

July 6, 1965

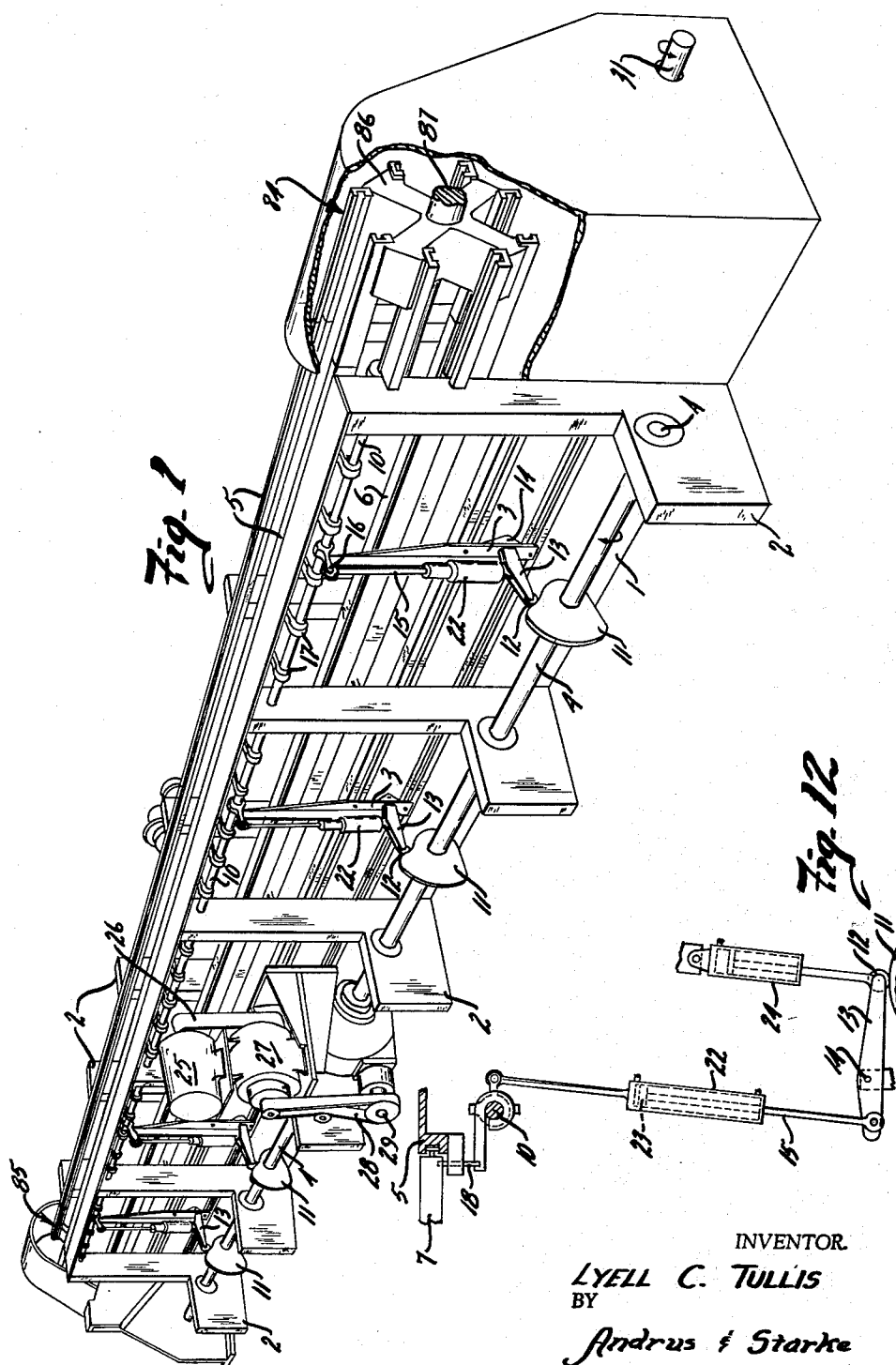
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3,192,873

AUTOMATIC ASSEMBLY MACHINE

Filed Sept. 3, 1963

5 Sheets-Sheet 1



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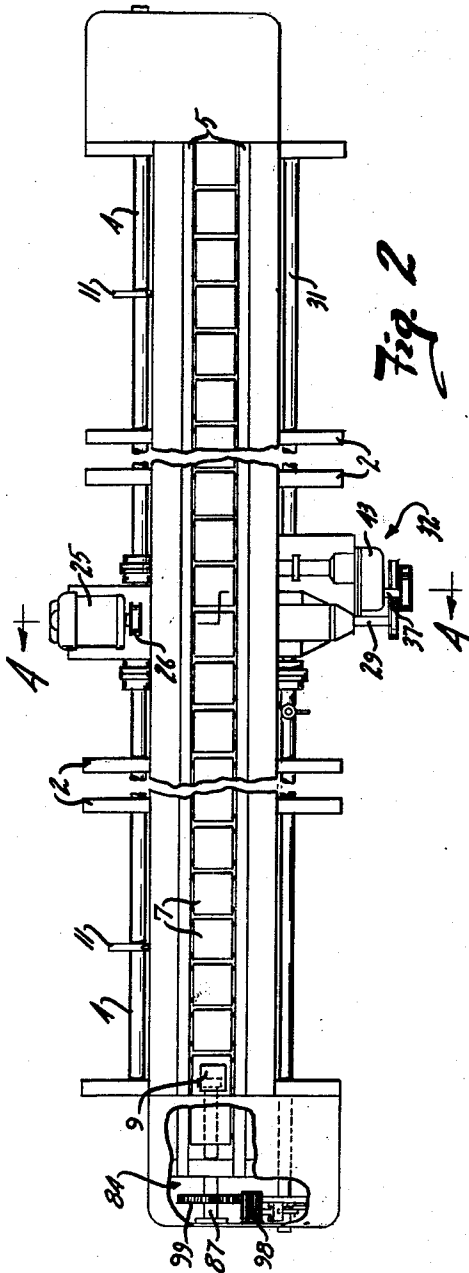


Fig. 2

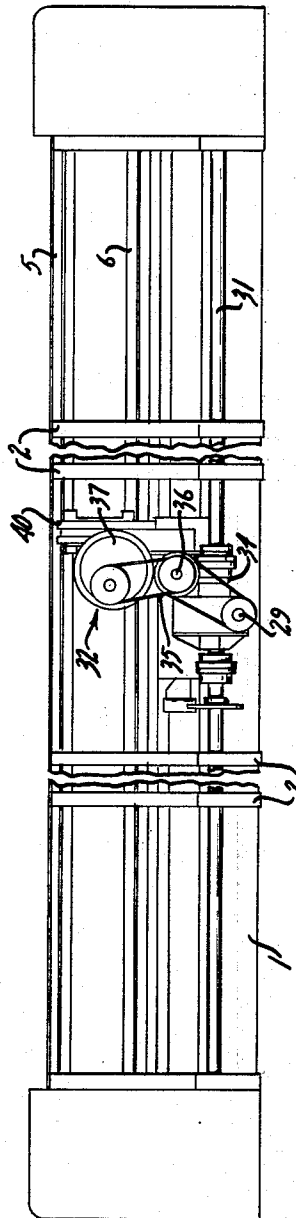


Fig. 3

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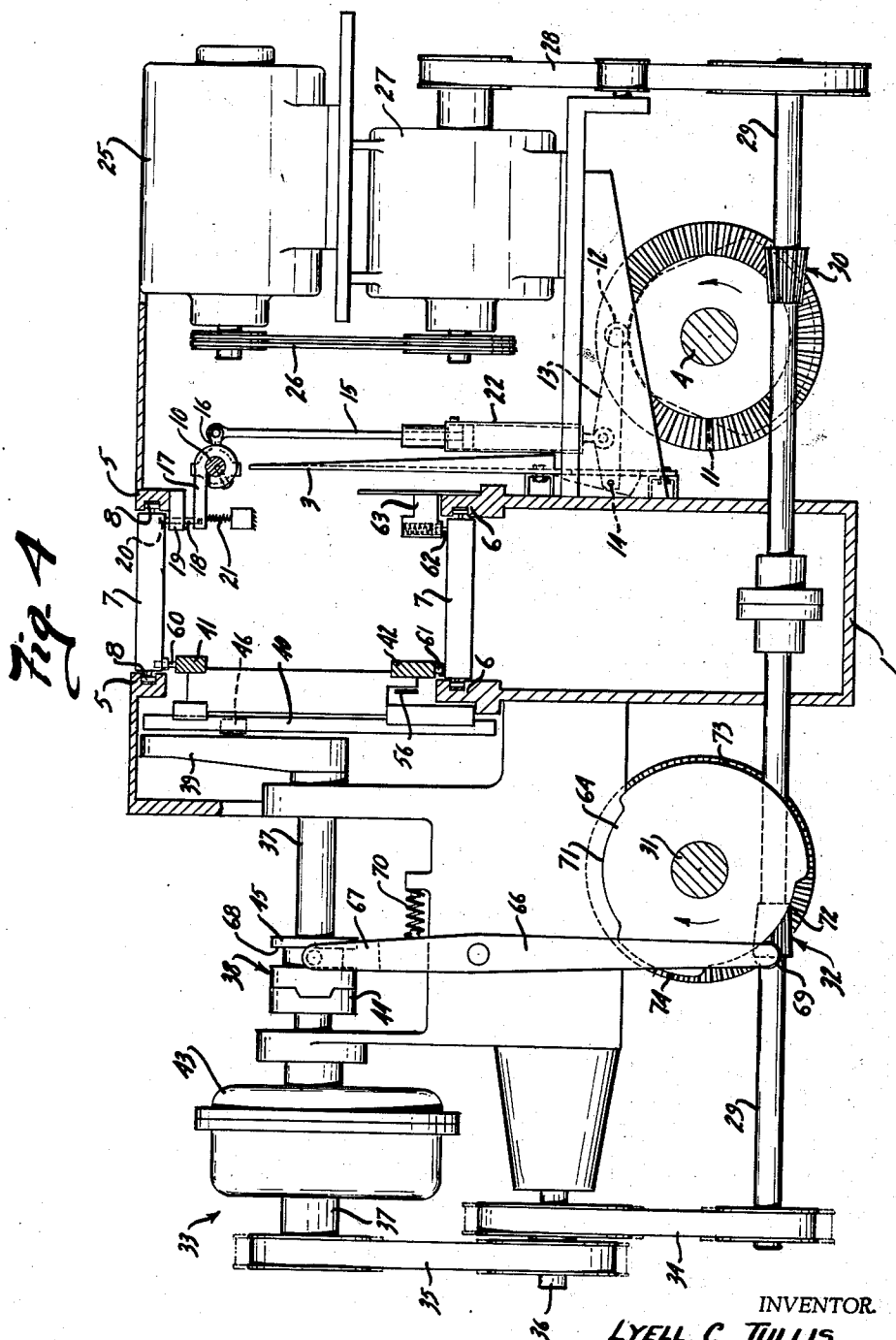
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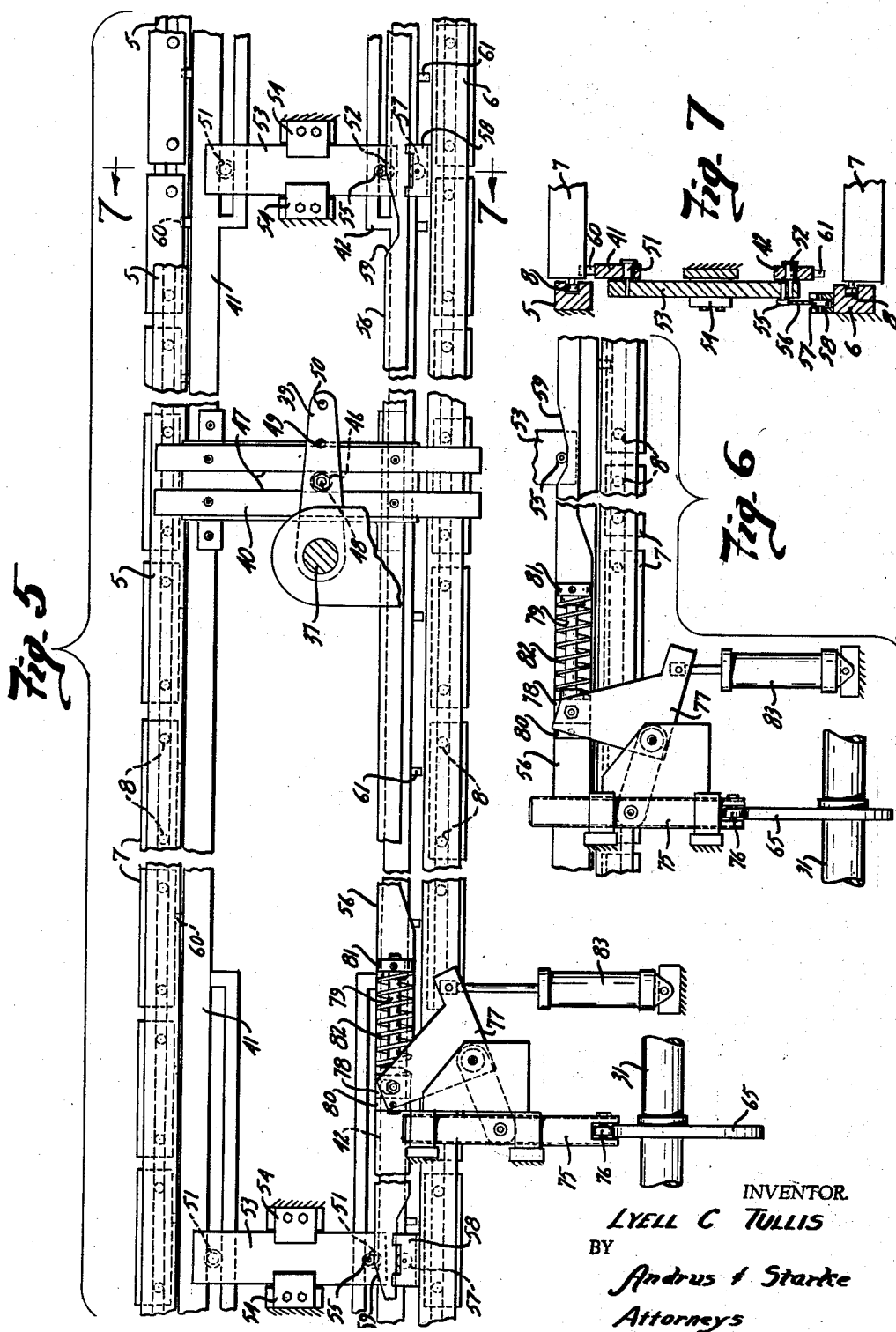
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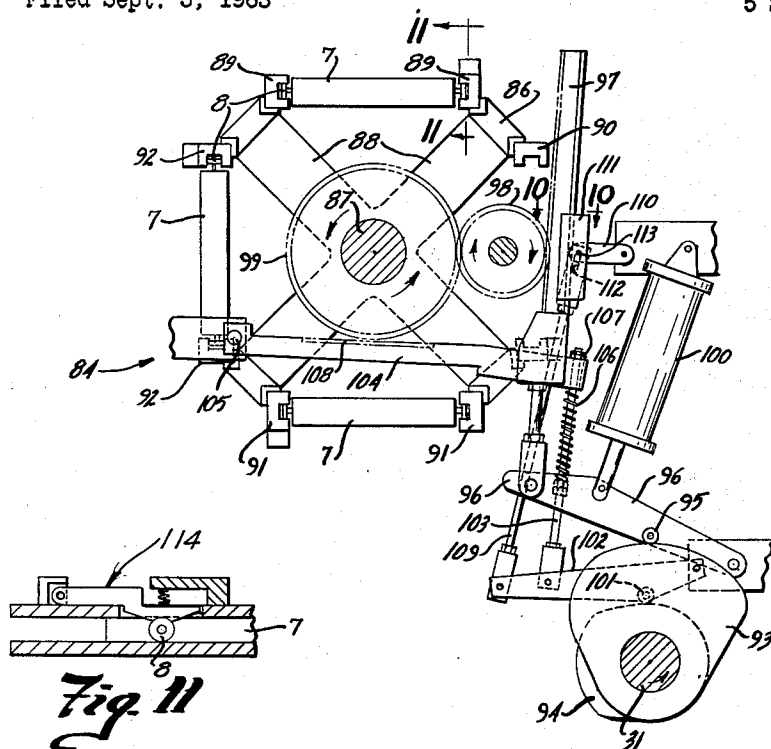


Fig. 8

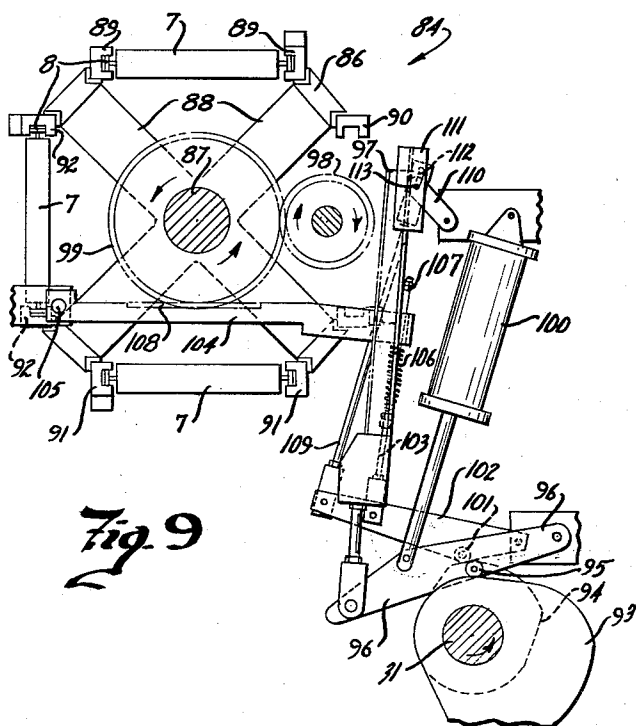


Fig. 9

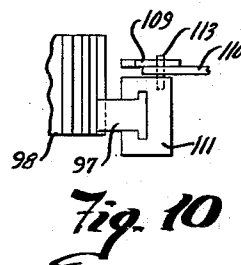


Fig. 10

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AUTOMATIC ASSEMBLY MACHINE

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19 Claims. (Cl. 104-162)

This invention relates to an automatic assembly machine of the type adapted to assemble various mechanical or electrical components and in which a series of separate platens each carrying a work assemblage are moved intermittently from station to station along an assembly line with automatic placement of work parts at the different stations as each platen moves down the line and a return of empty platens from the end of the line after the completed work assemblage is removed from successive platens.

In the manufacture of such machines, it is desirable to provide a construction which may be adapted for various products and thereby substantially reduce the cost as compared to specifically designed machines for each product.

The present invention accomplishes this by providing a construction of unit length having a basic number of stations and which may be readily added to in length to provide additional stations merely by adding units.

In order to provide a basic construction which may be made for various assembly needs, a simple way of providing changes in the desired speed and the dwell periods for the work carrying platens is employed in the machine. Also it is possible to vary the length of the stations with a corresponding change in distance of travel of the platens from station to station to accommodate work of different sizes.

The inertia forces in transferring the platens from station to station are taken care of by the use of a Scotch yoke drive, and by the elimination of backlash between the parts of the drive.

The need for greater access to the work on the platens is provided by use of a simple transfer mechanism for the fixtures or platens, leaving the top of the latter free for access from both sides and from above and also providing access from the bottom if needed.

The platens move on an assembly track and are indexed at each station for work thereon, and are returned empty on a track beneath the assembly track. In order to eliminate interference with the transfer mechanism by the returning platens, the platens are turned over at each end of the tracks by a turnover mechanism which provides for free manual removal of any platen at the end of the line and replacement thereof.

Any suitable mechanism for applying parts to the work, securing the parts in place and checking as to fit or completeness of the assemblage at various stations and stages of assembly may be employed, and the present invention is not concerned with these other than to provide adequate access for these to the work.

The present invention is more concerned with the work transporting and indexing mechanisms which constitutes the basic machine, including the closed circuit step by step movement of the platens.

The accompanying drawings illustrate the best mode contemplated of carrying out the invention.

In the drawings:

FIGURE 1 is a perspective view from the back with parts broken away of an automatic assembly machine showing the basic elements for transporting and indexing the work platens, and without showing the platens and the several mechanisms at the various stations for effecting the work;

FIG. 2 is a top plan view of the basic machine of FIG.

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1 with the machine broken in length to avoid unnecessary duplication and with the platens in place;

FIG. 3 is a front side elevation of the machine of FIGS. 1 and 2, broken in length as in FIG. 2;

5 FIG. 4 is an enlarged transverse section through the machine taken generally on line 4-4 of FIG. 2;

FIG. 5 is an enlarged detail section showing the drive for the transport cage;

10 FIG. 6 is a detail view showing part of the drive of FIG. 5 in the opposite operating position;

FIG. 7 is a detail section taken on line 7-7 of FIG. 5;

FIG. 8 is an enlarged detail end view of the drive for the turnover mechanism;

15 FIG. 9 is a view similar to FIG. 8 showing the parts in an opposite operating position;

FIG. 10 is a detail view taken on line 10-10 of FIG. 8;

20 FIG. 11 is a detail view of the detent locking means for the platens on the turnover mechanism, taken on line 11-11 of FIG. 8; and

FIG. 12 is a detail schematic view of an alternative form of shot pin actuation and which also may be employed in actuating assembly mechanism at the several stations.

25 The machine illustrated has a supporting base 1 adapted to rest on the floor and extending for the full width and length of the machine.

The base 1 has a plurality of longitudinally spaced pairs of oppositely disposed upstanding side posts 2 upon which the several operating elements are carried. Intermediate posts 3 are adjustably positioned to provide support for the platen indexing mechanism to be described hereinafter. Additional posts, not shown, may be secured to the base to carry various operating mechanisms used in assembling the workpieces at selected stations.

35 The side posts 2 extend outwardly from base 1 to provide an effective increased width for the machine and better stabilize its support upon the floor. The outward lateral extension of the side posts 2 on the back side of the machine shown in FIG. 1 carry a cam shaft 4 extending for the length of the machine.

40 The side posts 2 additionally carry two sets of tracks, the upper set comprising opposed laterally spaced channel rails 5 extending for the operative length of the machine, and the lower set comprising a similar pair of opposed laterally spaced channel rails 6 generally coextensive with tracks 5. The tracks 5 and 6 are horizontal and parallel so that they are uniformly spaced throughout the length of the machine.

45 A plurality of separate work carrying platens 7 are disposed between the rails of each set of tracks 5 and 6 to be moved therealong in succession from station to station. For this purpose each platen 7 has a pair of laterally extending trunnion carried rollers 8 on each side and which ride in the groove of the corresponding channel rail and support the platen.

50 The platens 7 are generally spaced end to end and are individually shot pinned at each successive station to hold them in position for performance of work assembly operations thereon at the corresponding stations. Each platen 7 is adapted to receive work parts (not shown) at successive stations and by the time it reaches the end of track 5, the work assembly 9, indicated as a block on the platen at the last station, is generally completed ready for removal.

55 The shot pinning or indexing of the individual platens at the several stations is accomplished by mechanism carried by intermediate posts 3 on the side of the machine. For this purpose a rocker shaft 10 is carried by posts 2 in suitable bearings and is oscillated by means of a cam 11 on shaft 4. A cam follower 12 rides on each cam 11 and actuates a lever 13 pivotally mounted on the correspond-

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ing post 3 at 14 and which pivotally carries a link 15 extending upwardly to an arm 16 secured to the rocker shaft 10.

The rocker shaft 10 has an arm 17 fixed thereto at each station and which extends inwardly to a position beneath the platen 7 as illustrated in FIG. 4. A shot pin 18 is pivoted to the inner end of arm 17 and extends upwardly through a vertical guide member 19 secured to the adjacent rail of the upper tracks 5. The upper end of each shot pin 18 is adapted to enter a recess 20 in the corresponding platen 7 at the given station.

Each shot pin 18 is spring loaded by a suitable spring 21 disposed to bias pin 18 upwardly into the recess 20. A safety relief device is disposed in link 15 and provides for emergency shortening of the link in case of jamming of the shot pin in recess 20. For this purpose the link 15 is made in two sections and has incorporated therein between the sections an air cylinder 22 secured to one end section thereof and a piston 23 secured to the opposite end section thereof and adapted to operate in the cylinder 22. Since the leverage system between cam follower 12 and shot pin 18 is arranged to withdraw the pin as follower 12 is raised by the cam 11, and to drive the pin into the recess 20 upon a lowering of follower 12, the piston 23 is normally biased by air pressure in cylinder 22 in the direction of greatest length for the link 15 so that in the event the shot pin 18 sticks in recess 20 the raising of the follower 12 by cam 11 will effect a shortening of the link by the yielding movement of the piston within the cylinder. In the event of jamming that might prevent shot pin 18 from entering recess 20 by the action of spring 21 as the cam 11 drops away from cam follower 12, the latter will remain out of contact with cam 11.

The cams 11 on cam shaft 4 are designed to permit followers 12 to drop when the platens have been advanced to their corresponding stations so that the several shot pins 18 move upwardly into the corresponding recesses under the influence of the springs 21. The platens 7 are thereby indexed or locked at their respective stations while work is performed upon the work assemblies thereon.

When it is time to advance the platens again, the cams 11 are designed to lift the followers 12, thereby rocking shaft 10 in a direction withdrawing the shot pins 18 from their recesses 20 against springs 21.

Should it be desired to provide for positive movement of shot pin 18 into the platen recess 20 when cam 11 raises and lifts follower 12, a construction similar to that shown in FIG. 12 may be employed.

In the construction of FIG. 12 the fulcrum 14 for the lever 13 is disposed intermediate the follower 12 and the connection for the link 15 so that as follower 12 is lifted by cam 11 the shot pin 18 will be moved upwardly into recess 20 in the corresponding platen 7. Should the movement be jammed for any reason the safety device in link 15 will yield to provide a lengthening of the link. The normal arrangement of the cylinder 22 and piston 23 should provide for this as shown.

Also in the construction of FIG. 12 a fluid pressure cylinder 24 constantly biases the cam follower 12 against cam 11 and effects a withdrawal of the shot pin 18 from recess 20 when cam 11 drops away from the follower 12.

For the purpose of freeing the shot pins 18 so that they can be maintained out of recesses 20 if desired, the piston 23 in cylinder 22 may be double acting so that the fluid operating pressure in the cylinder may be reversed thereby lifting follower 12 free from the influence of cam 11 and holding the pin 18 in its retracted position.

A drive motor 25 is mounted on the back of the machine and drives the same through a primary belt 26 to an electric clutch and brake unit 27 and from thence by belt 28 to a cross shaft 29 extending transversely of the machine base.

A suitable zero backlash worm gear speed reducer 30 drives cam shaft 4 from the cross shaft 29.

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The cross shaft 29 extends to the front side of the machine, as shown in FIGS. 2-4 and drives a cam shaft 31 extending parallel to shaft 4 for the length of the machine, by means of a second zero backlash gear reducing drive 32.

The cross shaft 29 also drives the transfer drive mechanism 33 on the front side of the machine by means of the toothed timing belts 34 and 35 and countershaft 36. The lower belt 34 drives the countershaft 36 from cross shaft 29. The upper belt 35 drives the clutch shaft 37 of transfer drive mechanism 33 from countershaft 36. By interchanging the toothed pulleys over which the belts 34 and 35 train in various combinations, it is possible to provide different transfer speeds for the platens 7 for different work cycles. This is readily possible since the several pulleys are secured on the outer ends of the corresponding parallel shafts 29, 36 and 37.

The transfer drive mechanism 33 comprises the clutch 38 connecting the input and output end sections of shaft 37, a crank 39 on the output end of shaft 37, a Scotch yoke 40 disposed to be driven by crank 39 and a pair of transfer bars 41 and 42 driven by the Scotch yoke. A suitable gear reducer 43, which is preferably of the zero backlash type, may be provided between sections of the input shaft 37, as may be desired.

The clutch 38 may be of any suitable type, the one illustrated in FIG. 4 being a dog clutch with its input member 44 secured to the inner end of the input part of shaft 37, and with an axially shiftable member 45 rotationally interlocked to the output section of shaft 37.

When the shift member 45 is moved axially into interlocking engagement with the constantly rotating member 44, the output section of shaft 37 will rotate to drive crank 39. When the shift member 45 is moved axially away from member 44, the clutch is opened to disconnect the drive to crank 39.

The crank 39 has a roller 46 carried thereby and riding in the vertical channel 47 of Scotch yoke 40 so that as crank 39 rotates from one horizontal position through 180° to the opposite horizontal position it moves the Scotch yoke 40 a distance longitudinally of the machine corresponding to the diameter of the circular path of movement of roller 46. This distance of movement of the Scotch yoke corresponds to the distance of movement required for a platen 7 in moving from one station to the next.

The machine is adjustable to accommodate different length stations and different numbers of stations. The machine illustrated, for instance, is constructed in six foot unit lengths with the drive mechanism located at only one of the units, and with a selected number of units to provide the desired number of stations, there being six stations for each unit, and each station having a length of one foot. In such a construction, the platens 7 are generally less than one foot in length and they travel one foot in moving from one station to the next.

Where it is necessary to provide longer stations, it is possible to space the platens so that there are only four stations per unit length of six feet with each platen traveling eighteen inches from station to station, or three stations per unit length with each platen traveling approximately two feet from station to station.

To accommodate this adjustment of the machine, the crank 39 has three spaced openings 48, 49 and 50 in its length for selectively receiving the trunnion support for roller 46. When the roller 46 is located at opening 48 in crank 39 as shown, the reciprocal stroke for the Scotch yoke 40 is approximately one foot in the machine referred to above as illustrative. When the roller 46 is at the intermediate opening 49 in crank 39, the throw of the Scotch yoke 40 is approximately eighteen inches, and when the roller 46 is at the outer opening 50 in crank 39 the throw of the Scotch yoke 40 is approximately two feet.

The Scotch yoke 40 is secured to the upper and lower transfer bars 41 and 42, respectively, and is carried vertically thereby. In turn, the bars 41 and 42 are carried

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by pairs of corresponding trunnion rollers 51 and 52 each secured to a vertically movable slide 53, and which space the bars.

The slides 53 are mounted in guides 54 secured to the back side of the corresponding posts 2 on the front of the machine. Each slide 53 is supported vertically by a trunnion roller 55 fastened to the slide and rolling on a cam bar 56.

The cam bar 56 extends longitudinally of the machine generally parallel to bars 41 and 42 and is reciprocally supported for longitudinal movement on rollers 57 carried in brackets 58 on the adjacent rail of lower track 6.

The cam bar 56 has spaced depressed notches 59 in the top thereof corresponding to the number and location of the slides 53, so that when bar 56 is pushed to the right from the location shown in FIG. 5 to that of FIG. 6, the rollers 55 ride down the incline to the bottom of the corresponding notches 59 and thereby let the slides 53 and the transfer bars 41 and 42 drop to a lower predetermined level. When the cam bar 53 is returned to the position of FIG. 5 the rollers 55 ride up the incline to the top of the bar where they support the slides 53 and bars 41 and 42 at a predetermined upper level.

The upper transfer bar 41 has a plurality of spaced upwardly extending pins 60 which interlock individually with the corresponding platen 7 on upper track 5 when the transfer bars 41 and 42 are in their uppermost position determined by cam bar 56.

Similarly, lower transfer bar 42 has a plurality of spaced downwardly extending pins 61 which interlock individually with the corresponding platens 7 on lower track 6 when the transfer bars 41 and 42 are in their lowermost position determined by cam bar 56.

When the upper pins 60 interlock with platens 7 on upper track 5, longitudinal movement of the transfer bars 41 and 42 in one direction by the crank 39 and Scotch yoke 40 will advance the platens to the next station. During this advance of the platens on track 5, the lower pins 61 are raised from interlocking contact with the platens 7 on track 6 so that these platens are not moved at that time. Instead, each platen 7 on track 6 is held stationary by a spring pressed detent 62 carried by a longitudinal bar 63 above the adjacent rail of lower track 6.

When the lower pins 61 interlock with platens 7 on lower track 6, longitudinal movement of the transfer bars 41 and 42 in the return direction by crank 39 and Scotch yoke 40 will move the empty lower platens in a return direction opposite to the direction of advance of the upper platens. During this return movement of the lower platens, the upper pins 60 are free from interlock with the upper platens and the latter are fixed at their corresponding stations by the shot pins 18 as previously explained.

Reciprocal movement of cam bar 56 is effected in timed relation to the operation of the Scotch yoke 40. For this purpose a rotary cam 64 is secured on cam shaft 31 to actuate clutch 38 and thereby determine the time cycle for the forward and return movements of the Scotch yoke 40 by crank 39 and the periods of dwell therebetween, and a cam 65 is secured to cam shaft 31 to actuate the cam bar 56 in timed relation to the forward and return movements of the yoke 40 so that the bars 41 and 42 are in their uppermost positions when the yoke is advancing forwardly and in their lowermost positions when the yoke is returning.

Cam 64 actuates clutch member 45 by a pivotally mounted lever 66 having a yoke 67 at its upper end with trunnion members (not shown) riding in a circumferential groove 68 in the shift member, and a cam follower 69 at its lower end riding on cam 64. Suitable spring loading of lever 66 as shown diagrammatically at 70 in FIG. 4 retains the follower 69 in contact with the cam 64 and biases shift member 45 into interlocking engagement with member 44.

In the machine illustrated, shafts 4 and 31 rotate one revolution for each work cycle which includes the simul-

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taneous performance of the assembly operations at the selected corresponding stations and the advance of the platens 7 on track 5 to the next station for each. With this construction, two separate depressed portions 71 and 72 are provided on cam 64 to effect closing of the clutch 38 to advance the upper platens 7 and a second closing of the clutch to return the lower platens 7 while assembly operations are being performed on the upper platens.

The cam 64 is provided with raised portions 73 and 74 between the portions 71 and 72 and which determine a dwell in the reciprocal movement of bars 41 and 42 to allow time for assembly work on the upper platens and for raising and lowering of the transfer bars 41 and 42 by cam bar 56.

The cam 65 reciprocates cam bar 56 by means of a vertical slide 75 supported on a cam follower 76 riding upon cam 65, and a bell crank lever 77 connecting the slide 75 with a pusher member 78 adjacent cam bar 56.

The pusher member 78 is mounted to slide on rod 79 which is secured at its ends to side brackets 80 and 81 on cam bar 56. Member 78 is normally held against bracket 80 by a strong spring 82 disposed between the member 78 and bracket 81. The spring 82 yields in an emergency in the event a jamming of the machine should prevent actuation of the cam bar 56 when follower 76 is raised by cam 65.

FIGS. 5 and 6 illustrate the actuation of the cam bar 56 by cam 65 with the parts shown in the opposite extremes of position. In the position shown in FIG. 5 the slide 75 is down, the bar 56 is to the left and the transfer bars 41 and 42 are raised for forward advance of platens 7 on upper track 5. In the position shown in FIG. 6 the slide 75 is raised by cam 65, the bar 56 is to the right and the transfer bars 41 and 42 are lowered for return movement of platens 7 on lower track 6.

The cam 65 operates to lift slide 75 to move the cam bar 56 in a direction which permits rollers 55 to ride down on the cam bar into notches 59 and thereby lower transfer bars 41 and 42 by gravity. Thus the cam 65 is not used against any substantial working force.

For the purpose of raising transfer bars 41 and 42, a power cylinder 83 has its output connected to bell crank lever 77 and is disposed to actuate the same to shift the cam bar 56 from the position shown in FIG. 6 to that shown in FIG. 5 as the cam 65 drops away from and controls the downward movement of follower 76. During this movement, the pusher member 78 bears against bracket 80 to shift the cam bar 56 to the left as described.

When the platens 7 on upper track 5 successively reach the end of the assembly line, the assembled work thereon is removed from the platen at the last station and then the empty platen is advanced to a rotary turnover device 84 which turns the platen upside down and lowers it to a position of registry with the end of lower track 6.

When the empty platens 7 have returned along track 6 to the opposite end, they move onto a turnover device 85 which turns the successive platens right side up and elevates the same to alignment with track 5. The platen in each instance is then ready for intermittent advancement on track 5 along the assembly line.

Turnover device 84 is driven from cam shaft 31 and turnover device 85 is driven from cam shaft 4. The two turnover devices are constructed alike and therefore only turnover device 84 is illustrated in FIGS. 8 to 10.

Each turnover device 84 and 85 comprises a hub 86 fixed on a central rotary shaft 87 parallel to tracks 5 and 6, and having four radial arms 88 disposed 90° apart around the circumference and carrying four sets of tracks 89, 90, 91 and 92 between the corresponding adjacent arms.

The tracks 89 and 91 are diametrically spaced apart the distance between tracks 5 and 6 so that when track 89 registers with the end of upper track 5 the track 91 registers with the end of lower track 6. At this time tracks 90 and 92 are disposed vertically on opposite sides of the turnover device.

When the turnover device is rotated 90° in the direction of the arrow in FIGS. 8 and 9, track 90 will register with the upper track 5 and track 92 will register with the lower track 6. The tracks 89 and 91 are then disposed vertically on opposite sides of the turnover device.

As each track 89-92 of the turnover device 84 successively registers with the upper track 5 it is adapted to receive an empty platen 7 therefrom, and as each track 89-92 of the turnover device successively registers with the track 6 it is adapted to deliver an empty platen 7 thereto. For this purpose transfer bars 41 and 42 move into the turnover device 84 when advancing platens on track 5 and bars 41 and 42 move out of the turnover device when returning empty platens to track 6.

With respect to turnover device 85, transfer bars 41 and 42 move into the device to deliver a return platen from track 6 to one of the corresponding lower turnover tracks registering therewith, and bars 41 and 42 move out of the turnover device to deliver an empty platen to track 5.

Actuation of turnover device 84 is effected by two cams 93 and 94 on cam shaft 31. Similar cams, not shown, are provided on cam shaft 4 to actuate turnover device 85.

A follower 95 riding on cam 93 is carried by an arm 96 pivoted at one end to the base 1. Arm 96 pivotally carries an upstanding rack 97 at its opposite end and which meshes with a gear 98 driving a gear 99 on shaft 87 to drive the turnover.

A fluid pressure cylinder 100 presses downwardly upon arm 96 to maintain follower 95 biased toward contact with cam 93 at all times.

In operation cam 93 has a raised portion by which the rack 97 is held in its uppermost position meshing with gear 98. When cam 93 rotates to withdraw the raised portion from beneath follower 95, the cylinder 100 will force arm 96 downwardly from its position in FIG. 8 to its position in FIG. 9 and thereby move rack 97 downwardly and turn gear 98 in a clockwise direction to drive the turnover device counterclockwise through 90° of rotary movement.

This will carry the platen 7 on track 89 rotationally to the left 90° and present track 90 in registry with track 5 to receive the next platen 7 therefrom. At the same time, track 92 which contains a platen 7 will be moved into registry with lower track 6 for delivery of the platen thereto.

Cam 94 actuates mechanism to lock the turnover device against rotation between intermittent downward movements of rack 97. For this purpose a follower 101 rides upon cam 94 and is carried by an arm 102 pivoted at one end to base 1.

Arm 102 pivotally carries an upstanding push rod 103 which has a substantially horizontal lever 104 impaled thereon and extending beneath gear 99 with its opposite end pivoted at 105 to base 1. A coil spring 106 encircling rod 103 biases lever 104 upwardly against the stop nuts 107 threaded upon the upper end of rod 103.

Lever 104 carries a short rack 108 directly beneath gear 99 on shaft 87 and which is adapted to be raised into mesh with gear 99 to lock the turnover device against rotation during loading and unloading of the device. Racks 97 and 108 function alternately in general so that the turnover device is always controlled by one or the other.

Arm 102 also pivotally carries a link 109 extending upwardly to a substantially horizontal lever arm 110 pivoted at one end to base 1 and pivotally carrying a T slot guide member 111 for rack 97.

When arm 102 is raised by cam 94, it first engages rack 108 with gear 99 and then pivots arm 110 upwardly to raise guide member 111 and move the same to the right by reason of the fixed pivot for the right hand end of lever arm 110, as shown in FIG. 9, thereby pulling rack 97 out of mesh with gear 98. For this purpose link 109

has a lost motion preferably in the form of a slot 112 in the link receiving the pin 113 carried by arm 110, so that it does not commence to raise arm 110 until after rack 108 has meshed with gear 99. At this time cam 93 has already lowered rack 97 to its lowermost position.

After rack 97 is withdrawn from gear 98 by guide member 111, the cam 93 lifts follower 95 against cylinder 100 and the rack 97 moves upwardly to its uppermost position as shown in FIG. 8, ready for the next cycle.

Then cam 94 lowers follower 101 which in turn pulls rack 108 out of mesh with gear 99 leaving the turnover device held against rotation by rack 97 until cam 94 again lifts rack 108. For this purpose the lost motion slot 112 for link 109 also drops arm 110 and engages rack 97 with gear 98 before rack 108 drops downwardly from gear 99.

During turnover, the platens 7 are held on the corresponding tracks 89-92 by means of a spring pressed cam latch 114 carried by each track and which engages the top of one of the trunnion rollers 8 supporting the platen as shown in FIG. 11.

The turnover devices are constructed with tracks 89-92 open at the outer end so that any platen thereon can be manually removed from the end of the track and replaced at any time.

The turnover devices are intermittently rotated during periods of dwell for transfer bars 41 and 42, and when assembly operations are being performed at the several stations.

In the event that inertia problems arise from backlash in the turnover drive, it may be desirable to employ a constant light drag as by some friction device, not shown, applied to the shaft 87 for the turnover device.

Inertia problems in the transfer of the platens are avoided by employing the Scotch yoke drive 40 and the zero backlash gearing between the two cam shafts 4 and 31 and the cross shaft 29.

The several cams 11, 64, 65, 93 and 94 are constructed in halves or segments so that they can be readily secured to the corresponding shafts 4 and 31 at the desired positions therealong.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In a machine of the class described, a conveyor track, a series of work carrying platens disposed to be moved along said track, reciprocating drive means disposed parallel to said track, means adapted to interlock said drive means with said platens only during one direction of movement of the drive means to advance said platens along said track step by step with periods of dwell between successive advancing movements, a rotatable crank having a throw corresponding to the distance of each successive advancing movement of said platens, a Scotch yoke associated with said crank and carried by said reciprocating drive means to actuate the latter in accordance with the rotation of said crank, and means to rotate said crank.

2. The construction of claim 1 in which said last named means comprises a constantly rotating drive shaft, a cam shaft driven continuously by said drive shaft, a clutch having its output shaft driving said crank and its input shaft driven by said drive shaft; and cam means on said cam shaft and connected to said clutch to actuate the same to provide an extended dwell in the actuation of said Scotch yoke at an end of the stroke therefor.

3. The construction of claim 2 in which the speed of said clutch input shaft is selectively adjustable within limits to vary the relative time of advancement and dwell in the step by step advancement of said platens.

4. In a machine of the class described, a conveyor track, a series of work carrying fixtures disposed to be moved along said track, reciprocating drive means dis-

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posed parallel to said track, means adapted to interlock said drive means with said fixtures only during one direction of movement of the drive means to advance said fixtures along said track step by step with periods of dwell between successive advancing movements, a rotatable crank having a throw corresponding to the distance of each successive advancing movement of said fixtures, means connecting said crank with said drive means to actuate the latter in accordance with the rotation of said crank, and means to provide a predetermined modification of the rotation of said crank generally at a dead center position to control the period of dwell of said fixtures between advancing movements.

5. The construction of claim 4 in which said last named means comprises a clutch which selectively stops the rotation of said crank for a predetermined period at dead center.

6. In a machine of the class described, a conveyor track having a plurality of stations therealong, a series of separate platens on said track and adapted to be individually advanced therealong to successive stations, a return conveyor track parallel to and beneath said first conveyor track and adapted to return the platens from the discharge end of said first track to the starting end thereof, means at said discharge end of said first track to receive successive platens therefrom and transfer the platens successively to said return track, said means serving to invert said platens during such transfer, means at said starting end of said first track to receive successive platens and transfer the same thereto from said return track and to invert said platens during such transfer, and releasable latch means on said receiving and transfer means disposed to retain said platens upon said means during transfer.

7. The construction of claim 6 in which said means each comprise a rotatable turnover device with its axis parallel to said tracks and having diametrically opposed tracks spaced apart to register correspondingly with the adjacent ends of said first track and said return track, and means to rotate said devices in correlation to the advancement of said platens on said first track and while said platens dwell at the corresponding stations.

8. In a machine of the class described, a conveyor track having a plurality of stations therealong, a series of platens on said track and adapted to be individually advanced therealong to successive stations, a return conveyor track parallel to said first conveyor track and spaced beneath the same, a series of platens on said return track, means at the discharge end of said first track to transfer successive platens therefrom to said return track, means at the starting end of said first track to transfer successive platens thereto from said return track, a reciprocating drive member disposed between said tracks and movable in opposite directions parallel thereto, said drive member having means thereon for interlocking with the platens on said first track when said member is moved in platen advance direction and having means thereon for interlocking with the platens on said return track when said member is moved in the platen return direction, and means to reciprocate said drive member.

9. The construction of claim 8 in which said reciprocating drive member is supported for vertical shifting of the same upwardly to effect said interlocking with the platens on said first track and downwardly to effect said interlocking with said return platens, and means are provided to shift said member up and down in correlation to the reciprocation thereof.

10. The construction of claim 9 in which said last named means comprises a cam bar extending longitudinally of said drive member, means supporting said reciprocating drive member upon said cam bar, cam means on said cam bar engageable by said supporting means to raise and lower said drive member upon predetermined longitudinal reciprocation of said cam bar, and means to longitudinally reciprocate said cam bar.

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11. In a machine of the class described, a machine bed of substantial length, a conveyor track supported thereon and having a plurality of work stations therealong, a return track carried by said bed and spaced beneath said conveyor track, a plurality of separate platens on said tracks, means at the discharge end of said conveyor track for transferring successive platens therefrom to said return track, means at the opposite end of said conveyor track for transferring successive platens thereto from said return track, a cam shaft extending longitudinally of said bed on each side thereof, cam means on one of said cam shafts for driving said first named end transfer means, cam means on the other of said cam shafts for driving said second end transfer means, and a common drive for said cam shafts.

12. The construction of claim 11 in which said end transfer means comprise rotary turnover devices having tracks adapted to register alternately with said conveyor track and said return track, and said cam means effects intermittent rotation of said devices.

13. In a machine of the class described, a machine bed of substantial length, a conveyor track supported thereon and having a plurality of work stations therealong, a return track carried by said bed and spaced beneath said conveyor track, a plurality of separate platens on said tracks, means at the discharge end of said conveyor track for transferring successive platens therefrom to said return tracks, means at the opposite end of said conveyor track for transferring successive platens thereto from said return track, a cam shaft extending longitudinally of said bed on each side thereof, means on one side of the bed to advance successive platens on said conveyor track from station to station in step by step movement, means on the other side of the bed to index said platens at the corresponding stations between successive advance movements thereof, means operative from the cam shaft disposed on the corresponding side of the machine to actuate said step by step advancing means for said platens along said conveyor track, means operative from the other of said cam shafts and disposed on the corresponding side of the machine to actuate said platen indexing means, means to drive said end transfer means from said cam shafts, and a common drive for said cam shafts.

14. In a machine of the class described, a machine bed of substantial length, a conveyor track supported thereon and having a plurality of work stations therealong, a return track carried by said bed and spaced beneath said conveyor track and parallel thereto, a series of separate work platens on said tracks, reciprocating means disposed between said tracks and adapted to advance successive platens in step by step movement from station to station on said conveyor track when said means moves in one direction and to return successive platens on said return track when said means moves in the opposite direction, a cam shaft extending longitudinally of the bed on each side of the machine, a cross shaft adjacent said cam shaft, power means to drive said cross shaft, speed reducing zero backlash gear drive connections between said cross shaft and each of said cam shafts, rotary crank means for driving said reciprocating means, means substantially free of backlash for driving said crank means from said cross shaft, means operative from one of said cam shafts for effecting a dwell in the operative cycle of said reciprocating means, and means operative from the other of said cam shafts for indexing said platens at said stations during said dwell periods.

15. In a machine of the class described, a conveyor track having a plurality of work stations therealong, a series of separate platens on said track and adapted to be advanced in step by step movement from station to station in succession, reciprocating means adjacent said track and adapted to advance all of said platens simultaneously to the next successive station for each platen upon each forward movement of said means, means to

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drive said reciprocating means with acceleration and deceleration of said reciprocating means effected by said means, an electric motor drive for said means, and a zero backlash speed reduction gear connecting said electric motor to said means to provide more uniform transmission of acceleration and deceleration forces between said reciprocating means and said motor.

16. In a machine of the class described, a reciprocally driven member subject to possible jamming in at least one direction of movement, a continuously rotating cam drive member, a follower for said cam drive member, a lever system interconnecting said follower and said driven member to effect actuation of the latter in either direction under the control of said cam drive member, means to yieldingly bias said driven member in one direction, means incorporated in said lever system to yield during actuation of said driven member in the opposite direction in the event of jamming, and power means to release said driven member from actuation by said drive member.

17. In a machine of the class described, a reciprocally driven member subject to possible jamming in at least one direction of movement, a continuously rotating cam drive member, a lever system including a cam follower interconnecting said members to effect actuation of said

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driven member in said one direction by said drive member, means to actuate said driven member in said other direction under the control of said drive member, means incorporated in said lever system to yield during said actuation in the event of jamming, and power means to release said driven member from said drive member.

18. The construction of claim 17 in which said last two means comprise in common a double acting fluid pressure cylinder and piston normally retained in power transmitting relation to effect actuation of said driven member in said one direction.

19. The construction of claim 14 in which said first named means is yieldable under predetermined actuating forces.

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