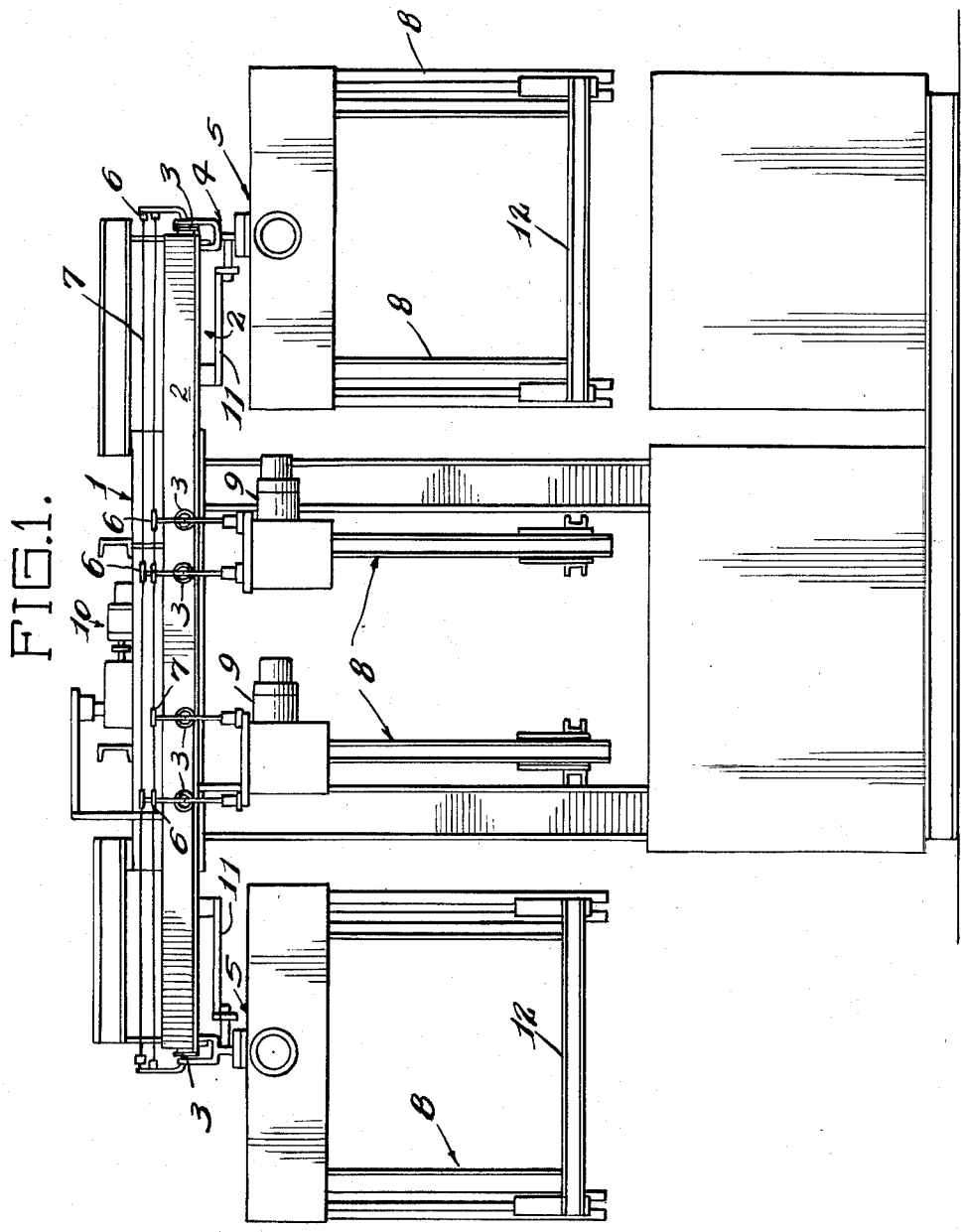
Nov. 1, 1960 G. E. HUENERFAUTH 2,958,330

ELECTRO-PROCESSING OR DIPPING APPARATUS

Filed Nov. 29, 1957 3 Sheets-Sheet 1

FIG. 1.



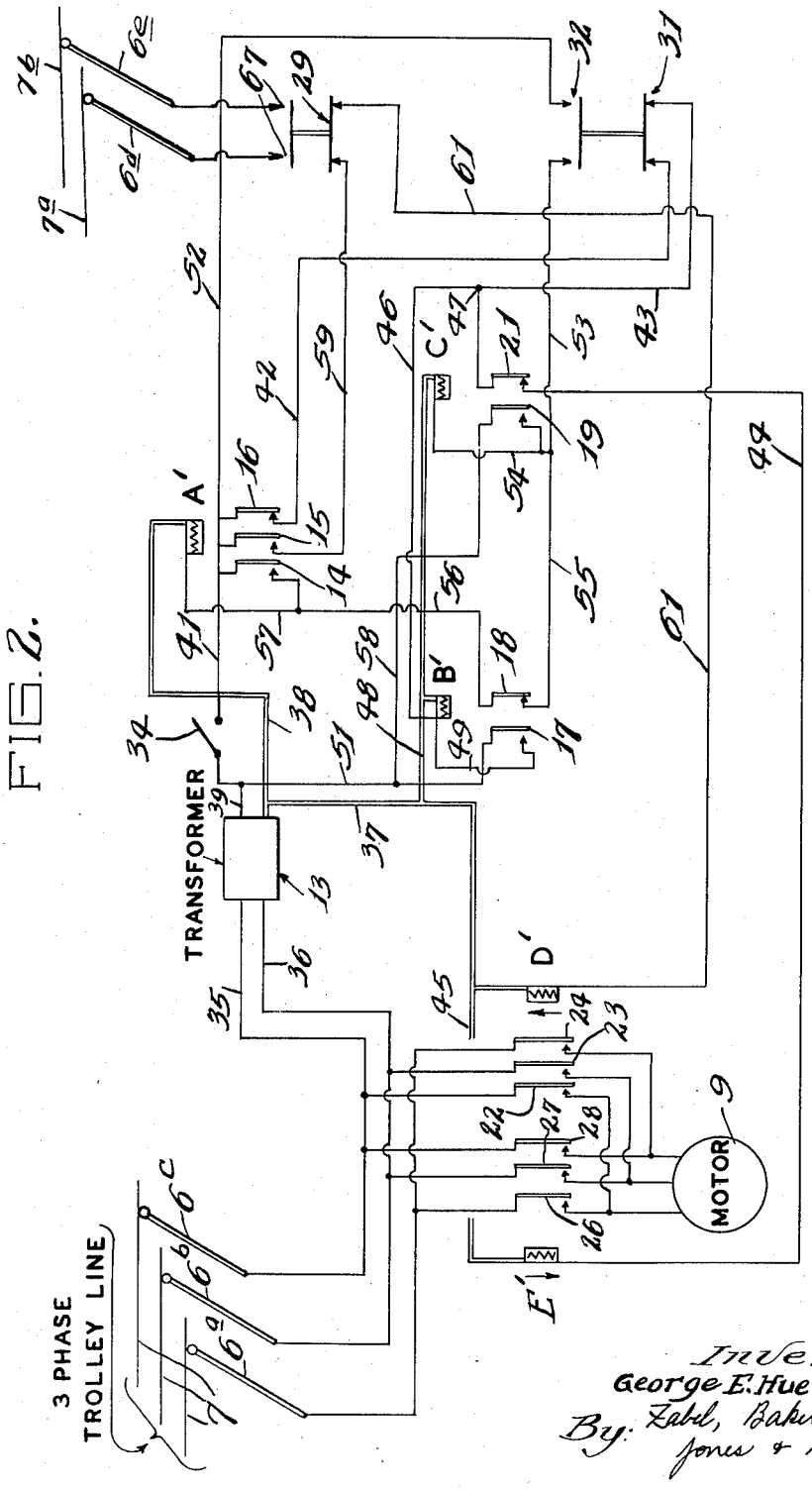
Inventor:
George E. Huenerfauth.
By: Zabel, Baker, York, Jones & Dithmar
Attorneys

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ELECTRO-PROCESSING OR DIPPING APPARATUS

Filed Nov. 29, 1957 3 Sheets-Sheet 2

FIG. 2.



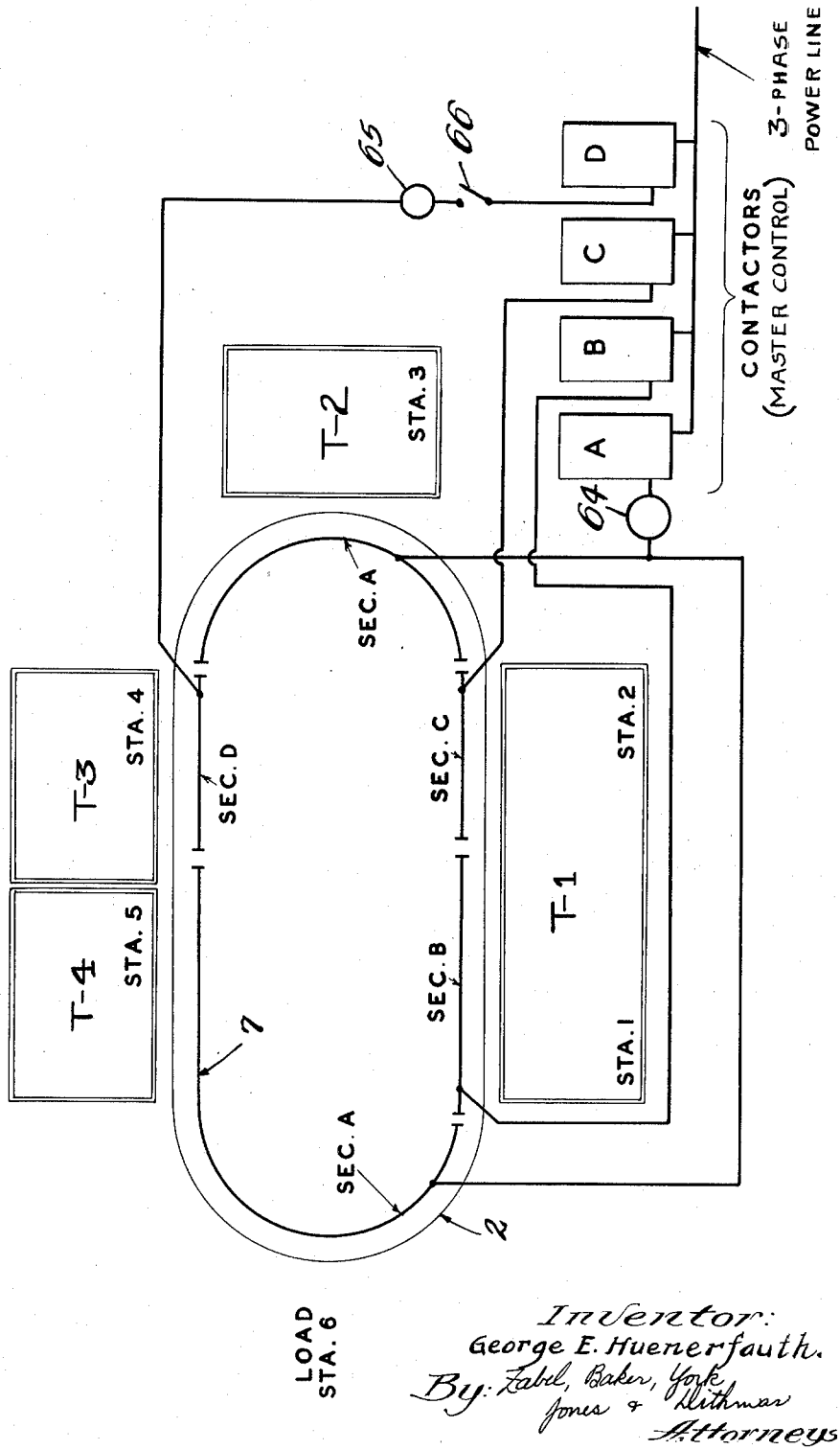
Inventor:
George E. Huenerfauth.
By: Zabel, Baker, York, Jones & Hitchman
Attorneys

Nov. 1, 1960 G. E. HUENERFAUTH 2,958,330

ELECTRO-PROCESSING OR DIPPING APPARATUS

Filed Nov. 29, 1957 3 Sheets-Sheet 3

FIG. 3.



Inventor:
George E. Huenerfauth.
By: Zabel, Baker, York, Jones & Hitchman
Attorneys

United States Patent Office 2,958,330
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2,958,330

ELECTRO-PROCESSING OR DIPPING APPARATUS

George E. Huenerfauth, Park Ridge, Ill., assignor to Crown Rheostat & Supply Co., Elk Grove Village, Ill., a corporation of Illinois

Filed Nov. 29, 1957, Ser. No. 699,755

20 Claims. (Cl. 134—58)

The present invention relates to improvements in electro-processing or dipping apparatus and, more particularly, to a novel apparatus for automatically conveying a plurality of work carriers through a series or sequence of dipping or processing steps such as employed in subjecting the work to electro-processing and similar operations, and to a novel control system therefor.

In the prior commercial type of conveying apparatus for electro-processing, the work is suspended from carriers that are raised and lowered by a common drive mechanism on the machine, and the treatment in all stations has been the same. In an endeavor to obtain variable treatment in different stations, delayed setdowns or skips have been added, but this has required the installation of auxiliary mechanism with separate drives, all at considerable extra expense.

In the present machine all the carriers have been placed in what might be termed a permanent "up" position and with each carrier provided with an individual lift whereby each carrier may be raised or lowered at any time to give a wide range of treatment at designated stations. Each lift and carrier of a multiple series is provided with a motor that can be controlled according to a predetermined cycle or given run which may vary through a wide range; for example, from approximately ten seconds in a single station to approximately one and one-half hours or more in a multiple station of a single machine.

To accomplish the above novel operation, an automatic control is mounted on each carrier which automatically lowers the carrier bar at all times, except when it is at the end of its "down" stroke. At this point, the carrier will automatically go "up," with the motor on each carrier receiving its current supply through trolleys from trolley wires or bus bars which are divided into sections to provide the second point of control. By dividing these trolley wires into sections, a variable treatment at the individual stations is obtained.

It is, therefore, an object of the present invention to provide an electro-processing apparatus comprising a plurality of work carriers arranged for horizontal movement from one station to another, each work carrier comprising a motor-operated lift adapted for vertical movement at each station, whereby work carried by the lift may be lowered and immersed in a processing or treatment bath for a predetermined period of time or dwell intermediate the completion of the downward movement and the commencement of the upward movement at each station, and thereafter by horizontal movement of the carrier be transported to the next station for a subsequent operation.

The present invention further comprehends an electro-processing apparatus having a novel trolley system in which the trolley lines or bus bars are divided into sections or segments with each section controlled by a contactor, and the control of these contactors in turn effecting the automatic raising and lowering of the individual carriers.

Another object of the present invention is to provide

in an apparatus of the character described for the operation in unison of a plurality of work carriers whereby a plurality of work units or articles carried thereby may be treated or processed simultaneously, one after another being subjected to the successive steps of a predetermined process and, upon the completion thereof, removed.

It is a particular object of the present invention to provide an apparatus for electro-processing or other treating operations, but hereinafter referred to generally as electro-processing apparatus, in which the lift of each work carrier is operable independently of that of any other work carrier for immersing work into a bath or treatment tank and lifting such work therefrom.

It is a further object of the present invention to provide a novel means for preventing operation of one or more selected lifts and immersion of work carried thereby at selected stations.

It is another important object of the present invention to provide a control system for such an apparatus whereby, upon the setting of the controls and the pressing of a start and stop button, an entire sequence of steps in the processing of a plurality of work units or objects to be treated can be accomplished progressively and automatically, and continuously without intervention of the operator except again to press the button to cease operation upon completion of a given run.

Other objects of the present invention include the provision of means for prolonging the dwell or period of treatment at selected stations, and the provision of means for retarding or delaying the immersion of work at selected stations to shorten the period of treatment thereat.

Further objects are to provide a construction of maximum simplicity, efficiency, economy and ease of assembly and operation, and such further objects, advantages and capabilities as will later more fully appear and are inherently possessed thereby.

In the drawings:

Figure 1 is a view in side elevation of the electro-processing apparatus.

Fig. 2 is a diagrammatic view of the wiring control for each carrier.

Fig. 3 is a wiring diagram of a layout for the novel electro-processing apparatus provided with six stations and showing the manner in which the trolley wires or bus bars are divided into sections whereby to obtain variable treatment at the individual stations.

Referring in greater detail to the drawings and to the novel illustrative embodiment and diagrammatic disclosure therein shown, the present invention relates to a novel electro-processing apparatus comprising a plurality of work carriers arranged for horizontal movement in sequence from one to another of a plurality of stations arranged about a substantially elliptical track, and each work carrier adapted to be moved vertically by a lift or hoist at these stations whereby work or articles carried thereby may be immersed in a processing or treating tank at one or more of said stations for a predetermined period of time, to dwell at one or more of said stations intermediate the completion of the downward movement of the work carrier and the commencement of its upward movement, or to skip vertical movement at one or more of said stations, when desired. At the completion of the operation or dwell at each of the stations, the carriers are transported by a motor driven horizontal pusher drive mechanism to a succeeding station.

The number of stations and the number of work carriers may vary depending upon the number of stations required for carrying out the process and the number of carriers required for handling the work pieces. Thus, due to the flexibility of the novel apparatus, the limit as to the number of stations depends merely upon the number of steps of the electro-process and the treatment and rinsing

baths accorded the work pieces. This flexibility further permits the installation of equipment in which one or more carriers may be subsequently added or removed, as required.

The present invention further comprehends a novel trolley system in which the trolley lines or bus bars are divided into sections or segments with each section controlled by a contactor mounted in the master control box. The controlling of these contactors in turn effects the automatic raising and lowering of the individual carriers by means of its individual lift or hoist whereby the lifts are controlled entirely by the trolley line being energized and deenergized.

The apparatus of the illustrative embodiment shown generally in Fig. 1 comprises a rigid steel frame construction designated generally by the reference numeral 1 rigidly supporting in elevated position an overhead, substantially elliptical monorail track 2 having a flanged base receiving and supporting thereon flanged wheels 3 with each wheel rotatably mounted on the upper end of an arm of a substantially U-shaped yoke 4 connected to the upper portion of the frame of a depending lift or hoist assembly 5. The arms of each yoke straddle the track with a wheel 3 carried by each arm and these arms are each provided with one or more upstanding collectors 6 maintained in contact with the trolley lines or bus bars. 7.

Each lift or hoist assembly 5 is provided with a depending work carrier or trolley 8 for supporting work pieces or articles to be lowered for treatment into a plurality of adjoining or connected tanks designated T–1, T–2, T–3 and T–4, arranged beneath the track 2 and in substantial alignment therewith, the tanks containing the necessary baths or treating solutions for electro-processing the work pieces or articles. Each hoist or lift assembly includes a hoist motor 9 for raising and lowering its carrier. These treating tanks may be any number and size, such as for cleaning, rinsing, acid dip, electro-plating and rinsing, with the number and contents of the tanks depending upon the treatment to be accorded the work pieces or articles. Other sequences and/or other types and numbers of treatment tanks may be provided, as will be apparent to those skilled in the art, with such tanks arranged to receive the articles on the carriers, a station 6 for loading and unloading being conveniently located adjacent the tank T–1 between it and the tank T–4.

It will thus be seen that the apparatus comprises a plurality of individual lifts 5 and work carriers 8 mounted for transportation along the continuous track or monorail 2 with each work carrier arranged for propulsion or horizontal movement along the track by a common motor 10 actuating pusher arms 11 for the work carriers controlled by a switch or start and stop button to propel the trolleys or yokes 4 and carriers 8 in unison over the processing tanks T–1 to T–4, inclusive, containing the selected treating baths.

As disclosed in the illustrative embodiment of Fig. 3, there are shown six stations, with station 1 and station 2 being a conveyor tank T–1 where a carrier 8 is lowered into station 1, conveyed in the down position to station 2, and then is raised to transfer to station 3. Station 4 is arranged for a delayed setdown or skip. Stations 3, 4 and 5 are single stations where each carrier and its work is lowered and raised in each tank or station.

The trolley lines or bus bars, designated generally by the reference numeral 7 and shown in the diagrammatic view of Fig. 3 as a single but interrupted line for the disclosed six station system, is divided into multiple sections designated in Fig. 3 as two sections A, and single sections B, C and D. The two sections A conrtol stations 3, 5 and 6, section B controls station 1, section C controls station 2 and section D controls station 4. The current is turned "on" and "off" by a contactor on each section mounted in the master control of the apparatus. These contactors of the master control are designated in Fig. 3 as A, B, C and D, corresponding with the similarly designated sections of the trolley line 7.

In Fig. 2, is disclosed a wiring diagram of an automatic control for each lift and carrier, in which the three-phase trolley line 7 is energized and deenergized in the operation. The three collectors 6 here designated as 6^a, 6^b and 6^c are supplied with a potential of 220/440 volts fed to a transformer 13 for decreasing the potential to 110 volts for the system. In this automatic control there is provided a relay A′ and associated switches 14, 15 and 16, a relay B′ and associated switches 17 and 18, a relay C′ and associated switches 19 and 21, a relay D′ and associated switches 22, 23 and 24 for controlling the "up" direction of the lift motor 9, a relay E′ and associated switches 26, 27 and 28 for controlling the down direction of the lift motor 9, a top limit switch 29, a bottom limit switch 31 and a switch 32 shown associated with the switch 31. A single-pole, single-throw switch 34 is provided for opening the circuit to the relays A′, B′, C′, D′ and E′. One side of the transformer is shown connected by double lines to one side of the relays merely to facilitate tracing of the circuit arrangement.

In the operation of the lift circuit, on the downstroke the contactors A, B and C in the master control connected to sections A, B and C of the trolley lines are "on" and the contactor D connected to the section D is "off" except that it is "on" after a delay such as contemplated with respect to station 4. On the upstroke, contactors A, C and D are "off" for a short period (for example, two seconds) and these contactors are then "on," while contactor B remains "on" so that the lift 5 in the conveyor tank T–1 remains down in moving forwardly from station 1 to station 2, the lifts moving in a counter-clockwise direction about the elliptical track 2.

On the horizontal stroke in which the motor 10 moves the lifts 5 and carriers 8 forwardly to the next station by means of the pusher arms 11, the contactors A and D are "off" and the contactors B and C are "on."

The automatic control mounted on each lift 5 and its carrier 8 is diagrammatically disclosed in Fig. 2, and comprises an important feature of the present invention. This control automatically lowers the carrier and its bar 12 at all times except when it is at the end of its downstroke when the carrier automatically goes up. The lift or hoist motor 9 functions when the "up" relay D′ or the "down" relay E′ are energized. The relay D′ controls its motor 9, lift or hoist 5 and its carrier 8 when they are being elevated or in the "up" direction, while relay E′ controls the motor, lift or hoist 5 and its carrier 8 when they are being lowered or in the "down" direction.

When the trolley line is energized, current for the control circuit (Fig. 2) flows from the 3-phase trolley line 7 (220/440 volts) through the conductors 35 and 36 to the transformer 13 where the potential is reduced to 110 volts. The output of the transformer 13 to the relays A′, B′, C′, D′ and E′ is shown by the double line conductors 37 and 38 so as to facilitate tracing the circuit from the transformer.

When the carrier 8 of the lift 5 is in any position other than at the bottom, the lift descends when the trolley line is energized. Thus when the lift is not in its "down" position, the bottom limit switch 31 is closed as shown in Fig. 2, and the motor relay E′ for the lift motor 9 is energized through conductor 39, closed switch 34, conductor 41, closed switch 16 associated with relay A′, conductor 42, closed bottom limit switch 31, conductor 43, closed switch 21 associated with relay C′, and conductor 44 leading to the relay E′. The other side of the relay E′ is connected back to the transformer 13 by means of a conductor 45 and the conductor 37 both of which are shown by a double line as they connect one side of the circuit to the transformer 13. Thus the relay E′ is energized and the lift 5 is moved downwardly.

The conductor 46 which branches from conductor 43 at the connection 47, leads to the relay B′, with the other

side of this relay being connected by the conductor 48 which is shown as a double line and thus connected to the other side of the transformer 13 through the conductor 37, and the relay B' is energized. This closes the associated switch 17 and the switch 18 is opened, thus establishing a hold circuit for the relay B' through the conductor 48, relay B', conductor 49 connected to the now closed switch 17, conductors 51 and 39 to the transformer 13. Thus relay B' will remain energized after the bottom limit switch 31 is opened.

When the lift 5 reaches the bottom of its stroke, the bottom limit switch 31 is opened and switch 32 is closed. This breaks the circuit to the lift motor 5 and the latter is deenergized. Closing of the switch 32 energizes the relay C' through conductors 39 and 41, conductor 52, closed switch 32, conductors 53 and 54 to the relay C', and back to the transformer 13 though conductor 48.

The lift 5 will now stay down until the master control (Fig. 3) deenergizes the trolley line 7 momentarily, whereupon both of the relays B' and C' are deenergized. When the trolley line 7 is again energized and with the switch 32 closed, the relays C' and A' are energized and establish the following circuits:

(1) Relay C' is energized through conductor 39 from the transformer, conductors 41 and 52, closed switch 32 and conductors 53 and 54 to the relay C'.

(2) Relay A' is energized through conductors 39, 41, 52, closed switch 32, conductors 53 and 55, closed switch 18 with the relay B' deenergized, conductors 56 and 57 to relay A'.

With relay C' being energized, its switch 19 is closed and switch 21 is open whereby the lift motor 9 cannot be energized in down direction by the relay E'. Switch 19 when closed establishes a "hold" circuit for relay C' through conductors 39, 51 and 58, through closed switch 19 and conductor 54 to this relay.

With the relay A' energized, switches 14 and 15 are closed and switch 16 is opened. Closed switch 14 establishes a "hold" circuit for relay A' through conductors 39, 41, closed switch 14 and conductor 57 to relay A'.

The hold circuits for relays C' and A' are independent of the closed switch 32 which switch is only momentarily closed and switch 31 is momentarily opened.

Closed switch 15 energizes the lift motor 9 in "up" position through the conductors 39, 41, closed switch 15, conductor 59, closed top limit switch 29 and conductor 61 to the "up" relay D' which, when energized, closes its associated switches 22, 23 and 24 to energize the lift motor 9 to "up" position. When the lift 5 reaches the top, a finger thereon opens the top limit switch 29, which in turn opens the above described circuit to "up" relay D' and deenergizes this relay and the lift motor 9.

The lift 5 stays "up" until the master control again deenergizes the trolley line 7 and this action initiates operation of the motor 10 and movement of the pusher arms for the horizontal movement of the lifts to the next station.

Thus it will be seen that when the carrier bar 12 of the carrier 8 on the lift 5 is in any position other than the bottom, the lift 5 descends when the trolley line 7 is energized. When the carrier reaches the bottom or its "down" position, it engages the bottom limit switch 31 which stops any further descent of the lift, and it remains in this down position until the master control momentarily deenergizes the trolley line 7.

When the trolley line 7 is again energized, the lift 5 rises and when it reaches its "up" position, it engages the top limit switch 29 which stops further ascent of the lift. Thereafter the master control deenergizes the trolley (momentarily) which causes the horizontal motion in which the motor 10 and its pusher arms 11 move the lifts 5 and carriers 8 to the next station or position. This cycle is repeated at subsequent stations with the lifts being wholly controlled by the trolley line 7 being energized or deenergized.

The arrangement and spacing of the carriers 8 and the stations 1 to 6, inclusive, are such that in a given period of time a work holder of a selected carrier can be advanced from one station to the next or adjacent station, lowered into the tank at that station, permitted to remain there for a predetermined period of dwell, and lifted therefrom to a position of readiness for the next operation.

The control system comprises the master timer 64 and the arrangement of circuits and contactors or switches disclosed for the lowering, raising and advancement of the work holders or carrier bars 12 of the carriers 8 separately and simultaneously, in successive steps throughout the entire sequence of the stations.

The novel arrangement of the controls is such that when a lift or hoist is in any except its lowermost position, downward movement of this lift will occur when the trolley line is energized. In its downward movement the carrier bar 12 of this lift actuates the bottom limit switch 31 to stop the downward movement.

Upon a predetermined lapse of time the master timer 64 causes the trolley line to be momentarily deenergized and, when it again becomes energized, the lift moves upwardly until its carrier engages the top limit switch 29 and is held until the master timer 64 functions to deenergize the trolley line. The carriers then advance a predetermined distance to the center line of the next adjacent station when the master timer again causes the trolley to be momentarily deenergized, and the cycle is repeated.

While the timing is so arranged as to provide uniformity in the normal periods of lowering, dwell, and raising, respectively, so that the complete cycle of operation may be completed in a predetermined period of time without manual intervention, provision is made for extending the period of dwell, and for delaying the lowering of the work container at one or more selected stations. Provision is also made for by-passing or skipping one or more selected stations by maintaining the work holders of selected carriers in raised position and preventing the lower thereof at those stations. Furthermore, as disclosed, provision is made for the carrier to have a double period of dwell in the two-station tank T–1, or for a fractional period of dwell at a station.

As disclosed in Fig. 3, there is provided an auxiliary timer 65 and a limit switch 66 in the circuit of controller D and tank T–3 at station 4. The timer 65 is provided for delay and the limit sitch 66 for skipping of the carrier at station 4.

The six stations shown in Fig. 3 are but illustrative for the number may be varied in accordance with the requirements of a given operation and may be increased or decreased, as desired. By providing for by-passing one or more selected stations, enables the limiting of a particular operation to a selected number of stations.

As shown in Fig. 3, the 3-phase trolley line 7 is broken at the various stations in accordance with the desired action at any particular location. Of the sections A, B, C and D, the main section of this trolley line would be sections A, A controlled by the contactor A in the master control circuit, and these sections are deenergized when all the hoists or lifts 5 that are to be transferred reach their "up" position. The master control circuit then moves all the carriers forward one station, and arriving at the center point of the stations, sections A, A are again energized and all hoists at these sections start their "down" motion and upon completing their "down" travel and the dwell period, the timer on the master control times out momentarily and these sections are deenergized. When the trolley line is again energized causing the hoists to automatically return to their "up" position, they will be held there until the machine is indexed again.

At station 1, the trolley line is controlled by the con-

tactor B in the master control box. The break in the bus or trolley line between sections A and B is sufficiently ahead of the stop position of the carrier 8 to be lowered at station 1, that the collectors 6 move onto it just as the carrier stops. The hoist then starts down so that when the next index occurs the hoist and its carrier remain in the "down" position in moving from station 1 to station 2.

Contactor C controls section C and station 2 and, like the contactor B, is normally energized so that when the carrier moves from section A to section B the collectors do not lose contact and the carrier 8 and its bar 12 remain down. When the timer 64 times out in the master control, the current is momentarily broken and the hoist at this point is elevated and proceeds in a normal manner.

Section D of the trolley line for station 4 is controlled by the contactor D of the master control box and the gap between sections A and D is such as not to lose contact or current flow when the collectors move from one to the other of said sections. Section D for station 4 is illustrated as a delay set-down or skip station and controlled by contactor D. This contactor has a timer 65 which after completion of the forward motion of the carrier, begins to operate and when the timer times out it closes the contactor D causing the carrier 8 and its bar 12 to start in the downward direction, whereby a variable treatment may be had. A limit switch 66 is also provided for permitting the hoist and carrier to skip this station 4, if desired. This is preferably accomplished by providing an arm on the carrier 8 or its bar 12 which will strike the limit switch 66 causing the carrier to skip this station.

The timer 65 is set to the difference between the dwell time of the apparatus and the desired shorter dwell time of station 4. The top contacts 67 of the limit switches 29 of the multiple carriers are all connected in series so that when the circuit is closed through the normally open contacts 67, all the carriers to be transferred must be in "up" position before the horizontal motion of the machine can be effected and start advancing the carriers to the next station. This is disclosed in Fig. 2 where the top contacts 67 of the upper limit switch 29 of each carrier 8 is shown connected to another pair of trolleys 6^d and 6^e, with the bus line of these trolleys being cut or divided into sections or segments 7^a and 7^b so that when the carriers are in "up" position at all points of transfer, these normal open contacts 67 of those carriers to be transferred are in series on a separate 110 volt circuit from the main control box (Fig. 3) through the then closed contacts to the starter coil of the motor 10. Thus as shown in Fig. 2, we have two additional trolley lines for controlling the starter and the motor 10 to obtain horizontal motion of the carriers 8 in "up" position.

When the forward motion is completed, the master timer 64 begins to cycle and the carriers start their downward motion and the cycle is repeated. The single horizontal switch for movement of the carriers along the track to the next station is operated from the carriers. When the carriers are in their normal position at the center of their stations, the arm of this switch is depressed and the timer is energized through the normally open contact. When a carrier moves off of this horizontal switch, all the carriers continue moving forward by the current moving through the normally closed contact of this switch until the next carrier hits this horizontal switch and causes the horizontal drive to stop and again re-cycle the timer.

Contactor B with a limit switch can be employed as a skip and also for lowering the bar into the tank T–1 at station 1 so that it may be conveyed to the next or station 2 without rising. Contactor C controls station 2 at the end of the conveyor tank T–1 and can be employed in the following ways:

(1) If the carriers have skipped the previous station, they can be made to skip this station.

(2) If the carriers have skipped the previous station, they can be made to lower at this station.

(3) If the carriers have been lowered and conveyed into this station, a momentary break in the current will cause the carriers to rise at termination of the proper time period.

With each of the sections A, B, C and D being controlled by a contactor A, B, C and D, respectively, mounted in the master control box, setting of the controls or contactors for each section of the trolley line and closing of a switch or pressing of push button initiates operation of the system which includes the following points of control:

(1) An automatic control is mounted on each carrier 8 which automatically lowers the carriers at all times except when at end of "down" stroke (Fig. 2).

(2) A motor 9 on each carrier 8 receiving its current supply through the trolley lines or bus bars 7 divided into sections whereby a variable treatment at the tindividual stations is obtained (Fig. 3).

In the operation of the novel apparatus and beginning with the horizontal travel of a carrier 8 by means of the motor 10 and pusher arms 11 from the loading station to station 1 of the conveyor tank T–1, the carrier moves forwardly until it engages a horizontal limit switch on the frame assembly whereupon the motor starter cuts out. The horizontal switch starts the master timer 64 and also closes the contactors to the trolley segments for vertical motion. Assuming the timer is set for 100 seconds closed (with 10 seconds consumed in moving down and a 90 second dwell), at the end of the set period the timer switches reverse and the contactors to the trolley segments are opened.

Approximately 10 seconds are required to elevate the carriers to be transferred to their "up" position and, when all are "up," the top contacts 67 of the limit switches 29 of the multiple carriers being connected in series are all closed to give starting impulse for operating horizontal motor 10 through the 110 volt circuit energizing the trolleys 6^d and 6^e (Fig. 2). This impulse closes the starter for the motor and moves the carriers to the next station where the master timer 64 is disengaged and in turn opens current flow through the top contacts 67 of the limit switches 29, and the horizontal limit switch stops further horizontal travel.

To permit one or more carriers to skip a station, for example station 4 in Fig. 3, the skip or limit switch 66 is mounted on the framework at that station and is actuated by an adjustable finger on each carrier. This finger is moved to a contacting position when skip is desired and engages the switch as the center line of station 4 is approached. The finger opens the normally closed limit switch 66 which prevents the contactor D of the master control from closing as it otherwise would.

To provide a delayed set-down for a shorter treatment period for station 4, a timer 65 is provided whereby the carrier may be held up for a predetermined time period. For example, if a bath of but 20 seconds is desired, and it requires 10 seconds for the carrier to go "down," a delay or dwell at the top of 70 seconds is provided, which together with the 10 seconds for the carrier to go down and the 20 seconds of dwell of the carrier at the bottom of the tank, makes a total of 100 seconds. All of the carriers to be transferred will rise at the same time to "up" position.

Any lift or hoist assembly 5 with its carrier 8 may be disconnected by opening its switch 34 should the occasion arise.

The present invention has among some of its more important advantages the following:

(1) The provision of a common horizontal motion and coordinated hoists or lifts and carriers whereby they are never out of step.

(2) Each carrier is provided with a complete and compact automatic control system including a motor-operated lift.

(3) The provision of the novel manner of control by energizing and deenergizing the trolley, the positive and effective control at the various stations, such as skip, delay, skip and delay, and multiple station tank where the carrier remains lowered in the conveying tank in its horizontal motion.

(4) It provides for maintenance of production. In the event of a defective lift motor, such motor merely affects one carrier and does not remove entire apparatus out of service, as is the case in prior machines employing but a single lift motor.

The apparatus is also greatly improved from the standpoint of maintenance in the field. Each lift motor may be easily and readily replaced, and one lift motor out of many reduces production only of said one lift and carrier. Where production from the electro-processing apparatus is tied in rather closely with plant production, the present novel assembly is highly effective.

(5) The apparatus allows for greater flexibility in that the machine may be readily and easily enlarged, as desired.

From the above it will be evident that the various movements and operations of the present apparatus are controlled by breaking the trolley line as illustrated in the above sections, and that the closing and opening of the current in these sections controls movement of the carriers at the various stations.

Having thus disclosed the invention, I claim:

1. In a system for electro-processing, a stationary track, a trolley line comprising a plurality of sections, a plurality of stations beneath said track including multiple tanks each containing a bath into which work to be processed is immersed, a plurality of work carriers and a lift for each carrier for lowering and raising its carrier at the successive stations, means for moving said carriers horizontally between stations, and means on each carrier for selectively controlling its vertical movement at each station with each lift and its carrier being controlled as a section of the trolley line is energized, and deenergized.

2. In an electro-processing apparatus having an overhead track, a trolley line and a series of stations and processing tanks arranged beneath said track and trolley line, a series of lifts and a work carrier for each lift depending from said track and movable horizontally from station to station and vertically at each station, and an automatic control including a motor for each lift and carrier operable when located over a station for automatically lowering its carrier except when the latter is in its lowered position, said trolley line being divided into sections with said sections controlling the operation of the lift motors at the several stations correspondingly.

3. In an electro-processing apparatus as set forth in claim 2, including a series of contactors connected to said trolley sections for controlling the energizing and denergizing of said trolley sections and through such energizing and deenergizing of said trolley sections controlling the operation of each lift and carrier.

4. In an electro-processing apparatus as set forth in claim 2, including a master control having a series of contactors connected to said trolley sections for controlling the flow of current to said trolley sections and with the latter controlling operation of said lifts and the treatment at the individual stations.

5. In an electro-processing apparatus as set forth in claim 2, including trolleys for supplying current from the trolley line to the lift motors.

6. In a system for electro-processing, including an overhead track and a trolley line divided into sections, a plurality of treating stations therebeneath for the work to be processed, multiple hoists supported from said track and each having a depending work carrier for work to be processed, and an automatic control mounted on each carrier for automatically lowering the carrier when disposed over a station except when it is at the bottom of its down stroke, said automatic control being arranged to operate as a section of the trolley line is energized, and deenergized.

7. In a system for electro-processing, including an overhead track and a trolley line comprsing a plurality of sections, a plurality of treating tanks therebelow providing multiple stations for the work to be processed, sections of the trolley line being disposed correspondingly with said stations, multiple lifts carried on said track and each provided with a vertically movable work carrier for supporting and immersing the work to be processed in said treating tanks, and an automatic control on each carrier for automatically lowering the carrier when over a treating tank except when the carrier is at the end of its down stroke when said automatic control elevates said carrier, said automatic control being arranged to operate as a section of the trolley line is energized, and deenergized.

8. In a system for electro-processing as set forth in claim 6, in which said automatic control on each carrier includes a lift motor receiving its current supply from a section of the trolley line.

9. In a system for electro-processing as set forth in claim 7, in which said automatic control on each carrier includes a lift motor receiving its current supply from a section of the trolley line, whereby to obtain variable treatment at the treating stations.

10. In electro-processing apparatus, an overhead track and trolley wires, a plurality of treating tanks therebelow providing multiple stations for the work to be processed, multiple lifts carried on said track and each provided with a trolley and a carrier for the work to be processed, and an automatic control on each carrier including a motor receiving its supply of current through said trolley from the trolley wires and means for automatically and selectively controlling the vertical movement of its carrier and in such movement lowering the carrier at all times except when it is at the end of its down stroke.

11. In an electro-processing apparatus having an overhead track, a trolley line and a series of treating stations beneath said track and trolley line, trolleys having contact with said trolley line and the latter divided into sections, multiple work carriers each provided with an individual lift and motor electrically connected with one of said trolleys and adapted to be controlled through a predetermined cycle, an automatic control on each carrier for operating the motor and provided with means for automatically and selectively controlling the vertical movement of its carrier including lowering the carrier except when it is at the end of its down stroke, and means for moving said work carriers horizontally on said tracks from station to station.

12. In an electro-processing apparatus as set forth in claim 11, in which each carrier and its lift motor is controlled by energizing and deenergizing a corresponding section of the trolley line.

13. In electro-processing apparatus, a trolley system divided into multiple sections in accordance with the number and arrangement of work stations, a master control having a contactor for each section of the trolley system, a track, and a plurality of work carriers each provided with a motor-operated lift, said lifts and carriers being movable horizontally about said track from one to a succeeding station, the controlling of said contactors causing the individual carriers and lifts to automatically lower for treatment and when at the end of the down stroke to be elevated, and when those carriers and lifts to be transferred reach their elevated position, the master control initiates movement of all the lifts and carriers forward to the next station.

14. In electro-processing apparatus as set forth in claim 13, including control means on each work carrier for selectively controlling its vertical movement at each station.

15. In electro-processing apparatus having multiple stations and treating tanks into which work pieces are to be immersed for a predetermined period of time, a trolley system divided into multiple sections in accordance with the number and arrangement of work stations, a track, a plurality of work carriers each provided with a motor-operated lift, said lifts and carriers being movable horizontally about said track from one to a succeeding station, a master control having a contactor for controlling each section and the energizing and deenergizing of each section causing the individual lifts and carriers to automatically lower and/or raise, and means on each work carrier for selectively controlling its vertical movement at each station.

16. In an electro-processing apparatus having multiple stations and treating baths, a trolley system, a track, a plurality of work carriers depending from said track and each provided with a motor-operated lift energized from said trolley system and adapted for vertical movement at each station, control means on each carrier for lowering the carrier and immersing the work carried thereby in a treating bath for a predetermined period of time and elevating said carrier and work upon expiration of said period of time, means for transporting the carriers from station to station for subsequent treatment, and means for varying the period of immersion of the work at individual stations.

17. In an electro-processing apparatus having multiple stations and treating baths at certain of said stations, a trolley system including a trolley line divided into sections, an overhead track, multiple work carriers supported from and horizontally movable on said track from station to station and vertically movable at said stations for immersion into a treating bath, control means on each work carrier for selectively controlling its vertical movement at each station, and a master control including a contactor for each section of the trolley line with each section controlled by its contactor and the control of said contactors effecting the automatic lowering and raising of the individual work carriers.

18. In an electro-processing apparatus having multiple stations and treating baths, a trolley system including a trolley line divided into sections, an overhead track, multiple work carriers supported from and horizontally movable on said track from station to station and lowered at said stations for treatment of the work, an automatic control mounted on each carrier for selectively controlling vertical movement of its carrier and automatically lowering its carrier for a predetermined period of dwell except when at the end of its downstroke when said control automatically elevates said carrier, and a master control including a contactor for each section of the trolley line with each section controlled by its contactor and the control of said contactors effecting the automatic lowering and raising of the individual work carriers with each carrier and its lift motor being controlled by the energizing and deenergizing of the trolley line.

19. In an electro-processing apparatus having multiple stations and treating baths as set forth in claim 18, including means operatively connected with said master control for varying the period of dwell at one or more selected stations.

20. In an electro-processing apparatus having multiple stations and treating baths as set forth in claim 18, including means operatively connected with said master control for skipping one or more selected stations.

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