This invention relates to automatic work transfer mechanism. More particularly the invention pertains to the provision of improved means for successively moving topmost work pieces from a stack and positioning them in predetermined arrangement in the operating zone of an adjacent automatic machine whereby its operating instrumentations can function continuously, or nearly so, without manual intervention on the pieces thus successively received. As herein illustrated, the invention is embodied in novel mechanism for transferring and positioning generally flat work pieces, especially of leather or the like, which are to be processed serially as occurs, for instance, in the upper fitting operations of a shoe factory. It will be appreciated that the invention is not thus limited in its application but is capable of broader industrial usage.

Many new machines are designed to complete automatically a process, treatment or progressive series of operations on a work piece once it has been properly presented thereto. In shoe machinery, for example, skiving, edge folding and stitching machines have been adapted by the addition of automatic work guidance mechanism (as disclosed, for instance, in United States Letters Patent No. 3,034,781—Touchman et al., No. 3,085,144—Weeks, and No. 3,080,836—Clemens et al., respectively) to operate satisfactorily and expeditiously on shoe parts without the aid of an operator when they have initially been positioned therein. Picking up, transferring and then putting down successive pieces of work, especially if they are of irregular shape, thin or flabby, can be a tedious and trying chore. It accordingly is an object of this invention to make more completely automatic the functioning of a cyclically operative machine by providing, as an adjunct, an automatic work piece feeder or presenting means adapted to unstack and then position successive pieces according to the cyclical needs of the machine.

In keeping with the object just stated, and as a feature of the invention, there is provided in combination with means for supporting a stack of work pieces, a movable transfer arm, work gripping means thereon, means for operating and controlling the gripping means, means for moving the arm laterally of the stack and heightwise thereof at first to seize successive pieces from the top of the stack and then deposit them in an operating zone, and self-adjusting mechanism for automatically determining heightwise the successive work seizing positions of said gripping means in accordance with the variable upper level of the stack.

A further feature of the invention resides in the provision of novel power means for seizing and carrying flexible work pieces from a supply source to a presenting position, the means including at least one pair of cooperative impaling pins relatively moveable toward and from another.

The foregoing and other features of the invention, together with novel details and combinations of parts, will now be more particularly described in connection with an illustrative embodiment thereof and with reference to accompanying drawings, in which:

FIG. 1 is a front perspective view of a mobile flat-piece feeder as adapted for transferring leather vamps;
FIG. 2 is a rear perspective view of the machine shown in FIG. 1;
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Totally connected at one end to the other end of the link 52. The other end of the link 56 is formed as a split clamp and held secured to the post 28 by means of a bolt 58 (FIG. 6).

For turning the post 28 on its axis the collar 40 threadedly receives a stud 60 having a universal joint connection 62 with one end of a link 64, the other end of which is connected to a crank arm 66 (FIGS. 1, 2 and 4). The latter is fastened on one end of a rod 60 which has journaled in a bearing bracket 70 secured to the frame 20. The other end of the shaft 68 is connected by a crank 72 (FIGS. 1 and 4), and a vertical link 74, to a cam lever 76 pivoted on a stub shaft 78 supported by the frame. Oscillation of the lever 76 is controlled by a dual cam 80, 82 cooperating with a pair of follower rollers 84, 84 carried by the lever.

For cyclical actuation of the transfer arm 26 a cam shaft 86 journaled in the frame 20, and on which the dual cam 80, 82 is secured, is driven from a variable speed motor 88 (FIGS. 1 and 3), a gear reducer 90 mounted on an internal portion of the frame and having conventional sprocket-and-chain operating connection. While the dual cam 80, 82 is positive in its torque-exerting action on the control post 28, a tension spring 92 (FIGS. 1 and 2) connecting the bracket 70 and an arm 94 affixed to the link 56 serves to bias the post 28 counter-clockwise (as viewed from above in FIG. 2) and thus aids in overcoming inertia of the transfer arm 26 when loaded and ready to carry a work piece from its stack.

For effecting cyclical heightwise movement of the transfer arm 26 the shaft 86 carries a cam 100 (FIGS. 2 and 5) cooperatively related to a follower roll 102 supported by a lever 104. The latter is pivoted at one end on a stub shaft 106 secured in the frame, and at its other end carries a roll 108 received in a lost motion slot 110 formed longitudinally in a link 112. A torsion spring 114 on the stub shaft 106 maintains the roll 102 in engagement with the cam 100. As indicated in FIG. 2, when the transfer arm 26 is in its initial work piece-seizing position, the roll 108 may be spaced from the upper end of the slot 110 by an amount (not exceeding the throw of the cam 100) which increases as the upper level of the stack of work pieces feeding operations. The lower end of the link 112 is pivoted to a lifting lever 116 (FIGS. 2 and 5). This lever has one end fulcrumed on a bearing pin 118 projected from the frame and its other, or forked, lifting end mounted with arcuate slots 120, 120 for respectively receiving rolls 122 (one shown) carried by a track post 28. Accordingly, the roll 102 rises on the high portion of the cam 100, the roll 108 will engage the upper end of the slot 110 and cause the lever 116 to elevate the rolls 122 and hence the arm 26.

The arm 26 may be modified a number of ways to adapt it for the handling of typical types of work pieces. FIGS. 7-11 indicate a pneumatic construction now to be described which has been found especially useful in seizing and feeding flexible leather, plastic, fabric and the like, where an important consideration is that a finished surface thereof must not be marred and little, if any, defect incurred in the surface actually seized. The arm includes a hollow base 130 and a cover 132 secured thereon. Affixed in the base 130 adjacent to the post 28 is an air motor 134 (FIGS. 7 and 13) including a reciprocating piston 136 (FIG. 13) having its rod 138 secured to a cable 140 for operating a pair of rotatably adjustable pinching heads generally designated 142, 142 (FIGS. 2, 3, 7, and 12). It will be apparent that for smaller and stiffer work pieces only one so-called pickup head 142, or its equivalent, may suffice and that for larger and more flabby work pieces two or more heads may be required. Since the construction and operation of each of the heads 142 is generally similar, it will now suffice to describe but one of them in detail.

Referring mainly to FIGS. 7-11, a plate 144 secured to the base 130 is bored to receive cylindrical bearing portions of a pair of depending, axially slotted members 146. Each of these members is integrally formed on the plate 144 by means of a retaining ring 148 (FIG. 8), a set screw 150 in the plate abutting the member endwise to hold it and a composite picker arm 152 secured thereto in selected position as desired within the angular range indicated by arrows 154. A depending plunger 154 extending into the member 146 and through a cap 156 adjustably screwed thereon is actuated by the cable 140, as will be described, simultaneously to control work seizure and release by spaced pairs of cooperative impaling pins 158, 160 in each of the heads 142. The arrangement is such that each of several (for this case 3) pairs of the pins 158, 160 is normally held ineffective and retracted within the picker arm 152 by means of a compression spring 162 (FIG. 8) which has an upper end abutting an internal shoulder of the member 146 and a lower end engaging a collar of the plunger 154 to urge it downward. Upon retraction of the cable 140 (to the left, as seen in FIG. 7) upon operation of controls later explained, an adjustable block 164 on the cable swings counter-clockwise (as seen in FIG. 7) a lever 166 pivoted to the base. Consequently a portion 168 of the lever 166 is caused to swing counter-clockwise a lever 170 pivoted to the base and thereby moves the plunger 154 upwardly endwise against resistance of the spring 162 to effect impaling movement of the pins 158, 160 by means next to be described.

The function of the cap 156 is to limit the return or clockwise movement of the lever 170 and hence determine the fully retractive position of the pins 158-160. As illustrated in FIGS. 10 and 11, the pins 158, 160 are preferably moved toward one another angularly to impale the work piece from one side thereof. For this purpose the pins are detachably mounted in oppositely rotatable cylindrical holders 172, 174 (FIGS. 10-11) having operative connection with the lower end of the plunger 154. Thus the holders 172, 174 have their outer ends journaled in an outer portion 176 of the picker arm 152 and their inner ends, which are integrally formed with meshing pinions 178, 178 have bearings in an insert portion 180 (FIGS. 8, 9 and 19) of the arm 152. The outer portion 176, the insert portion 180 and a hollow inner portion 182 of the composite arm 152 are threadedly secured in assembled relation by a screw 184 (FIGS. 7 and 8). For oscillating the holders 172, 174, one of their pinions 178 is energized with a drive gear 186 (FIG. 8) on a ball-ended shaft 188 which has respective meshed 180, 188, 182, 180. The shaft 188 has swivel connection by means of a link 190 to a ball-ended shaft 192 journaled in the member 146. Completing this pin-operating linkage is a crank arm 194 which has one end pinned to the shaft 192 and its other end pinned to the lower end of the plunger 154.

Referring mainly to FIGS. 2, 3 and 13, means for electromagnetically controlling seizure by the pins 158, 160 of each uppermost vamp V, and their subsequent release of it at the instant in transfer when it has been properly positioned and presented, for instance, with respect to operating tools about to operate thereon, will now be described. Secured on the cam shaft 86 is a pair of cams 200, 202 the high points of which are 180° out-of-phase. Each of these is arranged to cooperate with a microswitch 204, 206 respectively, one of which is thus held closed while the other is thus allowed to open. The switch 206 when closed as shown in FIG. 13 energizes a solenoid 208 effective to shift a four-way valve 210 thereby admitting air under pressure to the right side (as seen in FIG. 13) of the piston 136. This assumes that a master electrical switch 212 (FIG. 1) and a master air switch 216 (FIG. 1) of admitting air to inlet 216 (FIGS. 2 and 13) have been first turned to their "on" positions. As a result the cable 140 is retracted to
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project the pins 158, 160 downwardly and convergingly from the picker arm 152 and into the topmost stacked work piece. These pin projections are sufficient to enter and effect seizure of the piece so that it may thereafter be carried reliably despite abrupt motions in any direction, without detrimental marring or piercing of the opposite surface of the piece, which may be the grain side of leather, for example, is avoided.

When, near the end of the first half of the cycle, by reason of operation of the above described transfer mechanism, the arm 26 has delivered the work piece V to an operating zone, the cam 202 allows the switch 206 to open, deenergizing the solenoid 208, and the cam 200 closes the switch 204. Consequently a solenoid 218 is energized to return the valve 210 and hence admit air under pressure to the left side (as seen in FIG. 13) of the piston 136 thereby permitting the springs 162 to withdraw the pins 158, 160 simultaneously from the work so that it may be deposited in predetermined position.

The convergent-pin type of pick-up head 142 is useful in handling many materials provided they are not too flimsy. In FIGS. 14 and 15 is shown a divergent, multipin type of pick-up head 220 wherein its 4-pins 222 are respectively carried in an actuator lever 224 and 5 links mutually disposed at right angles. The lever 224 and the links 226 are respectively carried on pivot pins 228 in the head 220 and each has a narrower, semi-spherically recessed inner end for mating with a bearing ball 230. The other end of the actuator lever is pivoted to a rod 232. It will be apparent that movement to the right in FIG. 14 of the rod 232 is effective to project the pins 222 thus causing the work V to be seized; movement of the rod 232 to the left effects work release.

In FIGS. 16 and 17 an alternate form of impaling head 234 includes a solenoid 236 and its plunger 238 for actuating two pairs of straight pins 240, 242, one pair diverging from the other. Two pairs of parallel links 244, 246 (only one link of each pair is shown) are pivoted at their outer ends to the head 234. The lower end of the plunger 238 is formed with a horizontal slot 248 for receiving pins 250, 252 respectively bridging the links 242, 244. Accordingly energization of the solenoid 236 (which may, for instance, be effected by a circuit controlled by the switches 204, 206) depresses the plunger 238 against resistance of a return spring 254 centrally inserted in the head, thereby causing the impaling pins to be thrust into the work piece, two in one direction and two in a divergent path tending to spread it. Such work spreading impalements, also effected with the arrangement of FIGS. 14 and 15, are sometimes advantageous where the material to be transferred is of stretchable character or particularly thin and its quality does not impede release at the point of delivery.

Reviewing briefly a cycle of operation of the machine, the work to be fed is first uniformly stacked on the surface 22 and held in selected orientation with the aid of the gage blocks 24. The latter may have straight edges abutting the sides of the stack in spaced localities selected to avoid interference of the transfer arm 26, the stack itself being initially spotted to come within the range of the adjustably rotatable heads 142. At the end of each cycle these heads will normally come to rest on the uppermost work piece as shown in FIG. 2, the pins 155, 156, 158, 160 being inserted and the stack is raised a cycle by operation of the electromechanical control means above described, for instance, to impale the top piece V from the flesh side of a leather vamp. Then the cam 100 is effective through the lever 104, the link 112, the lever 116, and the control post 28 to determine upward separatation of the arm 26 and the impaled piece V is transferred to the lever 26 followed by further suitable heightwise movements of the arm to transfer the piece V to its release point, and then to return the heads 142 to their pick-up position on the stack. Simultaneously in the cycle the dual cam 89, 82 transmits torque to the post 48 via the lever 76, the link 74, the cranks 72 and 66, the link 64, and the collar 44. The post accordingly shifts the transfer arm 26 first to swing it with a work piece from the dash position shown in FIG. 3 to the full line position indicated. It will be apparent that cam of selected shape may be substituted as appropriate for different heightwise and/or lateral feeding movements which may be required. A knob 256 (FIG. 1) is rotatable to control the speed of the motor 88 and hence the rate of work transfer, the delivery of each piece preferably being timed to correspond with the production rate of the machine to be fed.

It is especially to be noted that, as the work stack diminishes, the described self-adjusting mechanism for controlling the heads 142 heightwise automatically adjusts to the changing height of the stack, the slot 118 allowing the lever 112, the lever 116 and the control post 28 to descend in steps (equal to work piece thickness) under the influence of gravity and to the extent required without disruption of the operative connection between the torque applying link 64 and the 3-part linkage 59, 52, 56 which is correspondingly collapsible heightwise as shown in FIG. 6. This is to say that the link 56, in any heightwise position imposed by the cam 100 and/or the work stack, remains operative to impart torque or lateral positioning to the arm 26 as dictated by the cam 89, 82.

A reason for employing impaling pin heads rather than, for instance, a suction type pickup means is that the former is commonly incapable of lifting from a stack only one work piece but will, depending on its foraminous nature, tend to separate more than one at a time. Also, precise control of the release of the work subjected to suction is at times difficult. Usage of pin type transfer heads of the sort herein illustrated normally requires a less expensive machine, and the pins normally only partly penetrate each work piece thus leaving fabric, plastic, and the grain side of leather unmarried.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a work transfer apparatus having a frame, and a transfer arm which has work gripping means for seizing an article and which swings horizontally and moves vertically to transfer the article from a stack, automatic means for permitting the work gripping means to assume in each seizing operation a new heightwise work seizing level corresponding to the current level of the stack from which the work is to be transferred, said automatic means comprising a post for supporting said arm, a lever connected to said post, a link connected to said lever, said link having a slot, a second lever attached at one end to said frame, a slide member attached to the other end of said second lever and being disposed in said slot, a cam follower attached to said second lever, and a rotatable cam engageable with said cam follower.

2. In a work transfer apparatus having a frame, and a transfer arm which has work gripping means for seizing an article and which swings horizontally and moves vertically to transfer the article from a stack, automatic means for permitting the work gripping means to assume in each seizing operation a new heightwise work seizing level corresponding to the current level of the stack from which the work is to be transferred comprising a control post for mounting said arm, a lifting lever connected to said control post, a link pivotally connected to said lifting lever and having a lost motion slot, a second lever pivotally attached at one end to said frame, a slide member attached to the other end of said second lever, slide member being slidably retained in said lost motion slot, a cam follower attached to said second lever, a rotatable cam engageable with said cam follower, and power means for rotating said cam.

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