March 3, 1964 L. J. PIANOWSKI 3,123,197

TRANSFER MECHANISM

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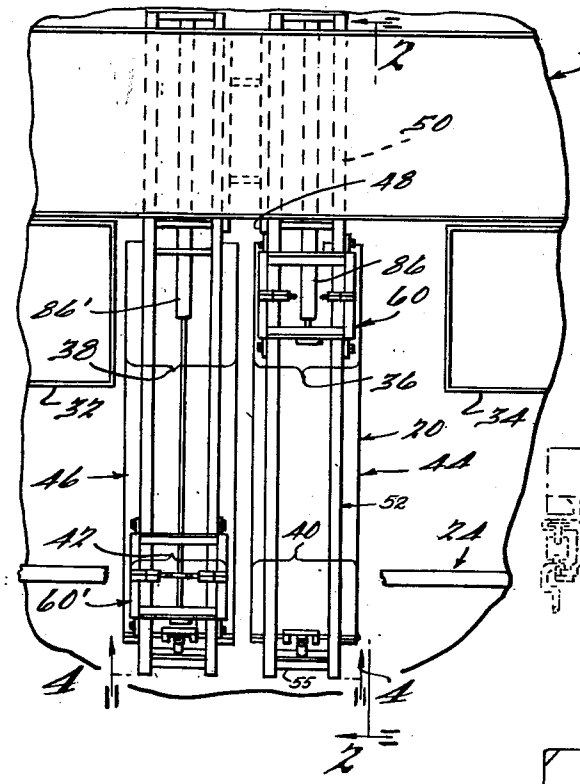


FIG. 1.

FIG. 2.

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TRANSFER MECHANISM

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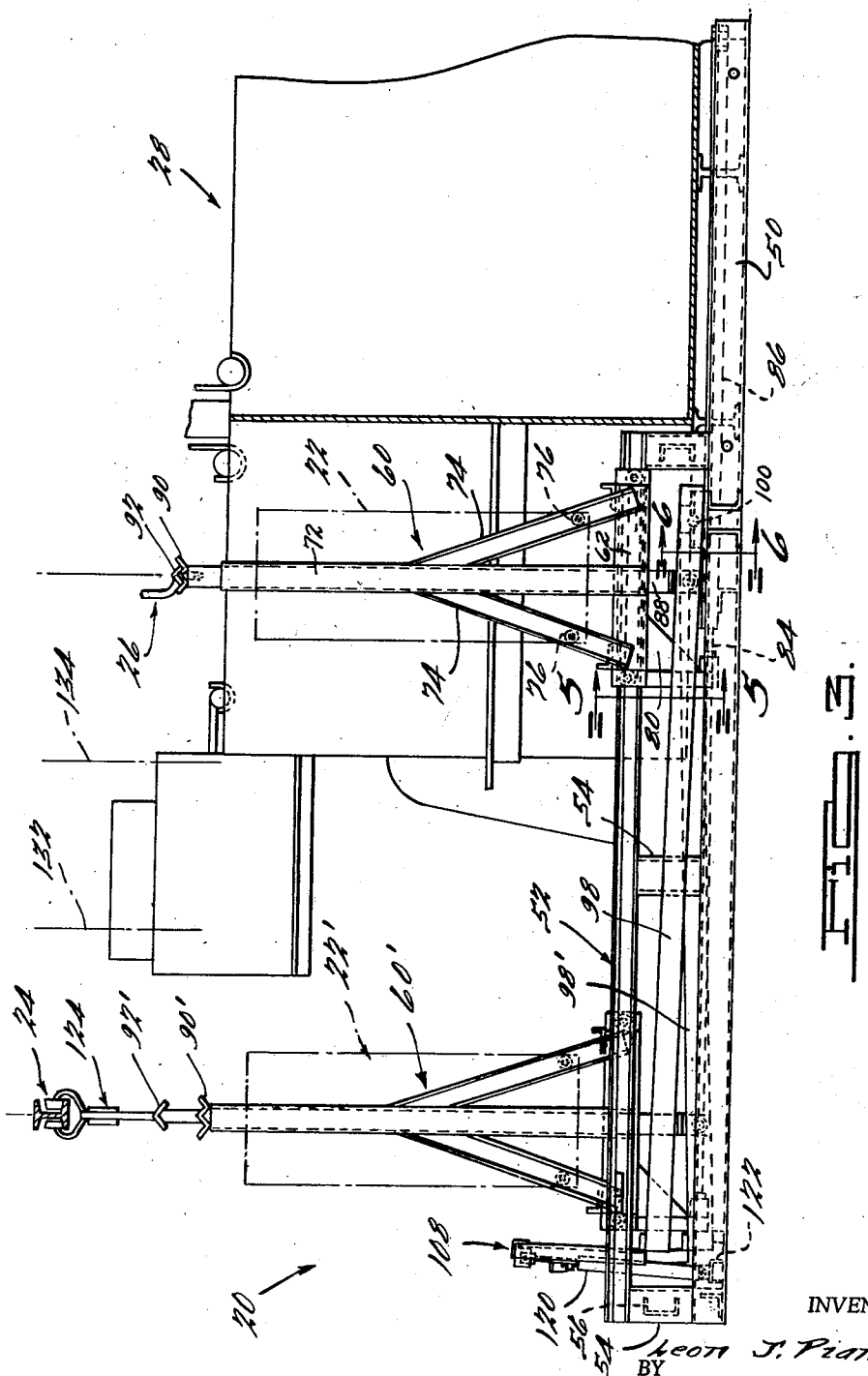


FIG. 2.

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TRANSFER MECHANISM

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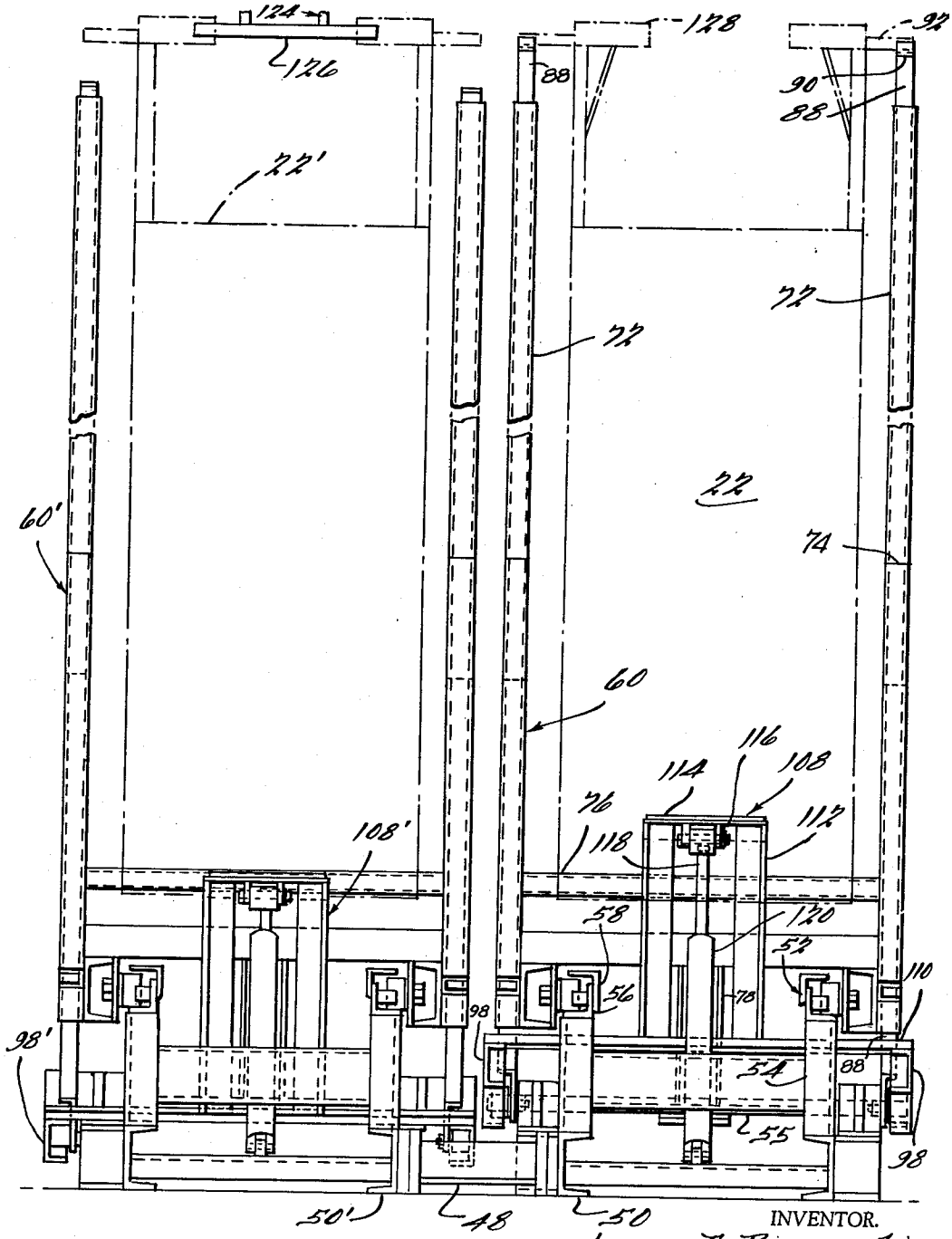


FIG. 4.

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TRANSFER MECHANISM

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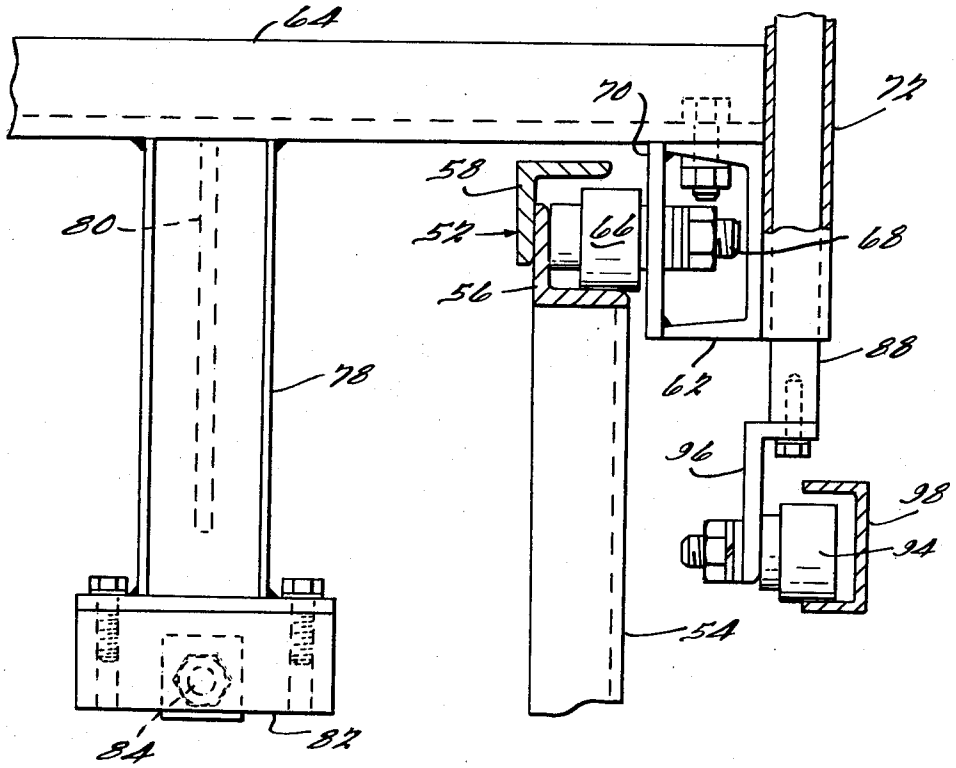


FIG. 5.

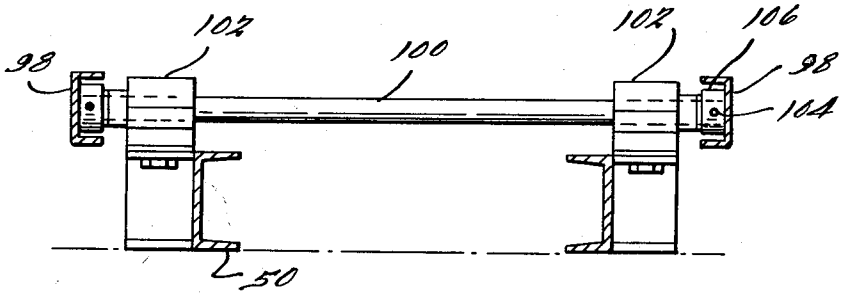


FIG. 6.

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TRANSFER MECHANISM

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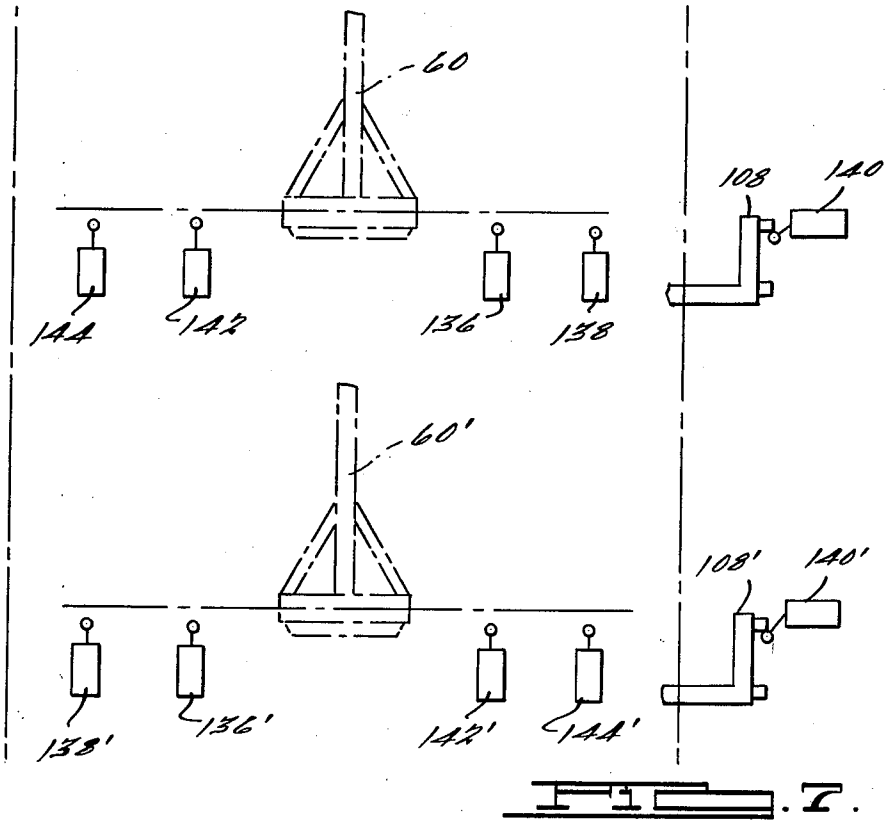


FIG. 1.

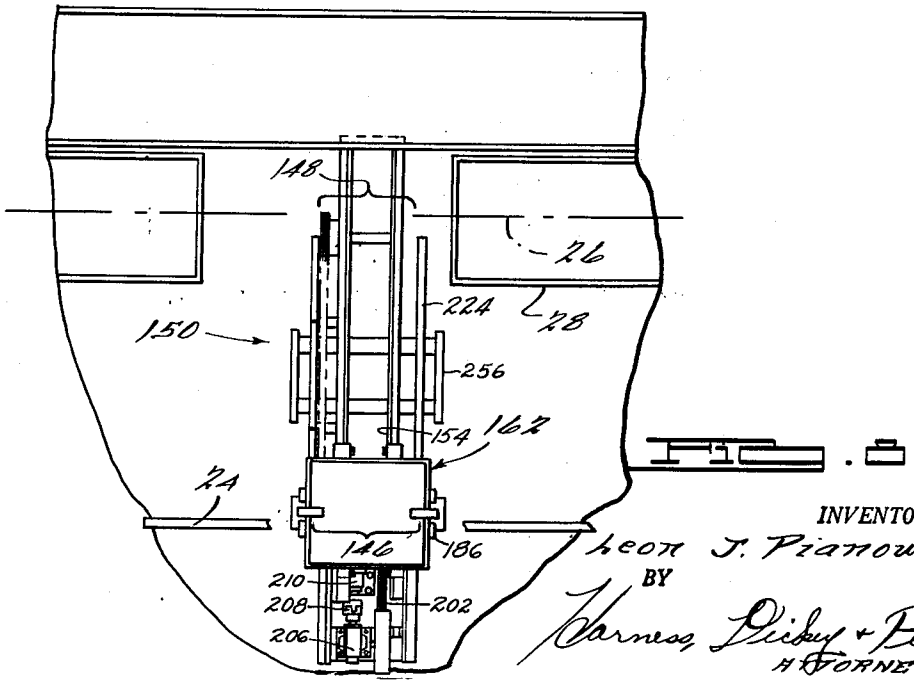


FIG. 2.

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TRANSFER MECHANISM

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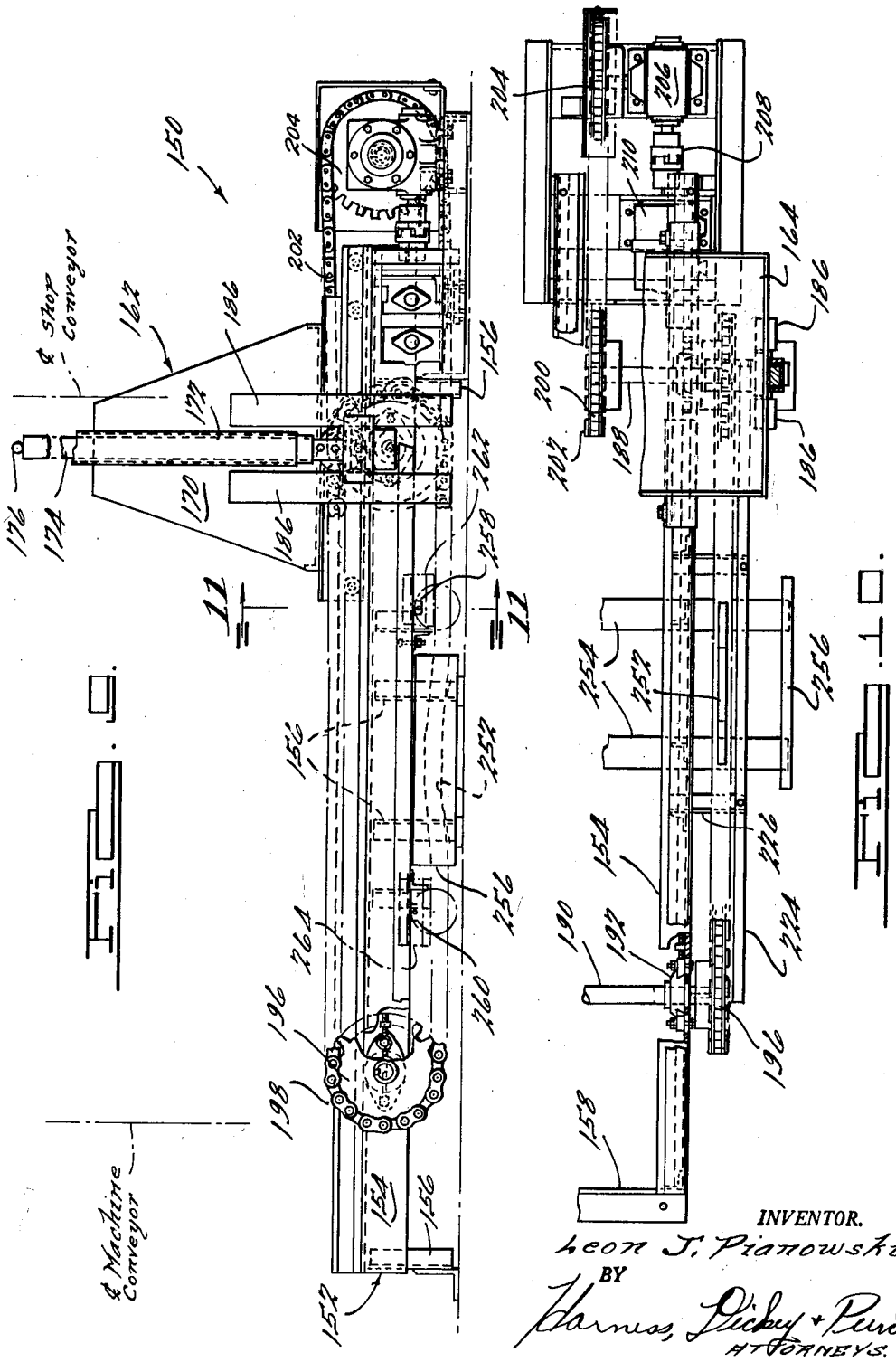


FIG. 9

FIG. 10

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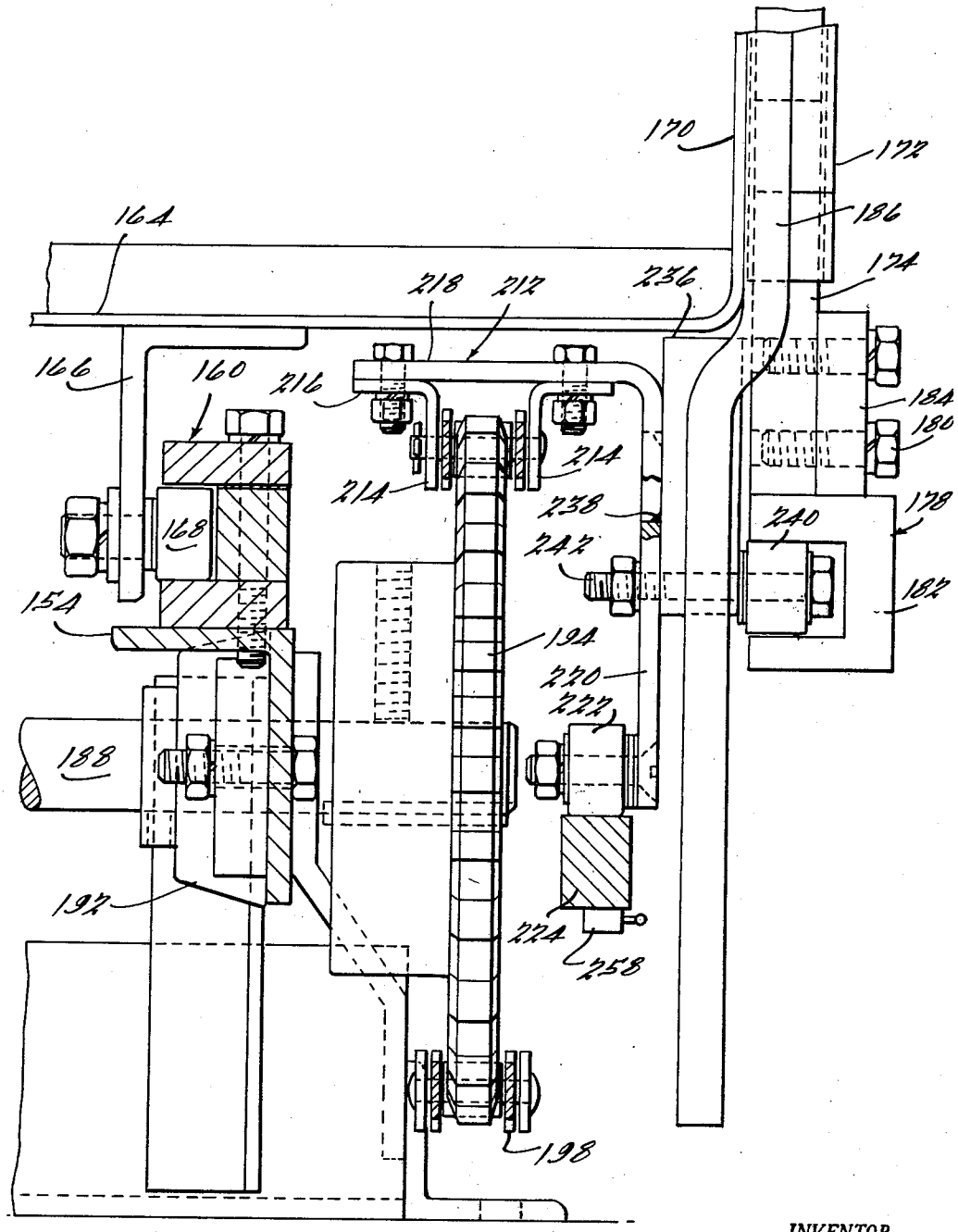


Fig. 11.

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TRANSFER MECHANISM

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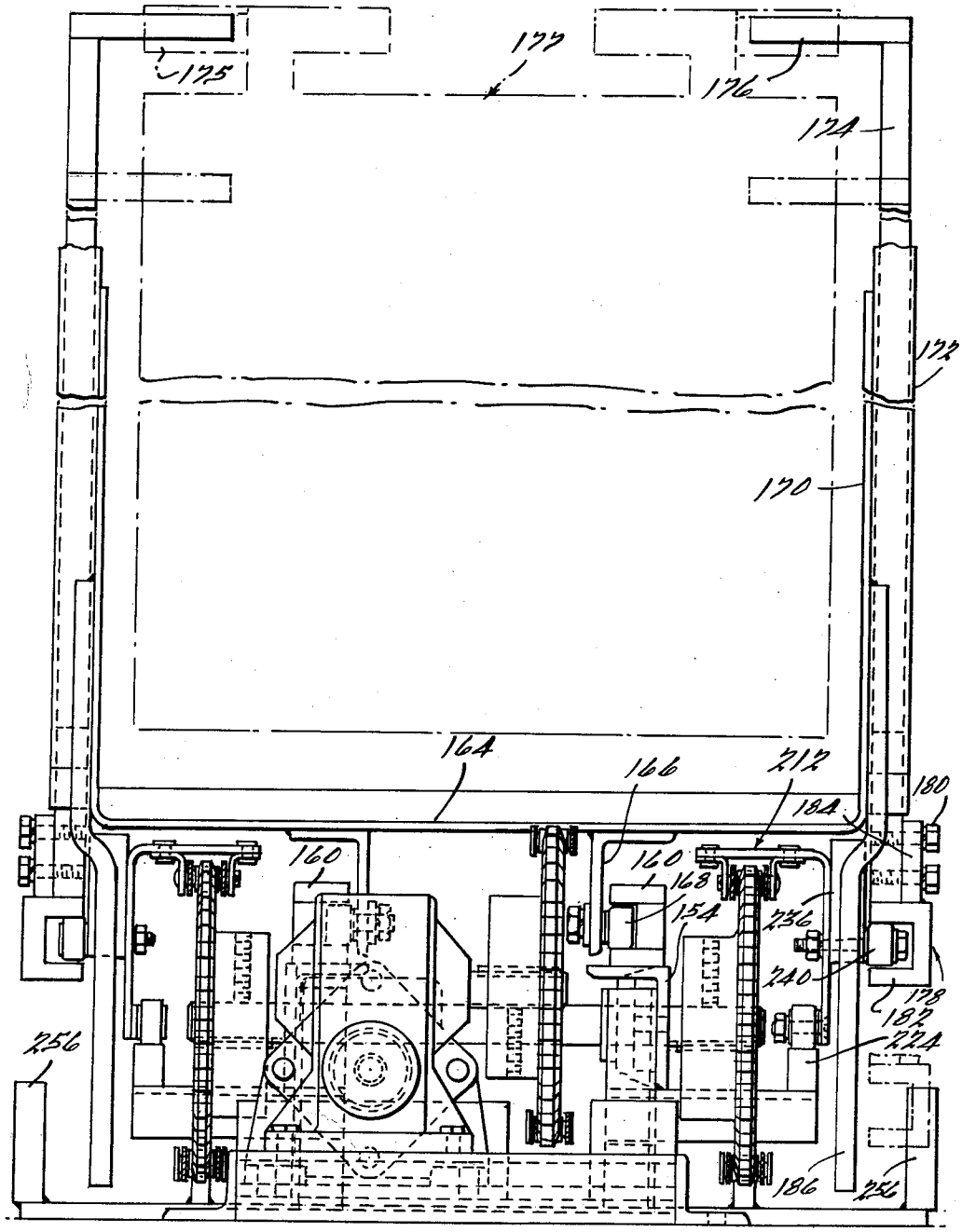


FIG. 12.

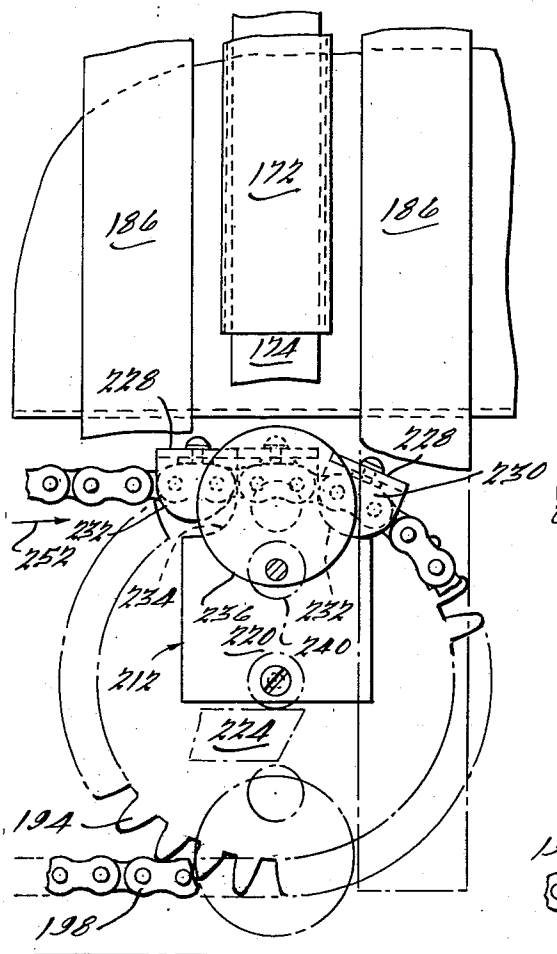
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TRANSFER MECHANISM

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FIG. 13.



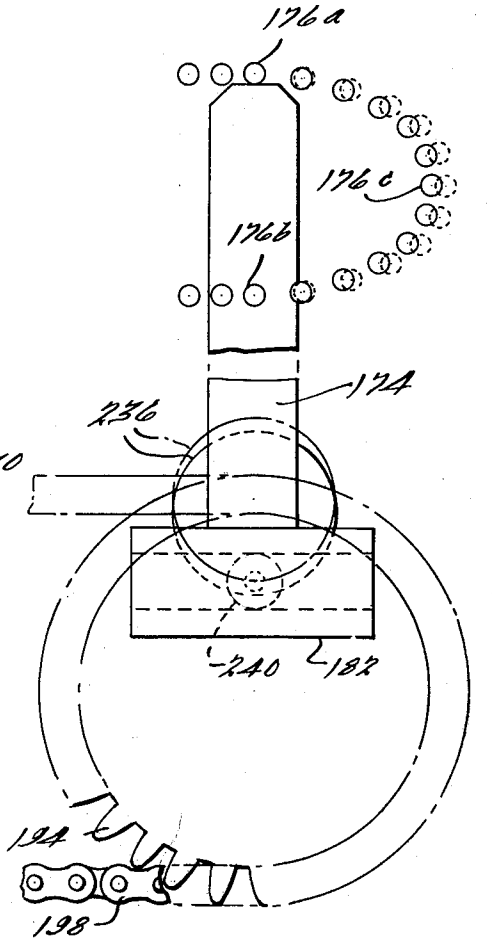


FIG. 14.

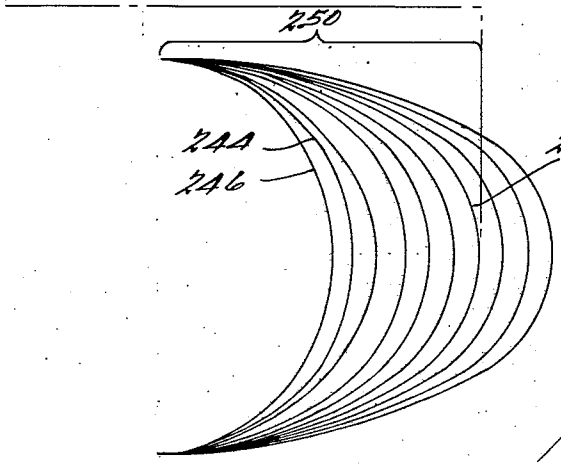


FIG. 15.

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TRANSFER MECHANISM

Filed Jan. 7, 1959 10 Sheets-Sheet 10

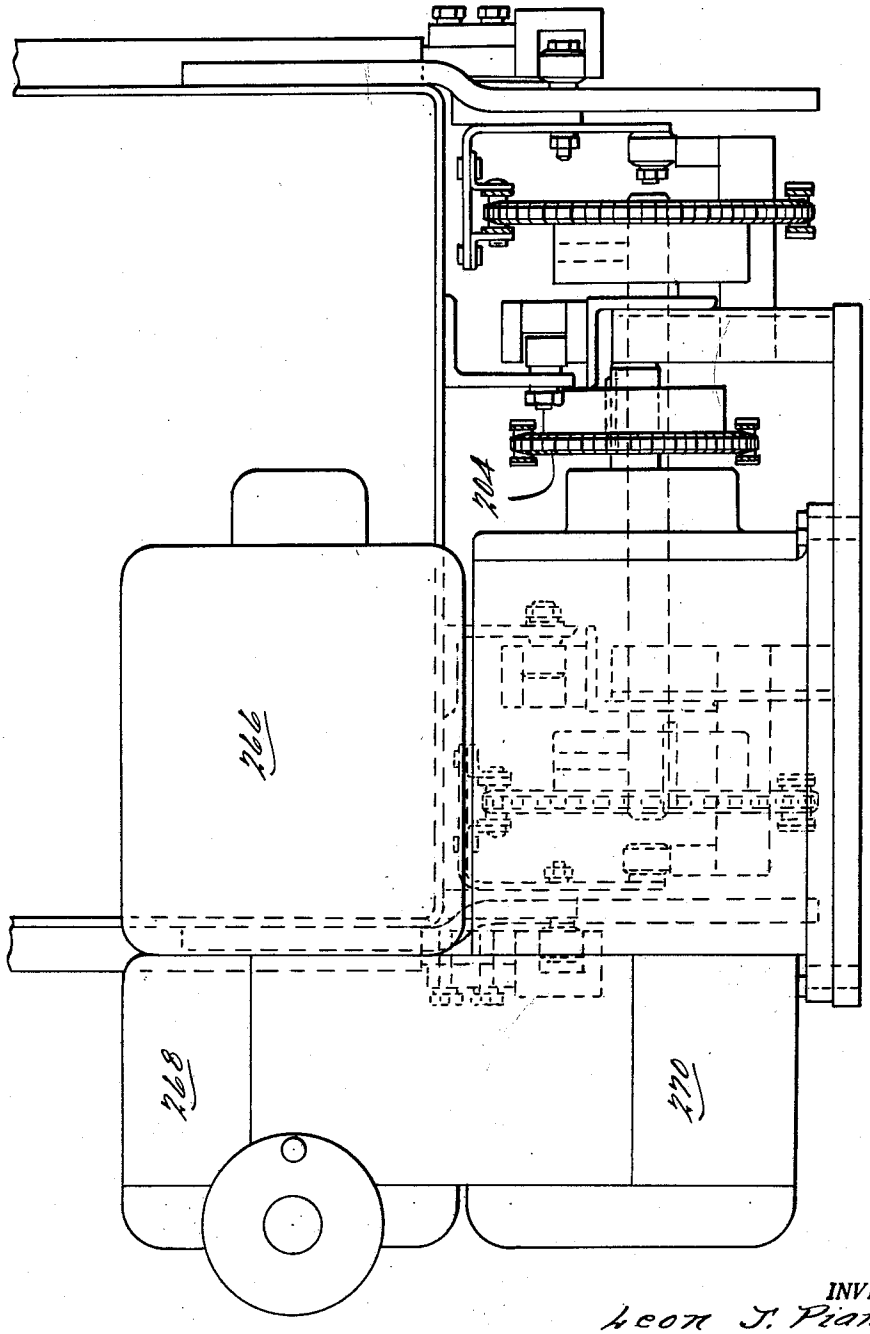


FIG. 16.

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United States Patent Office 3,123,197 Patented Mar. 3, 1964

3,123,197

TRANSFER MECHANISM

Leon J. Pianowski, Detroit, Mich., assignor to The Udylite Corporation, Detroit, Mich., a corporation of Delaware

Filed Jan. 7, 1959, Ser. No. 785,479
7 Claims. (Cl. 198—19)

The present invention relates to an improved transfer mechanism of the type used to transfer article carrying racks from one conveyor to another. More particularly, the present invention contemplates the provision of an improved transfer mechanism for use in automatically transferring such racks between intermittently moving conveyors or intermittently moving portions of conveyors.

While transfer mechanisms of this type have a wide variety of applications, the preferred embodiment illustrated and described herein illustrates the use of the improvements of the present invention in a transfer mechanism for transferring racks carrying articles to be electroplated, from an intermittently moving shop conveyor or portion thereof, while it is stopped, to an automatic plating machine, and transferring racks carrying processed, or plated articles, from the plating machine to the shop conveyor.

It is an object of the present invention to provide an improved transfer mechanism of the above mentioned type, which is simple in design, easily manufactured, durable in construction, and reliable and efficient in operation.

It is an object of the present invention to provide an improved transfer mechanism for transferring work carrying racks between first and second conveyors and in which a cart shuttles back and forth between the conveyors and is provided with rack supporting means which moves vertically only, relative to the cart, the latter being provided with guide means which prevents horizontal movement of the rack supporting means relative to the cart.

It is also an object of the present invention to provide an improved transfer mechanism of the above mentioned type which includes means providing delay safety positions and means successively moving a cart to transfer stations at each of the conveyors and then stopping it in a delay safety position intermediate the conveyors.

Another object of the present invention is to provide an improved transfer mechanism of the above mentioned type including a cart movable between a transfer station of the first conveyor and a transfer station of the second conveyor, and which includes a rack support which is adapted to carry a rack during movement of the cart in one direction between said stations and wihch includes means for gradually moving the rack support vertically in one direction during such rack carrying movement of the cart.

It is also an object of the invention to provide an improved transfer mechanism of the above mentioned type including a cart having a vertically movable rack support and rack support positioning means which is movable while the cart is in one of said stations to move the rack support vertically in one direction and which is movable while the cart is in the other station so that during movement of the cart from the unloading station to the loading station, the rack support is gradually moved vertically in the opposite direction.

A further object is to provide an improved transfer mechanism which provides vertical movement of the rack support for transferring of a rack between one conveyor and the transfer mechanism, but in which the transfer mechanism does not provide any substantial vertical movement of the rack support while the cart is at the other conveyor, the transfer between such other conveyor and the transfer mechanism being in response to vertical movement of a part of such other conveyor.

It is also an object of this invention to provide an improved transfer mechanism for automatically transferring article carrying racks from a first conveyor to a loading station of a second conveyor and simultaneously transferring article carrying racks from an unloading station of the second conveyor to the first conveyor.

Another object of the present invention is to provide an improved transfer mechanism for transferring work carrying racks between two spaced conveyors and which is powered by a simple single power means, which both moves a cart between transfer stations at the conveyors, and vertically moves rack supporting means carried by the cart reaching a transfer station.

More specifically, it is an object of the present invention to provide such a transfer mechanism which employs a simple mechanical drive which, without the operation of limit switches or valves, vertically moves the rack supporting means as soon as the cart reaches a transfer station and effects a transfer of a rack between the cart and one of the conveyors.

It is a further object to provide such a transfer mechanism which includes a chain and sprocket type drive mechanism in which a bracket connected to the chain drives the cart between transfer stations and passes around a sprocket wheel when the cart reaches a transfer station to effect vertical movement of the rack supporting means relative to the cart.

It is a further object to provide an improved transfer mechanism of the above mentioned type of a design such that the proportions thereof may be readily varied to provide desired variations in the path of travel of the rack supporting means.

It is also an object to provide such a construction in which the vertical load carried by the rack supporting means is separately taken and not transferred to the chain.

Other and more detailed objects of the present invention will be appreciated by those skilled in the art from a consideration of the following specification, the appended claims and the accompanying drawings wherein:

FIGURE 1 is a broken plan view illustrating partially diagrammatically a transfer mechanism embodying the present invention disposed for effecting transfers between a shop conveyor and an automatic plating machine;

FIGURE 2 is a sectional view of the structure illustrated in FIGURE 1, taken substantially along the line 2—2 thereof, but showing the position of the transfer mechanism just prior to the lowering of the rack onto the shop conveyor hook;

FIGURE 3 is an enlarged view similar to FIGURE 2 showing the position of the transfer mechanism after the transfer of a rack to the shop conveyor;

FIGURE 4 is an enlarged broken elevational view of the structure illustrated in FIGURE 1, taken substantially from the line 4—4 thereof;

FIGURES 5 and 6 are broken enlarged sectional views of the structure illustrated in FIGURE 3, taken substantially along the lines 5—5 and 6—6 thereof, respectively;

FIGURE 7 is a diagrammatic view showing the limit switch arrangement for the transfer mechanism illustrated in FIGURES 1 to 6, inclusive;

FIGURE 8 is a broken plan view similar to FIGURE 1 showing a transfer mechanism constructed according to a modified form of the invention;

FIGURE 9 is a broken side elevational view of the transfer mechanism illustrated in FIGURE 8;

FIGURE 10 is a broken plan view of the construction illustrated in FIGURE 9;

FIGURE 11 is a broken enlarged sectional view of the structure illustrated in FIGURE 9, taken substantially along the line 11—11 thereof;

FIGURE 12 is a broken enlarged end elevational view

of the structure illustrated in FIGURE 9, as seen from the right-hand end thereof;

FIGURE 13 is a broken enlarged somewhat diagrammatic view showing certain details of the structure illustrated in FIGURE 9;

FIGURE 14 is a diagrammatic view showing alternative part positions and the resulting effect upon the path of movement of the rack support;

FIGURE 15 is a family of curves showing various paths of movement of the rack support which may be selectively incorporated in the transfer mechanism; and,

FIGURE 16 is a broken end elevational view similar to FIGURE 12, showing a transfer mechanism embodying another modified form of the invention.

Referring to the drawings, and particularly to FIGURES 1 to 6 thereof, the transfer mechanism of the present invention is generally indicated at 20 and in the application thereof there illustrated, is employed to transfer work supporting racks 22 between a shop conveyor 24 and the conveyor 26 of an automatic electroplating machine 28. In the particular machine illustrated in FIGURES 1, 2 and 3, the machine conveyor 26 is carried by a machine chassis 30 which moves between a lower position illustrated in full lines in FIGURE 2, and a raised position illustrated in broken lines in FIGURE 2, and the machine 28 has at one side thereof a space between tanks 32 and 34 thereof providing a loading station 36 and an unloading station 38. The shop conveyor 24 has corresponding stations designated unloading station 40 and loading station 42. In the transfer mechanism 20 of FIGURES 1 to 6, inclusive, there are two substantially identical units 44 and 46, the unit 44 constituting a loader which is here so designated because it loads the plating machine 28, and the unit 46 constituting an unloader for the machine 28. These units are interconnected and held in spaced parallel relation by a spacer frame 48 and are disposed with the loader 44 extending between the unloading station 40 of the shop conveyor 24 and the loading station 36 of the plating machine 28, and the unloader 46 extending between the unloading station 38 of the machine 28 and the loading station 42 of the conveyor 24.

Because of the identity of construction of the units 44 and 46, only the loader 44 will be described in detail, the corresponding parts of the unloader 46 being designated by the same numeral with a prime mark, where reference thereto is believed to facilitate understanding of the invention. The loader 44 comprises a fabricated base frame 50 which is connected to the unloader base 50' by the spacer frame 48.

The loader base 50 extends from the shop conveyor unloader station 40 past the machine loading station 36 and underneath the tank at the opposite side of the machine, as best illustrated in FIGURE 1. A pair of tracks 52 are mounted on the base 50 and extend longitudinally thereof at opposite sides thereof between the conveyor unloading station 40 and the machine loading station 36 and are supported in spaced parallel relation above the base 50 on uprights 54 interconnected by transverse braces 55. In the preferred embodiment illustrated, these tracks 52 are formed of angles 56 and 58 which define outwardly facing channels. A cart generally indicated at 60 is mounted on the tracks 52 for movement between the unloading station 40 and the loading station 36. This cart 60 comprises a pair of inwardly facing channels 62 interconnected by transverse members 64 and which carry, as best illustrated in FIGURE 5, rollers 66 adapted to roll within the outwardly facing channels of the tracks 52, the rollers 66 rolling along the horizontal flanges of the lower angles 56.

As illustrated in FIGURE 5, each roller 66 is carried on a bolt member 68 which extends through and is supported on a plate 70 welded across the inwardly facing channel 62. The cart 60 also includes, at opposite sides thereof, vertically extending tubular posts 72, the lower ends of which are welded to the outer faces of the channels 62, as best illustrated in FIGURE 5 centrally thereof. The posts 72 are additionally supported by inclined braces 74 secured at their upper ends to the posts 72 and secured at their lower ends to the channels 62 adjacent the opposite ends thereof. These braces 74 are interconnected by tubes 76 extending transversely of the cart to further support the posts 72 against movement transversely of the cart. The transverse frame member 64 at the outer or left-hand end of the cart, as viewed in FIGURE 3, carries a depending channel 78 best illustrated in FIGURE 5, braced by a gusset plate 80 and which carries at its lower end a bracket 82 to which is connected the outer end of a piston rod 84 of a hydraulic cylinder 86 which is mounted in the base 50 and disposed longitudinally and centrally thereof.

Each tubular post 72, which is secured to the cart frame as above described, carries an inner movable post 88 extending outwardly of both ends of the post 72. At its upper end the post 88 carries a pair of angles welded thereto to provide a W-shaped rack support 90 which is adapted to receive and support a downwardly opening V-shaped arm 92 extending laterally outwardly of the rack 22. At its lower end the movable post 88, as best illustrated in FIGURE 5, carries a roller 94 supported on an angle 96 for rotation about a horizontal axis. Each roller 94 is received in a lift track 98 in the shape of an inwardly facing channel extending longitudinally of the loader below the track 52 and externally of the uprights 54 upon which it is supported. Referring to FIGURES 6 and 3, each lift track 98 is pivotally supported at its inner or right-hand end as viewed in FIGURE 3, upon a transversely extending pivot bar 100 (see FIGURE 6) rotatably supported at opposite sides of the frame 50 in bearing blocks 102. The bar 100 is connected to the lift tracks 98 by pins 104 extending through a collar 106 which is welded within the lift track 98 and receives the end of the pivot bar 100.

At its outer, or left-hand end, each lift track 98 is secured to a lift frame generally indicated at 108. The lift frame 108 comprises a transversely extending angle 110, the opposite ends of which are secured to the top of the lift tracks 98 at the outer or left-hand ends thereof. Adjacent its center the angle 110 has an inverted generally U-shaped frame portion 112 extending upwardly therefrom. The transversely extending angle 114 constituting the web portion of this U-shaped frame portion also serves to mount a bracket 116 providing a pivotal connection for the upper end of the piston rod 118 of a hydraulic cylinder 120, the lower end of the cylinder 120 being pivotally mounted on a transversely extending base member 122.

It will now be appreciated that when the cart 60 is in the loading station 40 of the shop conveyor 24, movement of the lift track 98 from its lower position, which is the position in which the lift track 98' is shown in FIGURE 3, upwardly to the position in which the lift track 98 is shown in FIGURE 3, will cause the movable post 88 and hence, the W-shaped rack support 90, at its upper end, to be raised. It will also be appreciated that the movable rack support post 88 may be gradually raised or lowered during movement of the car 60 depending upon the position of the lift track 98 which will serve as a ramp along which the roller 94 will travel.

The shop conveyor 24 has spaced therealong a plurality of supports generally indicated at 124 which are movable therealong and which include a horizontally extending bar 126 adapted to engage under laterally inwardly extending inverted V-shaped support arms 128 provided on the racks 22. From the foregoing description it will be appreciated that the cart 60 is moved, in the construction illustrated in FIGURES 1 to 6, inclusive, by the supply of hydraulic pressure to the hydraulic cylinder 86, and that the lift track 98 is moved to control the position of the rack support 90 by controlling the pressure in the hydraulic cylinder 120. It will, of course, be appreciated that the carts 60 and 60' must be moved in proper timed

relation to the operation of the shop conveyor 24 and the conveyor 26 of the automatic plating machine 28. The shop conveyor 24 forms no part of the present invention and may be of any construction such that the supports 124 are moved to and from and stopped in the unloading and loading stations 40 and 42, respectively, of the conveyor 24.

Similarly, the automatic plating machine 28 and its conveyor 26 form no part of the present invention and may be of any construction in which the chassis 30 is moved between the positions illustrated in FIGURE 2 and in which the conveyor 26 is provided with rack supports 130 which are moved to and from and are stopped in the machine unloading and loading stations 38 and 36, respectively.

From the foregoing description of the construction of the improved transfer mechanism of the present invention, it will be appreciated that the operation involves the transfer of a rack 22 carrying raw or unplated work from the shop conveyor 24 to the loader cart 60 at the conveyor unloading station 40, movement of the cart 60 to the machine conveyor loading station 36 and the transfer at that station of the rack 22 from the cart 60 to the machine conveyor 26. During these steps in the operation another rack 22' carrying plated work is simultaneously being transferred from the machine conveyor 26 at the unloading station 38 thereof to the cart 60', thence carried by the cart 60' to the loading station 42 of the shop conveyor 24 and there transferred from the cart 60' to the conveyor 24.

It will be appreciated that this general operation may be provided by any suitable control system, a controlling consideration being that the control of the transfer mechanism 20 is interlocked with the control of the automatic plating machine 28 and of the conveyor 24 to prevent damage to the equipment. To this end delay safety positions are provided at which the carts 60 and 60' stop until the conveyors are ready for them to effect their simultaneous loading and unloading transfers. The delay safety position of the cart 60 of the loader 44 is indicated in FIGURE 3 by the center line 132 and the delay safety position of the cart 60' of the unloader 46 is indicated by the center line 134. The loader cart 60 stops at the center line 132 when it is moving away from the machine conveyor 26 and the unloader cart 60' stops at the center line 134 when it is moving away from the shop conveyor 24. This may be accomplished in any suitable way as, for example, by limit switches 136 and 136' diagrammatically illustrated in FIGURE 7 which control the supply of liquid to the hydraulic cylinders 86 and 86'. When a rack support 124 of the shop conveyor reaches the unloading station 40 it actuates a limit switch (not shown), which starts the cart 60 of the loader toward the unloading station 40. As the cart 60 reaches unloading station 40, it actuates limit switch 138 which both stops the cart 60 by stopping the flow of liquid to cylinder 86 and supplies liquid to hydraulic cylinder 120 which raises the lift frame 108 and with it the lift track 98, the movable post 88 and the rack support 90 which lifts the rack 22 from the conveyor support 24. As the lift frame 108 reaches its upper limit of travel it actuates a limit switch 140 which starts the cart 60 toward the machine conveyor 26 and its loading station 36. As the cart 60, now carrying a rack 22 approaches the machine conveyor loading station 36, it may actuate a limit switch 142 causing the cart 60 to proceed toward loading station 36 at a reduced speed. Upon reaching loading station 36, the loader cart 60 is stopped by actuating limit switch 144 which also lowers the lift frame 108 and track 98 and starts the machine chassis 30 up. The lift frame 108 is stopped at its lower limit by again actuating limit switch 140 which also starts the loader cart 60 toward its delay safety position 132 at which it is stopped by actuating limit switch 136.

The cart 60' of the unloader 46 is started toward the machine conveyor 26 from its delay safety position 134 when the machine conveyor 26 has completed a transfer movement of the racks along the conveyor, which it effects while the chassis 30 is in its raised position. Upon completing this upper transfer movement a limit switch (not shown) is actuated which starts the machine chassis 30 down and also starts the cart 60' of the unloader 46 toward the machine and its unloading position 38. As the unloader cart 60' reaches this unloading position 38, it actuates a limit switch 138' which stops the cart 60' in the unloading position 38 and raises the lift frame 108' and the lift track 98'. When the lift frame 108' reaches the upper limit of its movement it actuates limit switch 140' stopping the lift frame 108' in its upper position and starting the unloader cart 60' toward the shop conveyor 24, provided the machine chassis has reached the lower limit of its travel and actuated a circuit preparing limit switch (not shown). This downward movement of the machine chassis 30 transfers a rack 22' of plated work from the machine conveyor 26 to the cart 60'. The unloader cart 60' then proceeds toward the shop conveyor 24 and the loading station 42 thereof and as it approaches this loading station, it may actuate a limit switch 142' causing the cart 60' to proceed toward the loading station 36' at a reduced speed. Upon reaching loading station 42, the unloader cart 60' is stopped by actuating limit switch 144' which also lowers lift frame 108' to transfer the rack 22' from the cart 60' to one of the supports 124 of the conveyor 24. As the lift frame 108' reaches its lower limit, it actuates limit switch 140' which stops it in its lower position and starts the unloader cart 60' toward its delay safety position 134. This actuation of the limit switch 140' also starts the conveyor 24. The unloader cart 60' proceeds toward and is stopped at its delay safety position 134 by actuating the limit switch 136'. The carts 60 and 60' remain in their respective delay safety positions 132 and 134 until they are again started toward the shop conveyor 24 and the machine conveyor 26, respectively, as described above.

Any suitable electric circuit and hydraulic system may be employed for providing the above described cycle of operation of the transfer mechanism. A suitable electric circuit and hydraulic system will be apparent to one skilled in the art and accordingly, the specific details of the electrical circuit and hydraulic system form no part of the present invention and are not included in the present disclosure.

In the embodiment of the invention illustrated in FIGURES 1 through 7, inclusive, the transfer mechanism comprises a pair of similar units 44 and 46 which operate simultaneously, one loading the automatic plating machine 28 from the shop conveyor 24, while the other is unloading the plating machine and transferring the racks to the shop conveyor.

In a modified form of the present invention, illustrated in FIGURES 8 through 16, inclusive, the transfer mechanism which is generally indicated at 150, comprises a single unit extending between the plating machine 28 and the shop conveyor 24 which unit successively operates to load and unload the machine conveyor. In the construction illustrated in these figures, the transfer mechanism 150, in addition to providing the vertical movement incident to unloading a raw rack from the shop conveyor and to loading a finished rack on the shop conveyor, also provides the vertical movement incident to transferring a raw rack to the machine conveyor and to transferring a finished rack from the machine conveyor. Referring to FIGURE 8, the transfer mechanism 150 extends between a transfer station 146 at the shop conveyor 24 and a transfer station 148 at the machine conveyor 26. The transfer mechanism 150 comprises a main frame generally indicated at 152 consisting of longitudinally extending angles 154 supported on legs 156 and connected by transverse frame members 158. These angles 154 carry longitudinally extending inwardly facing channel-shaped tracks

160. In this modified form of the invention the cart is generally indicated at 162 and includes a base plate 164 supported on spaced longitudinally extending angles 166 welded to the underside of the base plate 164 and carrying longitudinally spaced rollers 168 mounted for rotation about a horizontal axis and disposed to roll within the channel-shaped tracks 160. At its opposite sides the cart 162 has upwardly turned tapering sides 170 which may be formed integral with the base plate 164 and which carry centrally thereof vertically disposed hollow posts 172 welded or otherwise suitably secured thereto. Each hollow post 172 carries an inner vertically movable post 174, the upper end of which carries a laterally inwardly extending support arm 176 adapted to engage a co-operating support arm 175 on the rack 177 and the lower end of which has a lift bracket 178 secured thereto by bolts 180. This lift bracket comprises a horizontally extending inwardly opening channel-shaped section 182 and an upwardly extending attaching portion 184 adapted to overlie and be secured by the bolts 180 to the lower end portion of the movable post 174. Each of the side plates 170 of the cart 162 also has welded thereto a pair of vertically extending parallel drive bars 186 disposed at opposite sides of the post 172. As best illustrated in FIGURES 11 and 12, these drive bars 186 have inwardly offset lower end portions which extend downwardly from the cart base plate 164 in spaced parallel relation. The cart 162 is driven through these bars 186 in a manner which will now be described.

A pair of parallel sprocket shafts 188 and 190 are spaced longitudinally of and extend transversely of the frame 152. These shafts 188 and 190 are journalled in bearing blocks 192 secured to the inner sides of the depending flanges of the main frame angles 154. Outwardly of the frame channels 154 the shaft 188 carries at each end thereof a sprocket wheel 194 keyed thereto and similarly, the shaft 190 carries sprocket wheels 196. At each side of the frame 152 is a roller chain 198 trained over the sprocket wheels 194 and 196 at corresponding ends of the shafts 188 and 190. The shaft 188 is driven through a sprocket wheel 200 keyed thereto between the frame angles 154, by a chain 202 trained over the sprocket wheel 200 and over another sprocket wheel 204 keyed to the output shaft of a speed reducer 206 driven through a suitable coupling 208 by a hydraulic motor 210. Each chain 198 carries a drive bracket 212 secured to the chain by what is known in the trade as a K–1 attachment. In this attachment the conventional outer side plates of a roller chain are replaced by side plates 214 which have laterally outwardly turned flanges 216 for attachment purposes. As illustrated in FIGURE 11, the bracket 212 has a horizontal flange 218 which is bolted to the flanges 216 of the K–1 attachment and has a vertical flange 220 at the outer side of the chain and which carries a roller 222 mounted at the inner or left-hand side of the flange 220 as viewed in FIGURES 11 and 12, for rotation about a horizontal axis so disposed as to coincide with the axis of the shaft 188 when the portion of the chain to which the bracket 212 is connected, is engaging the sprocket wheel 194. Similarly, the axis of the roller 222 coincides with the axis of the shaft 190 when the portion of the chain 198 to which the bracket 212 is attached, engages the sprocket wheel 196. Each roller 222 rolls along the upper surface of a support bar 224 extending longitudinally of the main frame and supported therefrom outwardly of the chain 198 and sprocket wheels 194 and 196 on transversely extending angles 226. In this manner the bracket 212 is vertically supported on the frame 152 without relying on the chain 198 for vertical support. Stability for the bracket 212 in the plane of the chain 198 is provided, as best illustrated in FIGURE 13, by brackets 228 secured to adjacent links of the chain 198, also by K–1 attachments. These brackets 228 each have a vertically extending flange 230 disposed in the plane of the flange 220 of the bracket 212 and having aa arcuate edge surface 232 adapted to fit a co-operating arcuate edge surface 234 of the flange 220 of the bracket 212 when the links of the chain to which the bracket 212 and 228 are attached, are trained over the sprocket wheel 194.

The flange 220 of the bracket 212, at its outer or right-hand side, as viewed in FIGURES 11 and 12, carries a drive disk 236 stud welded thereto as illustrated at 238 in FIGURE 11, in spaced relation to the axis of the roller 222. The drive disk 236 fits between and is adapted to engage the adjacent edges of the drive bars 186 to drive the cart 162. The drive bracket 212 also carries a roller 240 which, in the construction illustrated, is mounted eccentrically of the drive disk 236 on a horizontally disposed bolt 242 extending through the disk 236 and the flange 220 of the bracket 212, the roller 240 being carried by the bolt 242 outwardly of the drive disk 236 or to the right thereof as illustrated in FIGURES 11 and 12. The roller 240 is disposed within the inwardly facing channel-shaped fitting 182 secured to the end of the movable lift post 174.

It will now be appreciated that as the drive bracket 212 is moved horizontally by and with the chain 198, the drive disk 236 engages one of the drive bars 186 and moves the cart along the track 160. When the bracket 212 reaches one of the sprocket wheels 194 or 196, and moves around the sprocket wheel, it will be appreciated that the drive disk 236 engages the opposite drive bar 186 to stop the cart and move the cart in the opposite direction. During this movement of the bracket 212 about either of the sprocket wheels, the roller 240 co-operates with the channel-shaped fitting 182 in which it is disposed, to move the movable lift post 174 vertically. During this movement of the drive bracket 212, its supporting roller 222 remains in engagement wih the upper surface of the supporting bar 224 at all times.

It will be appreciated, also, that the spacing of the roller 240 vertically relative to the roller 222 will determine the amount of vertical movement of the lift post 174. Also, the vertical spacing of the disk 236 relative to the roller 222 will determine the distance which the cart 162 moves beyond the axis of the sprocket wheels 194 and 196. Both of the factors, that is, the amount of movement of the cart beyond the axis of the sprocket wheels and the vertical movement of the lift post 174 co-operate to determine the path of movement of the rack supporting arm 176 at the upper end of the lift post 174.

This is clearly illustrated in FIGURE 14 in which the spacing of the roller 240 eccentrically of the sprocket wheel 194 is such as to provide the desired vertical movement of the rack support 176, the highest and lowest positions of which are there indicated at 176*a* and 176*b*, respectively. Intermediate positions of the rack support arm 176, corresponding to the full line positions of the drive disk 236, are shown in full lines in FIGURE 14. The broken line intermediate positions of the rack support arm 176 shown in FIGURE 14 illustrate the effect of moving the drive disk 236 from the full line position there illustrated to the broken line position there shown.

FIGURE 15 is a family of curves illustrating a number of different paths which the rack support arm 176 may be made to travel for a given spacing of the lift post driving roller 240 relative to the roller 222 by varying the vertical spacing of the drive disk 236 relative to the roller 222 which, as previously stated, is coaxial with the sprocket wheel during movement of the drive bracket 212 about the sprocket wheel. The curve indicated by the reference character 244 is a circle and represents the path of movement which would be obtained when the drive disk 236 is coaxial with the lift post roller 240. The inner, or left-hand curve 246 indicates a path of travel which would be obtained with the drive disk 236 disposed slightly closer to the axis of the roller 222 than is the lift post roller 240.

In the construction illustrated in FIGURES 8 through

14, inclusive, the drive disk 236 is spaced from the axis of the roller 222 a greater distance than is the roller 240 which drives the lift post 174. By varying this spacing the rack support arm 176 may be made to follow, for example, any of the paths indicated by the other curves of FIGURE 15. The transfer mechanism construction illustrated in FIGURES 8 through 13, inclusive, is designed to cause the rack support arms 176 to follow the path indicated by the curve 248 of FIGURE 15.

It will be appreciated that the spacing of the axis of the drive disk 236 from the axis of the roller 240 will determine the deceleration and acceleration of the cart 162 as the drive bracket 212 passes around the sprocket wheel. For example, when the rack support arm 176 follows a path indicated by the curve 248, the cart 162, which moves at a uniform rate of speed while the drive bracket 212 is travelling between the sprocket wheels 194 and 196, will decelerate in the distance indicated at 250 in FIGURE 15, which is the distance between the axis of the drive disk 236 and the axis of the roller 222. As the drive bracket 212 passes around the sprocket wheel 194, for example, while the chain is moving in the direction indicated by the arrow 252 in FIGURE 13, the cart 162 during the first 90° of rotation of the sprocket wheel 194, decelerates from the above mentioned uniform speed to a speed of zero and during the next 90° of rotation of the sprocket wheel 194, the cart 162 accelerates in the opposite direction to the above mentioned uniform speed.

The transfer of the rack to or from the rack supporting arm 176 is made at the midpoint of the curve, or referring to FIGURE 14, when the rack support arm 176 is in the position indicated at 176c. The sprocket wheel turns at a constant angular velocity during this transfer and accordingly, it will be appreciated that the linear velocity of the rack support arm 176 is less, at the midpoint of the curve, as the distance of the drive disk 236 from the roller 222 is increased. Referring to FIGURE 9, the transfer mechanism is so constructed that the center line of the shop conveyor is tangent to the path of movement of the center of the drive disk 236 as it passes around the sprocket wheel 194. Similarly, the center line of the machine conveyor is tangent to the path of movement of the center of the drive disk 236 as it passes around the sprocket wheel 196.

At the center of the lower course of the chain 198, between the sprocket wheels 194 and 196, is a chain support 252 which is supported on and extends between transversely extending base members 254. It will be appreciated that since the sprocket shaft 188 is the one which is driven, the lower course of the chain 198 will be slack during operation of the mechanism to move the cart 162 to the right, as viewed in FIGURES 7 and 8. During such operation the lower course of the chain is supported by the support 252.

The position of the fitting 182 at the lower end of the movable lift post 174, when the portion of the chain 198 to which the drive bracket 212 is connected is a part of the lower course of the chain 198, is shown in broken lines in FIGURE 10. At opposite sides of the base 10 and also mounted on the transverse base members 254 at the outer ends thereof, are suitable stop bars 256 which extend longitudinally of the mechanism, as is best seen in FIGURES 7 and 8. As will be seen from the above mentioned broken line showing in FIGURE 10, these stop bars 256 are disposed in the path of movement of the lift post fitting 182 as the drive bracket 212 moves along the lower course of the chain 198. The stop bars 256 are employed as safety stops and are not used in normal operation, the stopping of the cart 162 being in response to the actuation of limit switches 258 and 260 (see FIGURES 7 and 9) which may be mounted on the underside of the support bar 224 and disposed to be actuated by the flange 220 of the drive bracket 212 as the latter moves along the lower course of the chain 198.

In operation the above described transfer mechanism illustrated in FIGURES 8 through 14, inclusive, functions as follows. Generally stated, the transfer mechanism 150 operates to pick up a rack 177 from the shop conveyor and deposit it on a machine conveyor for loading a plating machine and after an indexing of the machine conveyor, serves to remove a finished rack from the machine conveyor and deposit it on the shop conveyor. As pointed out above, in the transfer mechanism 150, both of these functions are performed by a single loader-unloader unit, rather than by two separate units as in the embodiment illustrated in FIGURES 1 to 7, inclusive.

In one complete cycle of operation the cart 162 moves from a delay safety position indicated by the broken line showing 262 of the lift post end fitting 182 in FIGURE 9, to a second delay safety position indicated by the broken line showing 264 of another position of the lift post end fitting 182 and returns to the delay safety position 262. Describing the cycle of operation in more detail, the cart 162 starts from the delay safety position 262 in response to the actuation of a limit switch (not shown) on the shop conveyor by the arrival of a shop conveyor rack support in position for a rack carried thereby to be picked up by the transfer mechanism. It will be appreciated that during the initial movement of the transfer mechanism the drive bracket 212 is connected to the lower course of the chain 198 and moves toward the sprocket wheel 194, and as it moves upwardly around the sprocket wheel, it raises the movable lift post 174 through the cooperation of the roller 240 with the fitting 182, causing the rack support arm 176 to follow a path indicated by the curve 248 in FIGURE 13, and lift a rack of unplated work from the shop conveyor. As the movement of the chain 198 continues, the drive bracket 212 moves the cart 162 toward the machine conveyor with the bracket 212 moving along the upper course of the chain 198. When the bracket 212 reaches the sprocket wheel 196 it moves downwardly around the sprocket wheel 196 causing the rack support arm 176 to deposit the rack of unplated workpieces upon the machine conveyor.

The drive bracket 212 then moves along the lower course of the chain 198, moving the empty cart 162 to the delay safety position 264 at which it is stopped by actuation of the limit switch 260. The cart remains at this delay safety position while the machine conveyor operates to move the rack just delivered to the machine conveyor along the conveyor and move a rack of plated work into position to be removed from the machine conveyor by the transfer mechanism. The arrival in this position of the machine conveyor hook carrying a rack of plated work actuates a limit switch (not shown) on the machine and starts the cart 162 from the delay safety position 264 toward the sprocket wheel 196. As the cart 162 approaches the machine, the drive bracket 212 moves upwardly around the sprocket wheel 196 causing the rack support arm 176 to lift the rack of plated work from the machine conveyor. Upon continued movement of the chain 198 the cart 162 moves toward the shop conveyor with the drive bracket 212 moving along the upper course of the chain and as the bracket 212 passes around the sprocket wheel 194, the rack support arms 176 deposit the rack of plated work on the shop conveyor hook. The chain 198 continues to move with the drive bracket 212 moving along the lower course of the chain and carrying the cart 162 to the delay safety position 262 in which it is stopped by actuation of the limit switch 258. In addition to stopping the chain 198 by stopping the hydraulic motor 212, the limit switch 258 signals the shop conveyor 24 to move the hook to which a rack of plated work has just been delivered, along the conveyor and to move into position another hook carrying a rack of unplated work. From the time that the cart 162 starts from the delay safety position 262 toward the shop conveyor until the cart returns to and is stopped at the delay safety position 262 by actuation of the limit switch 258, the shop con-

veyor is stationary. It is appreciated, of course, that this may mean either that the shop conveyor runs intermittently, or that a type of shop conveyor is employed in which means are provided for maintaining a shop conveyor hook stationary in position at the transfer mechanism while the shop conveyor in general continues to move. It will be appreciated that any suitable electric circuit and hydraulic system for providing the above described cycle of operation may be employed and accordingly, it is not believed necessary to illustrate and describe in detail herein the electrical circuit and hydraulic system for providing this cycle of operations.

While the transfer mechanism illustrated in FIGURES 8 through 14, inclusive, employs a hydraulic motor 210, it is contemplated that if desired, a mechanical drive for the chain 198 may be provided. An embodiment of the present invention employing a mechanical drive is illustrated in FIGURE 16 which differs from the construction illustrated in FIGURES 8 through 14, inclusive, only in that in place of the hydraulic motor 210 and speed reducer 206, there are substituted an electric motor 266 which drives through a conventional variable speed motor 268 and a speed reducer unit 270 to the sprocket wheel 204.

While only several specific embodiments of the invention have been illustrated and described herein, it will be readily appreciated by those skilled in the art that numerous modifications and changes may be made without departing from the spirit of the present invention.

What is claimed is:

1. A transfer mechanism for transferring work racks between two spaced stations comprising a frame, track means on said frame extending between the stations, a carriage movably mounted on said track means, guide means on said carriage, a column including rack-engaging means thereon mounted in said guide means for up and down movement relative to said carriage, roller means rotatably mounted adjacent to each end of said track means, a flexible drive element extending longitudinally of said track means and trained around said roller means, drive means for moving said drive element along said track means, and engaging means on and movable with said drive element disposed in driving engagement with said carriage for movement thereof between the stations in response to movement of said drive element and for engaging coacting means on said column for raising and lowering said column in response to the arcuate travel of said engaging means around said roller means.

2. A transfer mechanism for transferring work racks between two spaced stations comprising a frame, track means on said frame extending between the stations, a carriage movably mounted on said track means, guide means on said carriage, a column including rack-engaging means thereon mounted in said guide means for up and down movement relative to said carriage, roller means rotatably mounted adjacent to each end of said track means for rotation about substantially horizontal axes, a flexible drive element extending longitudinally of said track means and trained around said roller means, reversible drive means for moving said drive element along said track means, and engaging means on and movable with said drive element disposed in driving engagement with said carriage for movement thereof between the stations in response to movement of said drive element and for engaging coacting means on said column for raising and lowering said column and for halting and reversing the direction of movement of said carriage in response to the arcuate travel of said engaging means around said roller means.

3. A transfer mechanism for transferring work racks between two spaced stations comprising a frame, track means on said frame extending between the stations, a carriage movably mounted on said track means, a pair of transversely spaced guide means on said carriage, a column including rack-engaging means thereon mounted in each of the pair of said guide means for up and down movement relative to said carriage, roller means rotatably mounted adjacent to each end of said track means, a flexible drive element extending longitudinally of each side of said track means and trained around said roller means, reversible drive means for moving each said drive element in synchronization along said track means, and engaging means on and movable with each said drive element disposed in driving engagment with said carriage for movement thereof between the stations and for engaging coacting means on the lower portions of each said column for raising and lowering each said column and for halting and reversing the direction of travel of said carriage in response to the arcuate travel of said engaging means around said roller means.

4. A transfer mechanism for transferring work racks between two spaced stations comprising a frame, track means on said frame extending between the stations, a carriage movably mounted on said track means, guide means on said carriage, a column including rack-engaging means thereon mounted in said guide means for up and down movement relative to said carriage, a wheel rotatably mounted for rotation about a substantially horizontal axis adjacent to each end of said track means, a flexible drive element extending longitudinally of said track means between and trained around each said wheel, reversible drive means for moving said drive element along said track means, and means on and movable with said drive element including an arm having first engaging means thereon disposed in driving engagement with said carriage for movement thereof between the stations in response to longitudinal movement of said drive element and for halting and reversing the direction of travel of said carriage in response to the arcuate travel of said first engaging means around said wheel, said arm including second engaging means thereon for engaging coacting means on said column for raising and lowering said column in response to the arcuate travel of said second engaging means around said wheel.

5. A transfer mechanism for transferring work racks between two spaced stations comprising a frame, track means on said frame extending between the stations, a carriage movably mounted on said track means, guide means on said carriage, a column including rack-engaging means thereon mounted in said guide means for up and down movement relative to said carriage, a wheel rotatably mounted for rotation about a substantially horizontal axis adjacent to each end of said track means, a flexible drive element extending longitudinally of said track means between and trained around each said wheel, reversible drive means for moving said drive element along said track means, means on and movable with said drive element comprising an arm including first engaging means thereon disposed in driving engagement with said carriage for movement thereof between the stations and for halting and reversing the direction of travel of said carriage in response to the arcuate travel of said first engaging means around said wheel, said arm including second engaging means thereon for engaging coacting means on said column for raising and lowering said column in response to the arcuate travel of said second engaging means around said wheel, and supporting means extending longitudinally of said track means for supporting said arm during the longitudinal and arcuate travel thereof.

6. A transfer mechanism for transferring work racks between two spaced stations comprising a frame, track means on said frame extending between the stations, a carriage movably mounted on said track means, guide means on said carriage, a column including rack-engaging means thereon mounted in said guide means for up and down movement relative to said carriage, a sprocket rotatably mounted on a horizontal axis adjacent to each end of said track means, a flexible drive chain extending longitudinally of said track means between and trained around the sprockets, reversible drive means for moving

said drive chain along said track means, an arm connected to and movable with said drive chain, means on said arm cooperating with a longitudinally extending supporting means for supporting said arm during its longitudinal travel and arcuate travel around said sprockets, first engaging means on and movable with said arm disposed in driving engagement with said carriage for movement thereof between the stations and for halting and reversing the direction of travel of said carriage in response to the arcuate travel of said drive chain around said sprockets, and second engaging means on said arm for engaging coacting means on said column for raising and lowering said column in response to the arcuate travel of said second engaging means around said sprockets.

7. A transfer mechanism for transferring work racks between two spaced stations comprising a frame, track means on said frame extending between the stations, a carriage movably mounted on said track means, guide means on said carriage, a column including rack-engaging means thereon mounted in said guide means for up and down movement relative to said carriage, a sprocket rotatably mounted on a horizontal axis adjacent to each end of said track means, a flexible drive chain extending longitudinally of said track means between and trained around the sprockets, reversible drive means for moving said drive chain along said track means, an arm connected to and movable with said drive chain, means on said arm cooperating with a longitudinally extending supporting means for supporting said arm during its longitudinal travel and arcuate travel around said sprockets, first engaging means on and movable with said arm disposed in driving engagement with said carriage for movement thereof between the stations and for halting and reversing the direction of travel of said carriage in response to the arcuate travel of said drive chain around said sprockets, second engaging means on said arm for engaging coacting means on said column for raising and lowering said column in response to the arcuate travel of said second engaging means around said sprockets, and sensing means operatively associated with said carriage and said stations for controlling the actuation of said reversible drive means for effecting transfer of work racks between the stations.

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