

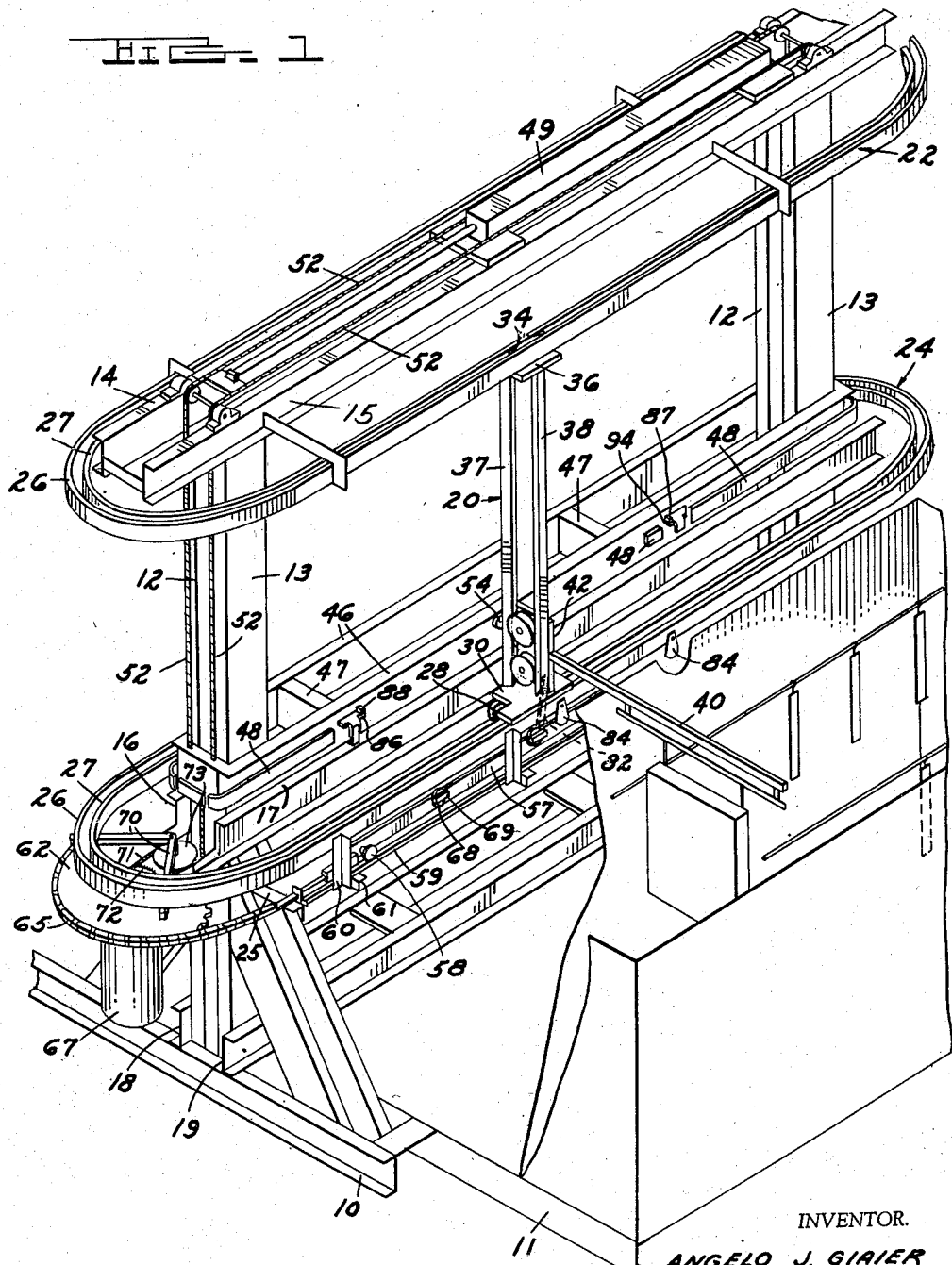
March 11, 1958

A. J. GIAIER
MULTI-STATION WORK PROCESSING MACHINE
WITH VARIABLE CARRIER SPACING

2,826,288

Filed May 10, 1957

4 Sheets-Sheet 1



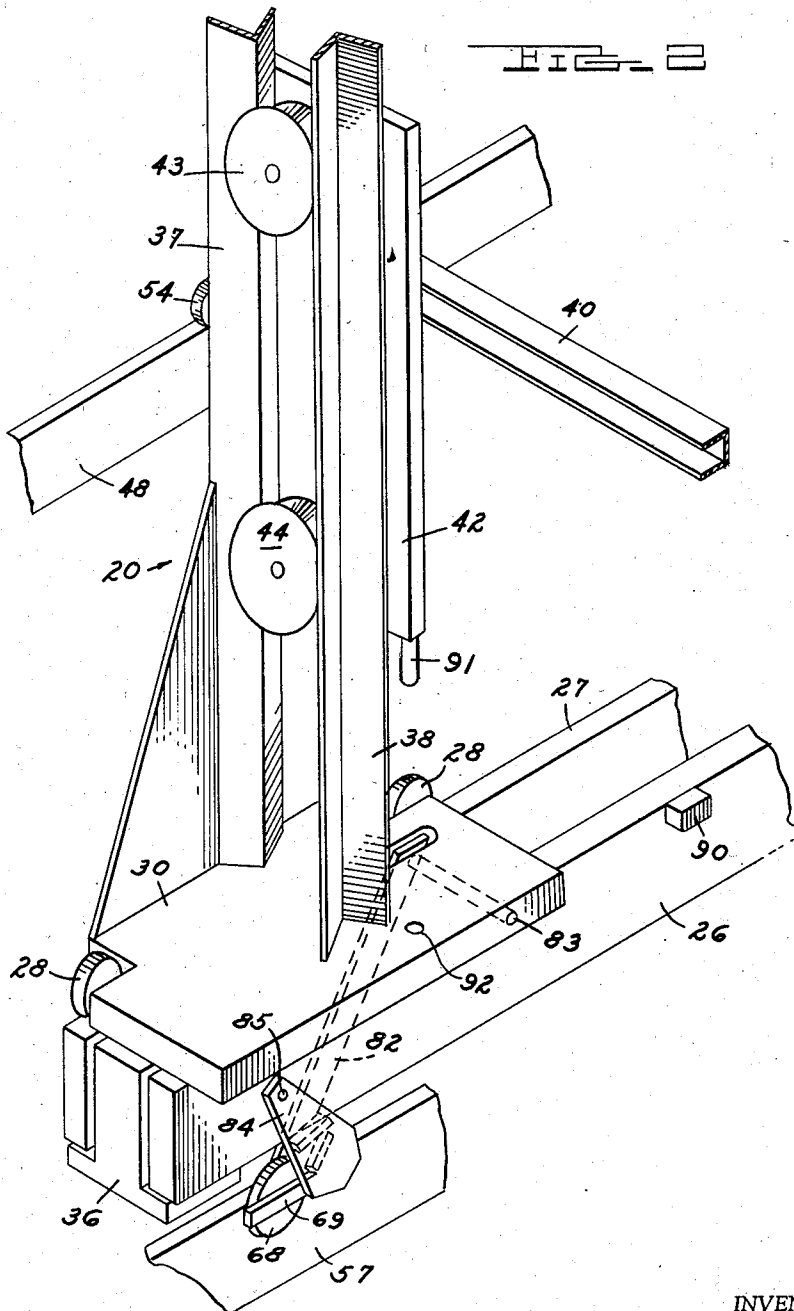
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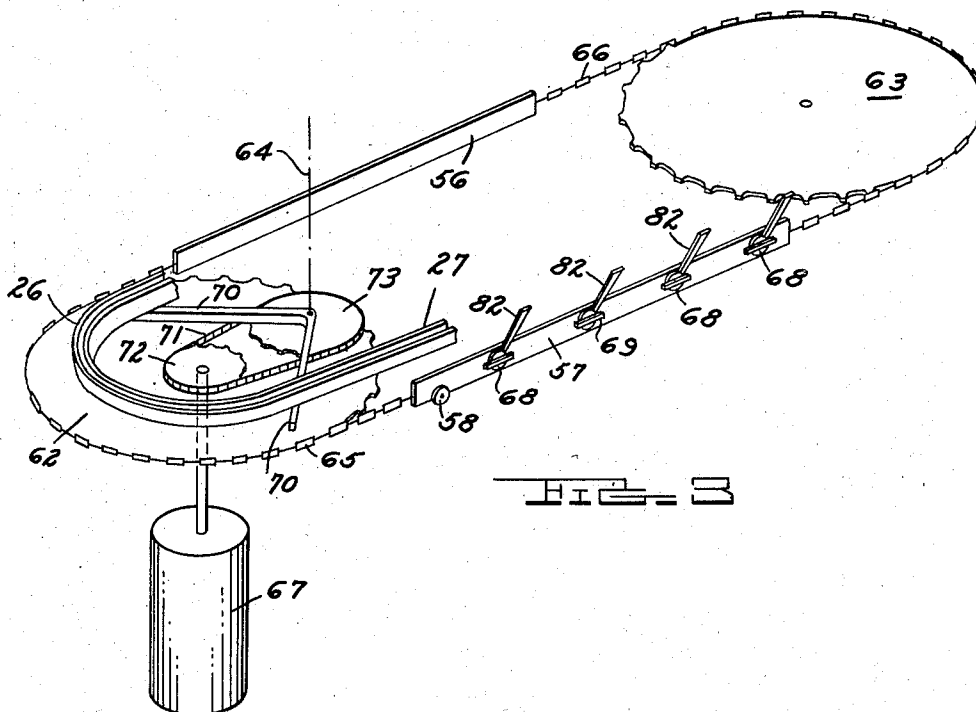
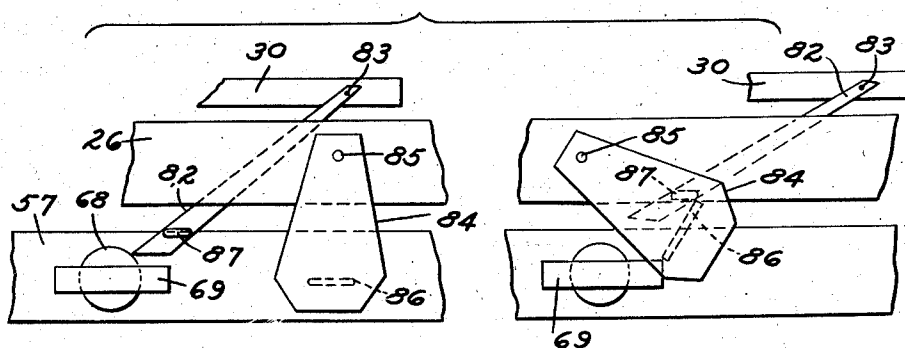


FIG. 4



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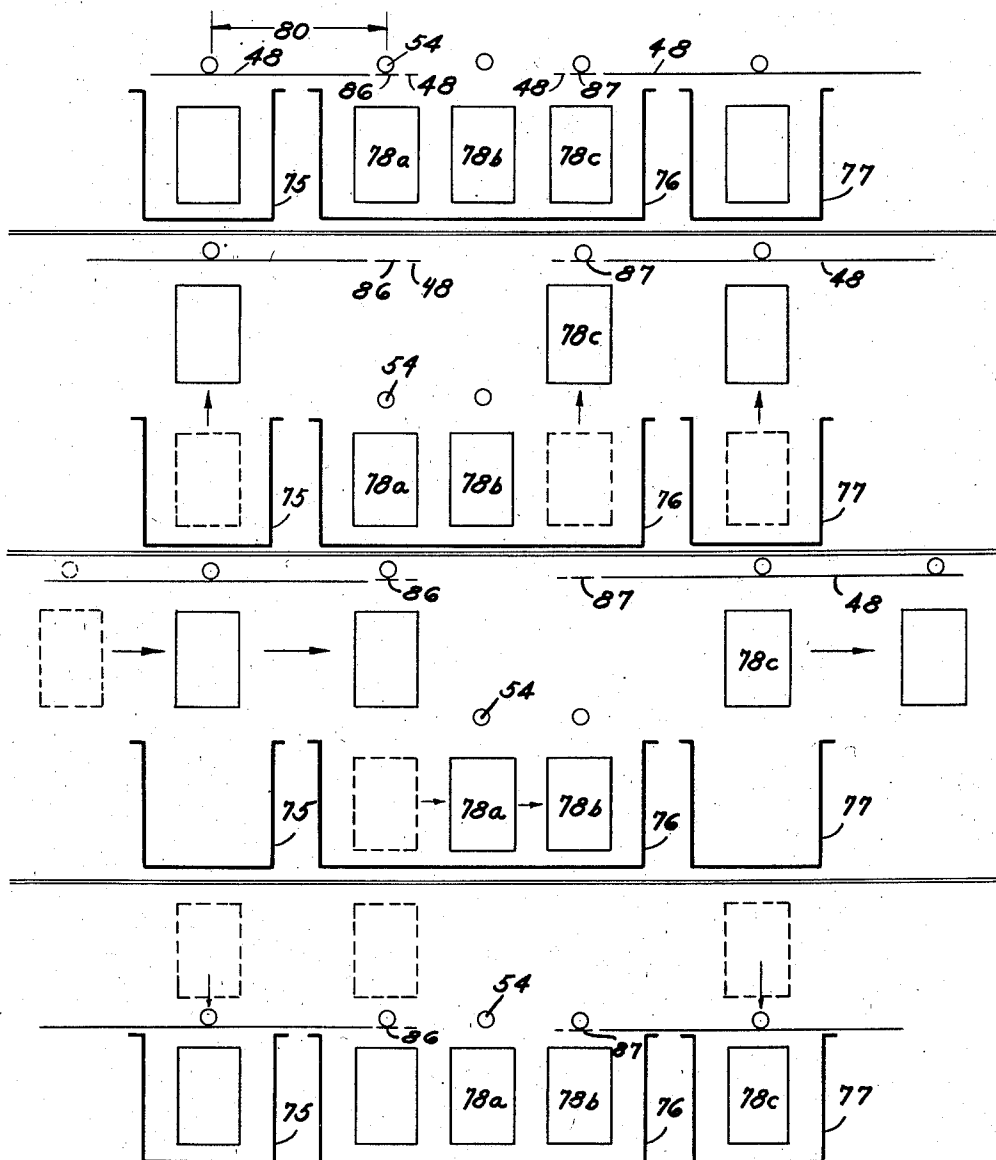


FIG. 5

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MULTI-STATION WORK PROCESSING MACHINE WITH VARIABLE CARRIER SPACING

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Application May 10, 1957, Serial No. 653,430

12 Claims. (Cl. 198—19)

This invention relates to improvements in the construction of work processing machines of the type having a plurality of work treating locations such as tanks. The invention will be illustrated in its application to a machine for electroplating work pieces.

Machines of the present type commonly employ a plurality of carriers each having a vertically movable work supporting member, an elevator for moving selected work supporting members vertically and means for advancing the carriers horizontally along a defined path of travel through the treating locations. A treating location may be a single station type having sufficient area to accommodate one carrier at a time, or a multi-station type where work supported from several carriers is treated simultaneously. The invention particularly applies to such machines wherein at least one work treating location is of the multi-station type.

The invention comprises an improved construction for mounting the carriers and work supporting arms thereof and for varying the spacing between adjacent carriers so that the maximum number can be simultaneously positioned at a multi-station work treating location.

The invention includes track means on which the carriers are supported for free movement in a horizontal path. Drive means including a series of spaced pusher members are mounted for reciprocating horizontal movement adjacent the path of carrier travel, and are reciprocated on a driving stroke at least equal in length to the longest increment of travel required for advancing a carrier from one station to a successive station. Each carrier includes a driven member engageable by one of the pusher members on the driving stroke only. Tripping means are employed for disengaging the pusher and driven members before the end of the driving stroke so that carriers can be advanced a shorter increment of travel where desired. These tripping means are actuated in response to the advance of a carrier by a pusher member to the position defined by the location of the tripping means along the path of travel.

In machines employing a continuous loop path of travel, the improved driving means includes means for advancing a carrier around the ends of the loop at decreased rates of acceleration and deceleration. As a result, an increased rate of travel can be used along the straight sides of the loop, decreasing the transfer time.

The improved carrier mounting includes upper and lower track members with means for supporting the carrier for free movement on one of these track members and means for guiding it on both track members. The guiding function is preferably performed in part at least by a guiding device which frictionally contacts at least one of the rail members to control carrier deceleration and over-travel.

Over-travel is positively controlled by a suitable system of mechanical stops, particularly at the work treating stations where over-travel must be limited.

Other features and advantages of the construction will be more fully explained in connection with the following

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description of the presently preferred embodiment of the invention illustrated in the accompanying drawings which comprise:

Fig. 1, a perspective view of a machine incorporating the improvements of the invention;

Fig. 2, an enlarged perspective view of the circled portion of Fig. 1 with portions of the structure broken away for clarity;

Fig. 3, a perspective view of the carrier driving means;

Fig. 4, an enlarged side elevation of the driving elements for one carrier; and

Fig. 5, a schematic view illustrating the operating cycle of the machine and the variable carrier spacing obtained.

Referring to Fig. 1, the main framework is evident and comprises transverse base members 10, 11 and vertical members 12 and 13 at each end of the machine. These are connected by upper 14, 15, intermediate 16, 17 and lower 18, 19 longitudinal members.

A plurality of carriers such as the carrier 20 are mounted for free horizontal movement between upper and lower tracks 22 and 24 supported by the framework as shown, the lower tracks resting upon members such as the angle member 25. Each track consists of a pair of laterally spaced rails 26 and 27 which form horizontal and vertical supporting and guiding surfaces. In the construction shown, a carrier is supported by a pair of wheels 28 rotatably carried by a base member 30 and engaging the upper surface of one of the lower rails 26. Vertically mounted guide blocks 34 are carried by an upper carrier member 36 and engage corresponding surfaces of the upper track 22. A shoe 36 (Fig. 2) is pivotally secured to the carrier base member 30 and rides between the rails of the lower track.

The carrier structure is completed by a pair of spaced angle members 37 and 38 mounted to form facing V guide rails.

A work supporting member 40 is secured to a carriage mounted for vertical movement on the guide rails 37 and 38, this carriage consisting of a plate 42 positioned alongside the guide rails and supporting V-groove guide wheels 43 and 44 intermediate the rails 37 and 38 (Fig. 2).

An elevator, consisting of longitudinal and transverse frame members 46 and 47, and fixed lifting rail sections 48 secured thereto, is mounted between the vertical end frame members 12 and 13, which serve as guides. Raising and lowering movement of the elevator is in response to the application of fluid pressure to an actuating cylinder 49, acting through a conventional system of chains 52 and counterweights (not shown).

Each work supporting carriage is provided with a projecting lifting roller 54 for engagement by lifting rail sections of the elevator in a manner similar to that disclosed in U. S. Patent 2,605,882.

Movement of a carrier 20 along the path of travel is obtained from a reciprocating type of driving arrangement, best shown in Figs. 1 and 3. A pair of shuttle bars 56 and 57 are located on each side of the loop path of travel below the lower track 24. Each shuttle bar is equipped with guide wheels 58 which ride on a shuttle track 59 suspended from the outer rail member 26, as by members 60 and 61. Sprockets 62 and 63 are mounted on a vertical axis, one at each end of the machine. The axis of each of these sprockets is located between the center line 64 (Fig. 3) of the track and the curved track end.

The shuttle bars 56 and 57 are connected together by a chain 65 trained about the sprocket 62 and by a second chain 66 trained about the sprocket 63. Sprocket 62 is oscillated by a rotary type actuating cylinder 67.

Each of the shuttle bars 56 and 57 is provided with a number of spaced pusher members 68 of circular shape. Each of these members has a projecting dog 69 secured

to it. The pusher members 68 act to advance carriers along the straight sides of the loop track on reciprocating movement of the shuttle bars 56 and 57. Carrier movement around each end of the loop is provided by a set of auxiliary oscillating, one-way pusher bars 70 mounted on an axis coinciding with the center line 64 of the end of the loop track. These pusher bars 70 are driven by a chain 71 and set of sprockets 72 and 73, sprocket 72 being oscillated by the actuating cylinder 67 along with main sprocket 62. This auxiliary pusher arrangement reduces the acceleration imparted to a carrier moving around the curved track ends and thus reduces swaying of a load supported by the carrier.

A typical arrangement of work treating locations incorporated in a machine of this type is schematically shown in Fig. 5, the work treating locations being defined by tanks 75, 76 and 77. Tank 76 is large enough to provide multiple carrier stations 78a, 78b and 78c. The amount of shuttle travel required in order to move a carrier from tank 75 to tank 76 is shown by the distance 80. The same amount of carrier movement is not required in the multiple station tank 76. Instead, more carriers can be simultaneously treated in this tank by reducing the increment a carrier is advanced with each driving stroke of the shuttle.

Figs. 2 and 4 best illustrate the construction employed for obtaining such a reduced increment of movement. Each carrier is equipped with a depending pawl 82 mounted on a pivot pin 83 and projecting downwardly between the lower track rails 26 and 27 into overlapping relation with a pusher bar for engagement by a pusher member 68 thereof.

A tripping cam 84 is provided at any work station where the amount of carrier travel from the preceding work station is less than the driving stroke of the shuttle bars 56 and 57. This tripping cam 84 is pivotally secured at 85 to the outer track rail 26 and hangs down in pendulum fashion into over-lapping relation with the pusher bar. A contact member 86 projects inwardly from the cam 84 for engagement by the dog 69 of a pusher member. This engagement, followed by further advancing movement of the pusher bar, pivots the cam 84 counterclockwise (as the parts are shown in Fig. 4) into engagement with an extension member 87 on the pawl 82, thus moving the pawl upwardly and out of engagement with the pusher member 68. After the pusher member 68 and dog 69 have moved on, the tripping cam 84 and pawl 82 both swing back to their normal positions by gravity. During return movement of the pusher bars 56 and 57, the pusher members 68 ride under the carrier pawls 82 which are tripped upwardly and then return after the pushers have passed on.

The operating cycle of the machine is diagrammatically illustrated in sequence in Fig. 5. In this view, the first position illustrated is the beginning of the treatment period. The elevator has been lowered. During the treatment period the shuttle is operated on its return stroke.

At the end of the treatment period the elevator is raised and the work supporting members 40 of all carriers in single station tanks and any carrier at the last station of a multi-station tank are lifted.

While the elevator remains in raised position, the shuttle is actuated on its driving stroke to advance all carriers one position.

The elevator is then lowered with the shuttle held at the end of its driving stroke and the next treatment period begins.

In multi-station tanks, no elevator lifting rail is provided for positions intermediate the entering and leaving stations. Once a carrier work supporting arm is lowered into a multi-station tank the work remains in lowered position until the carrier reaches the last station. This operation is accomplished by the provision of a movable elevator rail section 86 (Fig. 1) at the entering station and a second movable elevator rail section 87 at the leav-

ing station. Movable rail section 86 receives the lifting wheel 54 of an entering carrier and lowers its work arm 40. After the arm has been lowered, rail section 86 is mechanically moved to an inoperative position so that the arm of an entering carrier will not be raised on the next upward movement of the elevator.

Rail section 87 operates in a reverse manner. It receives the lifting wheel of a carrier advanced to the last station, raises the work arm of this carrier on the next upward movement of the elevator and, as the elevator returns to lowered position, swings to pass the lifting wheel of a following carrier advanced to the last station.

A system of mechanical stops is provided to prevent travel of the free carriers 20 at stations where movable elevator rail sections are employed. The rail section 86 at the entering station is equipped with a mechanical stop 88 (Fig. 1) on its rail surface for contact by the carrier lifting wheel 54. At the last station where movable rail section 87 is employed, an overtravel stop 90 (Fig. 2) is secured to the side of the outer rail member 26. A pin 91 projects downwardly from the work supporting carriage, and when this carriage is in lowered position, pin 91 extends through a hole 92 in the carrier base member 30 for engagement with the stop 90.

Preferably the machine is designed so that a carrier is advanced onto a movable elevator rail section 86 when the shuttle reaches the end of its driving stroke. The shuttle is held in this position while the elevator lowers and thus the engagement between the carrier pawl 82 and a shuttle pusher member 68 acts to positively prevent the carrier from coasting backward off the movable rail section. Such backward movement of the carrier is prevented on a movable elevator rail section 87 by a stop 94 secured to the upper rail surface thereof. The lower position of the elevator rail is sufficiently below the carrier lifting wheels 54 for a lifting wheel to clear this stop 94 when the carrier is advanced. This system of stops gives positive control over the increment of carrier travel to transfer stations and hence also contributes to increasing the allowable rate of shuttle movement with consequent decrease in transfer time.

The general construction of the machine is relatively simple in comparison with other known machines of this type. More important is the fact that the carrier supporting and driving arrangement results in a great degree of flexibility for a machine having certain basic structure. Without changing this basic structure the number of carriers employed can be varied, the maximum increment of carrier advance can be easily varied (by changing the stroke or effective stroke of the shuttle actuating cylinder), the increment of carrier advance can be varied by changing the location of tripping cams, and the number of carriers simultaneously occupying a multistation treating area can be varied to obtain the maximum capacity from the machine.

The size of a machine of given capacity is reduced because the maximum number of carriers can be used.

While preferred embodiments have been described above in detail, it will be understood that numerous modifications might be resorted to without departing from the scope of my invention as defined in the following claims:

I claim:

1. A work processing machine of the type having a plurality of work treating locations such as tanks, a plurality of carriers each including a vertically movable work supporting member, elevator means for moving selected work supporting members vertically, and wherein at least one of the work treating locations has a greater length in the direction of carrier travel than another and sufficient to provide a plurality of carrier stations; an improved construction for varying the spacing between adjacent carriers so that the maximum number of carriers can be simultaneously positioned at a particular work location, comprising track means on which said carriers

are each supported for free movement in a horizontal path of travel, a series of spaced pusher members mounted for reciprocating horizontal movement adjacent to the path of carrier travel, means for reciprocating said pusher members in unison on a driving stroke at least equal in length to the longest increment of travel required for advancing a carrier from a treating location to a successive treating location, a driven member on each carrier engageable by one of said pusher members, and tripping means for disengaging said pusher and driven members to define a shorter increment of carrier travel at least at a treating location of sufficient length to simultaneously accommodate more than one carrier, said tripping means being mounted adjacent to the path of movement of said pusher and driven members for actuation in response to the advance of a carrier by a pusher member to the position defined by the location of said tripping means along the path of travel.

2. A work processing machine according to claim 1 wherein said track means comprise vertically aligned upper and lower rail members, means for supporting each carrier on one of said rail members and means for guiding each carrier on both of said rail members, said guiding means including a member secured to the carrier for frictional engagement with at least one of said rail members.

3. A work processing machine according to claim 1 wherein a shuttle member is mounted for horizontal reciprocating movement adjacent to the path of carrier travel defined by said track means, said pusher members being secured to said shuttle member, said carrier driven members each comprising a pawl secured to each carrier for pivotal movement to a disengaged position in response to return movement of said pusher members and additionally in response to actuation of said tripping means.

4. A work processing machine according to claim 3 wherein said tripping means comprises a member mounted for pivotal movement at a particular location along the path of travel, means carried by said shuttle and said tripping member for producing pivotal movement of the latter upon the completion of a given amount of driving movement of said shuttle, and means for moving said pawl to disengaged position upon pivotal movement of said tripping member.

5. A work processing machine according to claim 3 wherein said shuttle member is mounted below said track means, the said pusher members of said shuttle being positioned in approximate vertical alignment with the center line of said track means.

6. A work processing machine according to claim 1 further characterized by means for positively preventing over-travel of a carrier advanced by one of said pusher members when the work supporting member of such carrier is in lowered position comprising a pin vertically movable with said work supporting member and a fixed stop engageable by said pin when said work supporting member is in lowered position.

7. A work processing machine according to claim 1 wherein the treating locations are arranged around a continuous loop path of travel and characterized by said series of equally spaced pusher members being mounted

along a pair of shuttles positioned on either side of said loop, flexible propelling members interconnecting the ends of said shuttles, said flexible members each being trained about a sprocket mounted on a vertical axis, oscillating pusher means for propelling a carrier around the end portions of said loop from one shuttle to the other including a pusher member mounted for movement on an axis eccentric to the said sprocket axis and driving means for oscillating said pusher member in response to oscillation of said sprocket, the distance between the axes of said sprockets being greater than the distance between the axes of said pusher members.

8. A work processing machine according to claim 7 wherein the driving means for oscillating said pusher member includes a reduction between said sprocket and pusher member.

9. In a work processing machine having a plurality of work processing stations, the combination of a plurality of carriers, means supporting each of said carriers for free horizontal travel, and carrier propelling means comprising a series of spaced pusher members, means mounting said pusher members for horizontal movement in unison adjacent the path of carrier travel, a driven member on each carrier engageable by one of said pusher members for driving such carrier in one direction of movement of said pusher member, means for reciprocating said pusher members on a driving stroke, at least some of said work stations having tripping cam means mounted adjacent thereto and means for actuating said tripping cam means to disengage said pusher and driven members before said pusher members reach the end of their driving stroke.

10. In a work processing machine having a plurality of work stations, the combination of a plurality of carriers, vertically aligned upper and lower tracks, means for supporting each carrier on one of said tracks for free movement thereon, means for guiding each carrier on both upper and lower tracks, carrier propelling means comprising a series of pusher members, means mounting said pusher members for horizontal movement in unison in approximate vertical alignment with said tracks, a driven member on each carrier engageable by one of said pusher members for driving such carrier in one direction, means for reciprocating said pusher members on a driving stroke and a return stroke, and means at least at some of said work stations for disengaging a carrier driven member from a pusher member before the end of said driving stroke.

11. A work processing machine according to claim 10 wherein said means for guiding each carrier includes a pair of vertical rail surfaces on each of said tracks and means on each carrier engageable with said vertical rail surfaces.

12. A work processing machine according to claim 11 wherein the engagement between each carrier and said vertical rail surfaces is of the sliding type.

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