

Nov. 15, 1966

D. E. KAPLAN

3,285,389

ITEM HANDLING APPARATUS

Filed Aug. 3, 1964

5 Sheets-Sheet 1

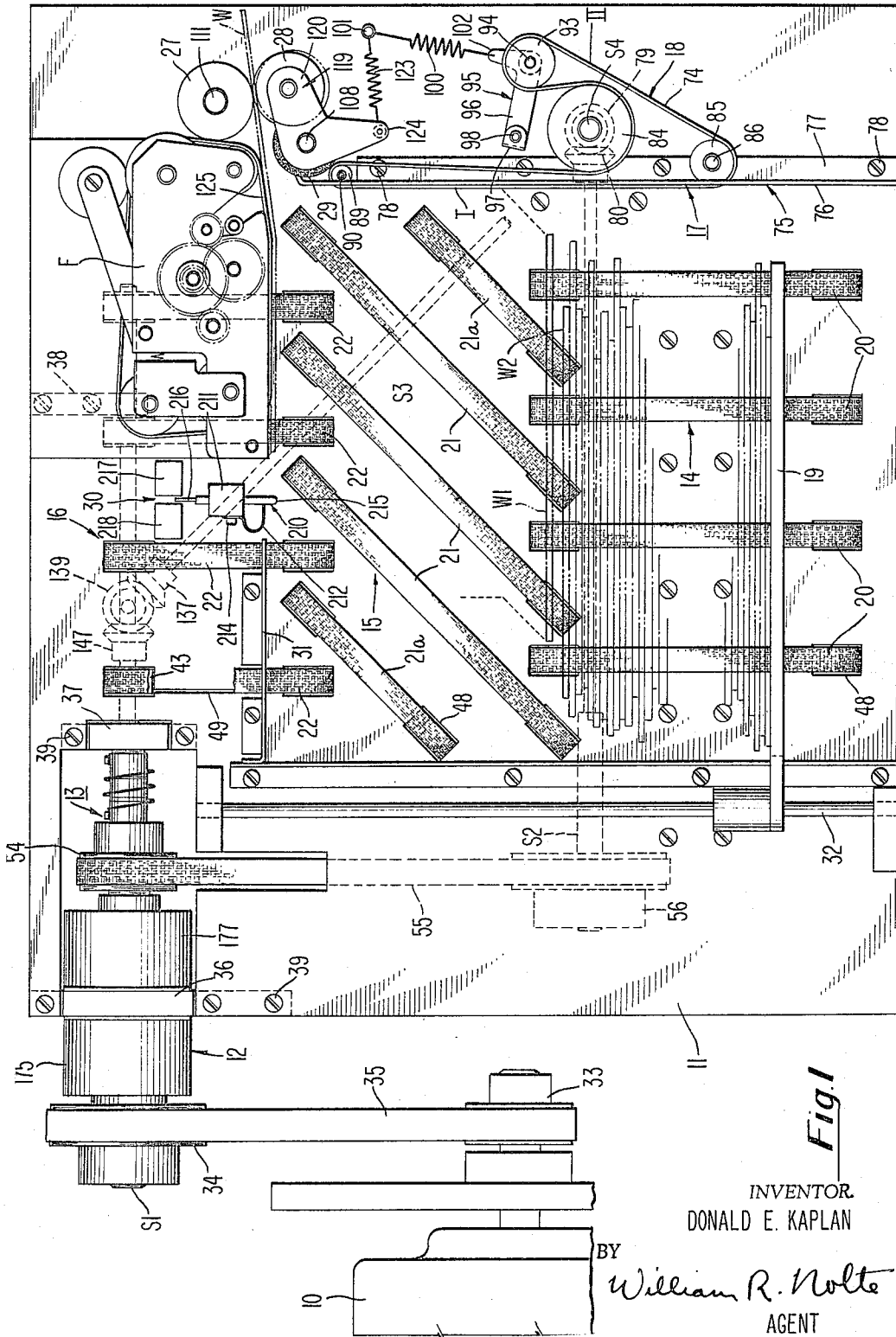


Fig. 1

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5 Sheets-Sheet 2

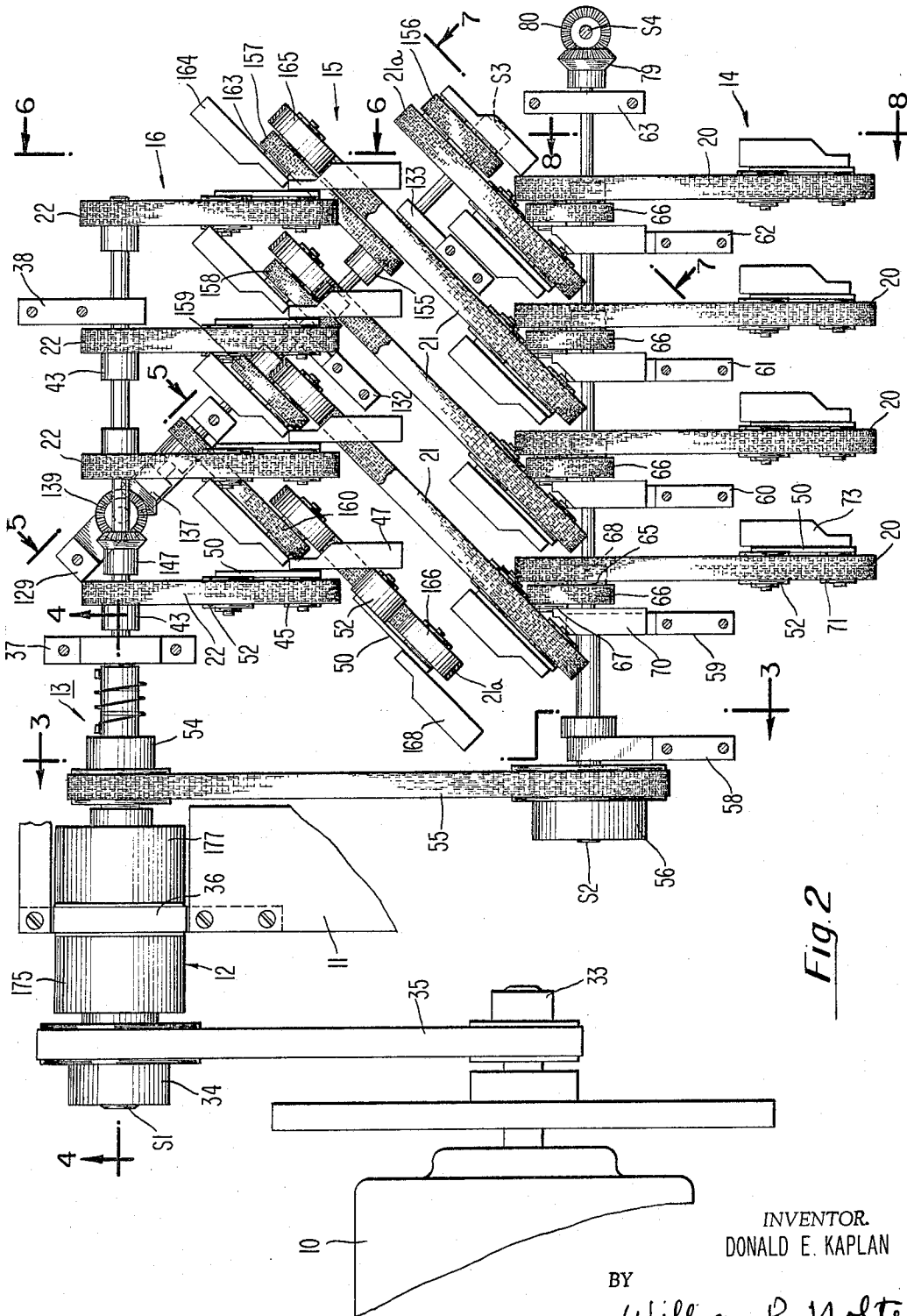


Fig. 2

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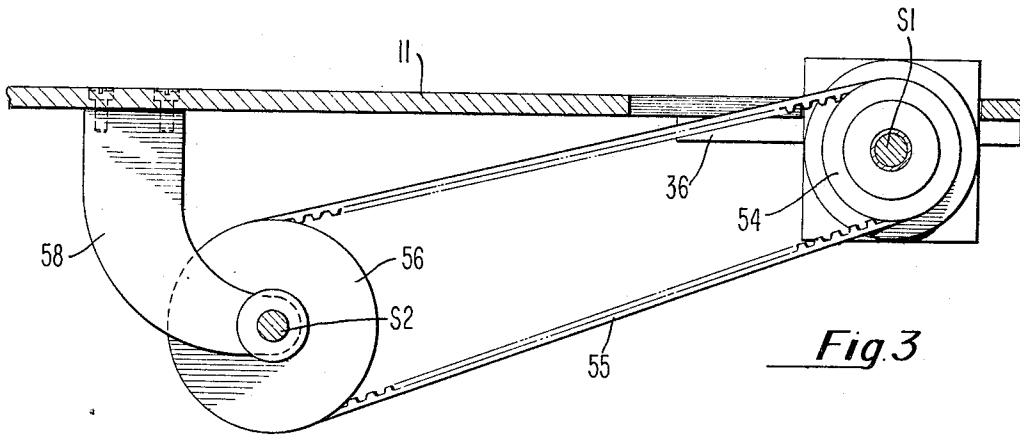


Fig. 3

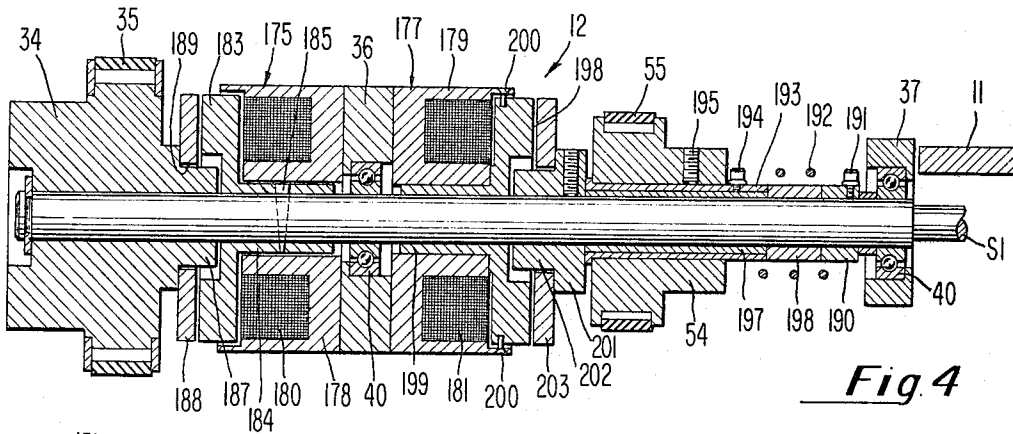


Fig. 4

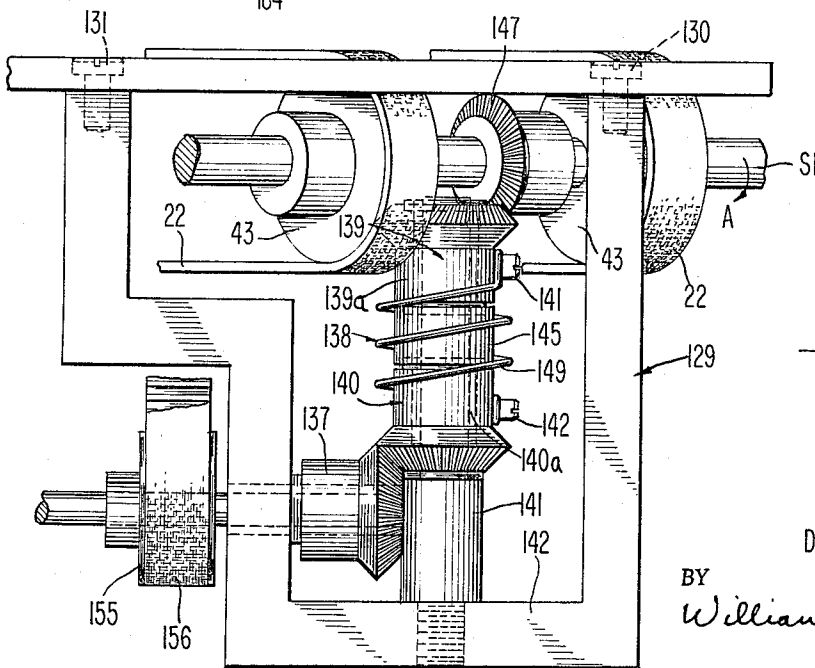


Fig. 5

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5 Sheets-Sheet 4

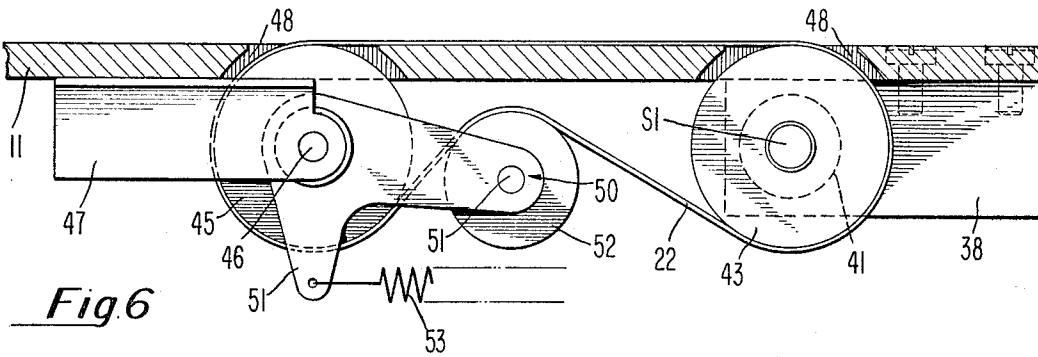


Fig 6

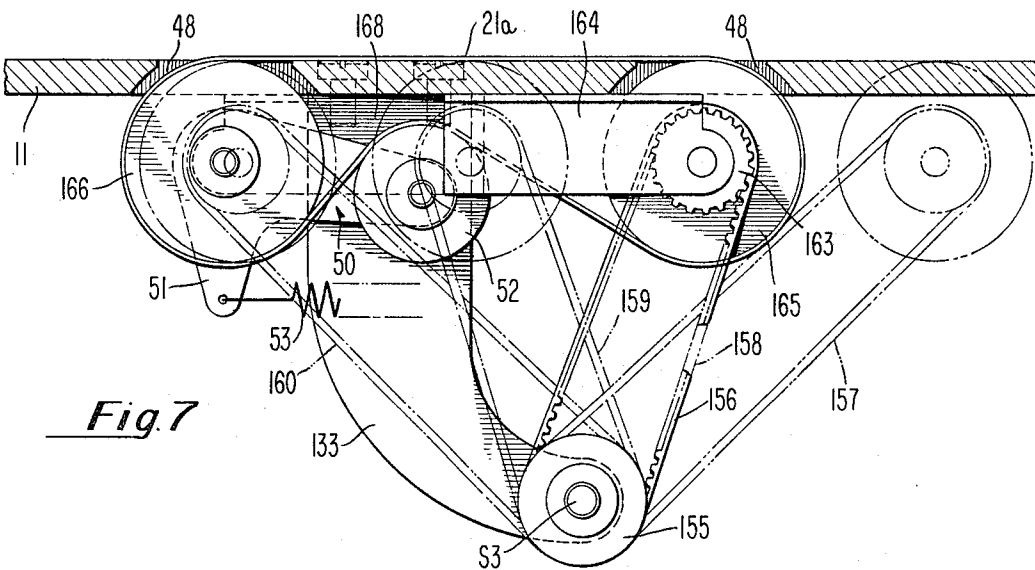


Fig 7

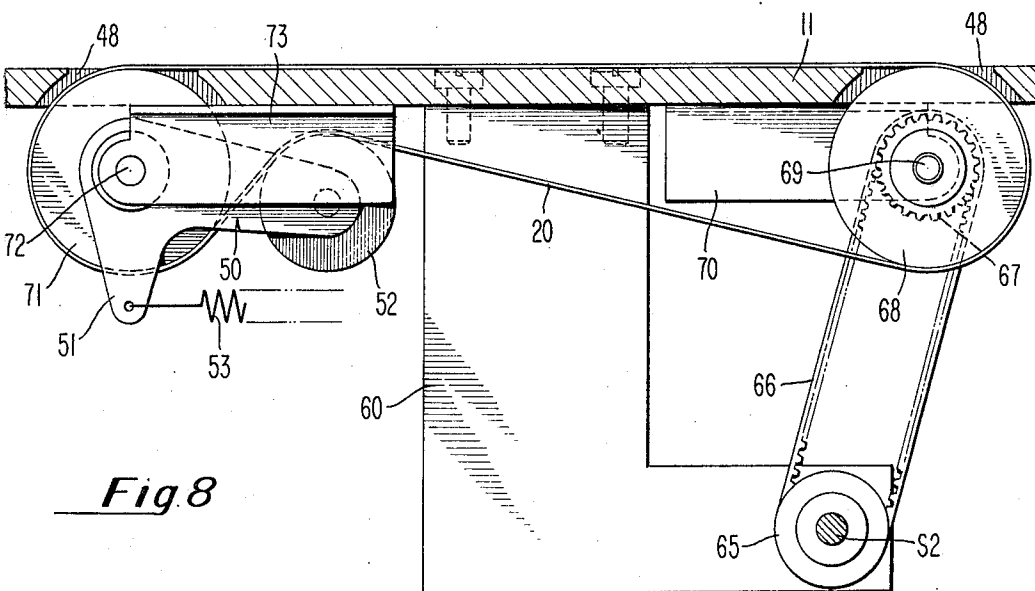


Fig 8

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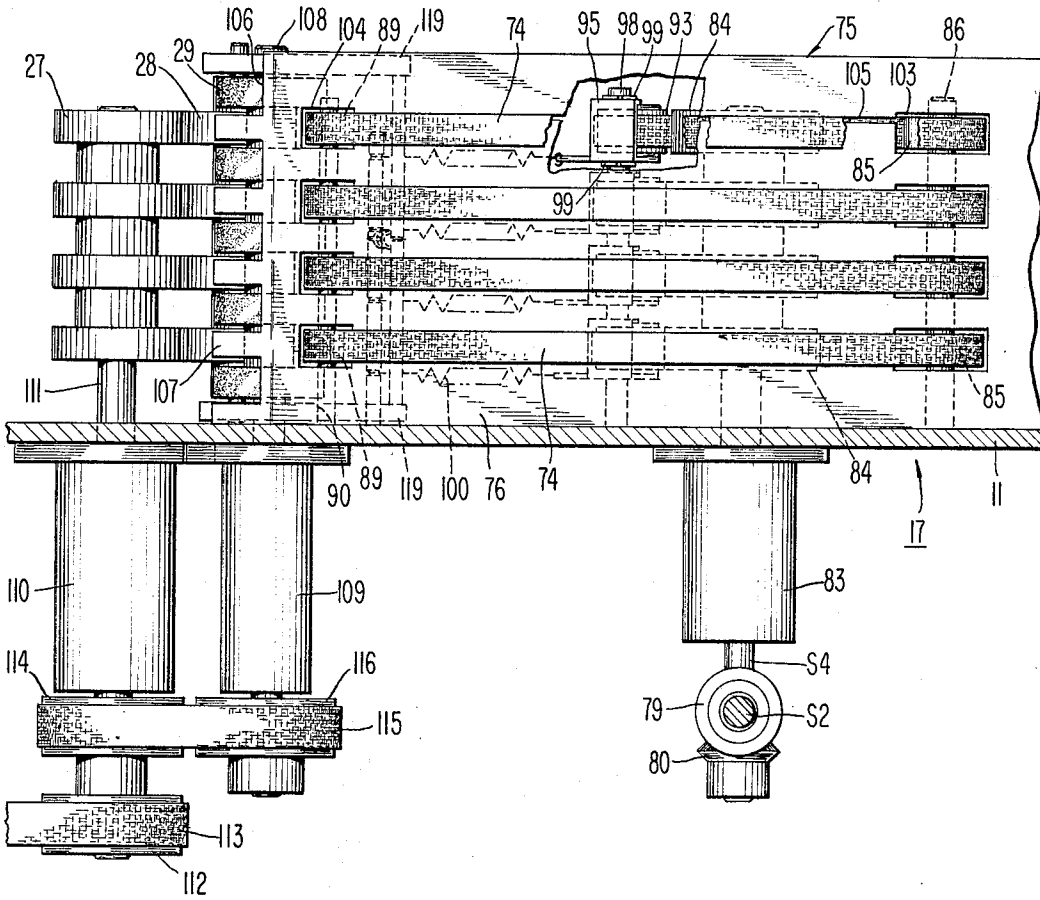


Fig. 9

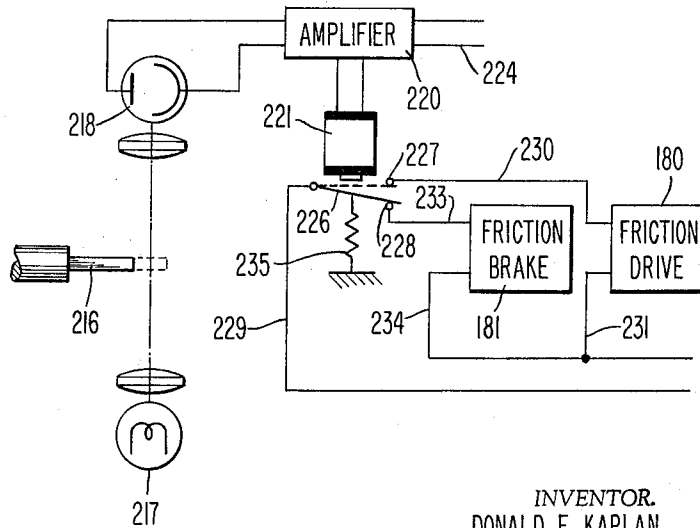


Fig. 10

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3,285,389

**ITEM HANDLING APPARATUS**

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Filed Aug. 3, 1964, Ser. No. 386,967  
5 Claims. (Cl. 198—34)

This invention relates to apparatus for advancing a stack of items toward a feeding location at which the items may be fed one at a time from the stack by suitable feeder means, and more particularly, to such apparatus including means for controlling the spacing of items during advance of the stack.

In many instances, where the items to be fed are of a wide range of intermixed sizes and thicknesses the advance of a stack toward the feeding location requires that the foremost item of the stack be positioned forwardly an amount to enable the same to be fed therefrom, but that such a stack advance however, should not be of such an amount as to cause the second foremost item to be fed with the foremost item in the stack. The manner by which the stack is advanced must therefore take into account the variations in rate of feed due to the different lengths of items handled, variations in item thicknesses within the stack, and the amount of compression in the stack. It is well known that the frictional force exerted by a second item on a first item, when the items are in sliding contact with one another, is proportional to the normal force by which the second item is urged against the first. With respect to the foremost and second foremost items in a stack, it follows that if the stack is under considerable compression, the frictional force between the two foremost items of the stack adjacent the feeder is high, thereby increasing the probability of their being fed simultaneously, and conversely, if the compression of the stack is slight, the frictional forces between the foremost items is minimized thus decreasing the probability of double feeds.

Independently of friction, it has also been observed that possible double feed of two foremost items in a stack may occur by virtue of an aerodynamic effect caused by the sudden motion of the foremost item. The motion due to the action of the feeder creates a region of reduced pressure behind the first item into which the second foremost item is moved because of atmospheric pressure on its rear side. The result of this effect is similar to a condition wherein the foremost item exhibits a higher porosity and such that the vacuum feeder would thereby cause a negative pressure on its rear side. In each of the above enumerated instances, the apparatus of the above invention provides a cure therefore by increasing the item to item spacing thereby decreasing the coupling forces between adjacent items in the stack.

In accordance with the apparatus of the present invention a platform or table is provided with plural conveyor means spaced along its length, operated at different velocities, with the conveyor means on the output side of the table operated at the greatest velocity. Edge aligning means disposed at one side of the worktable include additional conveyor means to register the items along one edge of the hopper device. A vacuum feeder device, not forming part of the present invention, is effective to feed items in one by one succession laterally from the forward end of the stack. Initially a group of unjogged items is placed edgewise upon the rearmost conveyor means of the worktable. Due to the compression of the stack, however, the bottom edges of certain of the items may not contact the rear conveyor means. Thereafter, as the stack is advanced so that the same contacts the intermediate or next forwardly spaced conveyor means of increased veloc-

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ity, the spacing between adjacent items is increased, permitting those items whose edges were not in contact with the first conveyor means to drop down into engagement with the intermediate conveyor means. As the stack is advanced still further, into engagement with the foremost carrier means operated at an even greater velocity, the pitch or spacing between the items is again increased thereby relieving the coupling pressure between adjacent items in the stack. The intermediate spaced carrier means may be inclined with respect to the side edge aligning means to provide a component of force to urge one side of the item in contact with the side edge aligning means while advancing the same toward the feeder. The velocity of the conveyor means associated with the side edge aligning means is equal to the forward component of velocity of the intermediate conveyor means to thereby prevent drag along one edge of the stack. Fence means are provided to support the stack upright and rides successively on the conveyor means spaced along the length of the hopper.

Position detector means sense the location of the foremost item of the stack and provides signals to control the operation of a clutch and brake assembly to either start or stop the operation of the conveyors. The coupling between the plural conveyor means may be flexible to permit the foremost one conveyor means to start or stop quickly while allowing the remaining conveyors more time for response. The flexible coupling provided produces no permanent change in the relationship between the front and rear of the stack.

Accordingly, an object of the invention is to provide new and improved hopper apparatus for controlling the advance of a stack of items as the same are fed in one by one succession from the forward end of the stack.

A further object of this invention is to provide such an apparatus which increases the item spacing or pitch from the loaded condition of the stack of items resulting in an increase in item-to-item spacing.

A further object of this invention is to provide such an apparatus for increasing the pitch of an unjogged stack of items of intermixed sizes and thicknesses and to cause the same to be aligned relative to their bottom and side edges prior to being fed in one-by-one succession from the forward end of the stack.

For a better understanding of the present invention together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims. In the drawings:

FIGURE 1 is a plan view broken away in part, of a workpiece stack advancing apparatus embodying the present invention and shown in conjunction with a porous belt vacuum feeding device for feeding the workpiece in one-by-one succession from the front of the stack;

FIGURE 2 is a plan view of the apparatus with the worktable broken away and showing the drive transmission for the conveyor systems;

FIGURE 3 is a side sectional view taken along the line 3—3 of FIGURE 2 and showing a portion of the drive transmission by which the apparatus is driven;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 2 and illustrating the clutch and brake mechanism employed in conjunction with the drive transmission;

FIGURE 5 is a fragmentary sectional view taken along line 5—5 of FIGURE 2;

FIGURE 6 is a fragmentary sectional view taken along the line 6—6 of FIGURE 2;

FIGURE 7 is a fragmentary sectional view taken along the line 7—7 of FIGURE 2;

FIGURE 8 is a fragmentary sectional view taken along line 8—8 of FIGURE 2;

FIGURE 9 is an elevational view of the side edge aligning means showing a plurality of endless advancing belts which coact with the side edges of the workpieces constituting the stack;

FIGURE 10 is a schematic wiring diagram for the stack advancing and separating apparatus according to this embodiment.

Referring particularly to FIGURE 1, the disclosed embodiment of the invention is shown as including a motor 10, a supporting plate or worktable 11, a clutch and brake assembly 12, and a drive transmission 13 supported adjacent the lower surface of the plate for driving a plurality of belt conveyors 14, 15 and 16. A side edge aligning assembly 17, which includes a loop belt conveyor system 18, cooperates to direct the items toward a feeding device F. The items in this case, illustrated in phantom as pieces of unjogged letter mail of varying lengths and thicknesses are deposited on the worktable 11 in bunches and on one of their long edges so that the same are in front of a fence 19. Although the items operated upon by the apparatus of the present invention will hereinafter be referred to as letters, it will be clear that other workpieces such as checks, cards, etc., are capable of being so operated upon. The belt conveyor 14, seen in the lower portion of FIGURE 1, includes a plurality of endless belts 20 having portions of their length translatable on the top surface of the worktable 11 and disposed parallel to the side edge aligning assembly 17. The intermediate belt conveyor 15 includes a plurality of endless belts 21 and 21a which also ride on the top surface of the worktable. The belts converge toward the side aligning assembly 17 and are effective to advance the letters forwardly while moving into engagement therewith. Conveyor 16 includes a plurality of endless belts 22 which are disposed parallel to belts 20 of conveyor system 14 and serve to advance the items into engagement with feeder mechanism F which forms no part of the present invention. The feeder mechanism F includes a plurality of continuously driven porous belts 25, each moving over a track where a vacuum is alternately created and destroyed to feed the letters toward the right one at a time in spaced relation. A letter W illustrated in phantom is being fed laterally from the stack and into engagement with a pair of pinch rollers 27, 28 which aid in transporting the letters to a reading station. The pinch rollers, reading station, and friction roller form no part of the present invention. A counter-rotating friction roll 29 is provided to engage and to separate any letter which may be moving with the foremost item in the stack to thereby discourage double feeds. The stack position sensing device 30 located at the left side of the feeder F senses the location of the front letter of the stack and provides electrical signals to control the motion of the stack through the clutch and brake assembly 12. The latter in response to the signals from the sensing device 30 starts and stops the belts of the conveyors 14, 15 and 16 through drive transmission 13. The speed of the belts is made just fast enough to insure reliable delivery of the letters to the feeder and to minimize brake and clutch wear. The fence 19 slidable forward and aft on rod 32 engages the rearmost letter of the stock and insures that the same is held in a vertical position. The fence rides the sets of belts 14, 15 and 16 successively as the size of the stack is diminished due to the successive feeding action of feeder F, but is not effective to alter the compression of the stack in any way.

In order to minimize double letter feed situations due to high sliding frictional forces between the foremost documents arising from compression of the stack, the velocities in a direction normal to the front face of feeder F of the three belt conveyor systems 14, 15 and 16 are progressively higher, the nearer they are to the front of the hopper. The foremost belt conveyor system 16 is operated faster than the intermediate belt conveyor system 15, and the rear belt system 14 is operated slower

than the conveyor system 15. These velocity changes increase the spacing or pitch between adjacent letters of the stack and thereby result in a reduction in letter-to-letter coupling force. The velocity of belt conveyor system 18 of the side aligning assembly 17 is equal to the forward component of velocity of the intermediate belt system 15, to eliminate drag on the registration surface.

Still referring to FIGURE 1 it is seen that power to drive the foremost set of belts 16 adjacent the feeder 19 is transmitted from motor 10, FIGURE 1, through speed reduction pulley 33 attached to the shaft of the motor, pulley 34 attached to shaft S1 and belt 35 to thereby drive shaft S1. The clutch and brake assembly 12 transmit power to the shaft S1 in a manner to be described later. The shaft S1 is supported along its length by bearing blocks 36, 37 and 37 which are suitably secured to the under surface of plate 11 as by bolts 39. As seen in FIGURE 4, bearing blocks 36, 37 are centrally apertured to receive ball bearing assemblies 40 which engage the left end of the shaft S1 which is of enlarged diameter. Referring to FIGURES 2 and 6, bearing block 38 is recessed to receive bearing assembly 41 which supports the right-hand end of shaft S1, of reduced diameter. A plurality of drive pulleys 43, suitably keyed to shaft S1 each engage an advancing belt 22 which in turn loops a driven pulley 45 mounted for rotation on a stub shaft 46, see FIGURE 2. The stub shaft projects from mounting bracket 47 which is secured to the under surface of plate 11. The plate contains a suitable cut-out 48 adjacent each drive and driven pulley with an interconnecting slot 49 (see FIGURE 1). The latter slot enables a portion of the belt to be passed from the underneath to the top side and thus permits a portion of its length to ride upon the top surface of the table 11. Bellcrank tensioning means 50, pivotally mounted on stub shaft 46, carrying an idler roller 52 at the extremity of one of its arms and having suitably anchored tension spring 53 connected to its other arm, is effective to maintain the desired tension within each belt 22.

The rearmost advancing belts 20 which make first contact with the stack, as seen in FIGURE 1 of conveyor 14 receive their driving force from pulley 54, which is mounted for rotation on shaft S1. Pulley 54, through toothed belt 55, drives pulley 56 keyed to shaft S2. The size of the pulleys 54, 56 is selected to cause the rear belts 20 to translate considerably slower than the front belts 22.

Referring now to FIGURES 2, 3 and 8 it is observed that shaft S2 is journaled for rotation relative to the under surface of plate 11, by means of mounting bearing brackets 58 to 63 inclusive. Driving sprocket wheels 65, spaced along and each locked on shaft S2, through toothed belt 66, rotate driven sprockets 67 integral with sheave 68. Each integral pulley sheave 67, 68, carrying the forward portion of belt 20, is mounted for rotation on stub shaft 69 of mounting bracket 70, the latter affixed to the under surface of plate 11. The rearward portion of each belt 20 encircles pulley 71 on stub shaft S2 integral with mounting bracket 73. Tensioning means 50 of the form previously described in connection with stack advancing belts 22, are utilized to maintain proper tension in belt 20, each of which is likewise passed through suitable slots through the plate so that a portion of its length slides on the top surface of the plate 11.

Referring now to FIGURES 1, 2 and 9, it is seen that the loop belt structure 18 of the slide edge aligning assembly 17 includes a plurality of advancing belts 74 arranged concentrically one above the other and suitably interconnected to shaft S4 to be driven by shaft S2. As seen in FIGURE 9, four such belts are illustrated with a portion of the length of each belt engaging the inside surface 76 of the upstanding edge aligning plate 75. Bottom flange 77 projecting from the plate, FIGURE 1, is secured to the top surface of the worktable 11 as by bolts 78. Bevel gear 79 fixed on shaft S2 meshes in driving

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relation with bevel gear 80, attached to the lower end of shaft S4 which is supported for rotation by bearing housing 83. The shaft extends upwardly through the worktable 11, adjacent to the outside surface of upstanding edge aligning plate 75, to carry a plurality of drive pulleys 84 each spaced from the other along the upper portion of shaft S4. Each pulley 84 engages an advancing belt 74 and divides each belt into two reaches designated by Roman numerals I and II. The first reach I extends from a rear set of idler pulleys 85 mounted on shaft 86 which extends upright from worktable 11, and a second smaller set of idler pulleys 89 mounted on shaft 90 in a similar manner. The second reach of each of the belts 74 designated by Roman numeral II, extends from the set of idler pulleys 85 to a floating idler pulley 93 which is carried by bellcrank 95 for rotation about pivot 94 thereon. The end of arm 96 of bellcrank 95 is channel-shaped as at 97 and is mounted for pivotal movement on pivot post 98. Each bellcrank is spaced along the pivot post so as to swing in the plane of rotation of its associated belt 74 being fastened on the post at its appropriate elevation in any suitable manner such as for example, by C-rings 99, FIGURE 9. A tension spring 100, having one of its ends secured to mounting post 101, FIGURE 1, engages at its other end the extremity of the other arm 102 of the bellcrank to thereby exert tension in belt 74 by applying a force to bodily move pulley 93 in a counterclockwise direction relative to pivot 98.

Referring to FIGURE 9, the upright plate 75 includes rectangular apertures 103, 104 adjacent pulleys 85, 89 respectively which apertures are interconnected by an elongated slot 105 to permit insertion of each belt from the far surface to the near surface 76 of plate 75. The size, i.e., the diameter of drive pulley 84 is selected so that the velocity of belt 74 is greater than that of the first set of belts 20, but is equal to the forward component of velocity of the intermediate sets of belts 21.

The forward end of the aligning plate 75 includes notches 106 along its vertical edge, whose margins define fingers 107 which are bent inwardly as shown in FIGURE 1, between friction rolls 29. The latter are mounted in spaced relation on shaft 108 which is journaled for rotation by bearing housing 109 secured to the under-surface of the worktable 11. Bearing housing 110, forward of housing 109 is likewise similarly mounted to the worktable, and supports shaft 111 which in turn carries the previously referred to pinch roller 27 on the portion of the shaft which extends thereabove. The lower extremity of shaft 111 has keyed thereon a driver pulley 112 which is driven by belt 113. A second pulley 114 also keyed on the shaft, through belt 115 drives pulley 116 affixed to shaft 108 to thereby impart suitable rotation to friction rolls 29. As seen in FIGURE 1, shaft 108 carries bellcrank 119 whose arm 120 carries shaft 121 about which the corresponding pinch rolls 20 rotate. A spring 123 connected at one of its ends to spring post 101 and at its other end to the other arm 124 of bellcrank 119, urges the pinch idler rolls 28 into suitable workpiece gripping engagement with its corresponding driven pinch rolls 27.

Referring to FIGURES 2 and 5 it is seen that the intermediate belts 21 derive their driving force from shaft S3 which at its forward end thereof is journaled for rotation by means of a generally U-shaped bearing yoke 129 secured to the under surface of worktable 11 as by bolts 130 and by additional bearing mounting brackets 132 and 133 disposed along its remaining length. The forward end of shaft S3 has affixed thereto a bevel gear 137 which receives rotative power from the aforementioned shaft S1 through flexible coupling unit 138 which includes upper and lower bevel gears 139, 140 mounted for free rotation about stub shaft 141, which is threaded in upright relation relative to the horizontally disposed base 142 of the yoke assembly 129. A spacer 145 also

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freely rotatable about the stub shaft compensates for the difference in elevation between shafts S1 and S3 and positions the upper bevel gear 139 in meshing relation with bevel gear 147 which is affixed to shaft S1, to rotate in unison therewith. A resilient member in the form of a coil spring 149 includes a number of convolutions which encircle the upper and lower bevel gears 139, 140 as well as the spacer 145 mounted therebetween. Its upper end is secured to the upper bevel gear 139 as by screw 141 and its lower end is secured to the lower bevel gear 140 as by screw 142. It should be noted that the diameter of the convolution of the spring is greater than the outside diameter of shoulder 139a, of bevel gear 139, shoulder 140a of bevel gear 140, and of spacer sleeve 145. As shaft S1 is caused to quickly start in the direction of arrow A, bevel gear 147 through bevel gear 139 tends to wind up the spring 149 about bevel gears 139, 140 and spacer 145 to cause the spring diameter to be reduced, conversely, after shafts S1, S3 have been brought up to operating speed and the brake is then applied to shaft S1 to which bevel gear 147 is affixed, the forces are opposite and thus tend to unwind the spring 138 relative to bevel gears 139, 140 and sleeve 145. It thus follows from above that when shaft S1 is caused to quickly start or stop, the intermediate belts 21 driven by shaft S3 are allowed more time to dissipate their energy.

Still referring to FIGURES 2 and 5, and also FIGURE 7, it is observed that shaft S3 has secured along its length a number of driver sprockets 155 to actuate toothed belts 156-160 inclusive. The upper portion of drive belt 156, FIGURE 7, meshes with sprocket 163 which is carried by bracket 164, mounted to the underneath side of the worktable in any suitable manner. Sprocket 163 includes an enlarged sheave portion 165 which carries one end of stack drive belt 21a. The other end thereof is carried by a driven pulley 166 mounted upon bracket 168. The belt is tensioned by tensioning device 50 previously described in conjunction with FIGURE 6.

Referring now to FIGURES 1 and 4, it is seen that the previously referred to clutch-brake assembly 12 consists of a clutch 175 and a brake 177 each having non-rotating field portions 178, 179 respectively, affixed to the shaft bearing bracket 36. The stationary field portions 178, 179 each contain an electromagnetic coil 180, 181 respectively. A clutch rotor 183 having a sleeve portion 184 extending within the bore of the field, is suitably pinned to the shaft S1 as at 185. Pulley 34 freely rotatably about shaft S1, includes an integral armature hub portion 187 of rectangular cross-section, which passes through a mating rectangular aperture 189 of armature disc 188. The armature disc 188 is free to move a slight amount axially on the hub for follow-up and release action. When the clutch coil 180 is energized, magnetic flux flows from the field to the rotor, which in turn attracts the armature disc 188 for coupled driving. Since the hub portion 187 of rectangular cross-section is locked for rotation by virtue of its engagement in the rectangular hole of the disc, the shaft S1 is thereby caused to rotate in unison with pulley 34. The end of shaft S1 opposite to that which carries pulley 34 has locked thereon a sleeve 190, as by set screw 191, the latter screw also serving to anchor one end of a coil spring 192. The other end of the coil spring is anchored to sleeve 193 by set screw 194, which sleeve is encompassed by pulley 54, and the pulley in turn is keyed thereto by set screw 195. Sleeve 193 is freely rotatable about bearing sleeve 197, pressed on shaft S1, thereby enabling free rotation of the pulley about shaft S1. A spacer element 198 separates sleeve 190 from bearing sleeves 193, 197. When shaft S1 is thus clutched to the source of motor power as described above, rotative power from the shaft is transmitted to the coil spring 192 and thence to pulley 54, belt 55, pulley 56, to thereby drive shaft S2, S4.

After the sets of translating belts have advanced the letter stack into engagement with position sensor 30, to be



later described, brake 177 is actuated to stop the shaft S1 immediately and shafts S2, S3 and S4 over a longer period of time. For this purpose the brake 177 is shown as including member 198 having a sleeve portion 199 extending within field member 179, but not fixed to shaft S1 and is riveted as at 200 to the field member 179. An armature hub, fixed to shaft S1, designated 201, having a shank 202 of rectangular cross-section carries an armature disc 203 which includes a rectangular opening 104 to permit axial movement along the shank. When the brake field 181 is energized in a manner to be later described, the armature is attracted to the friction face of member 198 to thereby immediately arrest its rotation and that of shaft S1 through armature hub 201. Thereafter, coil spring 192 and coil spring 149, see FIGURE 5, are enabled to dissipate the energy of the intermediate drive belts 15, rear belts 14, and side edge aligning belts 74, to stop the same over a longer period of time.

Referring now to FIGURES 1 to 10, it is seen that the stack position detector 30 for sensing the foremost letter in the stack includes a lightweight rod 210, suitably mounted for free fore and aft sliding movement in block 211. A spring 212 of generally U-shaped form, has the extremity of one of its legs fixed to one end of the rod as at 213, the other leg thereof is secured to the block as by a screw 214. The spring normally urges the rod rearwardly so that its end 215 projects beyond the plane of the front face of the feeder F. The opposite end of the rod may be flattened as at 216. When belts 20, 21 and 22 advance the stack so that the foremost item thereof is in face contact with the feeder, the item pushes the rod 210 forwardly, which in turn, interrupts the light from a light source 217 disposed on one side of the path of movement of the rod to a photocell unit 218 on the opposite side of its path. The interruption of the light source energizes the brake coil 181 in the following manner. As shown schematically in FIGURE 10 the photocell is connected to an amplifier 220. The amplifier is connected to the coil of the relay 211 with lines 224 connecting the circuit to source of electrical energy. The relay has a switch arm 226 operable between two fixed contacts 227, 228 and a line 229 connects the switch arm 226 to one side of a source of energy. Contact 227 through lines 230, 231 connects the clutch coil 180 to the other side of the source while contact 228 through lines 233, 234 connects the friction brake coil 181. The switch arm 226 is normally biased into engagement with switch contact 228 by spring 235. When the light beam is interrupted by interposition of the rod between the light source 217 and the photocell unit 218, so that the light cannot strike the photocell, the relay then being non-energized, the switch arm 226 is then drawn into engagement with contact 227 and away from contact 228. The friction brake coil 181 is energized by the source of energy over lines 229, 234. With the brake coil 181 so energized, armature 203 (FIGURE 4) is magnetically attracted to the brake face of member 198, thereby bringing the load on the belts 20, 21 and 22 to a stop as indicated above.

Alternatively, after the foremost letter in the stack has fed laterally to the right by feeder F, the spring 212 drives rod 210, FIGURES 1 and 10, into the space vacated by the letter so fed and thereby permits light to be transmitted from lamp 217 to the photocell 218. The signal amplified from the photocell energizes relay 221 which attracts switch arm 226 into engagement with contact 227 and away from contact 228. Friction brake coil 181 is thereby deenergized while friction drive coil 180, on the other hand, is energized by the source of electrical energy over lines 230, 231. When so energized, armature 188, FIGURE 4, is magnetically attracted to the friction face of rotor 183, thus transmitting power through the belts to drive the load.

In operation a bundle of unjogged letters is placed with long edges down on the rear of the worktable to the working surfaces of the forwardly moving

belts 20. The stack is travelled forwardly on edge and is prevented from falling over backward by the fence 19 which rides on the belts and is caused to slide forwardly on rod 32. Since the letters are unjogged, and due to the initial compression of the stack, not all of the letters will have their bottom edges in engagement with the belts. As the stack is advanced so that the foremost letter of the stack reaches the faster moving intermediate belts 21 inclined toward the side edge aligning device 17, the same is caused to be propelled forwardly faster than the remainder of the stack. As a consequence of this speed differential, the foremost letter is separated by a slight distance from the second foremost letter W-2 of the stack. In a similar manner as the second foremost letter reaches the faster moving belts 21 and leaves the slower moving first belts 20, the same is separated a slight distance from the third foremost letter. The remaining letters in the stack will be separated in like manner one from another during the transition from the first to the second set of belts. As a consequence of the greater spacing between adjacent letters in the stack, any letters which did not initially have their bottom long edges in contact with the first set of belts 20 are enabled to drop down to contact the intermediate belts 21.

The latter belts in addition to transporting the stack forwardly at a greater velocity than the rear belts 20, also moves the stack to the right as seen in FIGURE 1, to engage the forwardly moving side edge aligning belts 74 of the belt system 18. Since the velocity of the latter belts 74 is equal to the forward component of velocity of the inclined intermediate belts 21, there is thus no drag along the side edge aligning plate 76 which would tend to cause the letters to pivot about their side edges. By the time the letters in the stack are transported forwardly to reach the front belts 22, the same will have been aligned relative to the right side edges and also relative to their long bottom edges.

As previously noted the most forward set of belts 22 are moved at a velocity greater than the forward component of velocity of the intermediate belts 21. Consequently, each letter in transition from the slower moving intermediate belts to the faster moving forward belts is again separated an additional amount from the remainder of the stack. Upon additional forward advancement of the stack by belts 22, the foremost letter pushes the rod 210 of the light detector 30 to prevent the light beam source 217 from striking photocell 218. The signal produced in the photocell through the above described circuitry actuated brake 175 to immediately stop shaft S1, to thereby stop the transition of all of the belts and load thereon in the manner as previously indicated. At this position of advancement the porous belts of the feeder F wherein a vacuum is alternately created and destroyed feed the letter from the stack and into engagement with the faster moving pinch rolls 27, 28 shown at the right hand side of the feeder in FIGURE 1. The letter is moved laterally with respect to the axis of the stack and continues to maintain the light beam interruption via deflection of spring 212 affixed to rod 210 until the trailing edge of the letter has passed the top of the rod. Thereafter spring 212 drives the rod 210 of the letter position detector unit rearwardly into the space vacated by the last letter so that the opposite end 215 of the rod is withdrawn out of the path of the light source to the photocell. Light is thus again transmitted from the lamp to the photocell to create a signal which when amplified is directed to energize the clutch coil to thereby drive the sets of belts 14, 15 and 16 and 18 in the manner to enable the next foremost item and successive items therebehind to be fed by the feeder in like manner.

Since many changes could be made in the embodiment of the invention as particularly described and shown herein without departing from the scope of the invention, it is intended that this embodiment be considered as exem-

plary and that the invention not be limited except as set forth by the following claims.

What is claimed is:

1. Apparatus for aligning and increasing the distance between adjacent workpieces in a stack, while advancing the same toward a feeding device, comprising in combination, first conveyor means for advancing said workpieces toward said feeder, guide means for aligning said workpieces along a side edge of said apparatus, second conveyor means mounted between said first conveyor means and said feeding device and disposed at an angle toward said guide means for advancing said workpieces toward the feeder and guide means, means mounted for movement by said first and second conveyor means for engaging the rear of said stack to support the workpieces in edgewise relationship relative to said first and second conveyor means, means for driving said first conveyor means, and means for driving said second conveyor means at a greater velocity than said first conveyor means to thereby increase the distance between adjacent workpieces in said stack while advancing the same toward said feeder.

2. Apparatus for aligning and increasing the distance between adjacent workpieces in a stack, while advancing the same toward a feeding device, comprising in combination, plate means, edge aligning means disposed along one side of said plate means to define a path for movement of said workpieces toward said feeding device, first, second, and third sets of endless belt means mounted for movement to transport said stack adjacent said surface of said plate means and toward said feeder device, said first and third sets of belts being disposed parallel to said edge aligning means and said second set being inclined toward said edge aligning means, a fourth set of endless belt means associated with said edge aligning means to prevent edgewise drag during movement of the workpieces along said edge aligning means, means for driving said third set of endless belts, means including flexible coupling means connected to said last-named means for driving said first set of endless belt means at a velocity less than said third set, additional means including flexible coupling means connected to said means for driving said second set of belts to cause the same to be moved with a component of velocity parallel to said edge aligning means greater than the first set but less than said third set of endless belt means, and means connected to said additional means for driving said fourth set of endless belt means at the same velocity as said second set of endless belt means.

3. Apparatus for edge aligning and increasing the distance between adjacent workpieces in a stack, while advancing the same edgewise toward a feeding device, comprising in combination, side edge aligning means, first, second and third conveyor means disposed along said side edge aligning means with said first and third conveyor means being disposed parallel to said edge aligning means, and with said second conveyor means being inclined toward said side edge aligning means, said third conveyor means being effective to bring the foremost workpiece of a stack into engagement with the feeding device, fourth conveyor means associated with said side edge aligning means, means for driving said third conveyor means, means including flexible coupling means connected to said last-named means for driving said first conveyor means at a velocity less than said third drive conveyor means, and said second and fourth conveyor means at a velocity parallel to side edge aligning means, greater than said first conveyor means and less than said third conveyor means.

4. Apparatus for aligning and increasing the space between adjacent work pieces in a stack, while advancing the same toward a feeding device, comprising in combination, table means, first conveyor means mounted for

normal relation to said table means and for advancing said work pieces toward said feeding device, guide means for aligning said work pieces, second conveyor means mounted between said first conveyor means and said feeding device and disposed at an angle to the said guide means for advancing said work pieces toward the latter, means for driving said first and second conveyor means so that said work pieces are advanced in a direction parallel to said guide means by said conveyor means at a greater velocity than by said first conveyor means to thereby increase the distance between adjacent work pieces in said stack, third conveyor means operably associated with said guide and aligning means effective to register the items along one edge of said guide means, said latter conveyor means being operable at a velocity which is substantially equal to the forward component of velocity of the intermediate conveyor means so as to prevent drag along one edge of the stack of items, fourth conveyor means disposed between said second conveyor means and said feeding device and means for driving said fourth conveyor means to advance said work pieces at a greater velocity parallel to said guide means than said second conveyor means, and stack position detector means disposed in the path of the stack of items for sensing the foremost item in the stack effective to stop the conveyor means when an item is moved into position to be fed by said feeding device.

5. Apparatus for aligning and increasing the space between adjacent work pieces in a stack, while advancing the same toward a feeding device, comprising in combination, table means, first conveyor means mounted for normal relation to said table means and for advancing said work pieces toward said feeding device, guide means for aligning said work pieces, second conveyor means mounted between said first conveyor means and said feeding device and disposed at an angle to the said guide means for advancing said work pieces toward the latter, means for driving said first and second conveyor means so that said work pieces are advanced in a direction parallel to said guide means by said conveyor means at a greater velocity than by said first conveyor means to thereby increase the distance between adjacent work pieces in said stack, third conveyor means operably associated with said guide and aligning means effective to register the items along one edge of said guide means, said latter conveyor means being operable at a velocity which is substantially equal to the forward component of velocity of the intermediate conveyor means so as to prevent drag along one edge of the stack of items, fourth conveyor means disposed between said second conveyor means and said feeding device and means for driving said fourth conveyor means to advance said work pieces at a greater velocity parallel to said guide means than said second conveyor means, and stack position detection means disposed normal to said stack of items and including a relay actuated member arranged to project into the path of the advancing items effective to brake the conveyor means so as to enable the item to be fed by said feeding device.

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