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R. E. SLATTERY

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AUTOMATIC ASSEMBLING OR TRANSFERRING UNITS

Filed Nov. 18, 1963

3 Sheets-Sheet 1

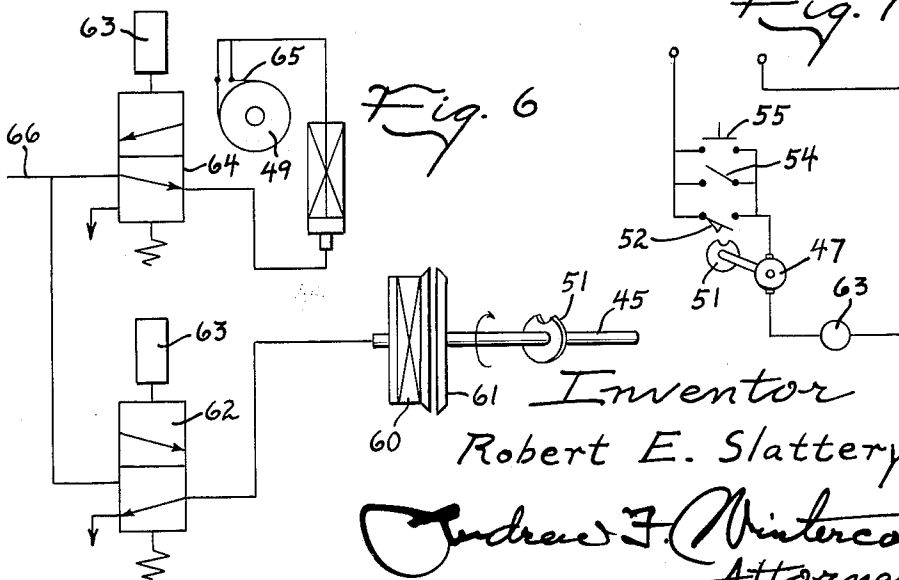
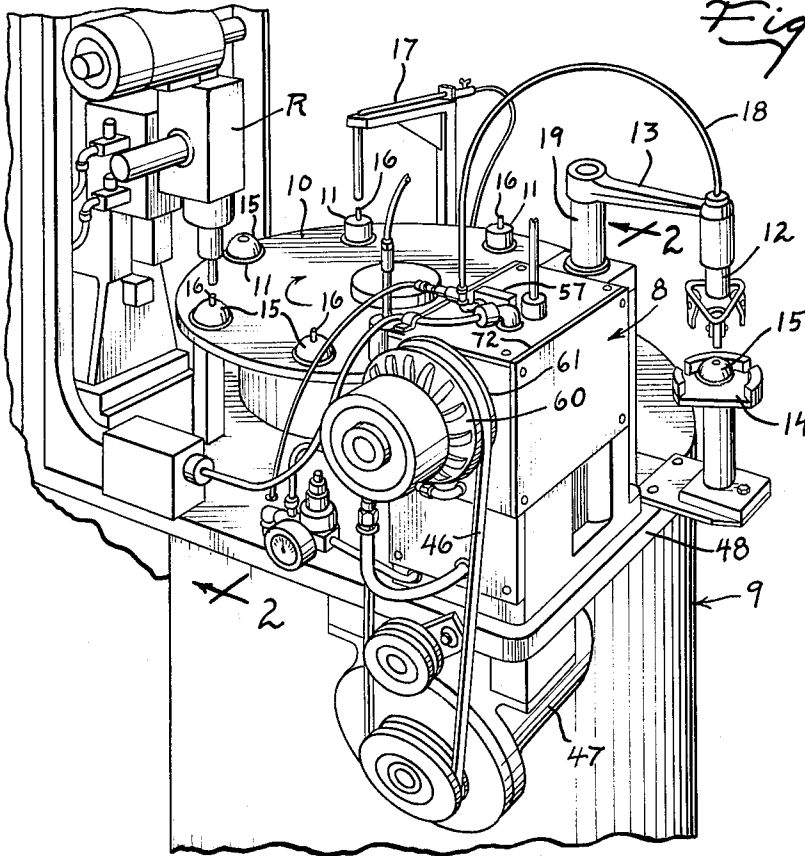
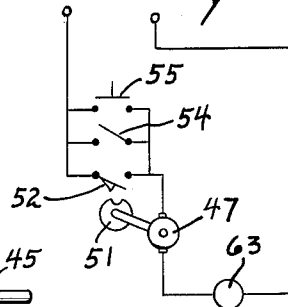


Fig. 7



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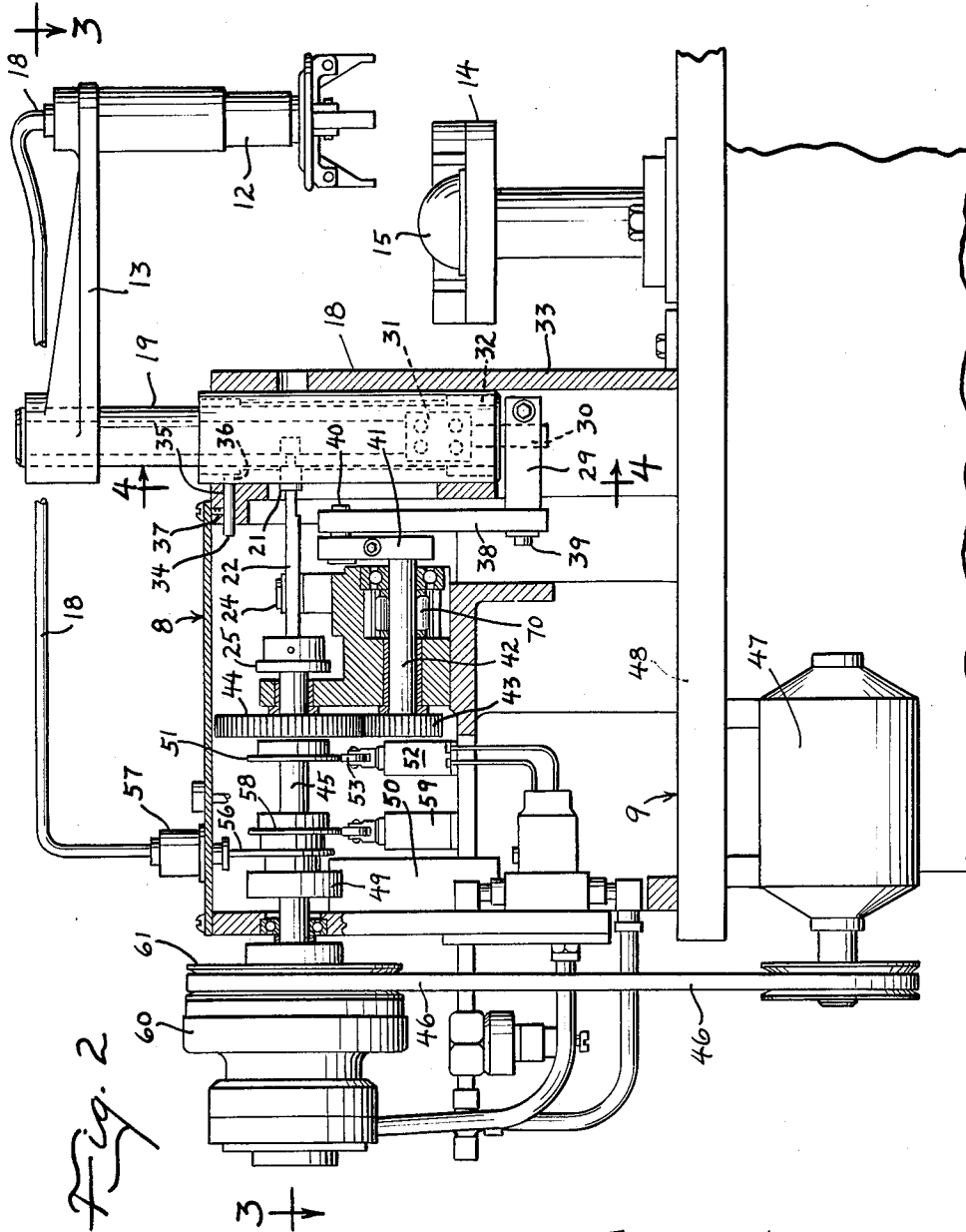
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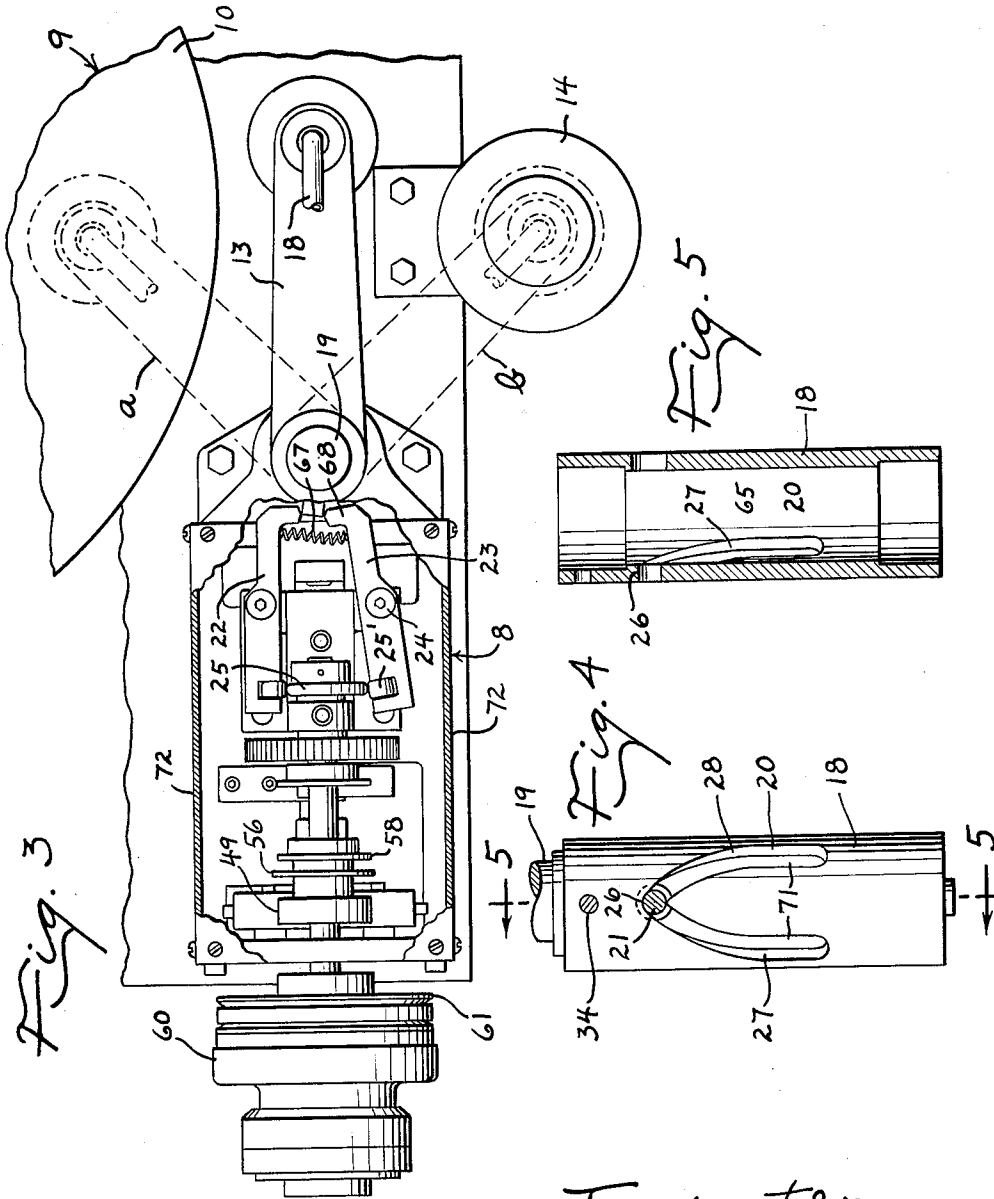
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AUTOMATIC ASSEMBLING OR TRANSFERRING UNITS

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3 Sheets-Sheet 3



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AUTOMATIC ASSEMBLING OR TRANSFERRING UNITS

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20 Claims. (Cl. 214—1)

This invention relates to an automatic assembling or transferring unit designed to pick up small parts and place them on or take them off of dial machines, punch-presses, and other assembling equipment, the basic motion of the pickup arm being first vertically, then laterally through an arc of 90° and then downwardly, and upwardly and back through the 90° arc and downwardly again, the parts being gripped by pickup fingers usually operated by compressed air, engageable either on the inside diameter or outside diameter, or by surface engagement utilizing either magnetism or vacuum. In some instances, parts or assemblies are turned around or turned over, with only slight changes in the pickup means. The pickup means in either event is operated in timed relation to the movements of the pickup arm by a cam operated valve or switch.

To obtain the U-movement of the pickup arm, a plunger is reciprocable and oscillatable in a tubular cam having a generally U-shaped slot provided therein, the upper ends of the two legs of the slot converging at a midpoint, and a follower pin extending radially from the plunger is guided in said slot and, when it reaches the midpoint at the end of an upstroke in one leg of the U-slot, either one of two fingers that are oscillated horizontally in timed relation to the reciprocation of the plunger applies pressure laterally to the pin in the right direction to insure the downstroke occurring in the other leg of the U-slot, thereby positively insuring complete 90° oscillation of the pickup arm between the vertical reciprocations at the two limit positions.

Another feature of this invention is the use of a crank and pitman rod for transmitting simple harmonic motion to the plunger, giving it the desired slowing down in endwise motion that is especially important at the lower end of the downstrokes at both of the work stations 90° apart.

Still another feature of this invention is the provision of the timer shaft from which drive is transmitted to the crank and pitman to reciprocate the plunger, and on which a program cam is mounted to operate a switch so that the unit goes through a complete cycle once the cycle is started by the indexing mechanism closing a starting switch to time the operation of the transfer unit properly with respect to the indexing of the dial or other machine with which it is associated, the timer shaft also being equipped with cams to operate either a switch to control a magnetic work pickup means, or valve means to control a pneumatically operable work pickup means, so that such pickups are operated in nicely timed relation to the reciprocation and oscillation of the plunger.

Still another feature is the provision of the timer shaft in an easily accessible portion of the transfer unit, where removal of a side plate near the cams on this shaft enables these cams to be adjusted easily to obtain exactly the right timing of the operation of the pickup means in relation to the rest of the unit for best operation.

The invention is illustrated in the accompanying drawings, in which—

FIG. 1 is a general view showing in perspective an application of my improved automatic assembling or transferring unit to a dial machine;

FIG. 2 is a vertical section through the unit on the line 2—2 of FIG. 1;

FIG. 3 is a horizontal section on the broken line 3—3 of FIG. 2;

FIG. 4 is a face view of the tubular cam and plunger assembly taken on the line 4—4 of FIG. 2,

FIG. 5 is a vertical section through the tubular cam on the line 5—5 of FIG. 4;

FIG. 6 is a pneumatic circuit diagram; and

FIG. 7 is an electrical circuit diagram.

The same reference numerals are applied to corresponding parts throughout the views.

Referring to the drawings, the automatic assembling or transfer unit is indicated generally by the reference numeral 8 and is shown in perspective in FIG. 1 mounted on a dial machine 9 and connected with the indexing mechanism thereof through a suitable switch indicated diagrammatically at 55 in FIG. 7 so as to be operated through one complete cycle each time the dial 10 is indexed, bringing the next work holder or nest 11 of the eight station dial into operative relationship to the pickup means 12 on the oscillatable arm 13 of unit 8, the arm 13 swinging through 90°, as indicated by the two dot and dash extreme positions *a* and *b* illustrated in FIG. 3, the pickup means 12 in position *a* being reciprocable vertically in coaxial alignment with one of the work holders 11, and in position *b* being reciprocable vertically relative to a table 14 in coaxial alignment with a suitably centered workpiece 15 thereon to enable, for example, assembling a pin 16 in the center hole of piece 15 so that when this assembly is subsequently indexed to a position under the riveter R the projecting end of pin 16 can be upset to complete the assembling operation, pins 16 being dropped one at a time into holders 11 from an escapement feeder unit 17 operated in timed relation to the indexing of table 10. The pieces 15 are fed to the table 14 by automatic means (not shown) and removed from holders 11 by other automatic means (not shown).

The workpiece 15 is gripped by the three pickup fingers shown bearing on the outside diameter and operated from inside the pickup means 12 by compressed air supplied from line 66 (FIG. 6) through a flexible tube 18 in timed relation to the indexing of dial 10 and the movements of the pickup arm 13, in the manner hereinafter described. In some cases, the fingers gripping a workpiece engage the same on the inside diameter. In other cases, electromagnetic means is employed as a part of the pickup means 12, or vacuum may be employed, the operation in either event being in timed relation to the indexing of the dial and movements of the pickup arm 13, as hereinafter described. The needs of each assembling operation determine what form or type of pickup means is best. Inasmuch as there is no novelty claimed in the pickup means per se there is thought to be no need for showing the same in detail, the present invention being more particularly concerned with the rest of the transfer unit, one important part of which is the novel combination of the tubular cam 18 and plunger 19 reciprocable and oscillatable therein to oscillate the pickup arm 13 through 90°, half of this 90° movement occurring in the upper half of the upstroke of the plunger and the other half in the upper half of the downstroke of the plunger, as determined by the generally U-shaped cam slot 20 in the tubular cam 18, in which a follower pin 21 extending radially from plunger 19 is guided, the plunger 19, as will soon appear, being operated by a crank and pitman rod so as to have the desired deceleration at the lower ends of its downstrokes when pickup and depositing of the workpieces occur and thereby avoid any objectionable jarring or shaking. Two opposed fingers 22 and 23 oscillatable in a horizontal plane relative to vertical pivots 24 are actuated at one end in timed relation to the reciprocation and oscillation of plunger 19 by a rotary cam

25 operating on rollers 25', so that these fingers cooperate with the follower pin 21 at their other end to switch the pin from one leg of slot 20 to the other when the pin reaches the dead-center or midpoint 26 of the slot toward which the upper ends of the two legs of the U-slot 20 converge. In other words, assuming follower pin 21 is rising in leg 27 and reaches the midpoint 26, finger 22 is actuated to apply lateral pressure to pin 21 to switch it into leg 28, so that there is no possibility of the pin returning on the downstroke in leg 27 instead of going downwardly in leg 28. On the next upstroke when pin 21 rising in leg 28 reaches midpoint 26, finger 23 is actuated to compel the follower pin to work in leg 27 of slot 20 on the downstroke. This operation is smooth, quiet and positive.

For the vertical reciprocation of plunger 19 by a crank and pitman rod with simple harmonic motion for deceleration at the ends of the strokes, my interest here being as stated before mainly in such deceleration at the end of the downstroke, plate 29 is attached to a neck 30 provided on a head 31 that is splined, as indicated at 32, to reciprocate in the tubular cam 18 and be thereby held against turning while the plunger 19 is free to turn relative to the head 31 as the follower pin 21 works in the U-shaped cam slot 20 provided in the tubular cam 18. The latter is held against turning and also against endwise movement relative to the supporting frame 33 by means of a pin 34 entered in registering radial holes 35 and 36 provided in the frame 33 and tubular cam 18, respectively. A set-screw 37 entered in a hole in the frame 33 intersecting the hole 35 serves to secure the pin 34 in place. Plate 29 has a pitman rod 38 pivotally connected thereto at one end, as at 39, the other end of this rod being pivotally connected, as at 40, to a crank-pin on the crank 41 which has its shaft 42 driven by means of a pinion 43 meshing with a gear 44 on a parallel shaft 45 to operate the crank 41 at double the speed of shaft 45, this high speed operation of plunger 19 being made practical only because of the decelerations at the ends of the strokes afforded by the crank and pitman rod operation. The rotary cam 25 previously mentioned is mounted on the shaft 45 to turn with it and thus time the oscillation of fingers 22 and 23 properly relative to the reciprocation of plunger 19.

The shaft 45, which I have referred to before as the timer shaft, because of the tie-up through it of the timed operation of the plunger 19, fingers 22-23, and pickup means 12, is driven through a belt and pulley connection 46 by an electric motor 47 mounted on the base 48 of the dial machine 9. A disk 49 is carried on and turns with the shaft 45 relative to a brake shoe that is part of the assembly indicated at 50 interconnected with a program cam 51 and switch mechanism 52 operated by the cam through a follower 53 so that in setup work or in demonstration of the machine the operator can by depressing the single cycle switch 54 put the unit 8 through a single cycle, and once the cycle has started, cam 51 controls the operation and switch 52 shuts off the machine at the end of that cycle. Cam 51 and switch 52 otherwise control the cycling of the unit in normal use thereof. A separate switch 55 connected in parallel with the switch 54 as seen in FIG. 7 is the one operated by the index mechanism of the dial machine, once per index, as previously described, to start each cycle in timed relation to the indexing of dial 10.

Timing the operation of the pickup means 12 properly with respect to the rest of the unit 8 is accomplished by a cam 56 rotatably adjustably secured on shaft 45 operating air valve 57 from which tube 18 extends to the outer end of pickup arm 13, as seen in FIG. 1, to operate the pickup means by compressed air in timed relation to the operation of the pickup arm 13. If the pickup means is of an electromagnetic type or the pickup air valve is controlled electrically another cam 58 rotatably adjustably secured on shaft 45 operates switch 59 to

secure such operation in timed relation to the operation of the rest of the transfer unit.

FIG. 6 is a pneumatic diagram and shows how the pneumatically operated clutch 60 is operable to transmit drive from the otherwise loose pulley 61 to the shaft 45 to turn disk 49 and program cam 51, the normally closed valve 62 being operated to open position upon energization of the solenoid 63 to engage clutch 60 to drive shaft 45, another normally open valve 64 being operable at the same instant preferably by the same solenoid 63 to closed position so as to release the brake 65 simultaneously with engagement of clutch 60, compressed air being supplied through the line 66 to keep the brake 65 applied until either switch 54 or 55 is closed to energize solenoid 63.

In operation, the pins 16 are fed automatically one by one into work holders 11 and these pins enter center holes in the workpieces 15 that are fed automatically one by one onto table 14 and transferred by pickup fingers 12 onto work holders 11 over pins 16. The riveter R upsets the protruding ends of the pins and the assembly 15-16 is automatically removed at the last station ahead of the one where the pins 16 are fed in. A separate transfer unit like that shown at 8 may be provided for that purpose. Referring now to cam 18 and plunger 19, a coiled compression spring 67 shown in FIG. 3 urges the L-shaped ends 68 of the fingers 22 and 23 apart thereby maintaining the follower rollers 25' in close contact with the rotary cam 25. Thus, the fingers 22 and 23 work together, one (23) applying lateral pressure to the follower pin 21 to move it to the left into the leg 27 of the U-shaped slot 20, as seen in FIG. 4, and the other (22) applying lateral pressure to the follower pin 21 in the opposite direction to direct it into the right leg 28 of cam slot 20. Engagement and disengagement of the part gripping fingers or jaws on the pickup means 12 is, of course, timed accurately by cam 56 operating air valve 57 in closely timed relation to the vertical movement of the plunger 19 at the end of the down strokes in position *a* and *b* so that the part 15 can, for example, be picked up in position *b* from table 14 and applied in position *a* to pin 16 on work holder 11, this operation being repeated once per indexing of the dial 10. The clutch 70 is a one-way type, and inasmuch as the unit's cycle always ends with the plunger 19 on its upstroke, no damage can result in the event of loss of air pressure allowing clutch 60 to release and brake 49 to release and the arm 13 to fall into a moving table 10, the one-way clutch 70 serving as a safety device to keep arm 13 raised. The amount of straight line vertical movement indicated by the length of the parallel end portions 71 of legs 27 and 28 of slot 20 in FIG. 4 is enough to take care of a considerable range of assembling operations as well as transfer operations and turn around or turn over operations. In set-up work, plates 72 on opposite sides of the frame 33 are removable to afford easy access to the cams on timer shaft 45 for adjustment thereof.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. In a mechanical movement, the combination of a stationary tubular cam having a cylindrical bore therein and a generally U-shaped cam slot provided in the wall thereof, a plunger reciprocable and oscillatable in said bore having a follower pin projecting radially therefrom and guided in said slot predetermining the oscillation of said plunger in relation to its reciprocation, the two legs of the U-slot converging toward a midpoint toward which the follower pin moves at the end of each stroke in that direction, means for transmitting reciprocatory movement to the plunger, and means operated in timed relation to the last mentioned means for directing said pin laterally

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from the midpoint first into one leg of the U-slot and then into the other leg alternately when the pin at the end of each stroke of the plunger reaches the midpoint.

2. The structure set forth in claim 1 wherein the U-shaped cam slot is inverted, the upper ends of the legs of the U-slot converging upwardly to the midpoint and the last mentioned means directing the follower pin laterally for downstrokes of the plunger alternately in first one and then the other of the legs of said slot when the pin reaches the midpoint at the end of the upstrokes of the plunger.

3. The structure set forth in claim 1 wherein the means reciprocating the plunger gives it deceleration at the end of each stroke.

4. In a mechanical movement, the combination of a stationary tubular cam having a cylindrical bore therein and a generally U-shaped cam slot provided in the wall thereof, a plunger reciprocable and oscillatable in said bore having a follower pin projecting radially therefrom and guided in said slot predetermining the oscillation of said plunger in relation to its reciprocation, the two legs of the U-slot converging toward a midpoint toward which the follower pin moves at the end of each stroke in that direction, means for transmitting reciprocatory movement to the plunger, and means whereby said pin on alternate strokes is urged laterally in one direction when it reaches the midpoint and on intermediate strokes is urged laterally in the opposite direction.

5. The structure set forth in claim 4 wherein the means reciprocating the plunger gives it deceleration at the end of each stroke.

6. In a transfer unit, the combination of a stationary tubular cam having a cylindrical bore therein and a generally U-shaped cam slot provided in the wall thereof, a plunger reciprocable and oscillatable in said bore having a follower pin projecting radially therefrom and guided in said slot predetermining the oscillation of said plunger in relation to its reciprocation, the two legs of the U-slot converging toward a midpoint toward which the follower pin moves at the end of each stroke in that direction, means for transmitting reciprocatory movement to the plunger, means whereby said pin on alternate strokes is urged laterally in one direction when it reaches the midpoint and on intermediate strokes is urged laterally in the opposite direction, an arm extending radially from said plunger, and pickup means carried by said arm and operated in timed relation to the reciprocation and oscillation of said plunger to grip an article at one limit position of said arm and plunger and release the same at the other limit position of said arm and plunger and release the same at the other limit position of said arm and plunger.

7. The structure set forth in claim 6 wherein the U-shaped cam slot is inverted, the upper ends of the legs of the U-slot converging upwardly to the midpoint and the last mentioned means causing the follower pin to move laterally for downstrokes of the plunger alternately in first one and then the other of the legs of said slot when the pin reaches the midpoint at the end of the upstrokes of the plunger.

8. The structure set forth in claim 1 wherein the means for transmitting reciprocatory movement to said plunger comprises a crank turning at a substantially constant speed, and a pitman rod interconnecting said crank with said plunger to transmit simple harmonic motion thereto, whereby said plunger decelerates at the ends of its strokes.

9. The structure set forth in claim 6 wherein the means reciprocating the plunger gives it deceleration at the end of each stroke.

10. The structure set forth in claim 6 wherein the means for transmitting reciprocatory movement to said plunger comprises a crank turning at a substantially constant speed, and a pitman rod interconnecting said crank

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with said plunger to transmit simple harmonic motion thereto, whereby said plunger decelerates at the ends of its strokes.

11. The structure set forth in claim 1 wherein the means for transmitting reciprocatory movement to said plunger comprises a crank turning at a substantially constant speed, and a pitman rod interconnecting said crank with said plunger to transmit simple harmonic motion thereto, whereby said plunger decelerates at the ends of its strokes, and a one-way clutch preventing reverse rotation of said crank.

12. The structure set forth in claim 6 wherein the means for transmitting reciprocatory movement to said plunger comprises a crank turning at a substantially constant speed, and a pitman rod interconnecting said crank with said plunger to transmit simple harmonic motion thereto, whereby said plunger decelerates at the ends of its strokes, and a one-way clutch preventing reverse rotation of said crank.

13. In a device of the character described, the combination of a timer shaft adapted to be driven always in one direction, a crank driven by said shaft, a pitman rod connected at one end with said crank, a plunger connected to the other end of said pitman rod and guided for reciprocation and carrying a radial arm with article pickup means thereon, guide means for said plunger including a stationary tubular cam having a cylindrical bore therein in which the plunger is reciprocable and oscillatable, there being a generally U-shaped cam slot provided in the wall of said bore in which a follower pin projecting radially from the plunger is guided predetermining the oscillation of said plunger in relation to its reciprocation, means operated in timed relation to the reciprocation of said plunger for directing said follower pin laterally from the mid-point first into one leg of the U-slot and then into the other leg alternately when the pin at the end of each stroke of the plunger reaches the midpoint, whereby alternate downstrokes of said pick-up means are in one vertical plane in one limit position and intermediate downstrokes of said pickup means are in another vertical plane in another limit position, and cam means turning with said timer shaft operating pickup control means connected with said pickup means, whereby said pickup means is closed and opened in timed relation to the reciprocation of said plunger and oscillation of said arm.

14. In a device of the character described the combination of a timer shaft adapted to be driven always in one direction, another shaft parallel to and driven off the timer shaft and carrying a crank, a pitman rod connected at one end with said crank, a plunger connected to the other end of said pitman rod and guided for reciprocation and carrying a radial arm with pickup means thereon, cam means having a generally U-shaped cam slot provided therein in parallel relationship to said plunger, a follower on said plunger projecting into said slot to predetermine oscillation of said plunger and arm in the reciprocation of said plunger, the two legs of said U-slot converging to a midpoint toward which the follower moves at the end of the upstrokes, two elongated fingers pivotally mounted on vertical axes intermediate the ends thereof to oscillate in the horizontal plane of the midpoint of said U-slot, said fingers being engageable at one end with said follower from opposite sides thereof at said midpoint, one finger adapted to move the follower laterally from said midpoint in one direction by oscillation of said finger and the other finger adapted to move said follower in the opposite direction by oscillation of said finger, and a cam turning with said timer shaft and engageable with the other ends of said fingers to transmit oscillatory movement thereto.

15. A device as set forth in claim 14, including spring means urging said fingers resiliently into engagement with said cam.

16. A device as set forth in claim 14, including a one-way clutch preventing reverse rotation of the second named shaft carrying the crank.

17. A device as set forth in claim 14, wherein the pickup means on said arm is fluid operated, the device including a fluid control valve controlling fluid flow to said pickup means, and a cam on said timer shaft operating said valve in timed relation to the operation of said plunger.

18. A device as set forth in claim 14 wherein the pickup means on said arm is electrically controlled, the device including a switch controlling the circuit for said electrically controlled pickup means, and a cam on said timer shaft operating said switch in timed relation to the operation of said plunger.

19. A device as set forth in claim 14 wherein the device is operable by an electric motor and there is a program cam on the timer shaft operating an electrical switch controlling the cycling of said device to complete a full cycle of plunger movements when the cycle is once started, and a start switch operable automatically in timed relation to the indexing of a dial machine or the like in connection with which the present device is employed whereby to start the motor and commence the cycle under the control of said program cam operated switch.

20. A device as set forth in claim 14 wherein the device is operable by an electric motor and there is a program cam on the timer shaft operating an electrical switch controlling the cycling of said device to complete a full cycle of plunger movements when the cycle is once started, and

a start switch operable automatically in timed relation to the indexing of a dial machine or the like in connection with which the present device is employed whereby to start the motor and commence the cycle under the control of said program cam operated switch, the device also including a brake that is air pressure operable to hold said timer shaft, said brake being automatically engaged at the end of a cycle and automatically disengaged at the commencement of a cycle, an air pressure operable clutch normally disengaged but engageable automatically at the commencement of a cycle to transmit drive to said timer shaft from said motor, a source of compressed air, solenoid operable valve means controlling said brake and clutch energized at the commencement of a cycle to disengage the brake and engage the clutch and vice versa at the end of a cycle, and a one-way clutch prohibiting reverse rotation of one of said shafts as a safety feature in event of failure of the source of compressed air.

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