Jan. 15, 1963 V. FINSTON 3,073,324

BARREL PLANTING MACHINE

Filed Jan. 19, 1959 3 Sheets-Sheet 1

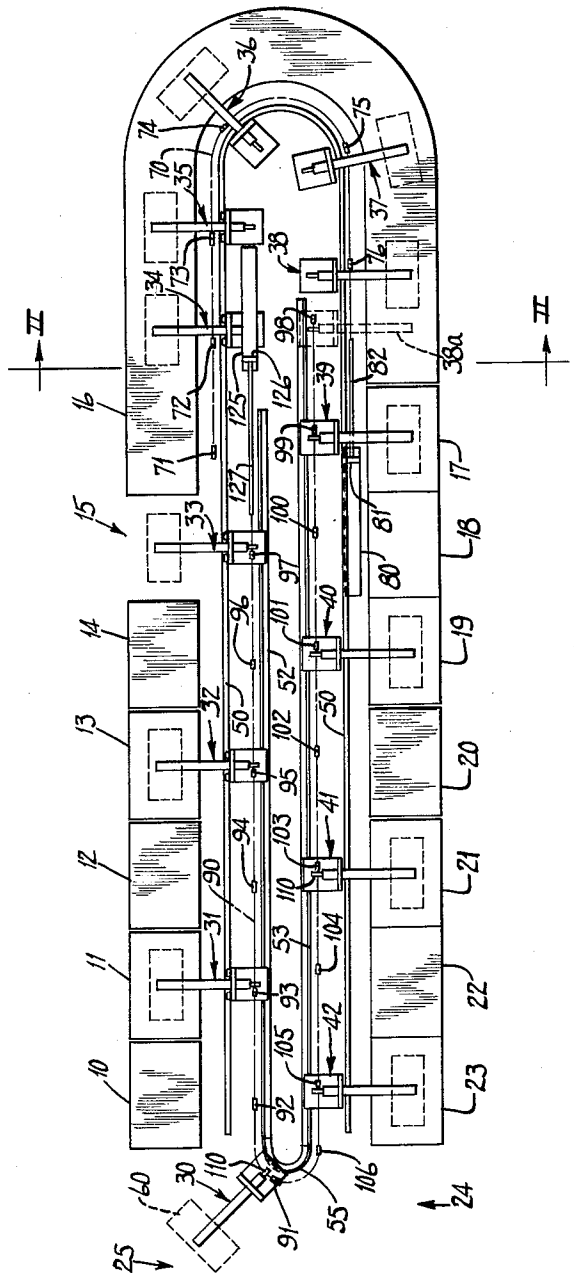


Fig. 1

Inventor
Victor Finston

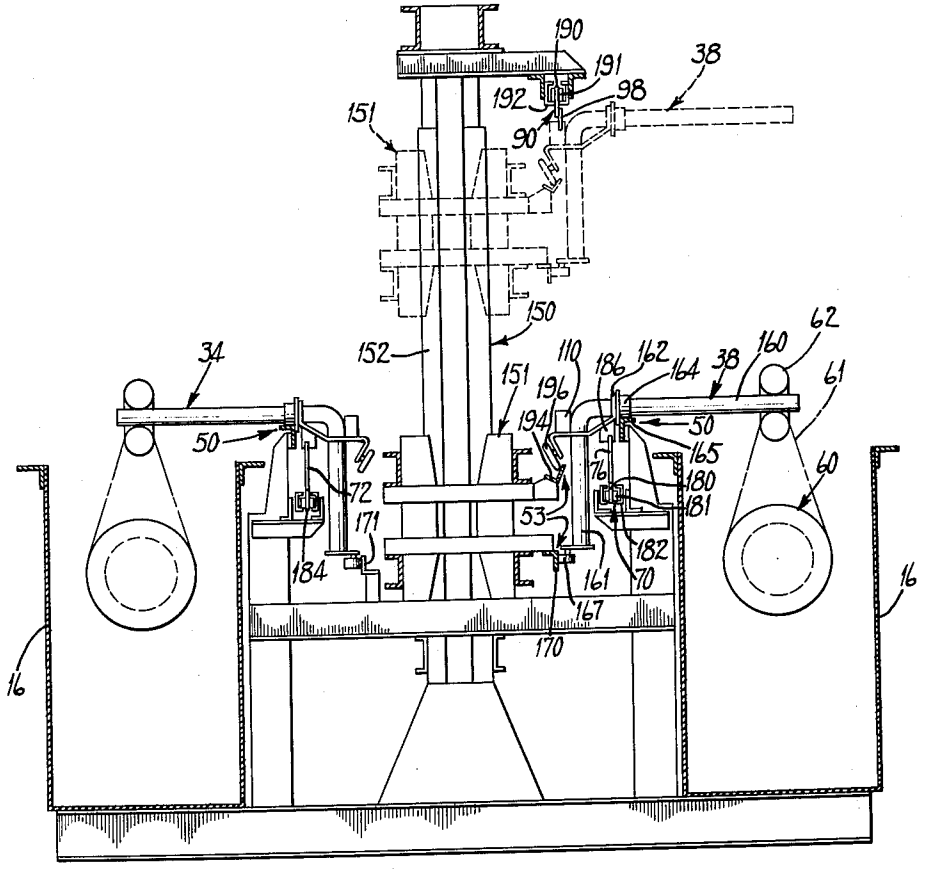
by Hill, Sherman, Meroni, Gross & Simpson Attys

Jan. 15, 1963 V. FINSTON 3,073,324

BARREL PLANTING MACHINE

Filed Jan. 19, 1959 3 Sheets-Sheet 2

Fig. 2



Inventor

Victor Finston

by Kill, Sherman, Meroni, Gross & Simpson Attys

Jan. 15, 1963 V. FINSTON 3,073,324

BARREL PLANTING MACHINE

Filed Jan. 19, 1959 3 Sheets-Sheet 3

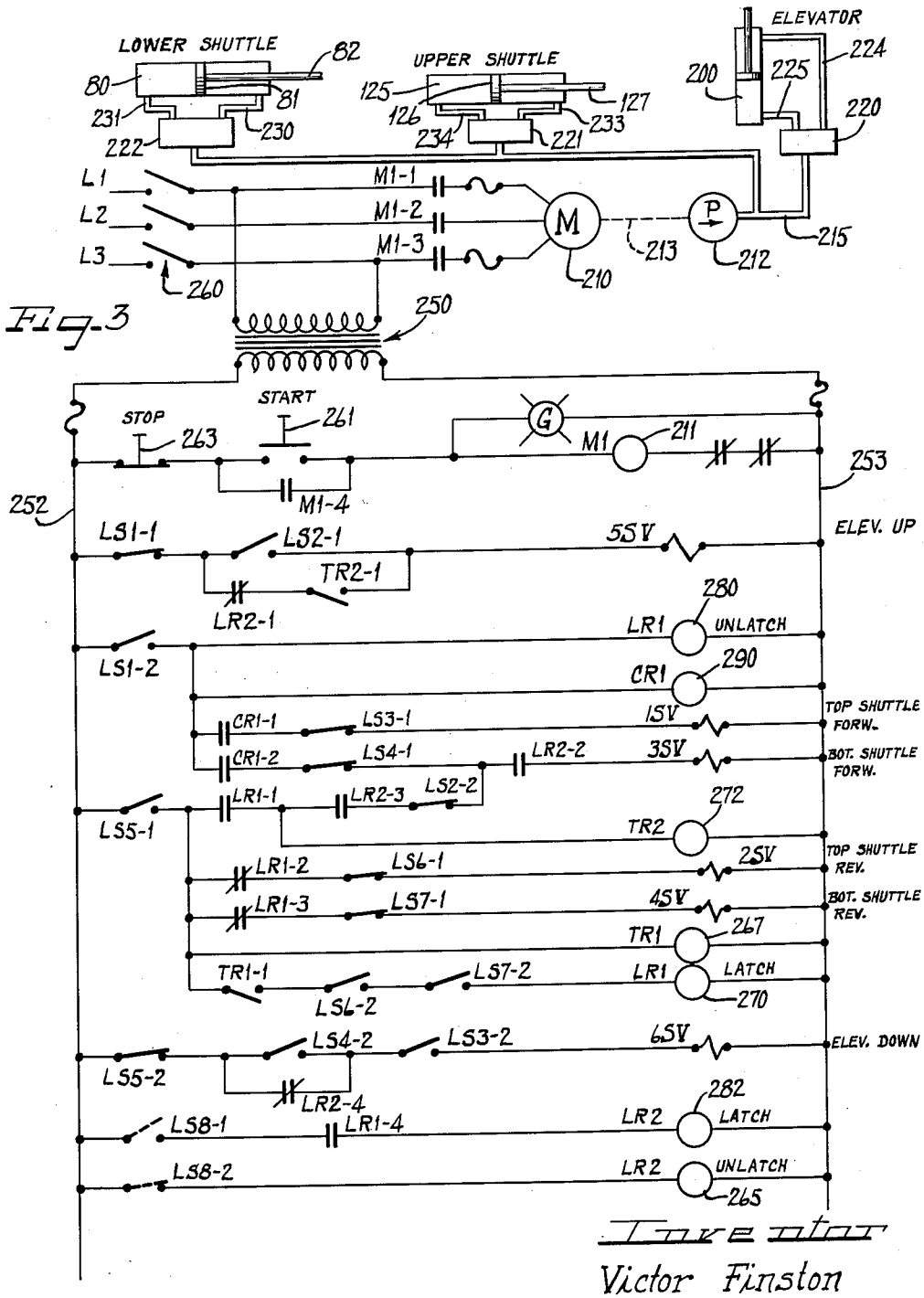


Fig. 3

Inventor
Victor Finston

by Hill, Sherman, Meroni, Gross & Simpson Attys

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3,073,324

BARREL PLATING MACHINE

Victor Finston, Chicago, Ill., assignor to The Meaker Company, Chicago, Ill., a corporation of Illinois

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8 Claims. (Cl. 134—77)

In accordance with an embodiment of the present invention, a processing machine has work carriers disposed at each of a succession of plating stations in a long plating tank, but only at spaced non-successive stations at other portions of the machine. For example, work carriers may be disposed at every other or every third non-plating station of the processing machine. The work carriers are then conveyed between successive non-plating stations at shorter intervals than work carriers in the long plating tank. For example, with work carriers at every other non-plating station, work carriers would be moved twice between successive non-plating stations for every movement of the work carriers in the plating tank. It is found that in many applications, adequate treatment is obtained with a short dwell time at the non-plating stations and a longer dwell time at the plating stations, so that with the present invention, the number of work carriers required outside of the plating tanks may be markedly reduced.

By way of specific example, if adequate plating can be obtained in a plating tank having a given number of stations by moving the work carriers between successive stations every six minutes, by the present invention, rather than having the work units move between successive non-plating stations with a six minute cycle, the work units at the non-plating stations may be transferred on a three minute cycle, a two minute cycle, or some other sub-multiple of the cycle in the plating tank. Where there are 15 stations outside of the plating tank, and where the carriers are disposed at every other non-plating station, a saving of 7 work carriers may be realized, which in one type of barrel plating machine, for example, represents a saving of the order of $7000 at present costs of barrel type work carriers.

Another important object of the present invention is to provide a processing machine capable of utilizing a reduced number of work carriers.

A more specific object of the invention is to provide a novel processing machine particularly adapted for barrel plating applications wherein a minimum number of barrel type work carriers are utilized.

Other objects, features and advantages of the present invention will be apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a diagrammatic plan view illustrating the layout of tanks and work carriers in a processing machine embodying the principles and teachings of the present invention;

FIGURE 2 is somewhat diagrammatic transverse sectional view taken generally along the line II—II of FIGURE 1 and illustrating the details of construction of a typical processing machine to which the present invention may be applied; and

FIGURE 3 is a diagrammatic showing of the electric and hydraulic circuit for the machine of FIGURES 1 and 2.

As shown on the drawings:

The processing machine of FIGURE 1 comprises a first series of dip-type short period treatment tanks **10–14**, an unload station indicated at **15**, an elongated plating tank **16**, and a second series of dip-type short period treatment tanks **17–23**. Work carriers may normally be unloaded at a station indicated generally at **24** and

reloaded at a station indicated generally at **25**. The successive work carriers indicated generally by the reference numerals **30–42** are arranged to be supported by means of a lower fixed rail system indicated diagrammatically at **50** in FIGURE 1 in lower position of the work carriers. The work carriers are raised for transfer between successive work stations by means of elevator rail systems designated generally by the reference numerals **52** and **53** in FIGURE 1. An upper rail fixed system **55** may be provided at the loading end of the machine as indicated diagrammatically in FIGURE 1 for maintaining the work carriers at the upper level as they move between the tank **23** and the tank **10**. By way of example, the work carriers **30–42** may include barrel type receptacles such as designated by the reference numeral **60** and indicated in dash outline in FIGURE 1. These receptacles may be supported with the work carriers in such a manner as to be rotatable on their longitudinal axes for example by means of a chain drive indicated at **61** in FIGURE 2 during immersion in the successive tanks and during transfer between the tanks. The motors **62** driving the chain drives **61** may be energized continuously during travel of the carriers through the machine by means of a stationary contact rail extending along the entire path of the carriers through the machine. Of course, any suitable type of work support or receptacle may be associated with the work carriers as desired.

FIGURE 1 illustrates in a diagrammatic fashion a lower shuttle conveyor **70** having a series of pivotal pusher lugs **71–76** for engaging the successive work carriers in the plating tank and advancing the work carriers between the successive work stations therein. As diagrammatically indicated in FIGURE 1, the lower shuttle conveyor **70** may be reciprocated by means of a hydraulically operated cylinder **80** having a piston **81** and a piston rod **82** connected with the conveyor. The conveyor **70** may correspond to the lower conveyor in Finston application U.S. Serial No. 536,866, filed September 27, 1955, in which case pusher lugs **71–76** of the conveyors are mounted so as to pivot beneath lugs on the work carriers as the conveyor is retracted and to rigidly engage the work carriers during forward strokes of the conveyor to move the work carriers between successive work positions. The lower shuttle is shown in its retracted position with the pusher lugs a short space behind the adjacent work carrier positions in FIGURE 1.

For transferring the work carriers in their upper positions, an upper shuttle conveyor designated generally by the reference numeral **90** is provided having a series of pusher lugs **91–106** for engaging fixed lugs such as indicated at **110** on the work carrier **30**. The upper shuttle pushers are likewise shown in their retracted positions. The upper pusher lugs **91** and **106** must be of the pivotal type so as to ride over the carrier lugs such as **110** during retraction, since these pusher lugs cooperate with carriers on the upper fixed rail system **55**. The other pushers may be of the fixed type since the shuttle **90** is moved from its forward to its retracted position with the elevator rail systems **52** and **53** in their lower positions. The upper shuttle is shown as being reciprocated by means of a hydraulic cylinder **125** having piston **126** and a piston rod **127** connected to the shuttle **90**. Since the shuttles **70** and **90** operate at the curved ends of the machine, it is necessary to provide flexible chain type coupling between the pushers at these portions of the machine. This may be accomplished in the manner disclosed at FIGURES 6, 9 and 10 of said Finston application Serial No. 536,866, now Patent No. 2,869,560, issued January 20, 1959.

FIGURE 2 illustrates certain of the details of a typical processing machine to which the teachings and principles

of the present invention may be applied. This figure is similar to FIGURE 3 of said Finston application Serial No. 536,866. It will be observed that the machine comprises a central framework **150** which may extend the length of the machine within the loop path of work carriers indicated in FIGURE 1. An elevator frame **151** is mounted for vertical reciprocation on spaced upright columns such as indicated at **152**, and the elevator frame carries the elevator rail systems designated generally by the reference numerals **52** and **53** in FIGURE 1.

It will be observed that the work carriers such as **38** may comprise a horizontally extending arm **160** and a vertically extending arm **161**. A carrier body **162** mounts rollers **164** on horizontal axes for riding on horizontal track **165** of fixed lower rail system **50**. The rollers **164** are disposed on opposite sides of the horizontal arm **160** to provide the necessary longitudinal stability of the work carrier. A roller **167** rotatable on a vertical axis is supported at the lower end of the depending arm **161** of the carrier and engages a track **170** which is mounted on the elevator frame **151** or a fixed lower track such as indicated at **171** at the left in FIGURE 2.

The lower shuttle **70** is illustrated as comprising shuttle bars such as **180** having rollers **181** riding along horizontal shuttle tracks **182**. The pushers such as **76** are pivotally mounted on the shuttle bar **180** so as to be pivotal a limited amount during retraction of the shuttle. The pushers may be counterbalanced so as to return to operative position and be rigidly retained in this position upon advance of the shuttle. As previously mentioned, straight shuttle bar portions such as **180** and **184** at opposite sides of the machine may be coupled by means of a flexible chain having rollers riding in the curved portion of the shuttle track **182** and carrying the pushers **73**, **74** and **75**, for example. A lug **186** of work carrier **38** which is engageable with the lower shuttle pushers is shown in FIGURE 2.

A suitable construction for the upper shuttle **90** is also indicated in FIGURE 2, wherein it will be observed that a shuttle bar **190** is provided with rollers **191** riding in an upper shuttle track **192**. The pusher lugs depend from the shuttle bar as indicated for the pusher lug **98** in FIGURE 2. There may be an upper straight shuttle bar such as **190** at each of the opposite sides of the machine, and these rigid straight shuttle bars may be connected together by means of a flexible chain also riding in the track **192** at the curved portion thereof in the same manner as described for the lower shuttle. The flexible upper shuttle chain portion would carry the pivotal pusher lugs **91** and **106** as previously described.

As seen in FIGURE 2, the elevator rail system **53** may comprise a rail section **194** for engaging and lifting rollers such as indicated at **196** on the work carriers as the elevator is raised. The elevator frame is also provided with tracks such as **170** for engaging and guiding the lower rollers **167** of the carriers.

The lower shuttle cylinder **80** and upper shuttle cylinder **125** are of course coupled to the shuttle bars **180** and **190** associated with the respective shuttles as indicated diagrammatically in FIGURE 1. The elevator frame **151** may be raised and lowered by means of a vertically disposed hydraulic cylinder indicated diagrammatically at **200** in FIGURE 3. The manner in which the cylinder is coupled to the elevator frame may be that shown in FIGURES 4 and 5, for example, of said Finston application Serial No. 536,866. Other details of construction may be as indicated in the Finston application, and the disclosure of said application is incorporated herein by reference.

Electric Circuit

Referring to FIGURE 3, an exemplary electric control circuit for the machine of FIGURES 1 and 2 has been illustrated for moving work carriers between successive non-plating stations at time intervals which are ½ the time intervals between successive movements of the work carriers in the plating tank **16**.

Three phase power is supplied from lines **L1**, **L2** and **L3** to a hydraulic pump motor **210** under the control of contacts **M1–1**, **M1–2**, **M1–3** of hydraulic pump motor starter coil **211** of starter **M1**. The motor drives a hydraulic pump **212** by means of a mechanical coupling indicated at **213**, and the pump in turn supplies operating pressure to hydraulic line **215** which leads to solenoid operated valves **220**, **221** and **222**. Valve **220** supplies pressure to line **224** to raise the elevator upon energization of solenoid coil **5SV**, and supplies operating pressure to hydraulic line **225** to lower the elevator upon energization of solenoid coil **6SV**. Similarly, valve **222** supplies fluid pressure to hydraulic line **230** to advance the lower shuttle upon energization of solenoid **3SV**, while pressure is supplied to hydraulic line **231** to retract the lower shuttle upon energization of solenoid coil **4SV**. Hydraulic line **233** is pressurized through valve **221** upon energization of solenoid coil **1SV** to advance the top shuttle, while valve **221** supplies pressure to hydraulic line **234** upon energization of solenoid coil **2SV** to retract the upper shuttles.

Single phase electrical energy is supplied to the primary of the transformer **250** from lines **L1** and **L3** to apply a control voltage between lines **252** and **253** for operating in proper sequence coil **211** of hydraulic pump motor starter **M1**, elevator up solenoid coil **5SV** of valve **220**, latching relays **LR1** and **LR2**, control relay **CR1**, top shuttle forward solenoid coil **1SV** of valve **221**, bottom shuttle forward solenoid coil **3SV** of valve **222**, timing relays **TR1** and **TR2**, top shuttle reverse solenoid coil **2SV** of valve **221**, bottom shuttle reverse solenoid coil **4SV** of valve **222**, and elevator down solenoid coil **6SV** of valve **220**.

The operation of the respective limit switch contacts may be tabulated as follows:

LS1–1 opens when the elevator reaches its upper position.
LS1–2 closes when the elevator reaches upper position.
LS2–1 closes when the lower shuttle reaches a mid position.
LS2–2 opens when the lower shuttle reaches mid position.
LS3–1 opens when the upper shuttle reaches its forward position.
LS3–2 closes when the upper shuttle reaches its forward position.
LS4–1 opens when the lower shuttle reaches its forward position.
LS4–2 closes when the lower shuttle reaches its forward position.
LS5–1 closes when the elevator reaches its lower position.
LS5–2 opens when the elevator reaches its lower position.
LS6–1 opens when the upper shuttle reaches its back position.
LS6–2 closes when the upper shuttle reaches its back position.
LS7–1 opens when the lower shuttle reaches its back position.
LS7–2 closes when the lower shuttle reaches its back position.
LS8–1 may be initially open with the elevator in down position and **LS8–2** may be initially closed. **LS8–1** is closed and **LS8–2** is opened the next time the elevator reaches down position. **LS8–1** is opened and **LS8–2** is closed on the next cycle and so on.

Limit switch **LS8** may be of the ratchet type such that if the limit switch is actuated by clockwise operation, the first downward clockwise movement of the actuating lever as the elevator frame reaches lower position causes the contacts to be moved from an original condition to a new condition and held by means of a ratchet in the new condition while the operating lever is spring returned as soon as the elevator frame moves out of its lower position.

The next downward movement of the actuating lever as the elevator frame again descends releases the ratchet to allow the contacts to return to their original condition to complete the cycle of operation. LS8–1 thus closes and LS8–2 opens on alternate cycles of the elevator.

When the line switch **260** is closed and start button **261** depressed, starter M1 is energized closing its contacts and energizing motor **210**. Contact M1–4 is also closed to maintain the energization of the starter until stop button **263** is depressed. With the actuating limit switch LS8 in its initial position, LS8–1 is open and LS8–2 is closed, so that unlatch coil **265** of relay LR2 is energized to unlatch this relay. Contacts LR2–1 are therefore closed and contacts LR2–2 and LR2–3 are open. Limit switch contact LS5–1 is closed with the elevator in lower position to energize timer relay TR1 by means of its actuating coil indicated at **267**. Timer TR1 controls the basic dwell time of the work units at the successive work stations. When timer TR1 times out, contact TR1–1 is closed to energize latch coil **270**, providing the upper and lower shuttles have returned to their back positions as shown in FIGURE 1. With LR1 latched, contacts LR1–1 are closed to energize actuating coil **272** of timer relay TR2. The timer relay TR2 is set to close contact TR2–1 a time period after energization of the timer TR2 which is approximately equal to the time it takes the lower shuttle to make a run to mid position where limit switch LS2 is actuated. In the present cycle, however, the lower shuttle does not move.

When timer TR2 times out, elevator up solenoid coil 5SV is energized to raise the elevator to upper position. When the elevator reaches upper position, top shuttle forward relay 1SV is energized, and after the top shuttle reaches forward position, the elevator moves down as a result of energization of coil 6SV.

When the elevator reaches its down position, bottom shuttle return coil 4SV is energized to return the top shuttle. When the elevator reaches the lower position, contacts LS8–1 are closed and LS8–2 are opened.

Timer TR1 is again energized, and when its time period expires and TR1–1 is closed, relay LR1 is latched, its unlatched coil **280** having been energized when the elevator reached upper position. Latching of relay LR1 causes relay LR2 to be latched by means of coil **282**. Closure of contacts LR2–2 of relay LR2 causes energization of the bottom shuttle forward solenoid coil 3SV under the control of contacts LS2–2 of the bottom shuttle mid-position limit switch, so that the lower shuttle is stopped at a mid position between its back and its forwardmost positions.

At the mid position of the lower shuttle **70**, the last carrier **38** in the plating tank is moved onto the elevator rail system **53** in readiness for transfer out of the plating tank as indicated in dotted outline at **38***a* in FIGURE 1. Since the elevator is raised when the lower shuttle reaches its mid position, the plating tank need not be long enough to accommodate movement of the carrier **38** the full distance between stations within the plating tank. The result of this two step operation of the lower shuttle is that the length of the plating tank can be materially reduced.

When the elevator is now raised and reaches its upper position, the bottom shuttle is energized under the control of limit switch contacts LS1–2 and LS4–1 to complete the advance of the bottom shuttle. Similarly, the top shuttle is moved to its forward position. When the top and bottom shuttles have reached their full forward position, the elevator starts down and upon reaching its lower position, LS8–1 and LS8–2 are actuated, closing contact LS8–2 to unlatch relay LR2 and conditioning the circuit so that the lower shuttle will not make a forward run during the next cycle of operation of the elevator. When the elevator reaches its lower position, the upper and lower shuttles start their return run, and

a new cycle is begun by energization of coil **267** of timer TR1. It will be noted that energizing coil **290** of relay CR1 is energized each time the elevator reaches its upper position.

By the time the work carrier **33** has been moved to the position of carrier **34** in the plating tank **16**, representing a movement of two work positions, the carriers in the plating tank **16** will have moved only one work position, the work carrier **34** being in the position of the work carrier **35** and so forth. Work carrier **38** will have been transferred to tank **17**, and work carrier **39** will have been transferred to tank **19**, having been positioned at tank **18** during the first cycle of operation of the elevator when the shuttle was not actuated. Similarly, work carrier **40** will have moved from tank **19** to tank **21**, work carrier **41** will have moved from tank **21** through tank **22** to tank **23** and so forth.

Summary of Operation

In operation of the machine shown in FIGURES 1, 2 and 3, work is loaded onto the carriers at position **25** shown in FIGURE 1, with the work carriers arranged at spaced non-successive ones of the short period (non-plating) work stations and arranged at successive ones of the plating work stations in the long tank **16**. With work carriers arranged as illustrated in FIGURE 1, the elevator frame together with elevator rail systems **52** and **53** is raised elevating work carriers **31–33** and **39–42**, whereupon the upper shuttle **90** is energized to advance the elevated work units the distance between successive work stations. The lower shuttle **70** is disabled by relay LR2 during this cycle, and does not operate. Thus the newly loaded carrier **30** indicated at loading station **25** would be moved to a position over tank **10**, while carrier **31** would be moved to a position over tank **12**, and so forth. Carrier **33** at this time would be positioned above the first station of the long tank **16**, and carrier **42** would be disposed at the unload station **24** on the fixed upper rail system **55**. The carriers **34–38** in plating tank **16** remain in the initial positions shown in FIGURE 1.

The elevator frame carrying rail systems **52** and **53** is then lowered to index a step type limit switch LS8, which causes relay LR2 to be latched to allow operation of the lower shuttle on the next cycle. After a predetermined dwell period, the lower shuttle **70** is advanced to a mid position to move each of the carriers in the long tank to an intermediate position between the positions as shown in FIGURE 1, and with the final work carrier in the tank **16** indicated by the reference numeral **38** at position **38***a* for engagement with the elevator rail system **53**. The elevator is now raised, and the lower shuttle caused to complete its stroke, while the upper shuttle also makes a full advance stroke.

When the elevator frame again returns to lower position, limit switch LS8 is again actuated, this time to unlatch relay LR2 and prevent actuation of the lower shuttle during the next cycle.

It will be apparent that work carriers may be placed in every third or fourth of the short period treatment stations such as **10–15** and **17–25** instead of every second short period station as indicated in FIGURE 1. In the case of the work units at every third short period station, a limit switch similar to LS8 would be operative to enable advance of the bottom shuttle on every third cycle of the elevator frame.

The placing of the limit switches is, of course, a matter of choice for those skilled in the art, it simply being necessary that the limit switches be so placed that their control arms are actuated in a given position of the elevator frame or conveyors while being released in other positions of the elevator frame or conveyors. By way of specific example, limit switch LS8 may be type ASC2–18 described in Allen-Bradley Company Bulletin 801.

In FIGURE 1, it will be understood that the upper pushers **91–106** and the lower pushers **71–75** may be equally spaced throughout where the spacing between successive non-plating work stations **10–14** and **17–25** is identical and is equal to the spacing between successive work stations in the long plating tank **16**. The work carriers in the plating tank will normally be equally spaced. The stroke of the upper and lower shuttles may be a few inches greater than the spacing between successive pusher lugs.

The present claimed invention is not limited to the specific type of processing machine shown in the drawings, and the invention in its broad aspects is applicable to many different types of processing machines and arrangements of processing stations. Similarly, it will be apparent that many different control circuits may be utilized and many different means for disabling the lower conveyor in selected cycles of the short period treatment station transfer apparatus. Many other and further modifications of the disclosed embodiment will be apparent to those skilled in the art which fall within the scope of the present claimed invention.

I claim as my invention.

1. A processing machine comprising a series of processing tanks arranged in a loop configuration, means comprising a series of short period processing tanks providing successive short period work stations, means comprising an elongated tank providing successive longer period work stations, a series of work carriers disposed at spaced ones of said short period work stations with each successive pair of spaced short period work stations having a predetermined number of interposed short period work stations therebetween and other carriers at successive ones of said long period work stations, means for moving the work carriers between successive short period work stations at first relatively short time intervals, means for delivering work carriers from a last one of said successive short period work stations to a first one of said successive longer period work stations, and means for moving work carriers between successive longer period work stations at second relatively longer time intervals.

2. In a processing machine, means defining a series of short time period processing stations, means defining a series of longer time period processing stations, a series of work carriers disposed respectively at a number of said short period processing stations which is equal to the total number of short period processing stations divided by an integral number and at successive ones of said long period processing stations, means for moving the work carriers between successive short period processing stations at a relatively fast rate, means for delivering work carriers from a last one of said series of short time period processing stations to a first one of said series of longer time period processing stations, and means for moving work carriers between successive longer period processing stations at a relatively slower rate.

3. A processing machine comprising means defining first and second series of work stations, means for moving work carriers to said work stations in succession including means for moving work carriers between work stations of said first series at relatively short time intervals and means for moving work carriers between work stations of said second series at longer time intervals which are equal to said short time intervals multiplied by an integral number, and means for delivering work carriers from said first series of work stations to said second series of work stations at said longer time intervals.

4. A processing machine comprising a first series of dip tanks, an elongated multi-station processing tank and a second series of dip tanks arranged generally in a loop configuration, a framework within said loop configuration, an elevator frame mounted on said framework for vertical reciprocation between a lower and an upper position and having elevator rail means for lifting work from the dip tanks, means for cyclically moving said elevator frame between said lower and said upper positions, upper conveyor means operable with said elevator frame in upper position to transfer work between successive dip tanks and to and from said multi-station tank, lower conveyor means for moving work between successive work stations of said multi-station tank and for moving work off of and onto said elevator rail means at the respective ends of said multi-station tank, means for operating said upper conveyor means each time said elevator frame reaches upper position, and means for operating said lower conveyor means on spaced cycles of said elevator frame.

5. A processing machine comprising means defining a first series of work stations requiring the presence of work units for only a relatively short time and a second series of work stations requiring the presence of work units for a relatively longer time, said work stations being arranged in an elongated loop configuration, a framework within said loop configuration, an elevator frame mounted on said framework for vertical reciprocation between a lower and an upper position and having elevator rail means for lifting work carriers from certain of the work stations, means for cyclically moving said elevator frame between said lower and said upper positions, first moving means for moving work carriers between successive work stations along said elevator rail means in upper position of said elevator frame, second moving means for moving work carriers between successive work stations of said second series of work stations, means for moving work carriers from a station of said first series to a station of said second series, means for moving work carriers from a station of said second series to a station of said first series, means for operating said first moving means each time said elevator frame reaches upper position, and means for operating said second moving means on spaced cycles of said elevator frame cyclically moving means.

6. A processing machine comprising means defining first and second series of work stations, means for moving work carriers to said work stations of said first series in succession and then to said second series of work stations in succession, elevator means operable to raise work carriers to an upper position above the work stations of the first series during transfer of the work carriers between work stations of said first series, said moving means comprising first conveyor means operable to move work carriers between work stations of said first series in elevated position of said elevator means and second conveyor means operable for moving work carriers between successive work stations of said second series, and control means for actuating said first conveyor means each time said elevator means is moved to upper position but operable to prevent actuation of said lower conveyor means during predetermined cycles of said elevator means.

7. A processing machine comprising means defining first and second series of work stations, means for moving work carriers to said work stations of said first series in succession and then to said second series of work stations in succession, elevator means operable to raise work carriers to an upper position above the work stations of the first series during transfer of the work carriers between work stations of said first series, said moving means comprising first conveyor means operable to move work carriers between work stations of said first series in elevated position of said elevator means and second conveyor means operable for moving work carriers between successive work stations of said second series, and control means for actuating said first conveyor means each time said elevator means is moved

to upper position but operable to prevent actuation of said lower conveyor means during predetermined cycles of said elevator means, said control means comprising a limit switch actuated each time said elevator means reaches lower position and providing an actuating signal for each predetermined number of cycles of said elevator means.

8. Apparatus for treating work carriers comprising a first series of short period stations requiring the presence of work for only a relatively short time period and a second series of longer time period stations requiring the presence of work for relatively longer time period, means for moving work carriers successively through said first series of work stations with a motion of the work carriers in unison but with the spacing between successive work carriers equal to the spacing between said first series of work stations multiplied by an integral number, means for delivering work carriers from the last of said first series of work stations to the first of said second series of work stations, and means for moving work carriers between successive work stations of said second series in unison with the work carriers spaced a distance equal to the distance between stations of said second series but moving said work carriers between work stations of said second series in time intervals equal to the time intervals for movement between stations of said first series of work stations multiplied by said integral number.

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