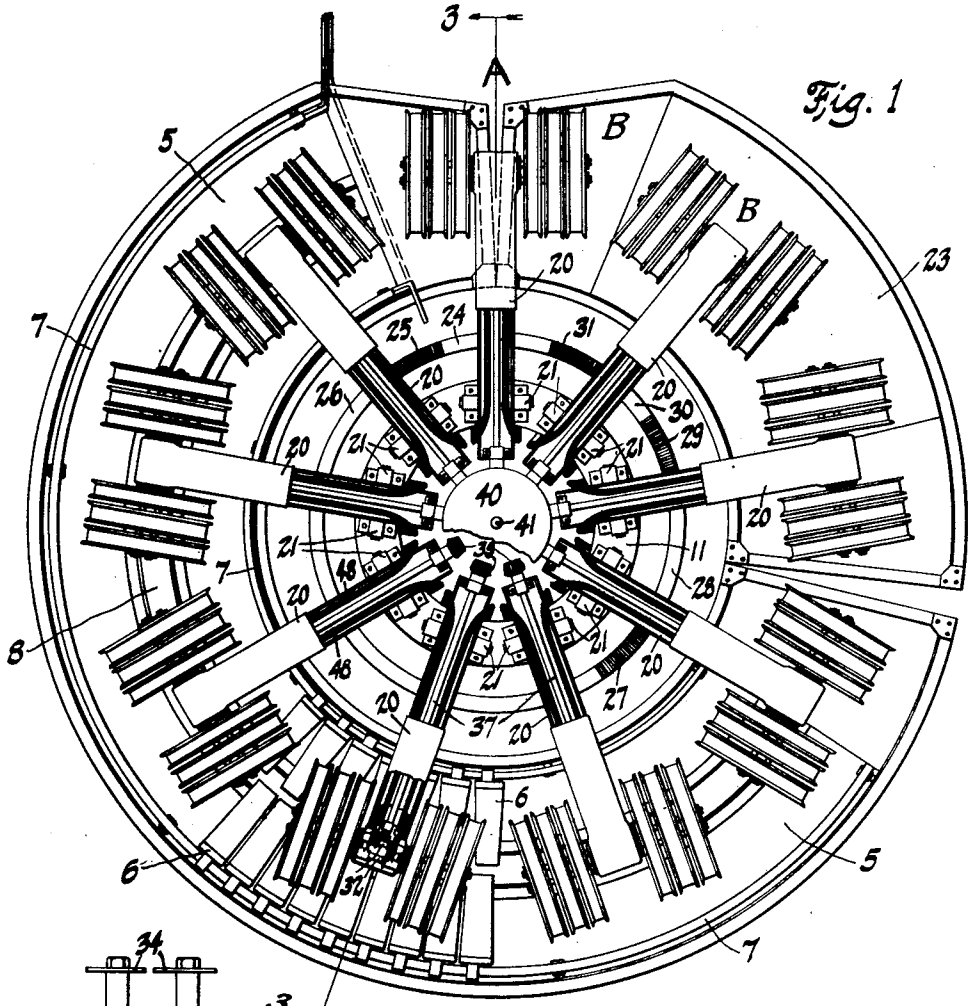


Fig. 1

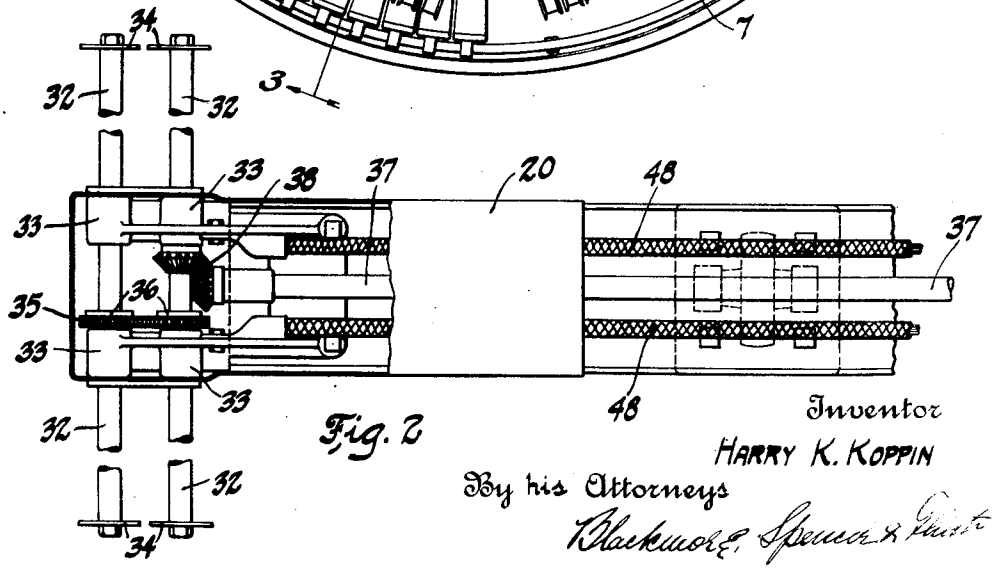


Fig. 2

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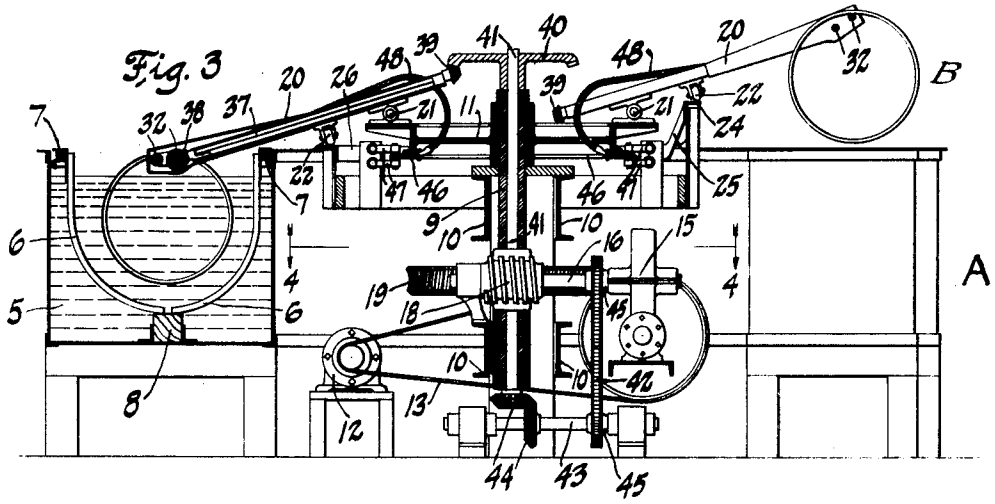
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Fig. 3



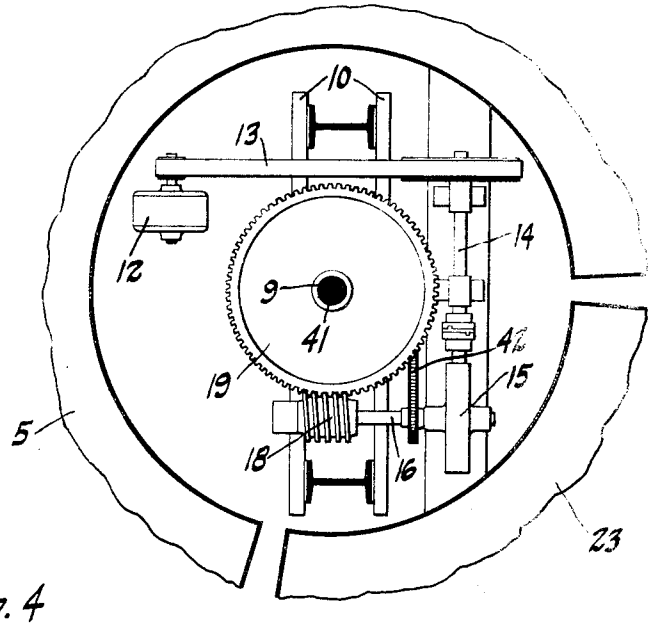


Fig. 4

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Patented Dec. 23, 1924. 1,520,676

UNITED STATES PATENT OFFICE.

HARRY K. KOPPIN, OF JACKSON, MICHIGAN, ASSIGNOR TO GENERAL MOTORS CORPORATION, OF DETROIT, MICHIGAN, A CORPORATION OF DELAWARE.

RIM-PLATING MACHINE.

Application filed June 25, 1923. Serial No. 647,589.

To all whom it may concern:

Be it known that I, HARRY K. KOPPIN, a citizen of the United States, and a resident of Jackson, county of Jackson, and State of Michigan, have invented certain new and useful Improvements in Rim-Plating Machines, of which the following is a full, clear, concise, and exact description, such as will enable others skilled in the art to which the invention relates to make and use the same, reference being made therein to the accompanying drawings, which form a part of this specification.

My invention relates to electro-plating machines or devices and the principal object thereof is to provide an electro-plating machine of simple construction and compact arrangement of the constituent parts which make up the same; and to provide an electro-plating machine especially adapted for the plating of annular articles, such as the rims, felly bands, tire retaining rings, etc., used in and forming parts of wheels for automobiles, motor driven trucks, and similar vehicles.

My invention, however, is in no sense limited to use with or for the plating of any particular article or device and, while the particular form thereof illustrated and hereinafter described is designed to plate annular or ring-like articles similar in form to those enumerated, various features of my invention are useful, generally, in electro-plating machines and devices, irrespective of the character of the articles designed to be operated upon.

The drawings accompanying and forming a part of this specification illustrate what I now regard as the preferred and best particular form of my invention; although the same may be embodied in various other forms all of which, so long as they come within the scope of the concluding claims wherein the features wherein my invention consists are particularly pointed out, are regarded as included in and as forming a part of my invention.

Referring now to the drawings wherein my invention is illustrated upon a small scale, and wherein like reference numerals indicate the same elements, features and parts in the several views:

Figure 1 is a view showing my improved electro-plating machine in plan, and broken away in part to better show features otherwise hidden by overlying parts of the machine.

Figure 2 is a fragmentary view upon a scale about four times that of the other views showing certain features of one of several work carrying devices or levers with which the machine is equipped.

Figure 3 is a view showing a section upon a vertical central plane indicated, approximately, by the line 3—3, Figure 1.

Figure 4 is a fragmentary view upon a horizontal plane indicated by the line 4—4, Figure 3; this view being particularly to show the driving mechanism which, inasmuch as it lies beneath other and in fact the principal parts of the machine, could not be shown at all clearly in Figure 1.

In the drawings, the reference numeral 5 designates a tank adapted to contain a plating solution suitable for use in plating with the metal to be plated on or deposited in each particular case, and 6 designates the anodes; which are of copper, zinc, nickel, etc., according to the metal to be deposited upon the articles being plated in each particular case. Only a few of these anodes are shown, although they are commonly arranged close alongside one another throughout a considerable part of if not in fact throughout the whole length of the plating tank. They are preferably of curved form when wheel fellies, rims or rings are to be plated, as shown in Figure 3, and have hooks at their upper ends for suspending them from bus bars 7 arranged upon opposite sides of and extending along the length of the tank and rest at their lower ends upon a sill 8 upon the bottom of and extending throughout the length of the tank or substantially so; the same being preferably made up of a plurality of wooden blocks held between angle iron bars fastened to the bottom wall of the tank. The bus bars are insulated from the tank, which is built up from metal plates and is a large and massive structure; and both bars are connected with the positive terminal of a dynamo designed to produce a current of exceeding large volume but of an electro-motive force of a few volts only, as will be appreciated by those skilled in the electro-plating art to which my invention relates.

The plating tank 5 is shown as curved in.

form and concentric, or substantially so, with a vertical axis and with a rotatable hollow shaft 9 which is properly supported as by channel iron frame bars or members 10; although it may be otherwise supported as it is immaterial in what way, or by what particular means the said shaft is supported in its upright and substantially vertical position. This hollow shaft has a horizontally arranged annular member 11 secured upon its upper end, which I call a "carrier" because it supports and carries the principal elements of the machine or at least a considerable proportion of them. This carrier is fast upon the hollow shaft 9; and the latter is shown as driven from an electric motor 12 through a belt 13 and pulley upon a shaft 14, suitable worm gearing at 15 and a shaft 16, and a worm 18 which meshes with and drives a worm gear 19 which is fast upon the said shaft 9. The speed reduction through the driving train above traced is extreme, and the carrier 11 rotates quite slowly; the articles to be plated carried by the carrier, and moved through the plating solution in the tank 5 as will hereinafter appear, requiring in a typical case something like three or four minutes for their journey or passage through the tank. This rate of travel, however, may be varied within comparatively wide limits, and will be determined in each particular case by the character of the plating operation for which the machine is to be used.

Carried by the carrier 11 are a plurality of what I call "work carrying devices" because they serve as mediate supports for articles being plated while said articles are being moved along the tank suspended in the plating solution and between the anodes. These work carrying devices are shown as hollow oscillating levers 20; the number thereof used obviously varying with the size of the machine and said levers being pivotally supported from the carrier at points 21 intermediate their length. These levers are shown as having rollers 22 upon their under sides and located between their free outer ends and their points of pivotal support; which rollers run along the upper side of a stationary cam member which is annular in form and surrounds the carrier 11, and has alternate high and low portions which cause the free outer ends of the levers to move up and down as they are carried along by the rotation of the shaft 9 and of the carrier.

Although my invention in its broader aspect includes a machine having one tank only, two tanks are preferred and the machine illustrated is one having two such tanks; the second tank being designated by the numeral 23, and the same being separated from the tank 5 by short gaps at one of which a loading station —A— is located. This second tank may be a plating tank; but in the machine illustrated it is a washing tank containing clean water, and consequently has no anodes in it.

Reverting now to the stationary cam above mentioned, and referring particularly to Figure 1 of the drawing, the portion 24 of this cam is a high portion whereat the levers are held inclined upwardly, as shown at the right hand side of Figure 3. Then as the carrier 11 rotates in a counterclockwise direction the rollers 22 run down an incline 25 and onto a low portion 26, along which they move while the free ends of the levers 20 move along and over and throughout approximately the whole length of the main plating tank 5. This downward swinging movement of the levers dips articles to be plated suspended from their free ends, as will hereinafter appear, into the plating solution in the tank, and the continued rotary movement of the carrier moves the articles along the tank and through the plating solution therein, as will be understood.

At the end of the low portion 26 is an incline 27 up which the rollers run onto a high part 28 along which they run while the free ends of the levers are moving from above the end of the tank 5 to a position over the beginning of the second or wash water tank 23, the articles being plated having been lifted from the plating tank as the rollers run up the incline 27 as will be appreciated; whereupon and as the carrier continues its movement the rollers run down an incline 29 and dip the things being plated into the liquid within the washing tank 23. This tank is comparatively short, and the articles being plated remain therein only while the rollers move along a short low portion 30 of the cam; whereupon they are lifted from the tank as the rollers move up the incline 31 and onto the high portion 24 assumed as a starting point in the above explanation. While each separate lever is moving over the high portion 24 of the cam and occupies substantially the position indicated at the right hand side of Figure 3 an attendant at the loading station —A— removes the plated rims —B— therefrom and replaces them with rims to be plated during their passage through the machine in the cycle above explained.

The rims, fellies, rings, or other articles being plated may be suspended from the work carrying devices or levers 20 as they move along and through the tank or tanks in various ways (determined frequently by the character of the devices being plated) and by various devices. In defining my invention in its broader aspect I refer to these immediate supporting elements merely as "work supporting members"; which members in the machine illustrated and ex-

plained herein take the form of transversely extending rotatable shafts one or two of which are supported in suitable bearings carried by and located adjacent the free end of each of said levers. These transverse shafts are all designated by the reference numeral 32, as all perform one and the same function of supporting the articles being plated as they move through the solutions in the tanks of the machine. They preferably extend to each side of the levers, as shown particularly in Figures 1 and 2, and are rotatable in bearings 33 carried by said levers; and are provided with discs 34 at their free ends to keep the rims from slipping off.

The shafts 32 are shown as connected so as to rotate in unison in one direction by a sprocket chain 35 extending about sprocket wheels 36 fast upon the shafts; and both shafts are driven by rotatable driving shafts 37 supported in bearings carried by the levers, which last mentioned shafts are operatively connected with the shafts 32 through bevel gearings 38. These shafts 37 are provided each with a pinion 39 at its inner end; and these pinions mesh with a single central driving gear 40 when the rollers 22 are running along the low parts of the lever operating cam and the levers are in their low positions with the articles being plated suspended in the liquids in the tanks, but are out of mesh with said driving gear when the rollers are upon the high portions of the cam; all as best shown in Figure 3 of the drawing.

The gear 40 is fast upon the upper end of a rotatable driving shaft 41 which extends through the hollow shaft 9 and is driven from the shaft 16 through a sprocket chain 42, a second shaft 43, bevel gearing 44, and sprocket wheels 45 upon the shafts 16 and 43 in the particular driving mechanism illustrated; the shafts 9 and 41 being thus driven in unison from the motor 12 as a source of power for driving the entire machine, as will be understood.

It therefore follows that the wheel rims because of their frictional engagement with the supporting shafts 32 are rolled like hoops when the pinions 39 are in mesh with the gear 40, which is when they are passing through the plating and washing tanks; thus submerging every part of their peripheries to the liquids in said tanks and insuring uniformity in the film of metal deposited upon them and preventing the formation of gas pockets which might prevent proper contact of the plating solution with the rims. The use of two transverse supporting shafts 32 at the end of each lever provides two spaced points of support when the rims are in the plating and washing solutions and traversing the tanks, which reduces the electrical resistance of the suspending mechanism and prevents sidewise swinging of the rims at such times; and also secures the suspending of the rims upon one shaft only when they are lifted from the washing tank and are at the loading station, thereby rendering the removal of plated rims and their replacement by unplated rims somewhat easier than would otherwise be the case. The gear ratio is such that the shafts 32 are driven at a comparatively high speed; although the rims, because of their lengthy peripheries as compared with the circumference of the rods and the unavoidable slipping due to wetness of the parts, are rolled quite slowly; some three or four rotations of the rims while they are traversing the plating tank being secured in the machine herein described and ordinarily sufficient to secure a uniform and proper deposit of the plating film.

The rims as will be appreciated are electrically connected with the negative terminal of the dynamo which supplies current to the machine to which end the rotatable carrier 11 is provided with a collecting ring 46 which moves in rubbing contact with terminals or brushes 47 to which the supply cable leading from the dynamo is connected. From the ring the current flows through cables 48 carried by the levers and extending along the same, the inner ends of said cables being connected with the ring and the outer ends with the bearings 33 whereby the shafts 32 are supported; and then through the articles being plated and the solution in the plating tank, and to the bus bars 7 and back to the dynamo; which is not shown as any suitable dynamo may be used. Two supply cables are shown as associated with each lever and pair of work supporting rods because of the large current flowing through the rods and rims, several hundred amperes as a matter of fact as regards each pair of rim supporting shafts when the machine is in use.

Having thus described and explained my invention, I claim and desire to secure by Letters Patent:

1. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; a movable carrier, and means for moving the same; a plurality of work carrying devices supported by said carrier and movable relative thereto, and having each a work supporting member arranged to move along and over said tank and adapted to suspend an article to be plated; and means for moving said work carrying devices up and down to thereby dip articles suspended by said work supporting members into and to remove them from said tank.

2. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; a movable carrier, and means for moving the same, a plurality of

levers pivotally supported by said carrier and the free ends of which are arranged over said tank, said levers having each a work supporting member at its free end adapted to suspend an article to be plated; means for moving said levers to thereby cause their free ends to move up and down, to thereby dip articles suspended by said work supporting members into and to remove them from said tank; and supply conductors extending along each of said levers, and through which current is supplied to said work supporting members.

3. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; a rotatable carrier, and means for rotating the same; a plurality of work carrying devices supported by said carrier and movable relative thereto, and having each a work supporting member adapted to suspend an article to be plated; and means for moving said work carrying devices so as to dip articles suspended by said work supporting members into and to remove them from said tank.

4. In an electro-plating machine of the class described, a curved tank adapted to contain a plating solution; a carrier rotatable about a vertical axis, and means for rotating said carrier; a plurality of work carrying devices supported by said carrier and movable relative thereto, and having each a work supporting member adapted to suspend an article to be plated; and means for moving said work carrying devices up and down to thereby dip articles suspended by said work supporting members into and to remove them from said tank.

5. In an electro-plating machine of the class described, a plurality of tanks arranged about a central vertical axis; a carrier rotatable about said axis, and means for rotating said carrier; a plurality of work carrying devices supported by said rotatable carrier and movable relative thereto, and having each a work supporting member adapted to suspend an article to be plated; and means for moving said work carrying devices up and down to thereby dip articles suspended by said work supporting members first into one and afterwards into another of said tanks, as said carrier is rotated as aforesaid.

6. In an electro-plating machine of the class described, a curved tank adapted to contain a plating solution; a carrier rotatable about a vertical axis disposed adjacent said tank, and means for rotating said carrier; a plurality of radially arranged oscillating levers pivotally supported upon said carrier, and movable in substantially vertical planes; work supporting members located at the outer free ends of said levers and adapted to suspend articles to be plated; and an annular stationary cam member surrounding said carrier and operatively associated with said levers and adapted to produce up and down movement of the free ends thereof, to thereby dip articles suspended by said work supporting members into and to lift them from said tank.

7. In an electro-plating machine of the class described, a curved tank adapted to contain a plating solution; a carrier rotatable about a vertical axis disposed adjacent said tank, and means for rotating said carrier; a collector ring carried by said carrier; a plurality of radially arranged oscillating levers pivotally supported upon said carrier, and movable in substantially vertical planes; work supporting members located at the outer free ends of said levers and adapted to suspend articles to be plated; means for moving said levers up and down to thereby dip articles suspended by said work supporting members into and to lift them from said tank; and a plurality of supply conductors the inner ends of which are connected with the collecting ring, and which supply conductors extend along the levers aforesaid and are connected at their outer ends with said work supporting members.

8. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a central vertical axis; a carrier rotatable about said axis, and means for rotating said carrier; a plurality of radially arranged oscillating levers pivotally supported upon said carrier, and movable about their pivotal supports in substantially vertical planes; work supporting members located at the outer free ends of said levers and adapted to suspend articles to be plated; and an annular cam member operatively associated with said levers and adapted to cause upward and downward movement of the free ends thereof, to thereby dip articles suspended by said work supporting members first into one and afterward into another of said tanks, as said carrier is rotated as aforesaid.

9. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a central vertical axis; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; a plurality of radially arranged levers pivotally supported upon said carrier and movable about their pivotal supports in substantially vertical planes, and the outer free ends of which levers move over the tanks aforesaid; work supporting members carried by and located one at the outer end of each of said levers, and which members are adapted to suspend articles to be plated; and an annular stationary cam member surrounding said carrier and having alternate high and low portions with which said levers engage between

their free ends and their points of pivotal support, and whereby the free outer ends of said levers are caused to move up and down to thereby dip articles suspended by said work supporting members first into one and then into another of said tanks, as said carrier is rotated as aforesaid.

10. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; a movable work carrying device disposed adjacent said tank; a rotatable work supporting member carried by said work carrying device; means for moving said work carrying device so as to dip an article suspended by said work supporting member into, and to lift it from said tank; and means for rotating said work supporting member to thereby roll an annular article to be plated suspended by said work supporting member while said article is in the solution contained in said tank.

11. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; a work carrying device movable relative to said tank; a rotatable work supporting member carried by said work carrying device; means for moving said work carrying device up and down to thereby dip an article suspended by said work supporting member into, and to lift it from said tank; and means for rotating said work supporting member to thereby roll an annular article to be plated suspended by said work supporting member while said article is in the solution contained in said tank.

12. In an electro-plating machine of the class described; a plurality of tanks arranged in circular series about a central vertical axis; a horizontally disposed annular carrier rotatable about said axis, and means for rotating said carrier; a collector ring carried by said carrier; a plurality of radially arranged oscillating levers pivotally supported upon said carrier, and movable about their pivotal supports in substantially vertical planes; work supporting members located at the outer free ends of said levers and adapted to suspend articles to be plated; cam mechanism operatively associated with said levers and adapted to move them up and down, to thereby dip articles suspended by said work supporting members first into one and afterwards into another of said tanks, as said carrier is rotated as aforesaid; and a plurality of supply conductors, the inner ends of which are connected to said collector ring, and which conductors extend along said levers and are connected at their outer ends to said work supporting members.

13. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; a work carrying device movable relative to said tank; a rotatable work supporting member carried by said work carrying device; means for moving said work carrying device up and down to thereby dip an article suspended by said work supporting member into, and to lift it from said tank; and intermittently operating driving means adapted to rotate said work supporting member when said work carrying device is in its lowermost position, and to cease to drive said member when said device is in its uppermost position.

14. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; an oscillating work carrying lever movable relative to said tank; a rotatable work supporting shaft located adjacent the free end of said lever and extending transverse thereto; means for moving said work carrying lever up and down to thereby dip an article suspended by said work supporting shaft into, and to lift it from said tank; a driving shaft extending along said lever and operatively connected with said transverse shaft to thereby drive the same; and a supply conductor extending along said lever and the outer end of which is connected with said transverse shaft.

15. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; an oscillating work carrying lever movable relative to said tank; a rotatable work supporting shaft located adjacent the free end of said lever and extending transverse thereto; means for moving said work carrying lever up and down to thereby dip an article suspended by said work supporting shaft into, and to lift it from said tank; and a driving shaft extending along said lever and operatively connected with said transverse shaft to thereby drive the same, and to roll an annular article to be plated suspended by said transverse shaft.

16. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; an oscillating work carrying lever movable relative to said tank; two rotatable work supporting shafts located adjacent the free end of said lever and arranged parallel with one another, and transverse to said lever; means for moving said work carrying lever up and down to thereby dip an article suspended by said work supporting shafts into and to lift it from said tank; and intermittently operating driving means adapted to rotate said work supporting shafts when said lever is in its lowermost position, with an article to be plated suspended from said shafts within the liquid in said tank, and to cease to drive said member when said lever is in its uppermost position.

17. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; an oscillating work carry-

ing lever movable relative to said tank; two rotatable work supporting shafts located adjacent the free end of said lever and arranged parallel with one another, and transverse to said lever; means for moving said work carrying lever up and down to thereby dip an article suspended by said work supporting shafts into and to lift it from said tank; a driving shaft carried by said lever and adapted to drive both said work supporting shafts; a pinion carried by said driving shaft; and a driving gear with which said pinion engages when said lever is in its lowermost position, but not when said lever is in its uppermost position with an article to be plated suspended up and above the liquid in said tank.

18. In an electro-plating machine of the class described, a tank adapted to contain a plating solution; a carrier rotatable about a vertical axis disposed adjacent said tank, and means for rotating said carrier; a plurality of work carrying devices supported by said carrier and movable relative thereto, and having each a rotatable work supporting member adapted to suspend an article to be plated; means for rotating said work supporting members to thereby roll articles to be plated suspended by them; and means for moving said work carrying devices to thereby dip articles suspended by said work supporting members into and to remove them from said tank.

19. In an electro-plating machine of the class described, a curved tank adapted to contain a plating solution; a carrier rotatable about a vertical axis located adjacent said tank, and means for rotating said carrier; a plurality of radially arranged oscillating levers pivotally supported upon said carrier, and the outer ends of which travel over said tank; rotatable work supporting members located at the outer free ends of said levers and adapted to suspend articles to be plated; means carried by said levers for rotating said work supporting members to thereby roll articles to be plated suspended by them; and means operatively associated with said levers for moving their free outer ends up and down, to thereby dip articles suspended by said work supporting members into and to remove them from said tank.

20. In an electro-plating machine of the class described, a tank curved relative to a vertical central axis and adapted to contain a plating solution; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; a plurality of radially arranged levers pivotally supported upon said carrier, and movable about their pivotal supports in substantially vertical planes; laterally extending rotatable work supporting members located at the outer ends of said levers and adapted to suspend articles to be plated; a plurality of shafts associated with and extending one along each of said levers, and the outer ends of which are operatively connected with said work supporting members; a single centrally arranged driving member adapted to rotate all of said shafts; and means associated with said levers for moving their free outer ends up and down, to thereby dip articles suspended by said work supporting members into and to remove them from said tank.

21. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a central vertical axis; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; a plurality of work carrying devices supported by said rotatable carrier and movable relative thereto, and having each a rotatable work supporting member adapted to suspend an article to be plated; means for rotating said work supporting members to thereby roll annular articles to be plated suspended by them; and means for moving said work carrying devices up and down to thereby dip articles suspended by said work supporting members first into one and afterward into another of said tanks, as said carrier is rotated as aforesaid.

22. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a central vertical axis; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; a plurality of radially arranged levers pivotally supported upon said carrier, and movable about their pivotal supports in substantially vertical planes; rotatable work supporting members located at the outer free ends of said levers and adapted to suspend articles to be plated; means carried by said levers for rotating said work supporting members to thereby roll annular articles to be plated suspended by them; and means operatively associated with said levers for moving their free outer ends up and down to thereby dip articles suspended by said work supporting members first into one and afterward into another of said tanks, as said carrier is rotated as aforesaid.

23. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a central vertical axis; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; a plurality of radially arranged levers pivotally supported upon said carrier, and movable about their pivotal supports in substantially vertical planes; laterally extending rotatable work supporting members located at the outer ends of said levers and adapted to suspend articles to be plated; a plurality of shafts

supported by and extending one along each of said levers, and the outer ends of which are operatively connected with said work supporting members; a single centrally arranged driving member adapted to rotate all of said shafts; and means operatively associated with said levers for moving their free outer ends up and down to thereby dip articles suspended by said work supporting members first into one and afterward into another of said tanks, as said carrier is rotated as aforesaid.

24. In an electro-plating machine of the class described, a tank curved relative to a central vertical axis and adapted to contain a plating solution; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; a plurality of radially arranged levers pivotally supported upon said carrier, and movable about their pivotal supports in substantially vertical planes; laterally extending rotatable work supporting members located at the outer ends of said levers and adapted to suspend articles to be plated; a plurality of shafts carried by and extending one along each of said levers, and the outer ends of which are operatively connected with said work supporting members; pinions one upon the inner end of each of said shafts; a centrally arranged driving gear adapted to drive all of said shafts; means for rotating said gear; and a stationary cam surrounding said carrier and having alternate high and low portions adapted to engage said levers between their free outer ends and the points of pivotal support aforesaid to thereby move said outer ends up and down, and said pinions into and out of mesh with said driving gear.

25. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a central vertical axis; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; a plurality of radially arranged levers pivotally supported upon said carrier, and movable about their pivotal supports in substantially vertical planes; laterally extending rotatable work supporting members located at the outer ends of said levers and adapted to suspend articles to be plated; a plurality of shafts supported by and extending one along each of said levers, and the outer ends of which are operatively connected with said work supporting members; pinions secured one to the inner end of each of said shafts; a centrally arranged driving gear adapted to drive all of said shafts; means for rotating said gear; and a stationary cam surrounding said carrier and having a plurality of high and a plurality of low portions with which portions of said levers between their outer ends and their points of pivotal support engage, whereby said outer ends are moved up and down and said pinions are moved into and out of mesh with said driving gear.

26. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a rotatable vertically arranged hollow shaft; a horizontally arranged carrier secured to the upper end of said hollow shaft; a plurality of radially arranged oscillating levers pivotally supported upon said carrier, and movable about their points of pivotal support in substantially vertical planes; rotatable work supporting members located at the outer ends of said arms and adapted to suspend articles to be plated; a plurality of shafts supported by and extending one along each of said levers, and the outer ends of which are operatively connected with said work supporting members to drive the same; pinions secured one to the inner end of each of said shafts; a rotatable shaft extending through said hollow shaft, and having a gear at its upper end adapted to engage the pinions upon and to drive the shafts carried by the levers as aforesaid; a stationary cam surrounding said carrier and having alternate high and low portions which engage said levers between their outer ends and their points of pivotal support and whereby said levers are caused to swing up and down, and the pinions aforesaid to engage with and to move out of engagement with the gear aforesaid; and means for driving said vertically arranged hollow shaft and the shaft aforesaid within the same in unison.

27. In an electro-plating machine of the class described, a tank curved relative to a central vertical axis and adapted to contain a plating solution; a horizontally arranged carrier rotatable about said axis, and means for rotating said carrier; an annular collecting ring carried by said carrier; a plurality of radially arranged oscillating levers pivotally supported upon said carrier; rotatable work supporting members located at the outer ends of said levers and adapted to suspend articles to be plated; a plurality of shafts carried by and extending one along each of said levers, the outer ends of which are operatively connected with said work supporting members to drive the same; pinions upon the inner ends of said shafts; a centrally arranged driving gear adapted to drive all of said shafts, and means for driving said driving gear; a stationary cam surrounding said carrier and having alternate high and low portions adapted to engage said levers and swing them about their points of pivotal support; a plurality of supply conductors, the inner ends of which are connected with said collecting ring, and which conductors extend along said levers and are connected

at their outer ends to said work supporting members.

28. In an electro-plating machine of the class described, a plurality of tanks arranged in circular series about a rotatable vertical arranged hollow shaft; a horizontally arranged annular carrier secured to the upper ends of said hollow shaft; a collector ring secured to said carrier and movable therewith; a plurality of radially arranged oscillating levers pivotally supported upon said carrier; rotatable work supporting members located at the outer ends of said arms and adapted to suspend articles to be plated; a plurality of shafts supported by and extending one along each of said levers, and the outer ends of which are operatively connected with said work supporting members to drive the same; pinions secured one to the inner end of each of said shafts; a rotatable shaft extending through said hollow shaft, and having a gear at its upper end adapted to engage the pinions upon and to drive the shafts carried by the levers as aforesaid; a stationary cam surrounding said carrier and having alternate high and low portions which engage said levers intermediate their free outer ends and their points of pivotal support, and whereby said levers are caused to swing up and down, and the pinions aforesaid to engage with and to move out of engagement with said driving gear; means for driving said vertically arranged hollow shaft and the shaft aforesaid within the same in unison; and a plurality of supply conductors associated one with each of said levers and extending along the same, the inner ends of said conductors being connected with said collector ring and the outer ends with said rotatable work supporting members.

In testimony whereof I affix my signature.

HARRY K. KOPPIN.