May 10, 1949. N. H. MAGEOCH 2,469,470

PLATING MACHINE

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FIG. 5

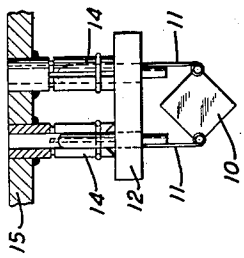
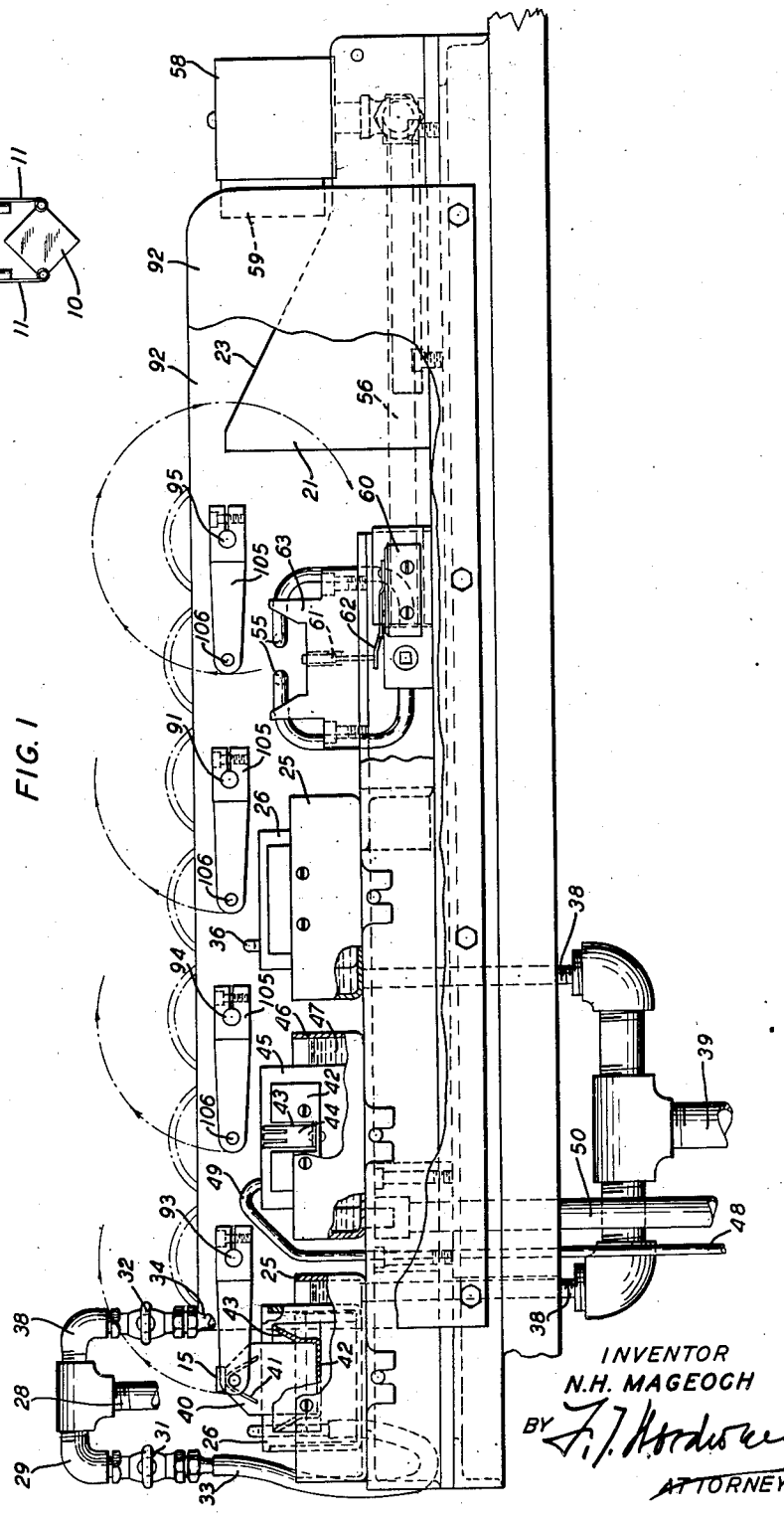


FIG. 1



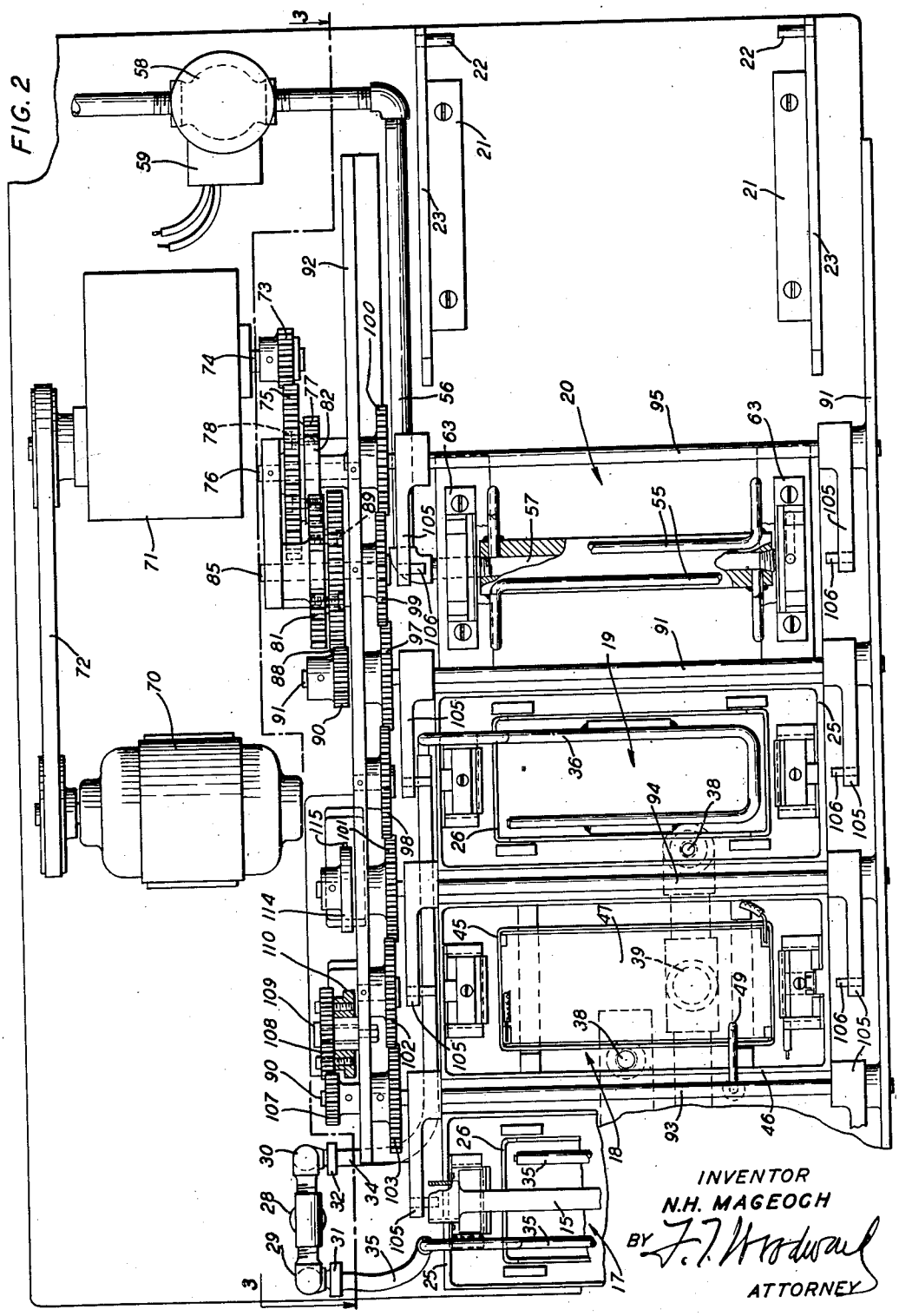
INVENTOR
N.H. MAGEOCH
BY F. J. Hardwood
ATTORNEY

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FIG. 2



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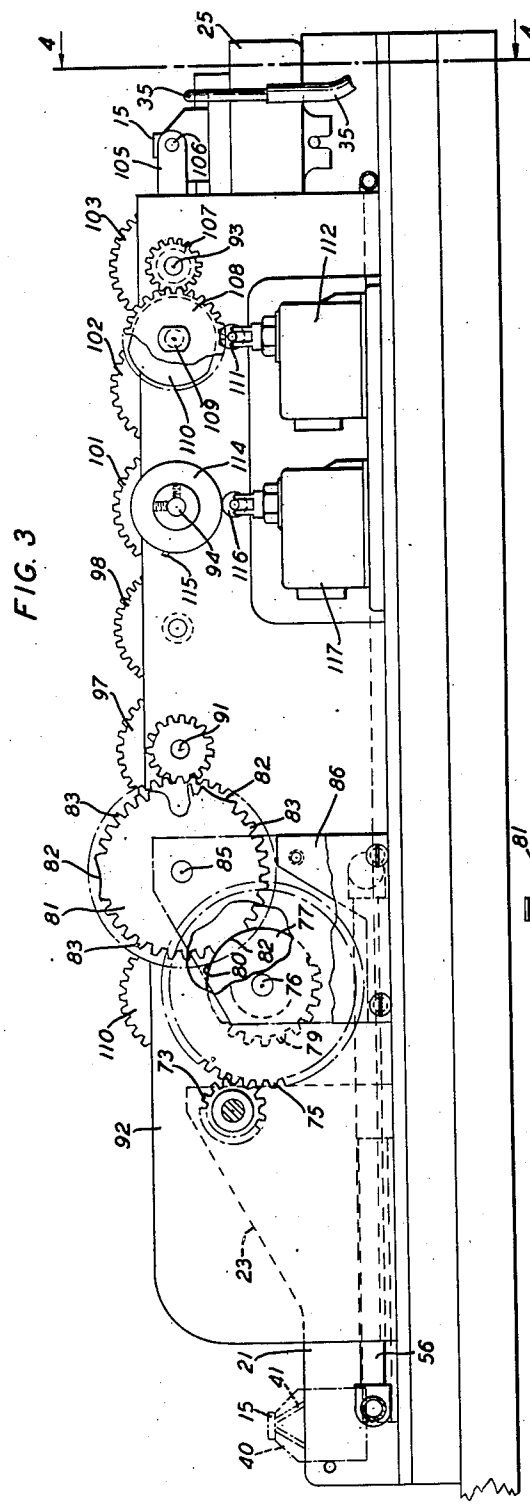


FIG. 3

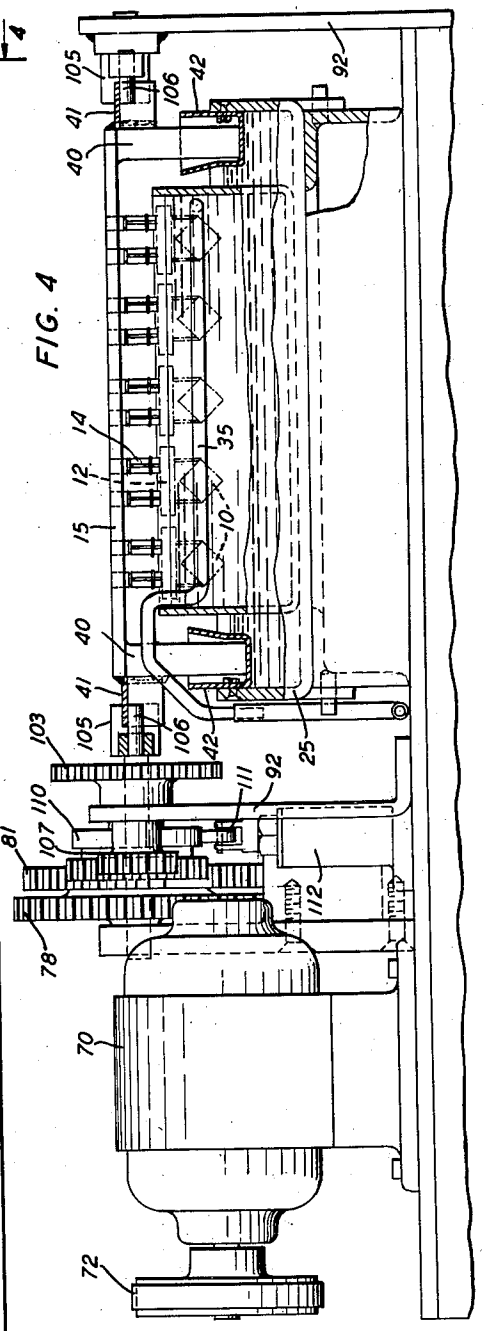


FIG. 4

INVENTOR
N.H. MAGEOCH
BY F. J. Meadows
ATTORNEY

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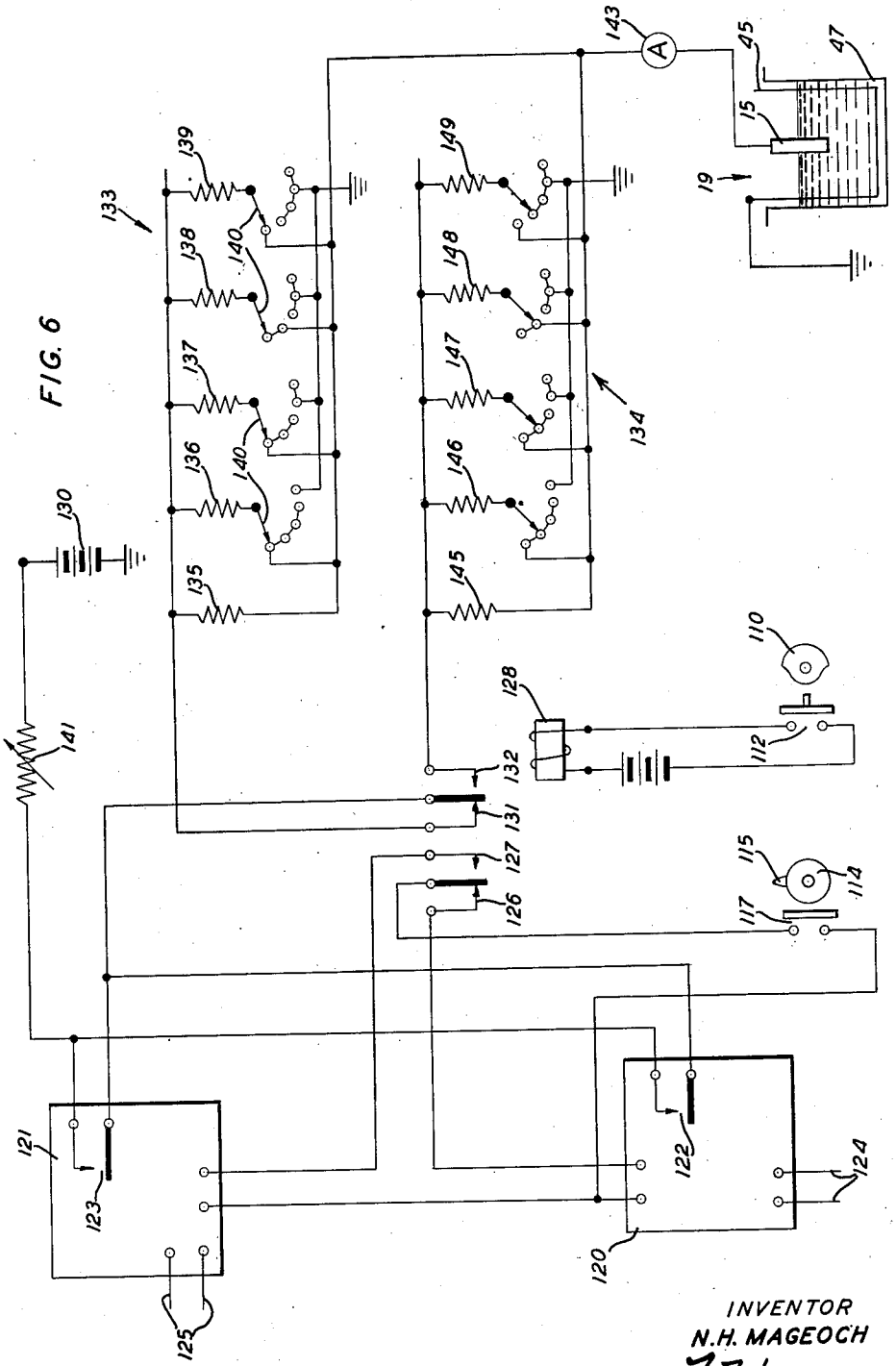


FIG. 6

INVENTOR
N.H. MAGEOCH
BY F. J. Hardwood
ATTORNEY

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UNITED STATES PATENT OFFICE

2,469,470

PLATING MACHINE

Nelson H. Mageoch, Westfield, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application November 1, 1944, Serial No. 561,405

2 Claims. (Cl. 204—198)

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This invention relates to plating machines, and more particularly to machines for plating quartz crystal elements.

In certain types of communication equipment, quartz crystal elements cut into various sizes and contours are to form parts of electrical units. These crystal elements are to receive metallic coatings of selected conductive materials such as gold or silver and it has been found advantageous to provide a variable means through the aid of which groups of such elements can be successively plated.

An object of the invention is to provide a plating machine which is simple in structure, efficient in operation and highly variable, depending upon the number of articles to be coated during each operating cycle.

With this and other objects in view, the invention comprises a plating tank, including a plating solution, means operable to move selected numbers of articles successively into and out of the plating tank and means to condition the plating material to plate varied numbers of articles simultaneously.

Other objects and advantages will be found in the following detailed description when considered in conjunction with the accompanied drawings, wherein

Fig. 1 is a fragmentary front elevational view of the plating machine;

Fig. 2 is a fragmentary top plan view of the plating machine, portions thereof being shown in section;

Fig. 3 is a vertical sectional view taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary detailed view of a portion of the holder and one of the articles to be plated; and

Fig. 6 is a wiring diagram illustrating the control circuits for the plating operation.

Referring now to the drawings, attention is first directed to the purpose of the machine. The articles to be plated, are in the present embodiment, crystal elements 10 supported by wires 11 from insulating members 12, the latter having terminals receivable in split tubes 14 which are carried by racks or holders 15. In the present illustration, there are five pairs of these split tubes 14 denoting five positions for crystal elements or articles 10 on each rack 15. In the machine, there are four operating positions, namely, a cleaning or washing position 17, a plating position 18, a rinsing position 19 and a

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drying position 20. The holders or racks 15 are manually disposed at the first operating position 17 where the elements or articles 10 are washed.

During this time, similar racks 15 are disposed at the plating position 18, the rinsing position 19 and the drying position 20, they having been moved into and out of the preceding positions. Adjacent the drying position 20, spaced receiving slides 21 are disposed, provided with stops 22 at their lower ends and having inclined surfaces 23 to receive the racks successively and allow them to move downwardly thereon limited by the stops 22. An operating mechanism is provided to simultaneously lift the racks at all of the operating positions, move them through similar arcs and deposit them at their next adjacent positions. In other words, the rack at position 17 will be moved to the plating position 18, while the rack previously disposed at the plating position 18 will be moved to the rinsing position 19, the rack previously disposed at position 19 will be moved to the drying position 20 and the rack previously disposed at the drying position 20 will be transferred to the slides 21.

Considering now the detailed structure of the machine, it will be noted by viewing Figs. 1 and 2 that the positions 17 and 19 include outer tanks 25 and inner tanks 26. The inner tanks 26 are smaller than the outer tanks, but are of greater height so that the fluids fed to the inner tanks may overflow into the outer tanks. A supply line 28 has connecting lines 29 and 30 in which valves 31 and 32 are disposed. Leading from the valves 31 and 32 are flexible lines 33 and 34 which have their forward ends connected to perforated tubes 35 and 36, the latter extending adjacent both sides and one end of their respective inner tanks 26. Through this means, a continuous supply of fluid, such as water, is directed to the washing position 17 and the rinsing position 19, namely, the inner tanks 26 thereof, under the control of their respective valves 31 and 32. The outer tanks 25 are provided with drain pipes 38 leading to a main drain 39.

Attention at this time is directed to the racks 15 which are identical in structure and a multiplicity thereof being provided so that groups of crystal elements 10 may be assembled in the split tubes 14 thereof to be placed in readiness for movement through the plating machine. Consider, for example, the rack shown in Fig. 4, the central portion of which has the split metallic tubes 14 mounted therein at spaced positions. Legs 40 are provided at the ends of the central portion and to the outer surfaces of the legs, in-

verted V-shaped members 41 are secured. Pockets 42 having outwardly flared upper portions 43 are mounted at each of the positions 17, 18, and 19 and disposed like distances apart to receive the legs of the racks as they are transferred thereto during the operating cycles of the machine.

The plating position 18 includes a structure similar to the washing position 17 and the rinsing position 19 in that it has an inner tank 45 and an outer tank 46. An electrolyte solution or plating bath 47 is provided for the plating tank 45 through a supply line 48, which leads from a pump (not shown) through a hook shaped pipe 49 and into the inner tank 45. An overflow pipe 50 leads from the outer tank 47 to the pump (not shown). At the plating position, the cup shaped members 42 are provided with cutaway portions 43 to receive resilient contacts 44 so that electrical contact may be made through the racks 15 as they are successively brought into this position. Further description of this electrical connection of the racks through the contacts 44 and the plating bath will be set forth in the description of the control circuit (Fig. 6) and during the description of the operation of the machine.

The drying position 20 includes spaced perforated pipes 55 which lead to a common supply line 56 through the aid of a connection 57. A valve 58, of the normally closed type operated into open position through the energization of a solenoid 59, controls air under pressure through the line 56 and through the perforated lines 55 to direct streams of air to both sides of a series of articles or elements 10 when transferred to the drying position from the rinsing position 19. A switch 60 of the normally open type, and disposed in a circuit to control the operation of the solenoid 59, is actuable into closed position through the aid of a plunger 61 and a resilient arm 62 when the adjacent leg 40 of a rack is disposed in the adjacent supports 63 thereof. The supports 63 are disposed at the ends of the drying position and are of the contour shown in Fig. 5, with the exception that only one is apertured for the switch plunger 61.

The power means for the operating mechanism of the machine includes a motor 70, which drives a reduction gear unit 71 through a belt and pulley connection 72. A pinion 73 is mounted upon the output shaft 74 of the unit 71 and interengages a gear 75. The gear 75 is mounted upon a shaft 76 and has a segmental gear 77 fixed thereto and rotatable therewith, through the aid of screws 78. The gear 77 is of the contour shown in Fig. 3 with a series of teeth 79 at one portion thereof, the remaining periphery of the gear being smooth as indicated at 80. The gear 77 is positioned to engage a gear 81 provided with equally spaced arcuate portions 82 for engagement with the surface 80 and intermediate groups of teeth 83 for interengagement with the teeth 79. The gear 81 is mounted upon a shaft 85, the latter being journalled in suitable supports including a bracket 86. The gear 81 has a gear 88 fixed thereto by suitable means, such as screws 89 and is rotatable with the shaft 85. The gear 88 interengages a pinion 90, the latter being fixedly mounted upon a shaft 91. The shaft 91 extends the full width of the apparatus between the rinsing position 19 and the drying position 20 and has its ends suitably journalled in bearings of a frame 92. Other shafts 93, 94 and 95 similar to the shaft 91 are respectively positioned between washing and plating stations 17 and 18, between the plating and rinsing stations 18 and 19 and beyond the drying station 20. The shaft 91 is directly connected to the power means through the pinion 90 and it has fixedly mounted thereon, a gear 97 which interengages idler gears 98 and 99. The idler gear 99 drives a gear 100, which is fixedly mounted upon a shaft 95, while the idler gear 98 drives a gear 101, which is fixedly mounted upon the shaft 94. Through the aid of an idler gear 102, interposed between the gear 101 and a gear 103, which is fixedly mounted upon the shaft 93, the latter may be rotated. Through this train of gears extending from the output shaft 74 of the unit 71, to the shaft 93, the shafts 93, 94, 91 and 95 are rotated in unison at predetermined time intervals. Furthermore, each of these shafts has a pair of arms 105 with inwardly projecting fingers 106 to move into the pockets of the inverted V-shaped members 41 to transfer the racks 15 from one position to another.

A pinion 107 is mounted upon the outer end of the shaft 93 and interengages a gear 108, the latter being rotatably mounted upon a stub shaft 109. A cam 110, rigidly secured to gear 108 as shown in Fig. 2, is mounted upon the shaft 109 and has the contour shown in Figs. 3 and 6. This cam is positioned to engage a roller 111 of a switch 112. A switch 112 is of the normally open type and when the roller 111 is positioned to ride upon the low portion of the cam, the switch will remain open, it being closed, however, by the high portion of the cam 110. The ratio between pinion 107 of the gear 108 is two-to-one causing the switch 112 to be closed during every other cycle of operation of the machine. A cam 114 mounted upon the outer end of the shaft 94 has a single high point 115 positioned to engage a roller 116 of a switch 117. The switch 117 is similar to the switch 112 in that it is of the normally open type, operated by the cam 114 for a short period of time during each cycle of operation of the machine.

Attention is now directed to Fig. 6. The plating solution is under the control of the electrical circuit shown in this figure aided by the cams 110 and 114. It is important that the plating circuit be varied to vary the electrical current passing through the plating bath or electrolyte solution, depending upon the number of crystals or articles being coated.

In the wiring diagram shown in Fig. 6 there are two control units 120 and 121 which are commercially known as electrical timers. It is believed that a detailed description and illustration of these timers are unnecessary for a clear understanding of the invention. They employ the conventional motor driven means to close their respective switches 122 and 123, immediately upon the closing of their main circuits, and to cause opening of their respective switches after given lengths of time. The electrical energies for the timing units are supplied through lines 124 and 125 respectively. The main circuits for the units 120 and 121 are respectively under the control of a break contact 126 and a make contact 127 of a relay 128. These circuits are also under the control of the switch 117 and the cam 114. When the relay 128 is deenergized, the circuit through the normally closed contact 126 is completed by the switch 117. Thus, the unit 120 may be rendered effective upon the closing of the switch 117 through the operation of the cam 114. This completes a circuit to the unit 120 to cause the unit to start functioning and immediately close the switch 122.

The relay 128 is included in a circuit which is under the control of the switch 112 and the cam 110. Although the cam 114 is driven to close the switch 117 at a given time interval during each cycle of operation of the machine, the cam 110 is driven at only half the speed of the cam 114 and thus closes the switch 112 during every other cycle of the machine. Through this means, the units 120 and 121 are rendered effective alternately due to the fact that during one cycle of operation, the relay 123 is deenergized, rendering the break contact 126 effective, while during the next cycle the relay is energized to render the make contact 127 effective. When this occurs, that is, when the contact 127 is closed and the contact 126 is opened through the energization of the relay 128, another circuit is completed by the cam 114 again closing the switch 117. At this time, the unit 121 is operated to close the switch 123 for a given length of time.

The plating circuit is provided with a power supply or grounded battery 130 and includes a break contact 131 and a make contact 132, these contacts also being under the control of the relay 128. Two resistance units, indicated generally at 133 and 134, are arranged to include varied numbers of known resistances in parallel in the plating circuit depending upon the number of articles or crystals to be plated. In the unit 133, there is a permanent resistance 135 and other resistances 136, 137, 138, and 139, all of like values, which may be selectively included in parallel in the plating circuit. The selective resistances, that is, the resistances 136 to 139 inclusive are provided with contacts of the arrangement shown so that beginning with the resistances 136, one, two, three, or all four of these resistances may be included in the plating circuit. In actual structure, separate contacts 140 mounted on a common shaft, are movable thereby to any of five positions to include one, two, three, four, or all five of the resistances in the circuit. In the present illustration, all five of the resistances of the resistance unit 133 are included in parallel in the plating circuit under the control of the timer or unit 120. This indicates, therefore, that five crystal units or articles are to be plated at the time when the plating bath is under the control of the units 120 and 133. The circuit completed may be traced from the grounded battery 130, through a variable resistance 141, switch 122 of the unit 120, break contact 131, through the parallel connections of all of the resistances 135 to 139, inclusive, as shown, through an ammeter 143 to indicate the value of the electrical current, through the rack 15, the split metallic tubes 14, the wires 11, the crystals or articles 10, the electrolyte 47 to ground.

The unit 134 is identical in every detail to the unit 133, including a fixed resistance 145 and other resistances 146, 147, 148 and 149, all known like values which may be selectively included in parallel in the plating circuit when the make contact 132 is closed to complete a circuit from the grounded battery 130, through the switch 123 of the unit 121, through the resistance 145 and a selected number of the resistances 146 to 149 inclusive in parallel, through the ammeter 143 and thus through the articles to be plated, the plating bath and to ground.

Considering now the operation of the plating machine, the operator prepares a rack 15 with a given number of articles 10 to be plated. This rack is placed at the washing position 17, but prior to this time, one of the units 133 or 134 is

adjusted, if necessary, so that at the time the first rack is moved to the plating position 18, the plating circuit will be conditioned to uniformly plate the articles. Let it be assumed that the first rack or articles has been plated under the control of the units 120 and 133 and that the second rack includes only four articles.

Prior to the placing of the second rack at the washing position 17, the operator adjusts the unit 134 for four articles, this adjustment being made to include four of the resistances (145 to 148 inclusive) in the plating circuit when the articles of the second rack are moved to the plating position 18. The switches 112 and 117, operable in synchronism with the transfer mechanism renders the control units for the plating bath effective alternately so that without disturbing the continuous function of the machine, the operator has time intervals, through the provision of two sets of controlling means, namely, the timing units 120 and 121 and the resistance units 133 and 134, to precondition the plating circuit.

The racks may be followed through the machine, considering the placing of the first rack at the washing position 17 during which time the continuous flow of water past the articles will remove all foreign particles therefrom. The arms 105, with their pins 106, are rotated in unison in a clockwise direction, so that at a given time interval, the first rack will be moved upwardly through an arc and placed at the plating position 18 where its legs 40 will form electrical connection with the resilient contacts 44. After this has taken place, the plating circuit conditioned for this rack, or rather, the articles carried thereby, will be rendered effective through the operation of the switch 117, depending upon the position of the cam 110 as to when the switch 112 remains open or is closed thereby. After the first rack has remained at the plating position 18, a given length of time, the adjacent arms 105 will transfer it to the rinsing position 19 where continuously flowing water will again rinse the articles, this time in their plating condition. After a given length of time, the first rack, through the said of the adjacent transfer arms 105, will be moved to the drying position 120 where jets of air will be directed to the articles to dry them. The drying means is rendered effective immediately upon the lowering of the first rack to the position 20, one of the legs 40 of the rack pressing the plunger 61 and the resilient arm 62 to close the switch 60 and energize the solenoid 59 to open the valve 58 in the airline 56. The moment the rack is removed from the drying position, the switch 60 will again be opened to deenergize the solenoid 59 and thus close the valve 58. The rack, upon leaving the drying station 20 is transferred to the slides 21 where they are allowed to travel downwardly limited by the stops 22.

Although specific improvements of the invention have been shown and described, it will be understood that they are but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined by the appended claims.

What is claimed is:

1. A machine for successively electroplating groups of articles variable in number, the machine comprising an electroplating bath, like holders each formed to receive and hold a variable number of the articles from one to a given maximum number of the articles, a loading position to successively receive the holders with their

articles to be plated, an electroplating bath disposed at a position spaced from the loading position, transfer elements actuable to transfer the holders from the loading position to the bath, where the articles will be positioned in the bath, and from the bath to another position spaced therefrom, mechanism operable to actuate the transfer elements to transfer the holders at given intervals of time whereby the articles held thereby will be positioned in the bath a known length of time plating circuit for directing a plating current through the articles and the bath, resistance units including electrical resistances of known values and corresponding in number to the said maximum number of articles capable of being held by each of the said holders, means operable in synchronism with the mechanism to alternately include the resistance units in the plating circuit for the articles, of alternate holders, moved into the bath, and separate means for each resistance unit actuable, prior to its unit being included in the plating circuit, to preset its unit to include, of its resistances, a number equal to the number of articles to be positioned in the bath by its holder when the preset unit is included in the plating circuit.

2. A machine for successively electroplating groups of articles variable in number, the machine comprising an electroplating bath, like holders each formed to receive and hold a variable number of the articles from one to a given maximum number of the articles, a loading position to successively receive the holders with their articles to be plated, an electroplating bath disposed at a position spaced from the loading position, transfer elements actuable to transfer the holders from the loading position to the bath,

where the articles will be positioned in the bath, and from the bath to another position spaced therefrom, mechanism operable to actuate the transfer elements to transfer the holders at given intervals of time whereby the articles held thereby will be positioned in the bath a known length of time, a plating circuit for directing a plating current through the articles and the bath, resistance units including resistances of like values corresponding in number to the said maximum number of articles capable of being held by each of the said holders, separate means for each resistance unit actuable to preset its unit by electrically connecting a number of its resistances in parallel, one for each article held by the holder at the loading position, and means operable in synchronism with the said mechanism to alternately include the resistance units in the plating circuit to control the plating circuit for the articles on the holders moved successively from the loading position into the bath.

NELSON H. MAGEOCH.

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Certificate of Correction

Patent No. 2,469,470. May 10, 1949.

NELSON H. MAGEOCH

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 7, line 11, claim 1, for "time plating" read *time, a plating;*

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of November, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.