

Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 1

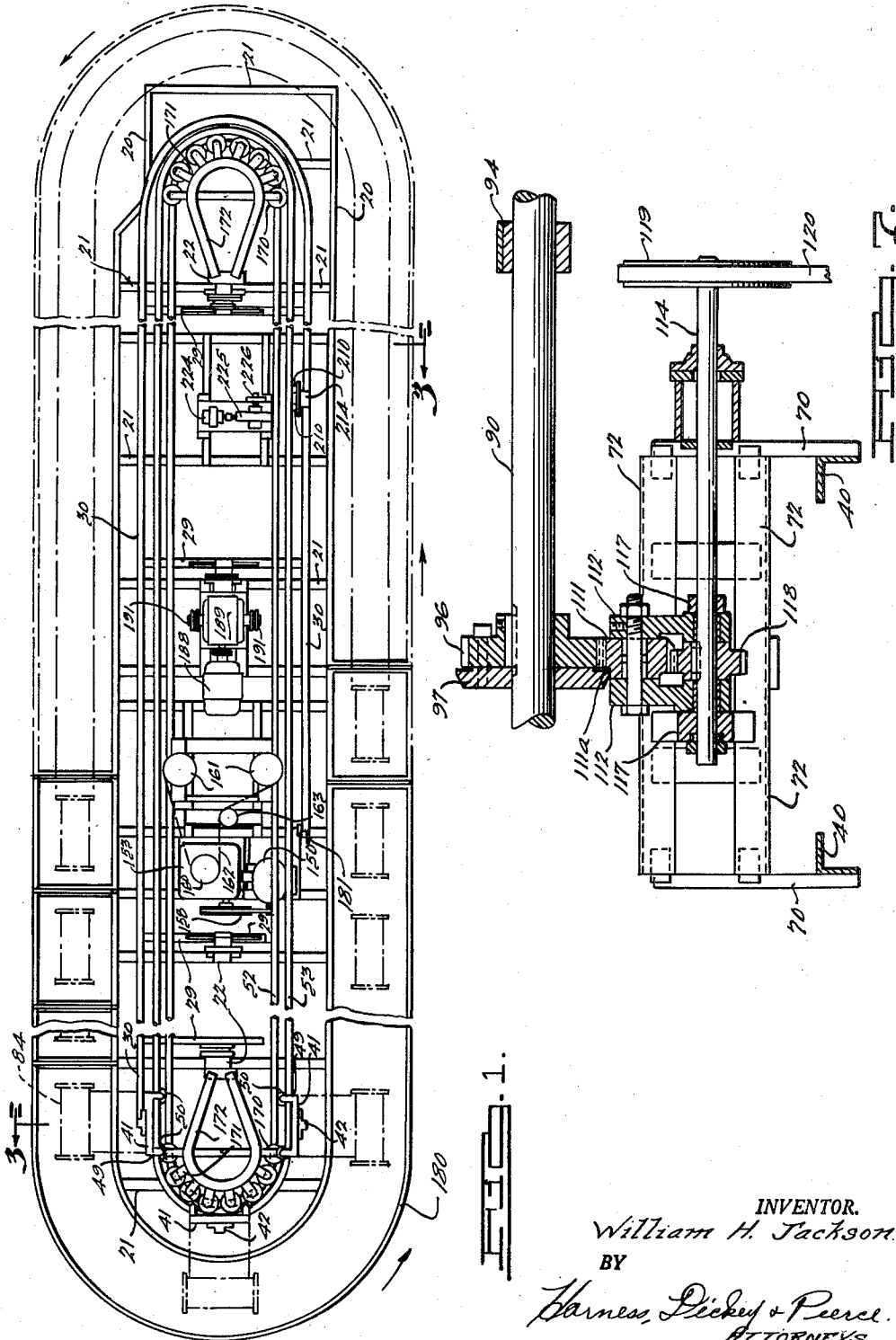


FIG. 1.

INVENTOR.
William H. Jackson.
BY
Harnes, Dickey & Pierce.
ATTORNEYS.

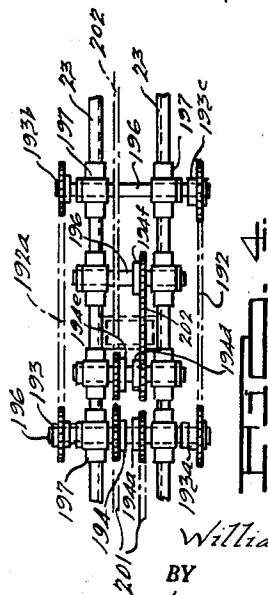
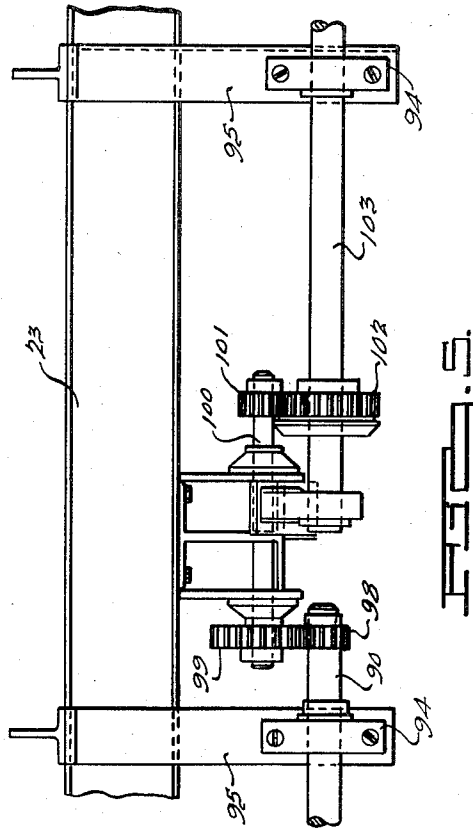
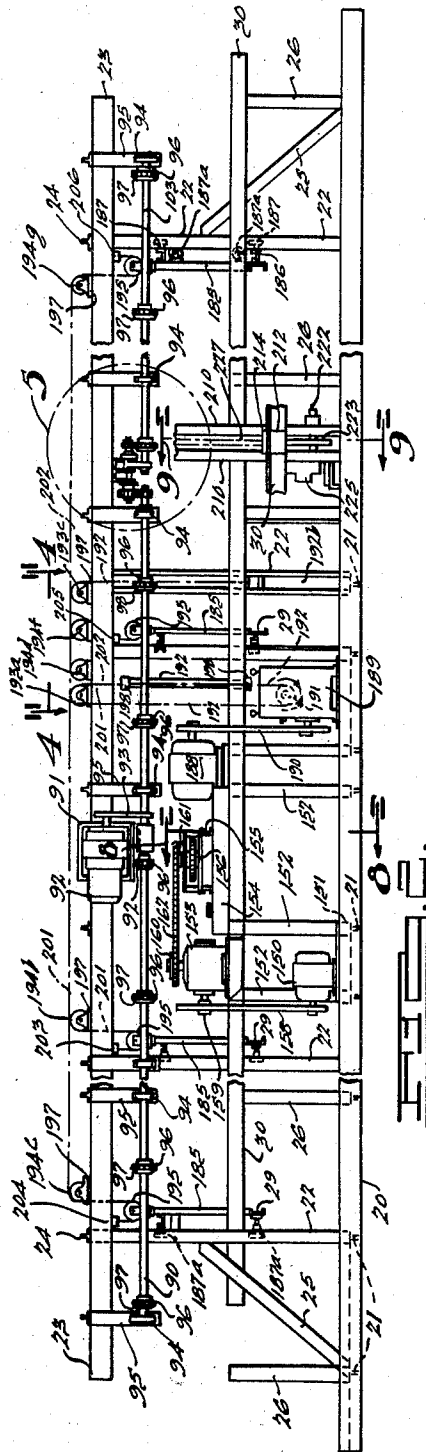
Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 2



INVENTOR.
William H. Jackson.
BY
Harnes, Dickey & Pence.
ATTORNEYS

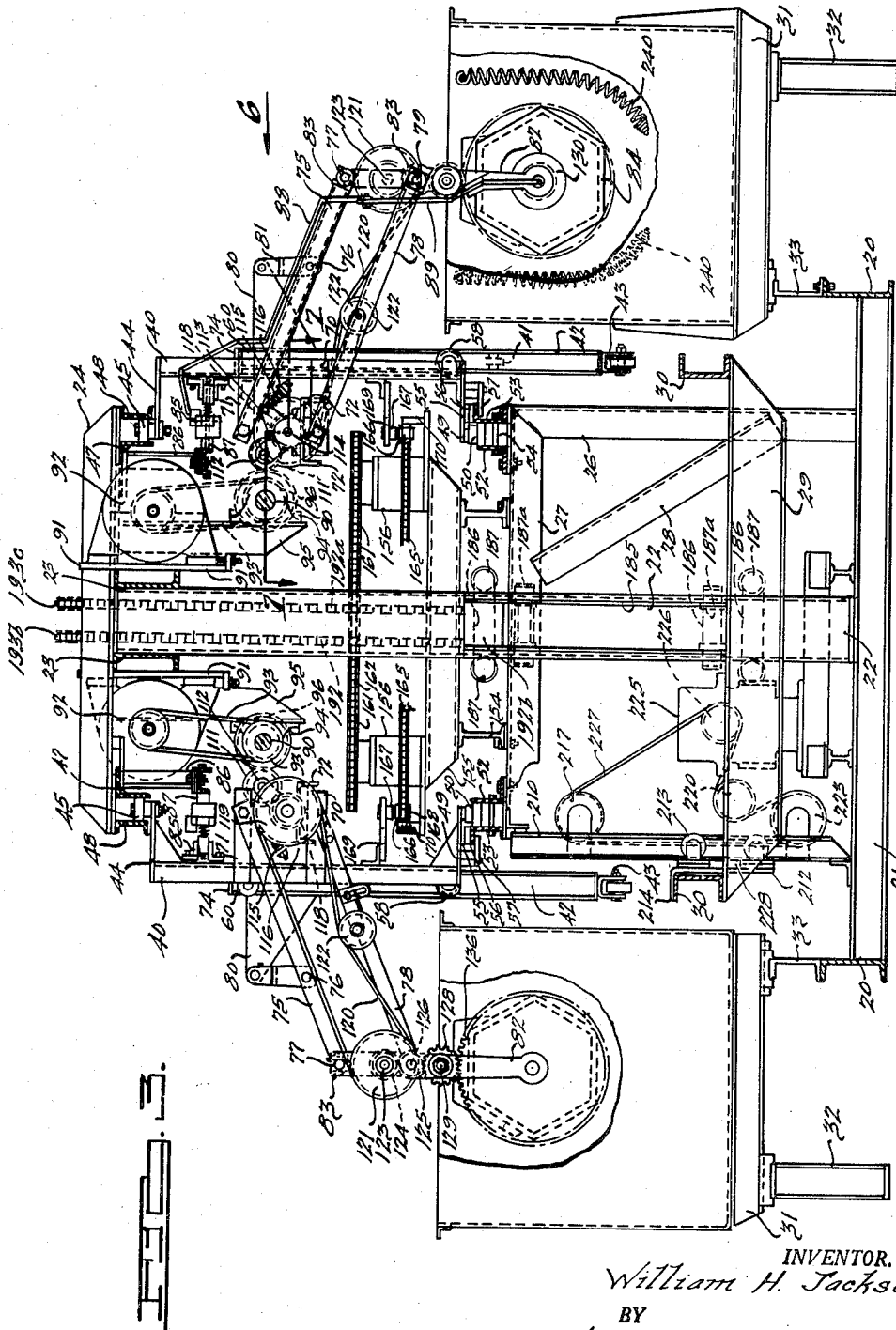
Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 3



INVENTOR.
William H. Jackson.

BY

Harness, Dickey & Pierce.
ATTORNEYS.

Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 4

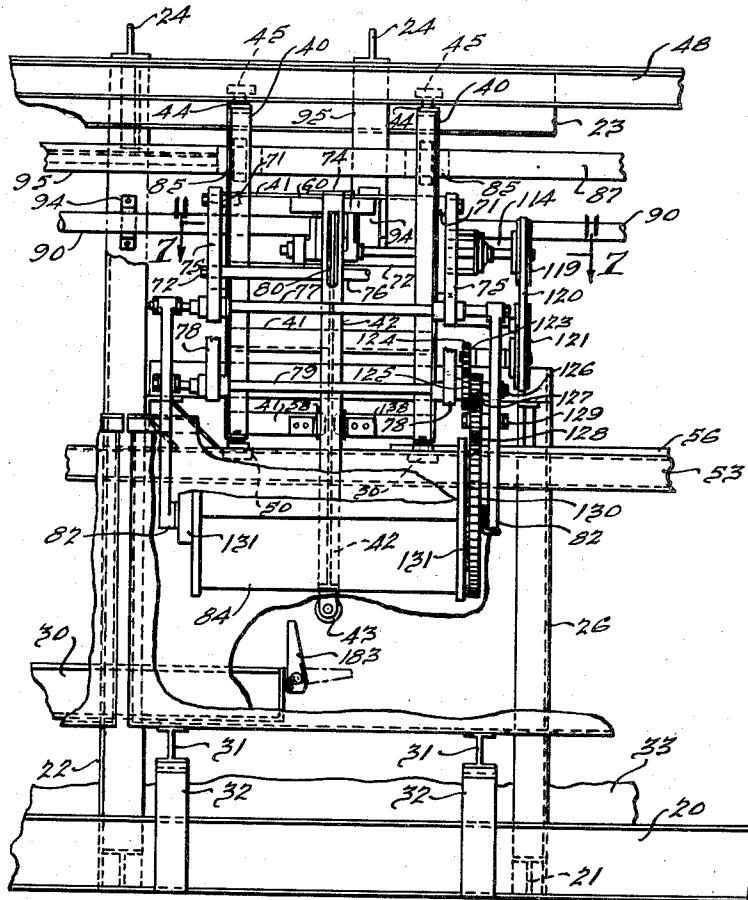


FIG. 6.

INVENTOR.

William H. Jackson.

BY

Harnes, Dickey & Peice.
ATTORNEYS.

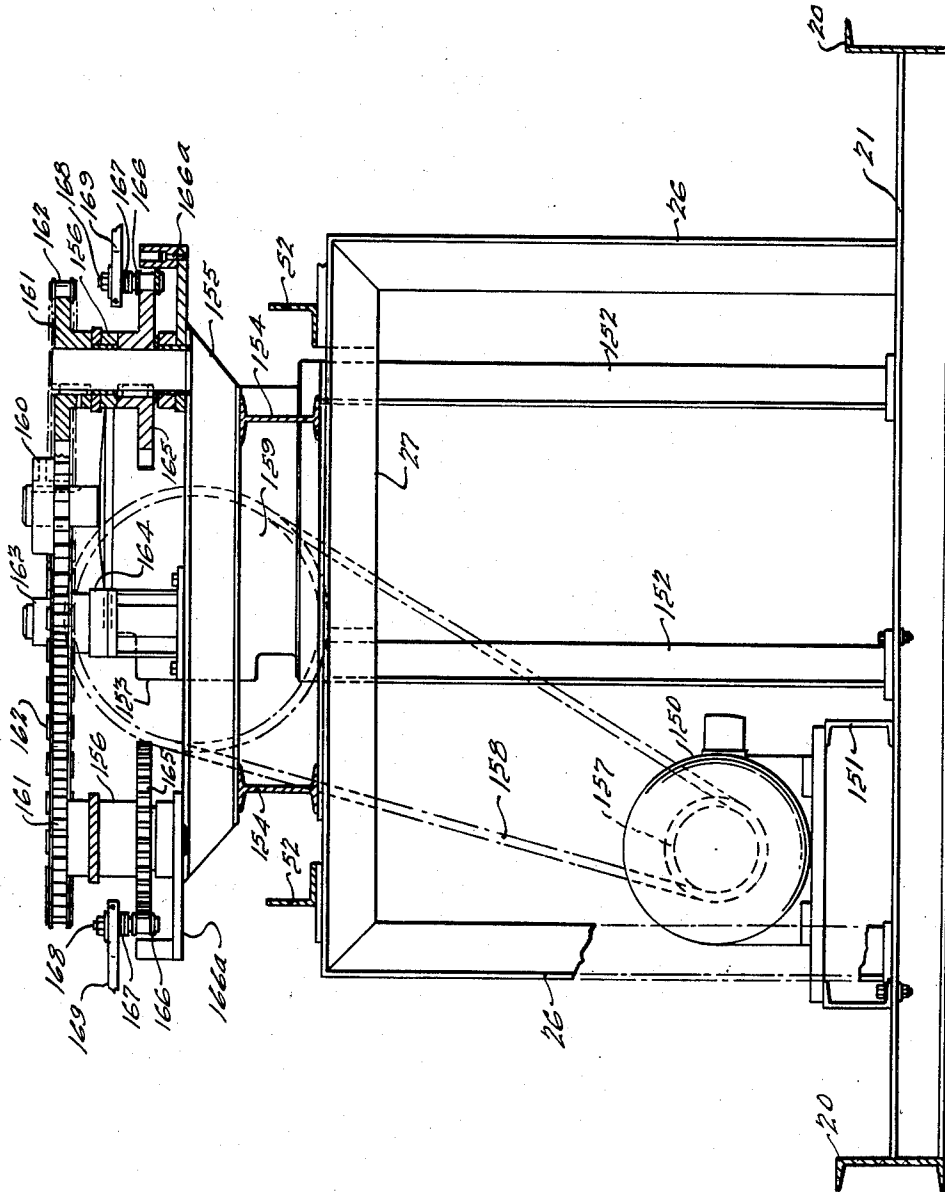
Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 5



INVENTOR.
William H. Jackson.

BY

Harniss, Dickey & Pears
ATTORNEYS

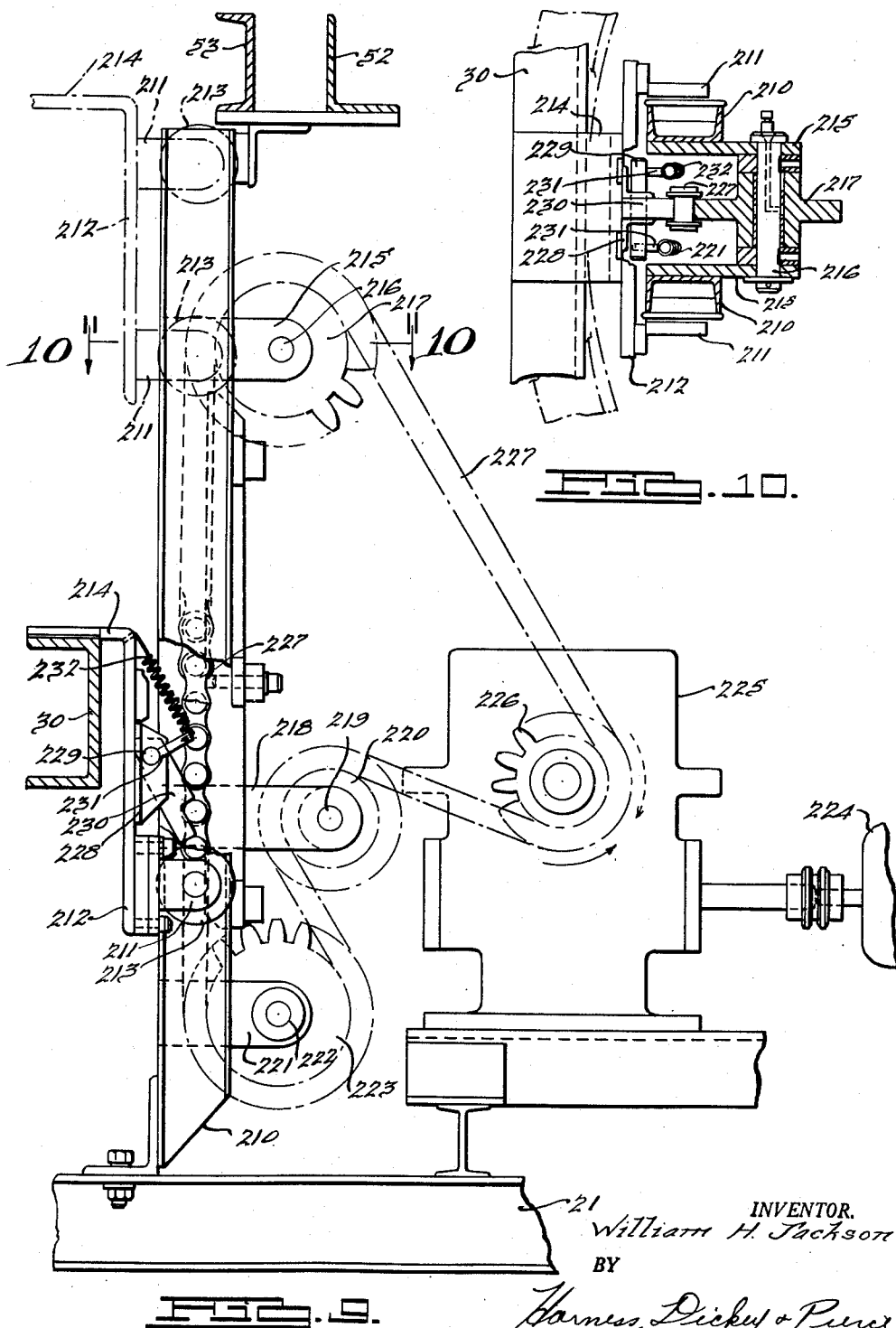
Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 6



INVENTOR.
William H. Jackson

BY

Harnes, Dickey & Puer
ATTORNEYS

Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 7

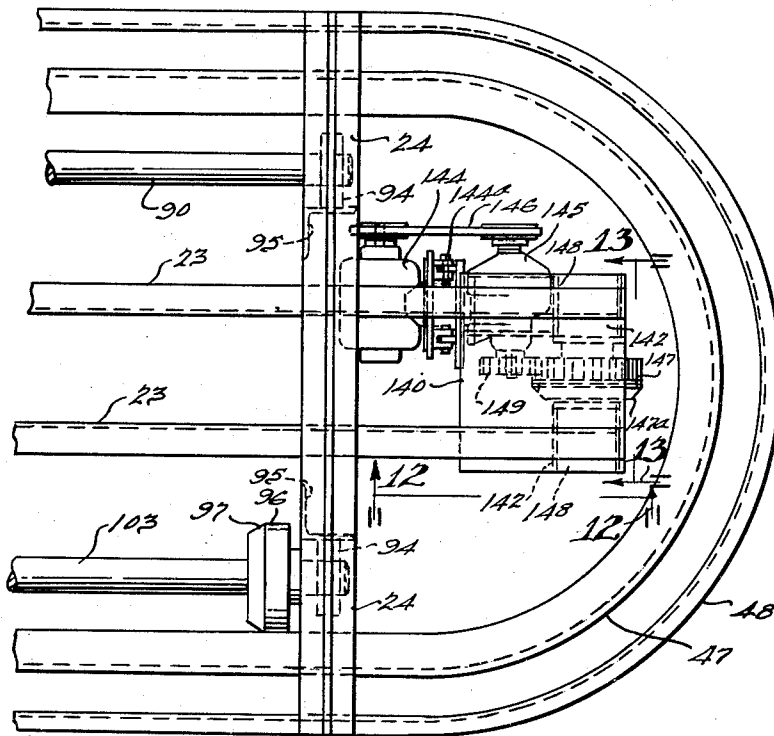


FIG. 11.

FIG. 12.

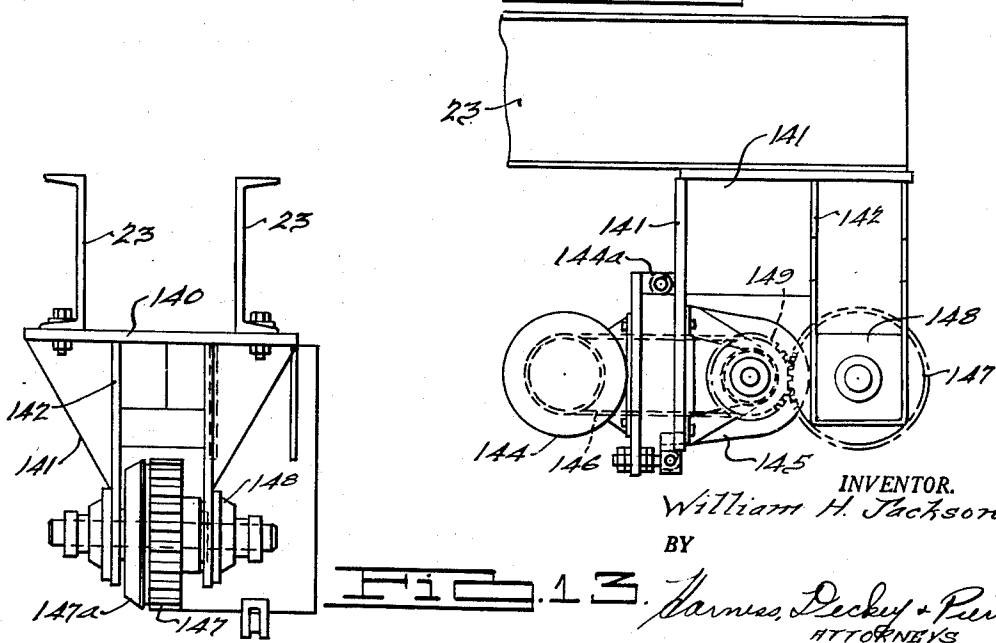


FIG. 13.

INVENTOR.
William H. Jackson.
BY
Harnes, Decker & Poirer
ATTORNEYS.

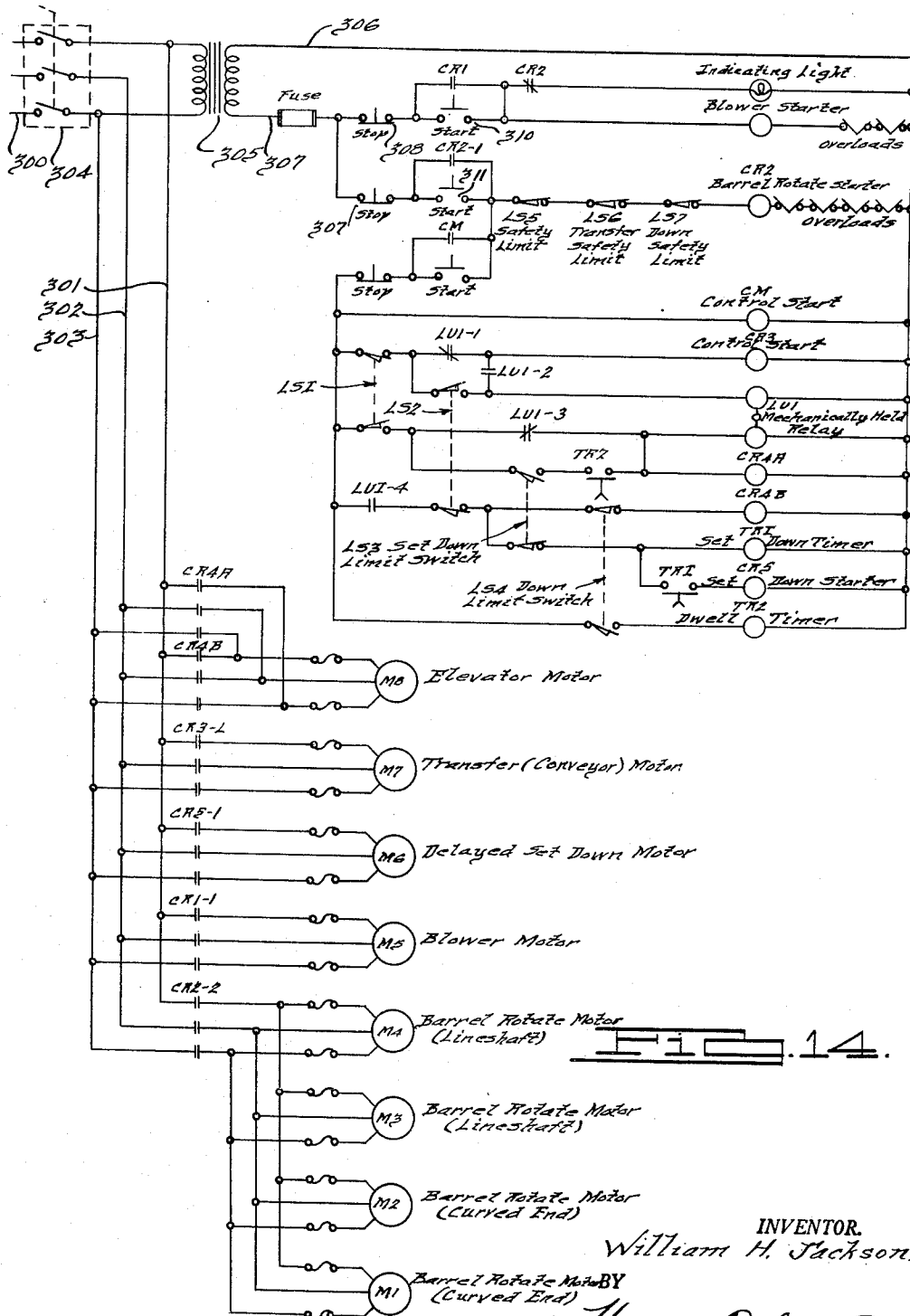
Aug. 26, 1958

W. H. JACKSON
AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF
METAL ARTICLES IN BULK

2,849,097

Filed Aug. 5, 1954

8 Sheets-Sheet 8



INVENTOR
William H. Jackson
Harness, Dickey & Pierce
ATTORNEYS

1

2,849,097

AUTOMATIC APPARATUS FOR CHEMICAL TREATMENT OF METAL ARTICLES IN BULK

William H. Jackson, Birmingham, Mich., assignor to The
Udylite Corporation, Detroit, Mich., a corporation of
Delaware

Application August 5, 1954, Serial No. 448,084

15 Claims. (Cl. 198—19)

The present invention relates generally to apparatus for the plating or chemical treatment of metal articles, particularly articles in bulk, that is, articles too small for, or not economically capable of, individual handling. The invention relates more specifically to an automatic machine for the cleaning, preparation and plating or coating in bulk of large quantities of small articles such as bolts, screws, springs, stampings, etc.

In the past, plating or coating in bulk has been carried out by placing a considerable number of small metal articles such as bolts, screws, washers, etc. in a tumbling barrel which is immersed in a plating or coating solution. Likewise, the cleaning, pickling, washing and rinsing of such articles preparatory to plating or coating have also been carried out in tumbling barrels immersed in the various cleaning or pickling solutions. Most commercial operations have utilized individual pieces of apparatus for each of these operations and sometimes these various pieces have been arranged close together in a lay-out favoring more or less intermittent flow of work. Mono-rails or overhead cranes are then utilized to advance a barrel or its contents from one treating tank to the next. In such a layout, each tank is separately equipped with duplicate barrel rotating drive and other accessories. However, the various acid-pickling, washing, rinsing and various plating solutions of necessity require different immersion times. Thus, between or about the various pieces of equipment, in such a typical commercial plant layout, there are usually provided work storage or hold-up devices for storing work from the faster operations. When this is done, damage to the work may occur due to drag-out of corrosive solutions or the corrosive plating room atmosphere. Thus, a true continuous operation in bulk plating has not been achieved to the same degree as in the plating of the type of work that can be individually suspended from continuous conveyor systems and successively raised and lowered into and out of the various treating baths.

In a similar fashion, the application of chemical coat-

2

ings and treatments such as phosphate and oxalate coatings on metal articles in bulk have been conducted in rotating barrels. Continuous operation in this field also has not been completely satisfactory.

It is a principal object of this invention, therefore, to provide an automatic machine for the complete preparation, cleaning, plating or coating and post treatment of articles in bulk.

Another object of this invention is to provide a machine in which work flows from one treating step to another without hold-up or storage.

Still another important object of this invention is to provide a plating or treating machine wherein the work is supported on individual carriages, the work is lifted independently of the carriages by an elevator rail, and flow of work is achieved by simultaneously advancing the carriages while the work is supported on the elevator rail.

Still another object is to provide a bulk plating or treating machine which rotates the plating barrels in both lower and upper positions at the respective processing tanks, this latter feature to cut down solution drag-out and undesirable action of such solutions. The equipment provided for this purpose comprises a lineshaft gearing and one or more individual motor drives opposite those stations requiring barrel rotation and an epicyclic gear train or power take-off device on each of a plurality of work-supporting carriage units for making contact with the lineshaft or individual motor drives.

Still another object is to provide a continuous bulk plating or treating machine wherein all drive mechanisms, controls, etc. are centrally located and easily accessible for inspection, lubrication and maintenance.

Another further object of this invention is to provide a continuous bulk plating or treating machine capable of specification plating or coating at high capacity with close quality control and which can be operated by a single operator.

Another object of this invention is to provide an automatic bulk plating or treating machine which has the high capacity derived from the use of the horizontal type of plating or treating barrel. The use of the horizontal barrels in the apparatus of this invention is permitted by suspending each barrel on a pantograph type suspension, supporting the pantograph suspension on individual carriages, and lifting the suspensions and suspended barrels independently of the carriages.

A yet further object is to provide a continuous machine which minimizes drag-out and loss of poisonous and expensive plating and treating solutions by virtue of continued rotation of the barrel in a position above the treating solution, and where necessary, a delayed set-down or

advance lift-up device to reduce contact time and permit longer drainage time.

It is also an object to provide a machine which is easily susceptible to modification to provide a variety of barrel rotation speeds as required by the nature of the plating or treating process. The variation in the barrel rotation speeds according to one mode of this invention is achieved by varying the size of lineshaft or individual drive gears opposite those stations requiring different speeds.

An object of this invention is to provide an automatic continuous bulk plating or treating machine having elevator and transfer or conveyor devices employing simple chain drives, the elevator device employing the mechanical advantage of the block and tackle.

An object of this invention is to provide a machine having horizontal barrels each carried by an individual carriage and an individual pantograph-type arm suspension, which permits the elevator device to deliver a vertical motive force independent of the conveyor mechanism and over a vertical distance which is adjustable according to the needs of the process and work. This result is accomplished by providing a lifting member which engages the elevator and lifts each suspension independently of its carriage. Variation in height of lift is achieved by varying the length of the lifting member or its connecting mechanism.

Still another object is to provide a machine having an elevator mechanism incorporating means for supporting the barrels at all times during their up-and-down movements and which will selectively disengage the barrels in those stations where the vertical movement is not desired. The apparatus provided for this purpose includes an elevator rail suspended around the machine opposite those stations where support or lifting of the barrels is required, a delayed set-down, skip-station or early-lift device at some stations, and engaging and disengaging fingers on the ends of the elevator rail at those stations where vertical movement is not required.

Yet another object is to provide a machine having a barrel elevating mechanism incorporating a device for either an early lift-up, delayed set-down or skip-station function, which device or devices are integrated with the main elevator and conveyor mechanisms of the machine to permit continuous, simultaneous advance of work. The apparatus provided for this purpose includes a work-supporting elevator bracket which is operated independently of and above the main elevator rail.

Another object is to provide a machine having a self-adjusting coupling device between a single conveyor chain and a plurality of barrel carriages to compensate for chain stretch and wear and commercial tolerances of machine frame elements.

An object is to provide a machine having a line-shaft type of barrel rotation drive and means including a combination of taper-faced cams and spur drive gears forming an epicyclic gear train for facilitating engagement of individual barrel rotate power take-off devices on each barrel carriage.

An object of this invention is to provide a machine of the return type employing a combination of line shaft and individual barrel rotation drives on the curved ends of the machine.

Another object is to provide a machine having on the individual barrel carriages a barrel rotating power transmission system of constant belt or chain length in both upper and down positions of the barrel.

Still other objects, features, and advantages of the present invention will become apparent in the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a plan view of the plating machine of this invention with much of the detailed mechanism removed in order to show the general disposition of the frame, tanks, barrels, tracks, elevator, etc.;

Fig. 2 is an elevational view, with portions broken away, of the supporting framework showing the disposition of some of the power drive mechanisms which operate the various machine parts;

Fig. 3 is a cross sectional view of the complete machine shown in Figs. 1 and 2, showing the details of the barrel carriage, the barrel suspension, the elevating means, the delayed set-down means and the barrel rotating means, the section being taken along the line 3—3 of Fig. 1;

Fig. 4 is an enlarged top view of a portion of the conveyor chain suspension, the portion enlarged being indicated between the arrows 4—4 of Fig. 2;

Fig. 5 is an enlarged side view of the compound line shaft connections, the portion enlarged being indicated by the circle 5 in Fig. 2;

Fig. 6 is a side elevation of one station of the machine of Fig. 1 showing further details of the barrel carriage, the barrel suspension, barrel rotation drive mechanism, and the barrel elevator mechanism, the view being taken in the direction of the arrow 6 in Fig. 3;

Fig. 7 is a sectional view showing the details of the individual power take-off means located on each of the barrel carriages, the section being taken along the line 7—7 of Fig. 3;

Fig. 8 is an end-view, partially in section, showing some of the details of the conveyor chain drive mechanism, the section being taken along the line 8—8 of Fig. 2;

Fig. 9 is an end view, partially in section, showing the details of the delayed set-down mechanism, the section being taken along the line 9—9 of Fig. 2;

Fig. 10 is a sectional view through the upper set-down sprocket, the section being taken along the line 10—10 in Fig. 9;

Fig. 11 is an enlarged plan view, with portions broken away, showing the details of the right-hand end of the machine of Fig. 1 and in particular the mounting of the individual barrel rotation motor and drive mechanism;

Fig. 12 is a side view showing further details of the barrel-rotating motor and drive mechanism of Fig. 11, and their mounting, the figure being viewed in the direction of arrows 12—12 of Fig. 11;

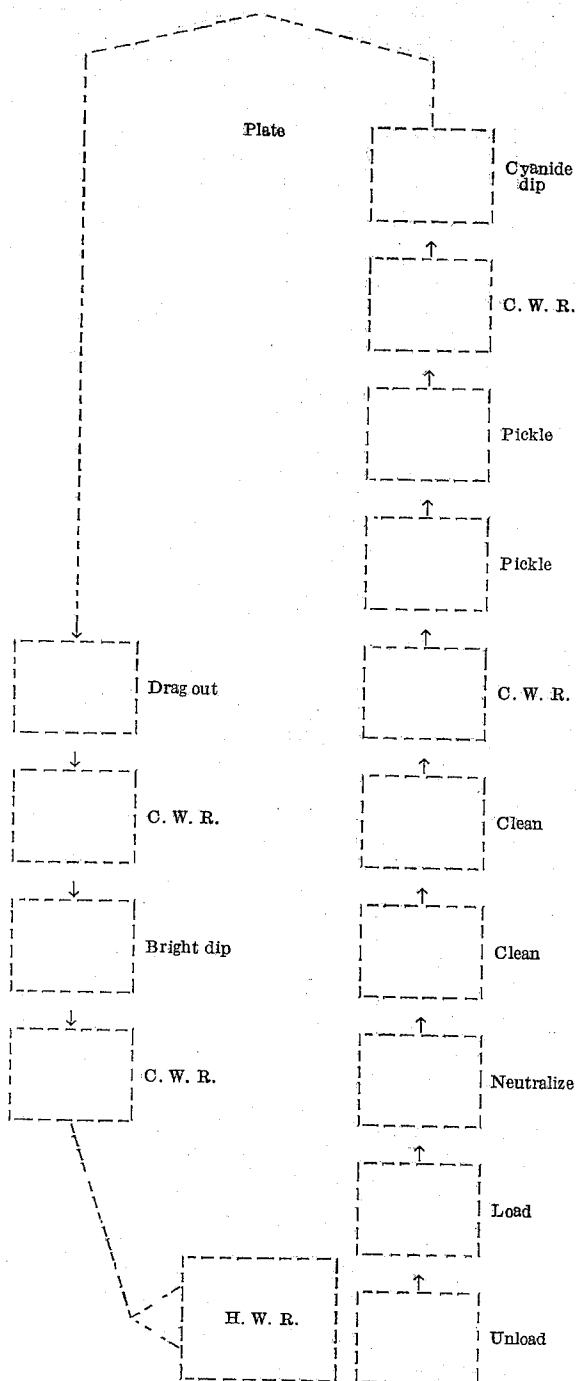
Fig. 13 is an end view of the barrel rotating mechanism, the view being taken in the direction of the arrows 13—13 of Fig. 11; and

Fig. 14 is a circuit diagram of the complete controls system for the machine of Figs. 1 to 13.

Referring now to the drawings and particularly to Figs. 1 to 3, it will be seen that the machine illustrated has a central frame of structural steel members surrounded by a plurality of tanks arranged end-to-end to form a continuous elliptical pathway thereabout. As will be seen in Fig. 1, the machine is designed for flow of work in the direction of the arrows. Thus, when Fig. 1 is laid on its side, the upper right-hand corner of the elliptical tank system will be the load and unloading stations. At the left-hand end of the machine, a single, continuous, curved tank is provided for a final plating operation. In the upper leg of the machine between the latter curved portion and the loading station located on the upper right-hand end, there are situated a number of neutralizing, cleaning, pickling and other pre-plating work preparation stations, a few of which are indicated in Fig. 1. Following the curved plating station, the lower horizontal leg of the elliptical tank contains the drag out, water rinse, bright dip and final rinsing operations.

Although the tank and the entire machine of Fig. 1 is shown broken in several places to reduce it to a convenient size for drafting purposes, it will be understood that the machine is designed with a sufficient number of stations to enable it to handle a wide variety of plating or chemical treating operations. The machine of Fig. 1 will be described in connection with an exemplary cyanide process for zinc plating. Such a process may be delineated schematically as follows:

5



This cyanide zinc plating process is seen to require fourteen separate stations exclusive of load and unloading. In such a process the neutralizing, cleaning, pickling, cyanide dip and cold (C. W. R.) and hot water (H. W. R.) rinse steps are in no wise critical. That is, the time of immersion in these stations can vary somewhat. Thus, the curved plating station on the left-hand end of the machine as seen in Fig. 1 is designed to have a length which is a simple multiple of a single station for carrying out any of the preparatory and clean-up operations. The solution used in the bright dip station, however, is an acid solution of considerable strength. The work is immersed in this solution for only a matter of a few seconds in order to generate a smooth, shiny surface. If the work is allowed to remain in this solution too long, the plated coating would be damaged or entirely removed. For this station, therefore, a delayed set-down

6

mechanism is provided in order to obtain a very short period of immersion.

The machine illustrated in Figs. 1 to 13 is of the return type wherein a series of horizontal plating barrels containing the small bulk workpieces are successively immersed in cleaning solutions, pickling solutions, and a cyanide dip solution preparatory for plating. The machine incorporates an elevator mechanism including a lifting rail or beam for simultaneously raising and lowering a number of the barrels, a transfer or conveyor mechanism for simultaneously advancing all barrels from one station to the next while elevated, a means for rotating the barrels in those stations requiring barrel rotation, and a delayed set-down mechanism for obtaining shorter immersion times and/or longer drainage times at those stations where necessary. In the machine illustrated, the barrels are lifted and lowered on the straight-sided portions and right-hand end of the machine, the barrels remaining in the lower or submerged positions at the left end of the machine during the plating operation.

The machine of Figs. 1 to 13 incorporates a number of separate power supply means, all electrical in nature, and it employs chain and V-belt power transmission systems. For example, separate barrel rotating line shafts are provided to rotate the barrels on the straight-sided portions of the machine and individual barrel rotation drives are provided on each curved end. The transfer or conveyor system is powered by a continuous chain and is supplied by one power source. The elevator mechanism and delayed set down mechanism are driven from separate electrical motors, as will be more fully described hereinafter.

Referring now to Figs. 1 and 3 of the drawings, it will be seen that the frame of the machine is formed of two spaced-apart bottom channel iron members 20, 20 running the length of each of the straight sides, a plurality of horizontal bottom I-beam members 21, 21 connecting the side channels 20, and a number of central, vertical columns 22, 22 each composed of a pair of juxtaposed channel irons to form a box-shaped column. Attached to either side of the top ends of the vertical columns 22, 22 (see Fig. 3) is a pair of upper longitudinal channel iron members 23, 23 each of which extends the length of the straight sides. Secured across the upper ends of columns 22, 22 and longitudinal top channels 23, 23 are a plurality of horizontal inverted T-iron top cross members 24, 24. At the ends, the frame is braced by inclined T-iron braces 25, 25. A series of shorter vertical angle iron uprights 26, 26 (see Fig. 3) are located inside the base channels 20, 20 and are secured at the top by horizontally welded angles 27, 27 to form a series of platform members along the straight length of the machine. The latter platform members are braced transversely by diagonal braces 28, 28 (only one of which is shown in Fig. 3). The rectangular platform members serve to support various of the drive mechanisms and the conveyor mechanism, as will be described hereinafter. Slidably attached to a number of the vertical central columns 22, 22 at a convenient height above the floor are a number of inverted T-iron or channel iron horizontal members 29, 29 which support an integral elevator rail or beam 30, which extends on each side of the machine and is curved to pass around the right-hand end. The members 29, 29 and the elevator beam 30 form an elevator chassis. About the central frame thus defined is located a series of tanks. The tanks (Fig. 3) are supported above the floor on transverse I-beams 31, 31 by an outer support 32 and an inner channel iron support 33 secured atop bottom base channels 20, 20 in order to keep the tank bottoms dry and free of corrosion.

Barrel carriage assembly

A plurality of horizontal plating barrels are carried on the machine frame just described, each by an individual carriage assembly, the details of which are shown most

clearly in Figs. 3 and 6 of the drawings. The barrel carriages run on the channel-shaped elevator rail or beam 30 which rests on the horizontal rail supports 29, 29 when the beam 30 is elevated during transfer. Each individual barrel carriage (Fig. 3) comprises a rectangular, vertical frame having two vertical side members 40 and three horizontal cross members 41 (Fig. 6). Carried in roller slides 58, 60 located in the middle of top and bottom cross members 41 is a single vertical I-beam leg 42. Vertical leg 42 slides up and down in slides 58, 60 as the elevator rail 30 is raised and lowered, thus actuating the lift mechanism, as will be more fully explained hereinafter. The leg 42 carries on its lower end a small wheel 43 which runs along the top of the elevator rail 30 during horizontal transfer operations. Each of the carriage side members 40 have on their top ends an inwardly-extended arm or bracket 44 which carries a horizontal guide wheel 45. The wheels 45 roll in an upper track defined by inner angle iron 47 and outer channel 48 which are secured in spaced-apart relationship to the lower surface of the outer ends of top cross members 24, 24. The upper track extends entirely around the machine. To insure against transverse movement of the carriage, the lower extremities of side members 40, 40 are provided with arms 49 which are secured thereto and extend inwardly and carry on their inner end extremities guide wheels 50. The wheels 50 run in a lower track defined by an inner angle iron 52 and an outer channel iron 53 secured to platform members 27, 27. The inner side 52 and outer side 53 of the track are secured together by bolts and spacers indicated generally in Fig. 3 by the numeral 54. The lower track thus defined likewise extends entirely around the machine.

When the elevator beam 30 is in its down position, the main vertical component of the weight of the barrel and its carriage assembly is taken up by the arm 49 on an Oilite thrust pad 55 which rests on a steel pad 56 secured to the top edge of channel 53. An adjustable gib arrangement 57 secured to arm 49 extends under pad 56 to prevent the vertical movement of the elevator rail 30 and leg 42 from separating the pads 55, 56. The Oilite pad 55 can be tapered inwardly and outwardly from its middle to partially compensate for slant or inaccuracies in the top edge of channel 53 which supports the pad 56. The pad 55 then will rest on either taper and prevent binding of the carriage in its guide tracks.

The lower carriage cross member 41 carries on the middle of its outer side a roller guide 58 which serves to guide leg 42 as the carriage is raised and lowered. A similar roller guide 60 is provided in the center of the upper horizontal carriage member 41 for guiding the upper end of leg 42. The members 40, 40; 41, 41; and 42 with their accessory parts comprise a vertical carriage frame on which are mounted and carried an outwardly extending pantograph barrel suspension.

Barrel suspension

Near the upper ends of the carriage side members 40, there is rigidly attached to vertical members 40, 40 a rectangular frame composed of a pair of lower horizontal members 70, 70, a pair of upper horizontal members 71, 71 (only one of each being visible in Fig. 3), and a pair of longitudinal angle iron cross bars 72, 72. The frame members thus provided form a rigid platform on which is mounted an individual power take-off assembly for a V-belt driven barrel rotation mechanism, as will be explained more fully below. Pivotaly attached to each of the upper horizontal frame members 71 is an outwardly extending, upper parallelogram or pantograph suspension arm 75 (see Fig. 6) between which is an inner cross bar 76 and an outer cross bar 77. Likewise, pivotaly attached to each of the lower frame members 70 is an outwardly extending lower pantograph suspension arm 78. Between the latter is a cross bar 79. Rigidly attached to lift-dip leg 42 is an outstanding lift bracket

80. The latter is connected to cross bar 76 by a vertical, pivotable Y-shaped linkage 81. The arms 75, 75 and 78, 78 together with cross bars 76, 77 and 79 and linkage 81 form a set of pantograph arms which are lifted up and down by vertical up-and-down movement of lift-dip leg 42. The lift bracket 80 and/or the Y-linkage 81 can be made adjustable to permit shorter or higher lifts with a given lift leg 42. The latter also could be made adjustable as to length, if desired. The distance of upward travel of the elevator rail 30, however, actually is determined by electrical limit switches governing the elevator as will be explained more fully hereinafter. The distance of downward travel of the arms 75, 78 is limited by the location of a stop plate 74 attached to the top end of leg 42, the plate 74 coming to rest on the top rollers of upper roller guide 60 when the leg is in its lower position and the elevator beam 30 has been lowered to its bottom rest position some distance below wheel 43. The plate 74 also can be made adjustable, if desired, to vary the depth of immersion.

At the ends of pantograph arms 75, 75 and 78, 78 on the projecting ends of horizontal cross bars 77 and 79, there is suspended a pair of vertical barrel hanger arms 82, 82. The ends of the pantograph arms 75, 75 and 78, 78 are fitted with U-shaped saddles 83, 83. In the saddles 83, 83 carried by the arms 75, 75 the cross bar 77 is fitted, and into those carried by the lower arms 78, 78 the cross bar 79 is fitted. The hexagonal plating barrel 84 is suspended in bearings located in the vertical barrel hanger arms 82, 82. The barrel 84, therefore, will be lifted vertically in a slight inward-upward arc by the suspension assembly formed by arms 75, 75 and 78, 78 and cross bars 76, 77 and 79.

It is easily seen that instead of the horizontal type of barrel illustrated, each of the vertical barrel hanger arms 82, 82 could be replaced by arms, hooks or hangers for supporting non-rotating baskets, plating racks and the like. The use of horizontal rotatable plating or coating barrels is much preferred, however.

For plating or electro-cleaning, there is attached to the upper ends of each of the carriage uprights 40, 40 a spring-loaded, pivotable electrical contact shoe 85, which makes contact with an insulated bus bar 87 suspended from the upper horizontal frame members 24, 24 on brackets 86, 86. Cathode cables 88, 88 secured to each of the upper pantograph suspension arms 75, 75 serve to connect the contact shoes 85, 85 with shorter, expendable lower cables 89, 89. The latter connect with cathodes (not shown) located inside the barrel 84. Ball-type anode containers 240, 240 are suspended in the tank on each side of the barrel as shown in Figs. 3.

The electrical circuit thus described furnishes current for any plating or electrocleaning stations. The tank shown at the left in Fig. 3 is not electrified.

Barrel rotating mechanism

The lineshaft drive mechanism will be described before the individual power take-off units. There is a lineshaft on each long, straight side of the machine, one of the latter being indicated generally in Fig. 2 by the numeral 90. The lineshafts 90, 90 are suspended on arms 95 which depend from the upper central horizontal T-iron cross members 24 secured across the top of longitudinal channels 23. A bracket 91 is mounted on the side of each of channels 23 between upper horizontal cross beams 24. On each of these brackets are mounted a direct-coupled electric motor and reduction gear 92. The lineshafts 90, 90 are driven by a triple roller chain drive, indicated collectively by the numeral 93. The lineshafts 90, 90 (one on each straight side of the machine) are supported in bearings 94 secured to a plurality of the downward hanging arms 95. At intervals opposite each station along the machine, the lineshafts 90, 90 are provided with power take-off spur gears 96 each having an attached tapered cam 97 in the direction facing

the approaching barrel carriages in order to facilitate engagement with individual barrel rotation take-off gears. This arrangement is very similar to a shrouded gear. The leading and trailing edges of the teeth of gears 96 are chamfered to facilitate meshing.

The lineshaft 90 shown in Fig. 2 is compounded on its right-hand end to reduce the rate of rotation in the last washing and post-treatment stations. Fig. 5 shows an enlarged view of the circled area of Fig. 2 wherein the lineshaft 90 is shown to carry a small end gear 98 which meshes with a larger gear 99 carried by the compounding shaft 100. On the opposite end of the compounding shaft 100 a small gear 101 meshes with a larger gear 102 on the lineshaft stub end or continuation 103 with the net result that the rate of rotation of the stub-shaft end 103 is such that the end barrels will rotate something like 1-2 R. P. M. as against 6 R. P. M. for those connected to main section of lineshaft 90. This compounding arrangement can be varied to deliver any desired rate of barrel rotation at any station. It also may be designed to provide slower rates of rotation than is possible to obtain with individual geared motor drives.

The individual barrels are driven off lineshafts 90, 90 by their individual power take-off mechanisms meshing with lineshaft gears 96. The individual power take-off mechanisms are more clearly illustrated in Figs. 3 and 7, particularly the latter. As indicated above, the individual power take-off units are mounted, one on each carriage, on the platform formed by the lower horizontal members 70, 70 and a pair of longitudinal angles 72, 72. A small spring-loaded gear 111 is carried in a pair of arms 112, 112, the latter being integral with a second pair of arms 113 set at an angle thereto, the arms 112, 113 forming a rocking assembly which is pivoted on shaft 114 and supported by spring 115 and bracket 116. The shaft 114 is journaled in two upstanding ends of a shaft support housing 117. Also attached to the shaft 114 is a second, fixed gear 118 which meshes at all times with the spring-loaded gear 111. Thus, the small gear 111 first makes contact with the tapered face 97 of lineshaft gear 96 and is biased outwardly a short distance and at an angle until its teeth fall into smooth full-face engagement with the teeth of the former. The gears 96, 111 and 118 form an epicyclic gear train. Damage to the teeth of both gears is prevented by this arrangement since the gear 111 remains in engagement with gear 118, and, as will be seen in Fig. 7, the cam 97 and the hub 111a of gear 111 are in contact to prevent binding by too deep engagement of their teeth. The shaft 114 thus is driven, the rotation being transmitted to a V-belt pulley 119 on the end thereof. A V-belt 120 runs over sheave 119 down to a drive sheave 121 located on the vertical barrel hanger arm 82 and returns over the top of an adjustable idler pulley 122 located in the lower pantograph arm 78. The arms 75, 75 and 78, 78, together with sheaves 119, 121 define a belt transmission system which has a constant length during upward and downward movement of the barrels.

Referring now to Fig. 6, the V-belt drive pulley 121 is attached to a short pinion shaft 123 located in barrel hanger 82. On the inner end of shaft 123 is a pinion gear 124 which meshes with a second inner gear 125 carried by a second short shaft 126 located in arm 82, the shaft 126 in turn carrying another gear 127. Gear 127 in turn meshes with a gear 128 carried on a shaft 129 below shaft 125. Gear 128 meshes with a large ring gear 130 attached to the hub 131 of the barrel 84. Thus, the V-belt 120 actuates the vertical gear train carried on the hanger 82. The lineshafts serve to rotate the barrels only on the two straight-sided lengths of the machine, however. On each of the curved ends of the machine separate drive motors and gearings are provided in the machine illustrated, although gearing connected to the lineshafts could be substituted therefor. It is also to be understood that instead of the lineshafts and end

drives, an individual gear head motor could be mounted on each carriage with a trolley-type power take off.

Only the individual barrel rotating drive for the right end of the machine is shown in detail in Figs. 11-13 of the drawings. It is to be understood that a similar means is provided at the opposite left-hand end, as is indicated in Fig. 1. In Fig. 11, the projecting ends of the upper longitudinal top channel beams 23, 23 serve as a support for a base plate 140 to which are attached a downwardly-depending gusset plate 141 and a box-shaped member 142. On one side of plate 141 is mounted an electric motor 144 having tension-adjusting means 144a incorporated in its base. On the other side of plate 141 is mounted a side-mounting reduction gear 145. The motor 144 drives the reduction gear 145 by means of a V-belt drive indicated generally by the numeral 146. A large spur gear 147 is mounted in bearings 148, 148 which are fitted into the box-shaped supporting member 142 (as shown in Fig. 12). The reduction gear 145 carries a pinion gear 149 which meshes with the large drive gear 147. Like the lineshaft gears 96, 96, gear 147 has a beveled cam 147a attached to its face and facing the direction of approach of the barrel carriages. The flexible individual power take-off gears 111, 111 on the barrel carriages make contact with the tapered cam 147a and flex sufficiently to make an angular full-face sliding engagement with gear 147. The leading edges of gears 111 and 147 are chamfered to facilitate this type of engagement. In the machine illustrated the drive mechanism of Figs. 11-13 rotates the barrels at about 1 R. P. M. The individual drive located in the left-hand rounded end of the machine is similar in details and mounting but for the exemplary cyanide zinc plating process utilizes a reduction gear adapted to rotate the barrels at 6 R. P. M., the same speed as is derived from the lineshafts 90, 90.

Conveyor transfer mechanism

There have been described thus far the details of the barrel carriage, barrel pantograph suspension, and barrel rotating drive mechanisms. The carriages are moved around the machine by means of a chain drive conveyor mechanism indicated generally in Figs. 1 and 2 and shown in greater detail in Fig. 8. As will appear most clearly in Fig. 2, a motor 150 is mounted at one side of the machine adjacent the floor and in the left-hand end of the machine on a support 151 of channel iron secured atop bottom horizontal frame members 21, 21. A small platform located directly above and slightly toward the center of the machine with respect to the motor 150 is composed of four short, vertical angle iron columns 152, 152. Atop the latter platform is mounted a speed reducing unit 153. On an adjacent platform formed of a pair of longitudinal I-beams 154, 154 secured atop members 27, 27 and a pair of horizontal top channel iron members 155, 155, there is secured a pair of sprocket-supporting hubs 156, 156. The motor 150 drives the speed reducer 153 by means of a triple V-belt drive composed of a sheave 157 on the motor, three V-belts 158, 158 and a large sheave or pulley 159 located on the speed reducer 153, the sheave 159 incorporating a torque-limiting clutch, not shown. The speed reducer 153 is of the top take-off type, having a horizontal sprocket 160 mounted in its top. In the hubs 156, 156 there are mounted a pair of identical chain sprockets 161, 161. The speed reducer 153 drives sprockets 161, 161 by means of a single width, roller-type chain 162. The chain 162 travels over an idler sprocket 163 carried in a hub 164 which is mounted on channels 155, 155.

Also mounted on each of hubs 156, 156 there is a conveyor drive sprocket 165 for engaging a main conveyor chain 166 on each side of the machine. The individual carriages are adjustably secured to the conveyor chain 166 by means of two bolts 168, 168 which replace chain pins, the bolts 168 being attached to a block 167. The

block 167 is fitted into a slot in arms 169, 169 so as to slide in and out to provide clearance for pivoting of the connection in the curved ends of the machine. This arrangement also permits self-adjustment in order to prevent binding due to frame inaccuracies and the like. Each of the arms 169, 169 is rigidly attached (see Fig. 3) to a vertical barrel carriage member 40. The chain 166 (see Fig. 8), runs in a protective trough 166a which is attached to the horizontal I-beams 155, 155.

The conveyor chain 166 thus extends entirely around the machine and simultaneously moves all individual barrel carriages a given distance which distance is referred to as the "stroke" of the machine. The stroke of the machine is determined by the distance between the centers of the individual tanks. In the machine illustrated, a typical stroke would be about four feet.

As will be seen in Fig. 1, the curved ends of the machine are provided with a plurality of idler sprockets 170, 170, each of which are attached to individual arms 171, 171, the latter in turn being attached to curved, horseshoe-shaped members 172, 172. The horseshoe members 172, 172 in turn are attached to vertical columns 22, 22. The sprockets 170 guide and support the chain 166 in the curved end sections of the machine.

Elevator mechanism

In order to transfer the barrels from one station to another, they must be lifted to clear the edges of the tanks. In the machine illustrated, this is performed by raising the elevator chassis which is composed of rail 30, horizontal arms 29, 29 and vertical lift legs 185, 185. As will be noted from an inspection of Fig. 1, the elevator rail or beam 30 is not continuous, that is, it does not extend entirely around the machine. At the left-hand end of the machine in Fig. 1, the barrels are not elevated and they remain immersed in the curved plating tank.

At the right-hand end of the machine, in the final hot water rinse, unload and load stations, the barrels are raised and lowered simultaneously with the barrels of the straight-sided portions of the machine. The elevator rail 30, therefore, begins just inside the end of the continuous curved left-hand plating tank 180, as seen in the plan view of Fig. 1, and continues along the length of the lower leg of the machine around the curve of the right-hand end of the machine and the full length of the straight upper leg of the machine to a point of termination just inside the upper end of the tank 180. Both ends of elevator rail 30 are provided with hinged, spring-loaded or counterweighted pick-up or drop-off fingers, respectively, 181 and 183, in order to disengage or engage the first and last barrels. In the upper leg of the machine, as will appear in Fig. 6, the end of the elevator rail 30 is provided with a normally-erect spring-loaded or counterweighted drop-off finger 183 (see Fig. 6) which is depressed by the wheel 43 carried by each of the vertical lift-dip legs 42, 42. When each carriage has travelled out to the end of finger 183, the drop-off finger 183 is disengaged when the elevator rail continues its downward movement below the lowest position of the barrel. In this position, the spring or counterweight causes the finger 183 to pivot to the vertical position in which position it will clear the carriage wheel 43 in the next succeeding upward movement of the elevator rail 30.

The pick-up finger 181 attached to the end of the elevator rail 30 in the lower leg of the machine is normally extended so as to engage in its upward travel the carriage then located at that station. When the rail 30 is lowered, however, another barrel has moved into position and the finger 181 will be flexed upwardly by contact with the leg 42 or the wheel 43 and then dropped back into extended position when the rail 30 has continued below the pick-up position. The fingers 181, 183 prevent damage to the barrel carriage and provide a means for smoothly engaging and disengaging with carriages located in the two stations.

The elevator rails 30, 30 are lifted vertically by the T-shaped lifting mechanism formed by horizontal rail support members 29, 29 and vertical lift pieces 185, 185 which are slidably supported by the vertical columns 22, 22. The lift pieces 185, 185 (see Fig. 3) have brackets 186, 186 located top and bottom, the latter having outer guide rollers 187, 187 on either side thereof to smoothly guide the up-and-down movement.

The elevator mechanism is powered by a motor 188 mounted on an extension of the conveyor drive platform. The motor 188 drives a speed reducer 189 by means of a V-belt drive sheave 190, the latter incorporating a torque-limiting clutch (not shown). The speed reducer 189 has a pair of take-off sprockets 191, 191, one on each side. Along the top of the longitudinal top frame members 23, 23, there are secured a plurality of brackets 197 (Fig. 4) which support a series of short shafts 196. Attached to the shafts 196 are a number of outer sprockets 193 and inner sprockets 194. The sprockets 191 engage a pair of elevator chains 192, 192a which extend vertically and pass over the outer sprockets 193, 193a shown in Fig. 4. The chains 192, 192a pass over the second set of outer sprockets 193b, 193c and then down to a counterweight 192b slidably supported in column 22. The other ends of conveyor chains 192, 192a are wrapped around reducer sprockets 191, 191 and brought upwardly to be attached to either end of a chain block 198. The distance of travel of block 198 is indicated in dotted line. From the top of block 198, two pairs of chains 201, 202 are secured and extend vertically to pass over the inner sprockets. Chains 201, 201 pass over inner sprockets 194, 194a and then are brought along the top to the left-hand end of the machine, one passing over the top of inner sprocket 194b and down under sprocket 195 attached to lift piece 185 and secured at its end to channel 23 at 203. The other of chains 201 is continued down the length of the machine so as to pass over sprocket 194c, then down under another lift piece sprocket 195 and its end finally secured to channel 23 at 204. The other pair of chains 202, 202 are brought upward over sprockets 194d, 194e and then passed lengthwise to the right-hand end of the machine. One of the latter chains 202 is passed over sprockets 194d and 194f, then down under still another lift piece sprocket 195 and attached to channel 23 at 205. The second of chains 202 is brought up over sprocket 194e and extended the length of the right-hand end of the machine to pass over sprocket 194g, then down under lift piece sprocket 195 and its end secured to the channel 23 at 206. Thus, when reducer 189 is energized in the direction of the solid arrow, a downward pull is exerted on chains 192, 192, block 198 and chains 201, 201 and 202, 202 so as to exert an upward pull on all vertical lift pieces 185, 185, the counterweight 192b meanwhile travelling downwardly. When the reducer 189 is energized in the direction of the dotted arrow, the vertical lift pieces 185, 185 will be lowered and the counterweight 192b will be raised. The main function of the counterweight 192b is to maintain a tension on the chains 192, 192 to keep them wrapped around speed reducer sprockets 191, 191.

The lifting mechanism just described raises the elevator rail 30 and all barrel carriages in contact therewith. At those stations such as the bright dip station where shorter immersion times are required, a secondary elevating means is provided for advance-lift, delayed set-down or skip-station function.

Delayed set-down mechanism

This secondary elevating mechanism is shown at the bright dip station in the right end of the machine, general details being shown in Fig. 2 and in more detail in Fig. 9. As shown, the mechanism is used as a delayed set-down mechanism. It is to be understood that it can be used as an early lift or skip mechanism, if desired. At this station, two vertical channel iron members 210, 210 sim-

ilar to columns 22, 22 (see Fig. 10) are provided as vertical guides. Two pairs of outside vertical arms or brackets 211, 211 are attached top and bottom to a flat shoe or plate 212 riding on the flanged edges of channels 210, 210. The arms 211, 211 each carry two pairs of large, tapered rollers 213, 213 (see Fig. 10), one pair at top and a pair at the bottom. The rollers 213, 213 fit inside the outstanding channel edges and guide the mechanism in its vertical movement up and down. An integral projection 214 of the plate or shoe 212 rides on the top of the elevator rail 30. This projection or bracket 214 has tapered edges (not shown) to facilitate the climb of wheel 43 to a position atop it. Attached to the vertical members 210, 210 are three pairs of arms. The upper of these pairs of arms 215, 215 bear a shaft 216 on which is secured a chain sprocket 217. A middle pair of arms 218, 218 bear a shaft 219 on which is attached an idler chain sprocket 220. The lower arms 221, 221 carry a shaft 222 on which is secured sprocket 223. A motor 224 is directly connected to a speed reducer 225. The speed reducer 225 drives a sprocket 226. A chain 227 passes over sprocket 226, idler sprocket 220, thence over lower sprocket 223 and up between the uprights 210, 210 to pass over top sprocket 217.

Attached to the face of plate 212 is a pair of brackets 228, 228 in which is supported a rod 229. At the middle of rod 219 there is attached a dog 230. The dog 230 is spring loaded through a pair of arms 231, 231 and tension springs 232, 232 so as to maintain continuous contact with chain 227. When the elevator beam 30 is raised by the above-described elevator mechanism the plate 212 carried by bracket 214 is also raised vertically until it reaches the position shown in dotted line at top of Fig. 9. When this is done, the dog 230 slides over the chain links due to its shape and angular disposition. When the elevator rail 30 is lowered, however, the step-shaped end of the dog 230 engages the chain 227 and prevents the lift leg 42 (which is riding on top of bracket 214) from dropping to the lower position. When the reducer 225 is driven in the direction of the solid arrow, however, the chain 227 is slowly lowered to the lower position and the barrel likewise is lowered. When the elevator rail 30 is raised again, the delayed set-down mechanism also is raised, the dog 230 sliding over the chain as before. If the motor 224 is reversed, the same mechanism can be employed as an advance-lift mechanism. In this latter situation, the speed reducer 225 is energized in the direction of the dotted arrow. An advance-lift mechanism can be employed to raise a plating barrel to the upper transfer position in order to reduce immersion time and to allow greater time for solution drainage. If the motor 224 is not energized, the mechanism just described will function to cause a barrel to skip the station because the bracket 214 will remain in the upper position to be picked up by the elevator rail on the next cycle.

Controls

The machine of the invention is provided with limit switches to control the various elevating, transferring and delayed set-down motions. The various drive motors are controlled by electrical controls operating in conjunction with the limit switches and electrical timers. These control elements combine to produce a pre-selected sequence of operations which advance the barrels from one station to another and maintain them immersed on a pre-selected time basis. Fig. 14 shows a complete wiring diagram of the controls for the machine of Figs. 1-13. The diagram of Fig. 14 incorporates controls for the motor of a blower of a ventilating system which is not shown in any of the drawings since it is only an accessory to the plating machine. Nevertheless, its operation is necessarily integrated with the plating machine proper.

Since the control circuit of Fig. 14 controls the operation of the various mechanisms described above, the

description of the control circuit will be incorporated with a detailed explanation of the stepwise operation of the integrated machine. It must be borne in mind that the various limit switches are too small to appear in any of the drawings. Their exact location, as will be understood, may be varied somewhat according to the type of operation desired of the machine.

As shown in Fig. 14 power is supplied to the motors and control circuit through a set of three-phase power input leads 300, 300 which are attached to a main power switch 304. From the latter, three power leads 301, 302 and 303 are taken off to supply the eight motors of the machine and accessory parts. The motors are identified both by letters M-1 through M-8 and by suitable legends indicating their function. All of the motors are connected in parallel with all of the barrel rotate motors being controlled by one relay (CR2) and each by an overload switch.

A transformer 305 is provided for isolating the control circuit and supplying current at the correct voltage. The two terminals of the transformer are connected to two leads 306, 307 which are connected to two hand-operated override stop switches 308, 309, the former located in the blower control circuit and the latter in the barrel rotate control circuit. The latter switches are normally closed when the machine is operating properly and are intended to be tripped by the operator when it is desired to stop either the blower or the barrel rotate motors. The blower motor circuit is controlled by relay CR1 which has a set of contacts CR1-1 in the blower motor circuit. The barrel rotate motor circuit is controlled by relay CR2 having several sets of contacts, CR2-1 located in the main control circuit and CR2-2 in the barrel rotate motor circuit ahead of the motors M1-M4. Blower motor relay CR1 is energized by pressing start button 310. Barrel rotate relay CR2 is energized by pressing start button 311. When this is done, the ventilator blower is running and the barrels are rotating in all stations except the load and unload stations.

The main control circuit is energized by pressing main motor start switch button CM connected between leads 306 and 307. As shown, the transfer conveyor motor M7 is controlled by a relay CR3 having a set of contacts CR3-1 in the motor circuit, the elevator motor by a reversible motor starter relay CR4 having a set of contacts CR4A in the circuit of an up coil and a set of contacts CR4B in the circuit of a down coil, and the delayed set down motor by relay CR5 which has a set of contacts CR5-1 in the motor circuit.

A mechanically-held relay LU1 is the traffic center of the control circuit. This relay is tripped by the dwell timer TR2 and functions to energize the elevator, transfer and set-down motors. To do this, relay LU1 has four sets of contacts, LU1-1 in the circuit of the transfer motor relay CR3, LU1-2 in the elevator up limit switch (LS1) circuit, LU1-3 in the circuit of the transfer limit switch LS2, and LU1-4 in the circuit of the set down limit switch LS3 and elevator down limit switch LS4.

The circuit is shown in Fig. 14 with the machine and its parts in normal starting position, that is, with the elevator rail up and the up limit (LS1) and transfer limit (LS2) switches operated. In this position, the machine is ready to transfer. A loaded barrel is in the load station ready for transfer to the first, or neutralizing station.

The pressing of main motor control button CM energizes the transfer starter relay CR3 through up limit switch LS1-1 and contacts LU1-1. This starts the transfer motor M-7 and the barrel carriages start moving. This movement breaks contact between a cam on one of the carriages and transfer limit switch LS2. This completes the circuit through LS1, LS2 and LU1-2 to hold relay CR3 in operation. When the transfer is

complete, the cam on another carriage trips transfer limit switch LS2 and breaks the CR3 circuit. This stops the transfer motor. At the same time, tripping of LS2 completes the circuit to elevator starter down coil CR4B through LU1-3, LS2, and elevator down limit switch LS4. At the same time, a circuit is opened to dip relay timer TR1 through relay LU1-4, transfer limit switch LS2 and delayed set down limit switch LS3. The elevator motor then is running and the chassis is moving down. The carriage in the delayed set-down (bright dip station), however, remains up. When the chassis has moved down a short distance, it releases the elevator up limit switch LS1. At the bottom of its drop, the chassis operates the down limit switch LS4 which breaks the circuit to the elevator down coil CR4B and stops the elevator motor.

Simultaneously, operation of limit switch LS4 completes the circuit to dwell timer TR2. In this position, all barrels except that in the bright dip station are immersed in the solutions and are rotating therein. After a selected interval, the set down relay timer TR1 times out and completes the circuit to set down motor starter relay CR5. The set down mechanism then starts to move down. At its lowest position, it trips set down limit switch LS3 which resets set down timer TR1 and drops set down motor starter relay CR5. In this position, all barrels except those at the load and unload stations are rotating immersed in the treating solutions.

After an interval of such operations, the dwell timer TR2 times out and completes the circuit to the up coil of the elevator motor starter CR4A and trips mechanically held relay LU1. Both the chassis and the delayed set-down section begin to move up. This releases elevator down limit switch LS4 and the delayed set down limit switch LS3 and allows dwell timer TR2 to reset. The elevator motor starter up coil CR4A is held in by a circuit established through LS1 and contacts LU1-3. When the chassis reaches its upper position, the up limit switch LS1 is tripped dropping CR4A and picking up transfer motor starter relay CR3 through LU1-1. This starts the transfer motor M-7 and the second cycle of the machine begins. The machine will continue to move through consecutive cycles of the type described.

The circuit shown in Fig. 3 incorporates a number of safety limit switches. Should either up limit switch LS1 or down limit switch LS4 fail to operate, the elevator would continue to operate until either up safety limit switch LS5 or down safety limit switch LS7 would be tripped stopping the elevator motor and lighting the indicating light. Should transfer limit switch LS2 either fail to operate or fail to release, the conveyor would continue to operate until transfer safety limit switch LS6 was tripped, the machine stopped and the indicating light turned on. Should up limit switch LS1 fail to release, the machine will continue to operate until the carriages are all down and the dwell time is completed, the machine then stopping until LS1 releases. Should down limit switch LS4 fail to release the machine will continue to operate until the transfer is complete at which time it will stop until LS4 is released. Thus provided, the machine cannot operate in such a manner as to suffer damage. The indicating light will promptly notify the operator and enable him to locate the trouble.

The machine of this invention can be employed to clean, pickle, prepare and plate or coat articles in bulk. In addition to the zinc plating process illustrated, the machine may be employed to apply copper, nickel, cadmium and many other metal platings, or phosphate, oxalate and other chemical coatings. The machine utilizes the efficient high capacity horizontal type of plating drum which permits high continuous output, efficient operation, and the obtaining of high quality plated coatings. The machine is easily serviced and maintained because the guide rails, sliding mechanisms, conveyor and elevator chains, lineshafts, and other drive mechanisms are

centrally located. Ordinary grease and oil may be employed since drippings will not fall in the tank. Corrosion of gears, sprockets and chains is effectively inhibited by such lubricants. The barrel rotate devices are V-belts which require little or no lubrication and are resistant to plating and acid fumes. The machine eliminates many duplicate accessories and is less expensive to build and maintain for a given output capacity than equivalent batch style capacity.

While it will be apparent that the preferred embodiment of the invention herein disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. Apparatus for plating and chemical treatment of metal articles, comprising a plurality of individual carriage frames mounted for horizontal travel, an upper and a lower pantograph arm pivotally attached to each said carriage frame and extending outwardly therefrom, a work-supporting arm suspended between the said arms, the said carriage frame forming with said pantograph arms and work-supporting arms a pivotable parallelogram suspension capable of being raised and lowered about the points of attachment on said carriage frame, and means pivotally attached to said suspension at a point outwardly from said carriage frames for raising and lowering said suspension.

2. A machine as described in claim 1 and further characterized in that said raising and lowering means comprises an elevator beam in contact with a vertical lift leg carried on each said carriage frame, said vertical lift leg being pivotally attached to said suspension at a point outwardly from said carriage frames.

3. An automatic machine for plating and chemical treatment, which machine comprises an elongated, centrally-located frame, a guide track extending around the outer periphery of said central frame, a plurality of individual carriage frames mounted for movement around said central frame in said guide track, an upper and a lower pantograph arm pivotally attached to each said carriage frame, a work-hanger arm suspended from the outer ends of said pantograph arms, means pivotally attached to one of said pantograph arms outwardly from said carriage frame for raising and lowering said pantograph arms and the said work-hanger arms and means for moving said carriages around said central frame.

4. A machine as claimed in claim 3 and further characterized in that said raising and lowering means comprises a vertical lift leg slidably carried by each said carriage frame and pivotally attached to one of said pantograph arms at a point spaced outwardly from said carriage frame, and an elevator beam which engages said lift legs so as to lift their said attached pantograph arms and work-hanger arms.

5. An automatic machine for plating and chemical treatment of metal articles in bulk, which machine comprises an elongated, centrally-located frame, guide tracks extending around said central frame, a plurality of individual vertical carriage frames mounted in said tracks for travel around said machine, an upper and a lower pantograph arm pivotally attached to each said carriage frame and extending outwardly therefrom, vertical barrel hanger arms suspended from the outer ends of said pantograph arms, a horizontal barrel suspended between said barrel hanger arms, means for moving said carriages around said guide tracks, and means pivotally attached to one of said pantograph arms outwardly from said carriage frames for lifting and lowering said pantograph arms.

6. A machine as claimed in claim 5 and further characterized in that said lifting and lowering means comprises an elevator beam mounted on both sides of said central frame below said pantograph arms, a lifting mem-

ber extending from said elevator beam to each pair of said pantograph arms and pivotally attached thereto at a point spaced outwardly from said carriage frame, and an elevator including a plurality of central inverted T-shaped members which engage said beam on both sides of said frame and a means for lifting and lowering said T-shaped members.

7. In an automatic machine for plating and chemical treatment of metal articles, which machine has a central frame adapted to be surrounded by a plurality of separate treating stations, the improvement which comprises a plurality of vertical carriage frames mounted for travel around said machine, a pantograph suspension pivotally attached to each said carriage, a vertical lift leg slidably carried by each said carriage frame and pivotally attached to said pantograph suspension at a point outwardly from said carriage frames, primary elevator means for simultaneously engaging and lifting said lift legs, transfer means for moving said carriages around said machine while in the elevated position, and a secondary elevator means at those stations requiring shorter immersion and longer drainage times for engaging one of said lift legs while said last-named means is advancing said carriages, for supporting said lift leg and its pantograph suspension and for lowering said leg and said suspension all independently of said first-named elevator means.

8. A machine as defined in claim 7 and further characterized in that control means are provided which operate said primary elevator, said transfer means and said secondary elevator means in ordered and timed sequence such that work is progressively advanced around the machine and given a pre-selected sequence of treatments during the circuit of the machine.

9. A machine as claimed in claim 7 and further characterized in that each said pantograph suspension supports a horizontal, rotatable barrel and means are provided around said machine frame for rotating said barrel in both immersed and elevated positions in those stations requiring barrel rotation.

10. In an automatic machine for the plating and chemical treatment of metal articles, which machine has a central frame surrounded by a plurality of separate treating stations, the improvement which comprises a plurality of individual carriage frames mounted for travel around said machine, a barrel suspension attached to each said carriage frame and extending outwardly therefrom, a horizontal, rotatable barrel attached to each said suspension, a lineshaft mounted along the said central machine frame, a lineshaft spur gear on said lineshaft opposite those stations requiring barrel rotation, a cam associated with each said lineshaft gear and having a tapered face facing against the direction of travel of said carriages, a power take-off device mounted on each said carriage including a spring-biased, pivotally-mounted gear for engagement with said cam-faced lineshaft gears and a fixedly mounted gear meshing with said spring-biased gear, and means associated with each said suspension for transmitting rotational power from said fixedly mounted gear to each said barrel.

11. A machine as claimed in claim 10 and further characterized in that said lineshaft extends along each side of the straight-sided length of said machine, and an individual barrel rotation gear drive is provided for engaging said spring-biased gears in a curved portion of said machine.

12. In an automatic machine for plating and chemical treatment, which machine has a central frame adapted to be surrounded by a plurality of separate treating stations, the improvement which comprises a plurality of vertical carriage frames mounted for movement around said machine, a pantograph suspension pivotally attached to each said carriage frame and extending outwardly therefrom, a

lift leg slidably carried by each said carriage frame and pivotally attached to said suspension at a point outwardly from said carriage frame, an elevator beam suspended from said central frame in a position to engage said lift legs, elevator means for lifting and lowering said elevator beam, a conveyor chain attached to said carriages and adapted to move them around the machine while said suspensions are in an elevated position and control means for operating said elevator means and said conveyor chain to secure progressive and repeated movement of said carriages around said machine.

13. A machine as claimed in claim 12 and further characterized in that a horizontal barrel is attached to the outer ends of each said pantograph suspension.

14. An automatic machine for plating and chemical treatment of articles in bulk, which machine comprises an elongated, central frame, a plurality of treating stations around the outer periphery of said frame, a plurality of individual carriage frames mounted for movement around said central frame, a pair of upper and a pair of lower pantograph arms each pivotally attached to each said carriage frame and arranged to extend outwardly therefrom over said stations, a barrel hanger arm suspended between such upper and lower pantograph arms to form a parallelogram suspension, a horizontal rotatable barrel attached to said hanger arms, a lift leg slidably carried on each said carriage frame and having its upper end attached to said suspension, an elevator beam suspended along said central frame opposite stations requiring barrel elevation, said beam being supported from below by a plurality of inverted T-shaped elevator members slidably suspended from said central frame, means for lifting and lowering said elevator members, a lineshaft along the straight-sided portions of said central frame and having spur gears thereon opposite those stations requiring barrel rotation, an individually-driven barrel rotation gear in a curved end portion of said frame, an epicyclic gear train on each said carriage for engagement with said lineshaft and individual barrel rotation gears, a belt drive and gear train mounted on said pantograph and barrel hanger arms for rotating said barrel, transfer means for advancing said carriages from one said station to the next said station, a delayed set-down mechanism at those stations requiring shorter immersion times and larger drainage times, and control means integrating said elevator means, said transfer means, and said delayed set-down means to secure progressive movement of each barrel around said central frame and through said stations.

15. In an automatic machine for plating and chemical treatment of articles, which machine has an elongated, centrally-located frame surrounded by a plurality of separate treating stations, and a plurality of rotatable barrels mounted for travel through said stations, the improvement which comprises a lineshaft extending along said central frame opposite those stations requiring barrel rotation, a spur gear on said lineshaft opposite each station requiring barrel rotation, a taper-faced cam on said lineshaft in front of each spur gear and facing in the direction of approach of said barrels, and a spring-loaded pivotally mounted gear in engagement with a fixed gear, connected with each said barrel and its mounting, for engagement of said spring-loaded gear with said cam and lineshaft spur gear, and transmission means connecting said fixed gear with said barrel.

References Cited in the file of this patent

UNITED STATES PATENTS

1,210,853	Schettler	Jan. 2, 1917
1,319,872	Jones et al.	Oct. 28, 1919
2,214,262	Todd	Sept. 10, 1940
2,626,621	Curtis	Jan. 27, 1953