June 4, 1968 D. E. KAPLAN 3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 1

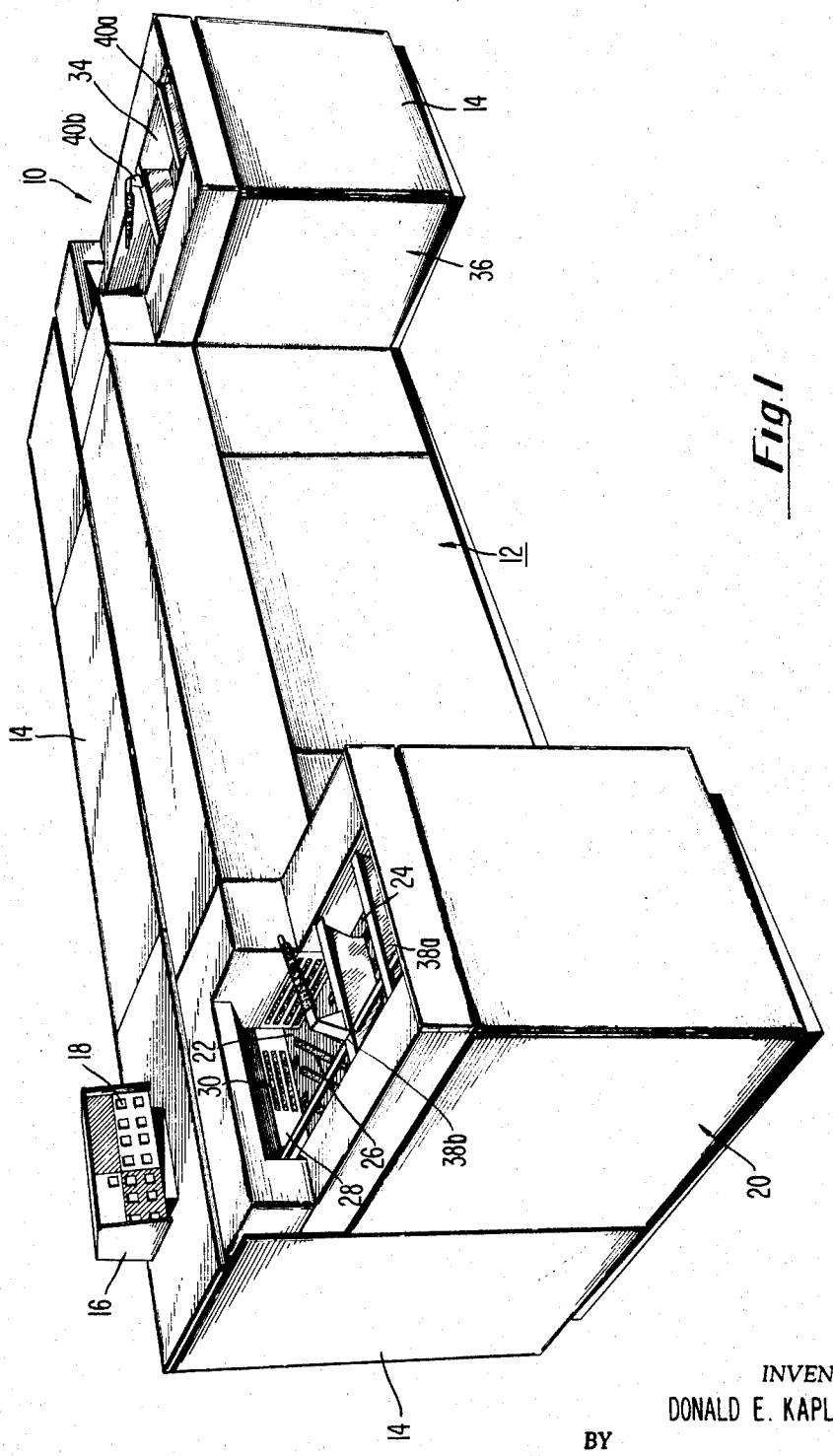


Fig. 1

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June 4, 1968 D. E. KAPLAN 3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 2

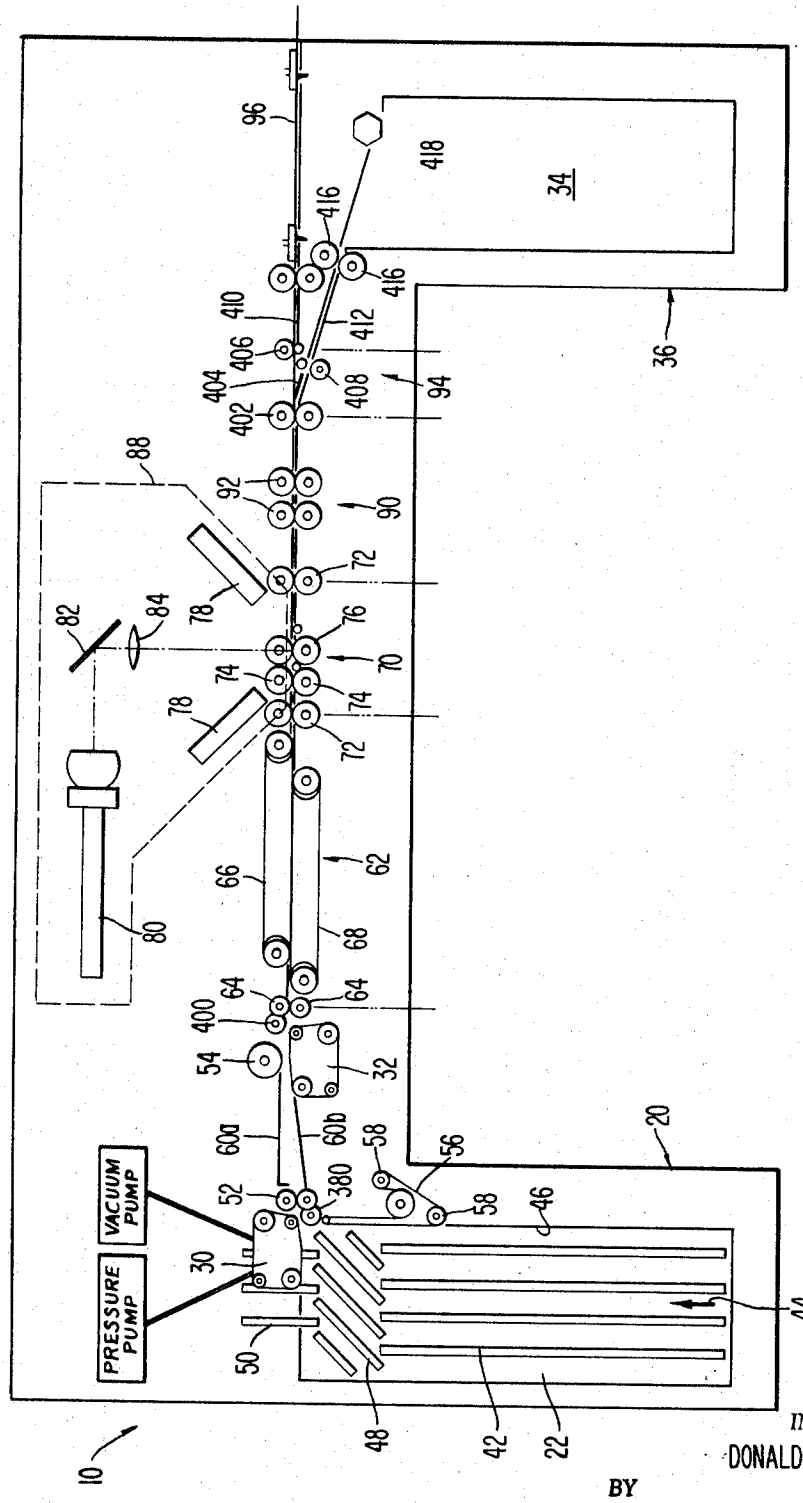


Fig.2

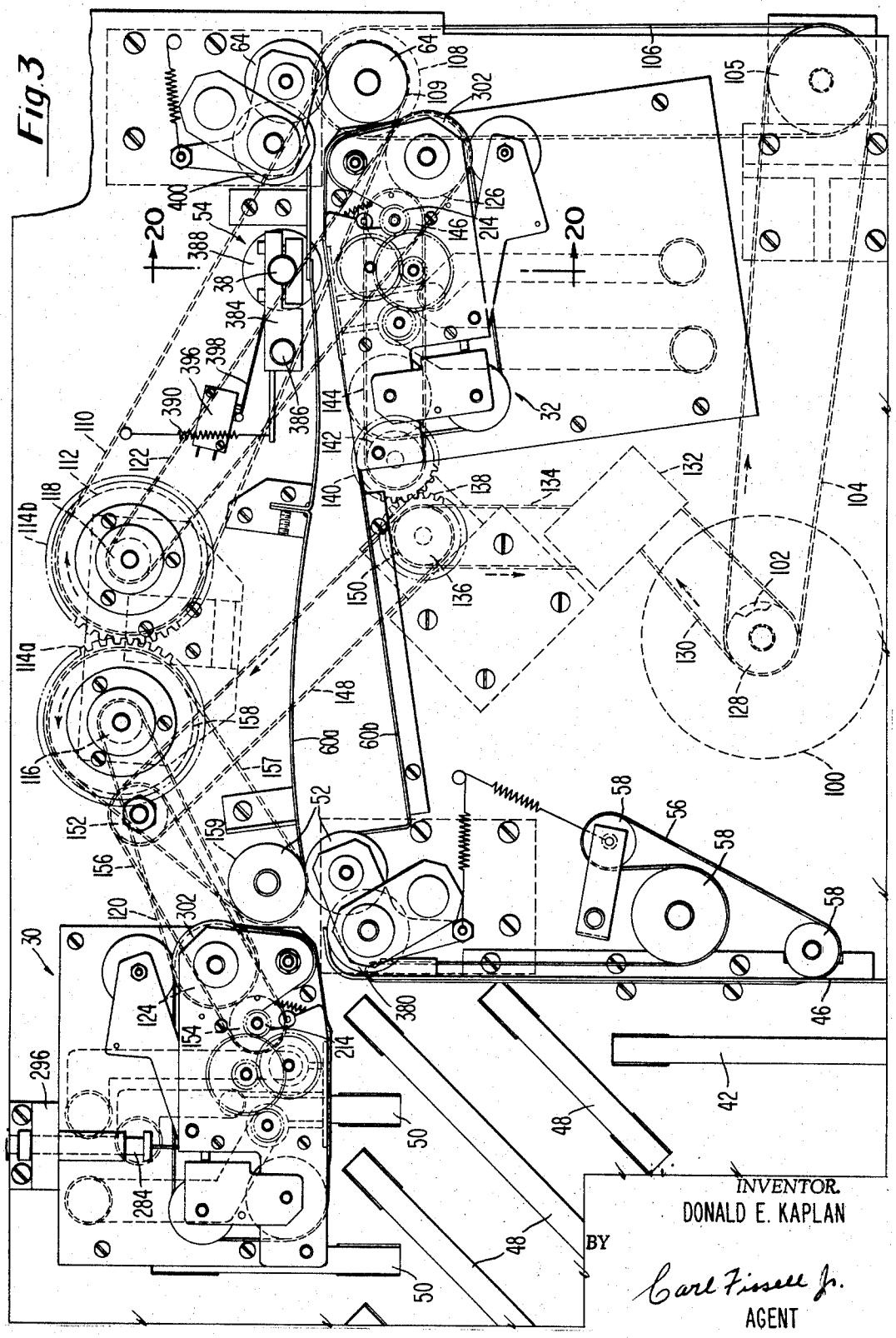
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HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 3

Fig. 3



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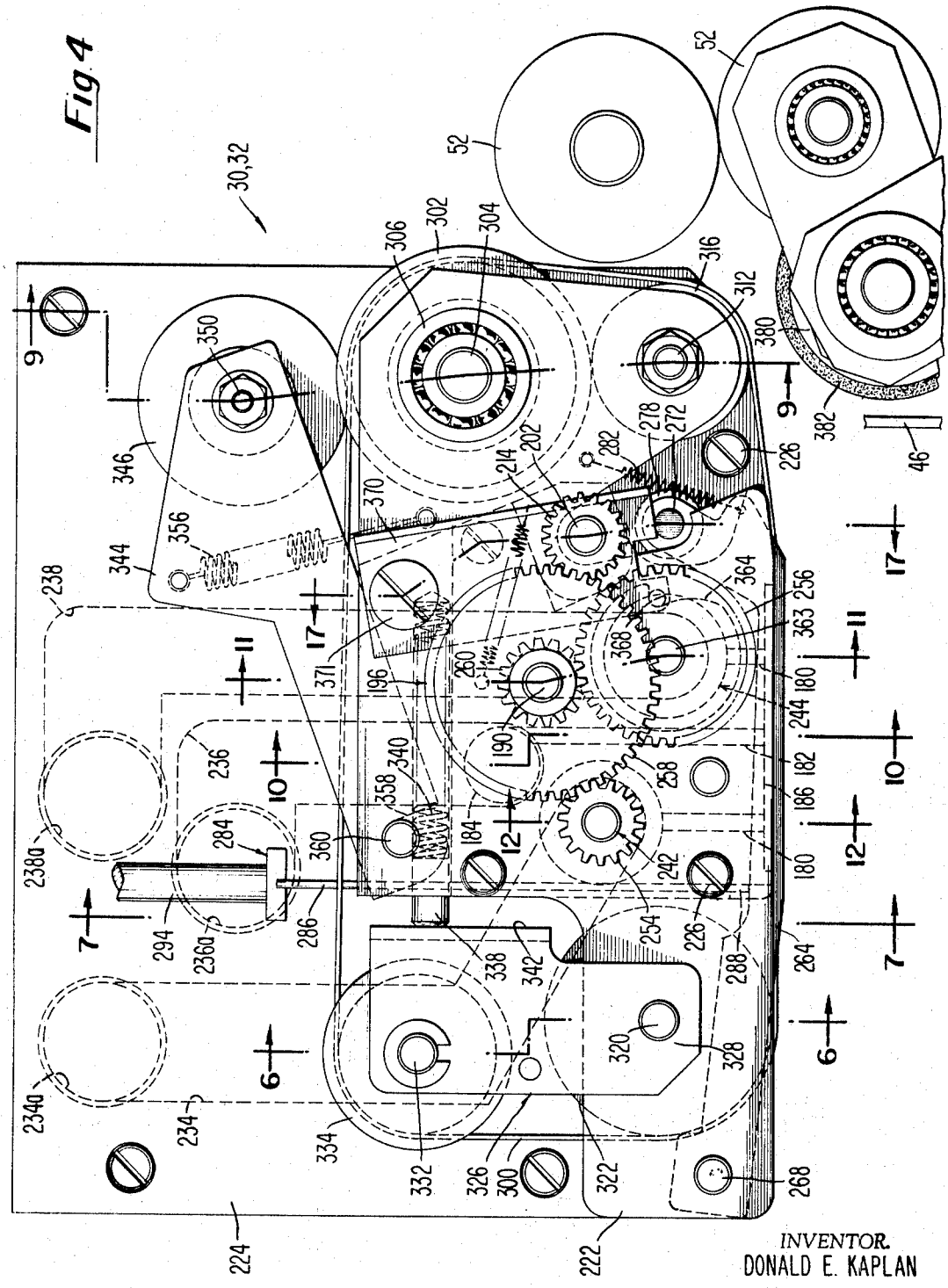
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HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 4

Fig 4



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June 4, 1968 D. E. KAPLAN 3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 5

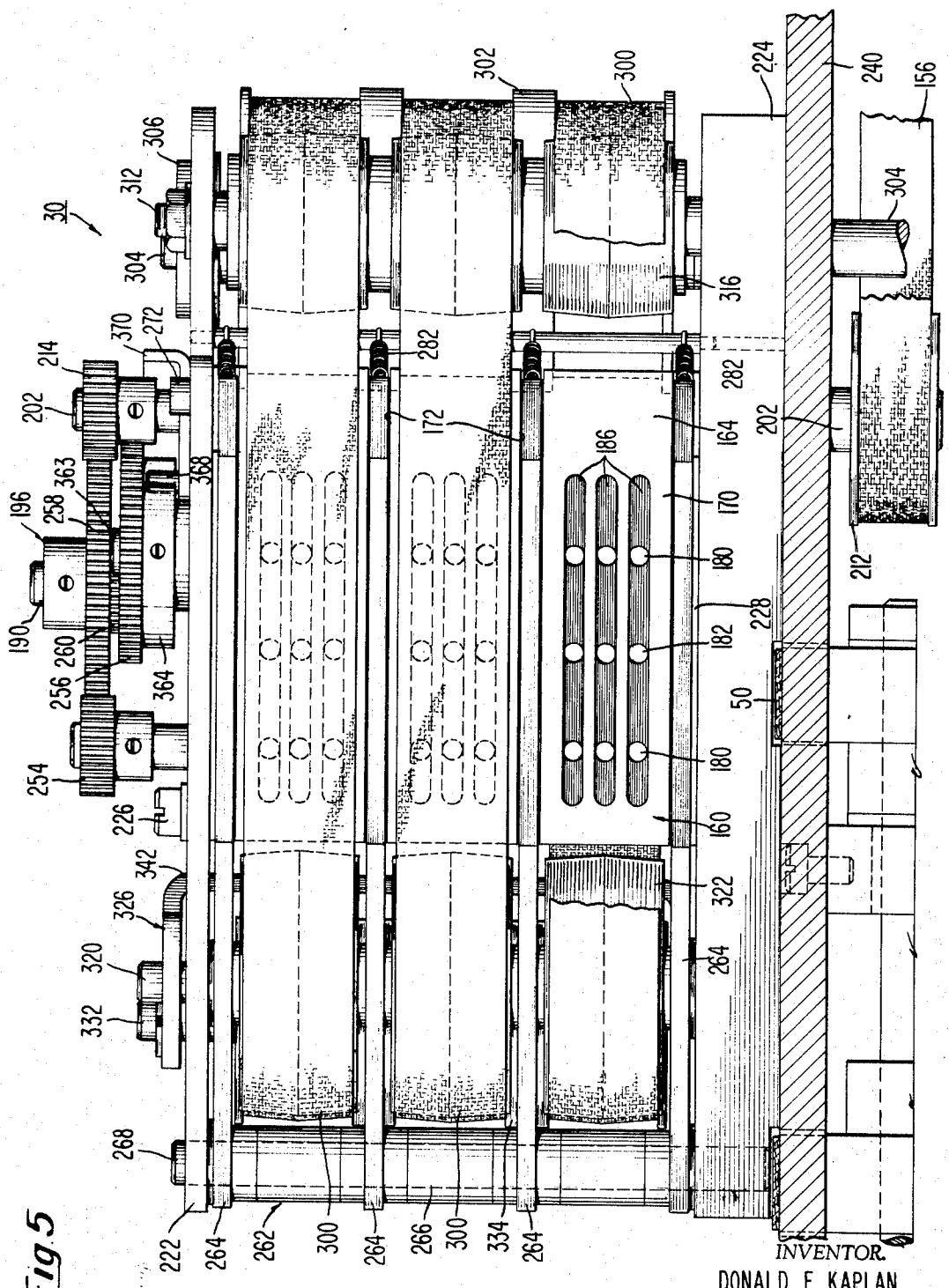


Fig. 5

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HIGH SPEED ITEM HANDLING APPARATUS

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Fig. 5A

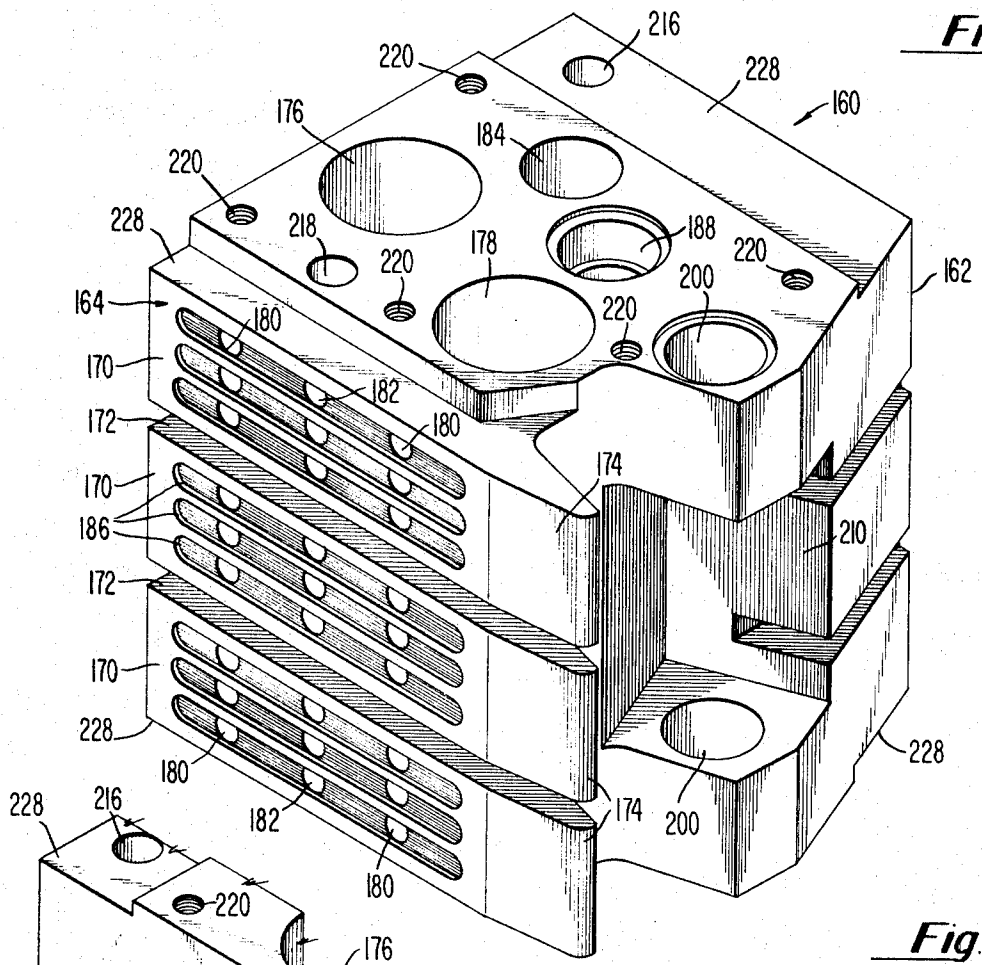
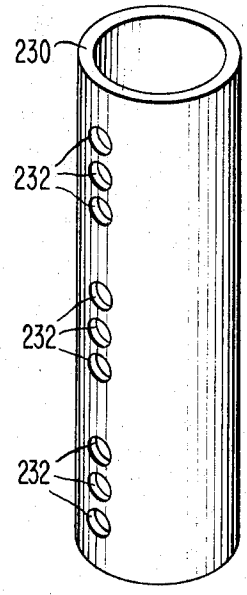


Fig. 5C



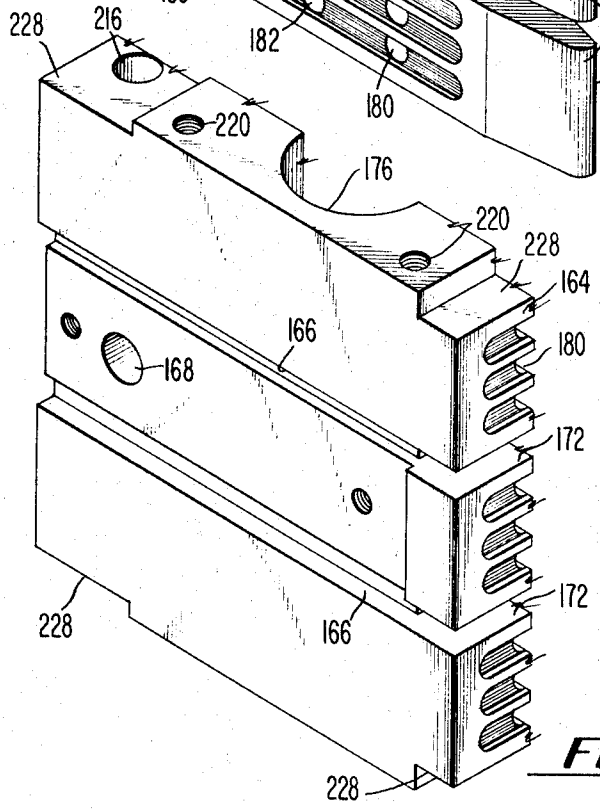


Fig. 5B

June 4, 1968 D. E. KAPLAN 3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 7

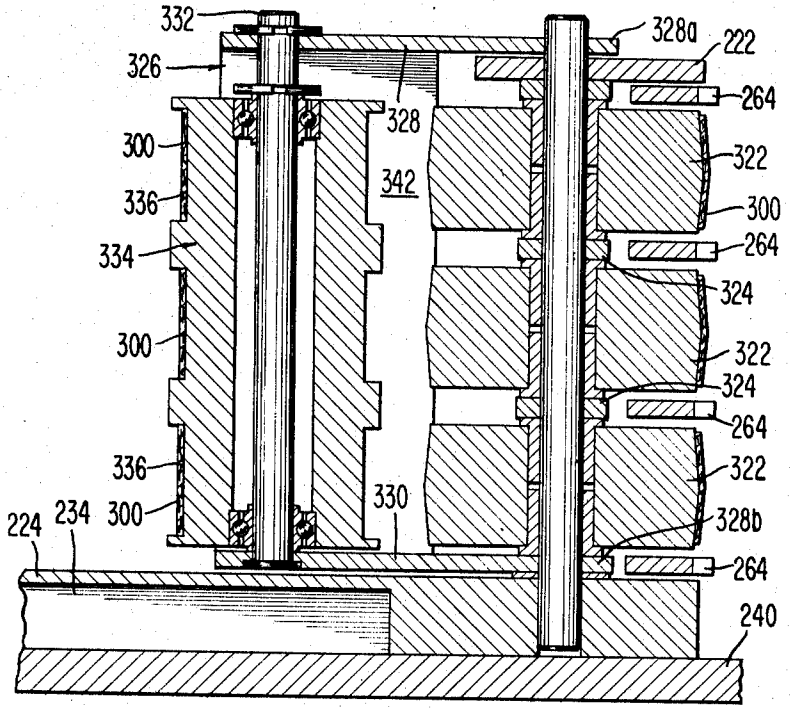


Fig.6

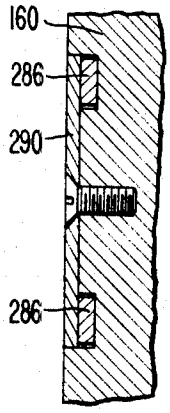


Fig.8

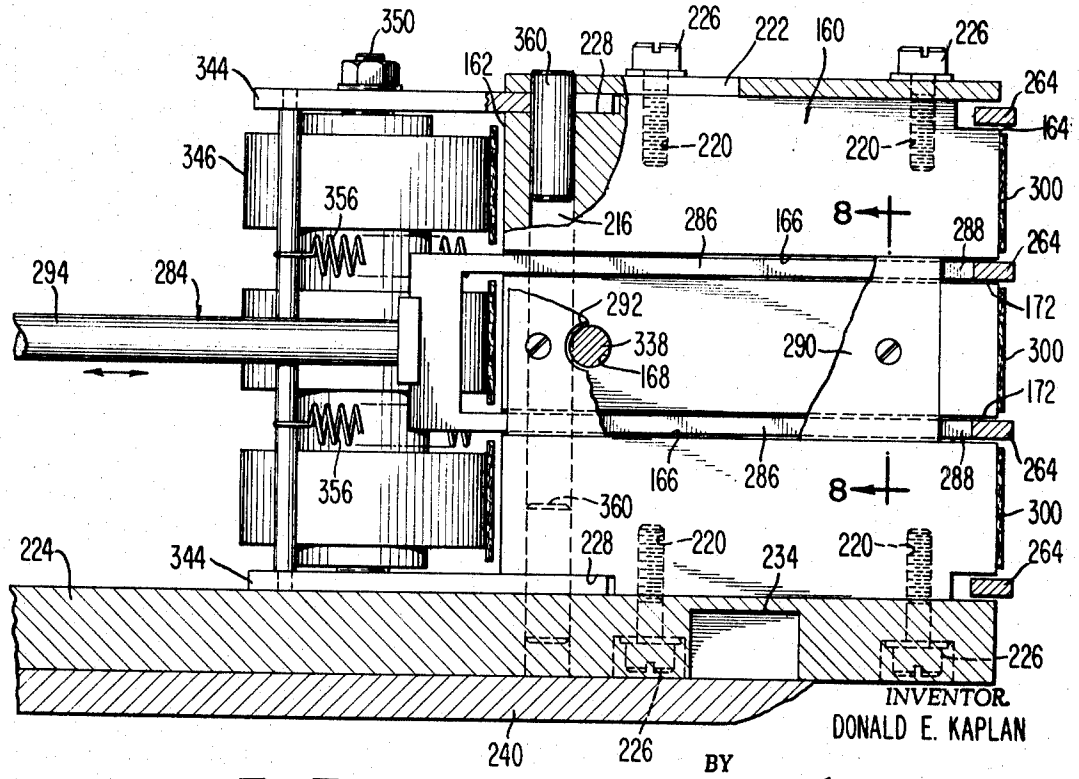


Fig.7

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June 4, 1968 D. E. KAPLAN 3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 8

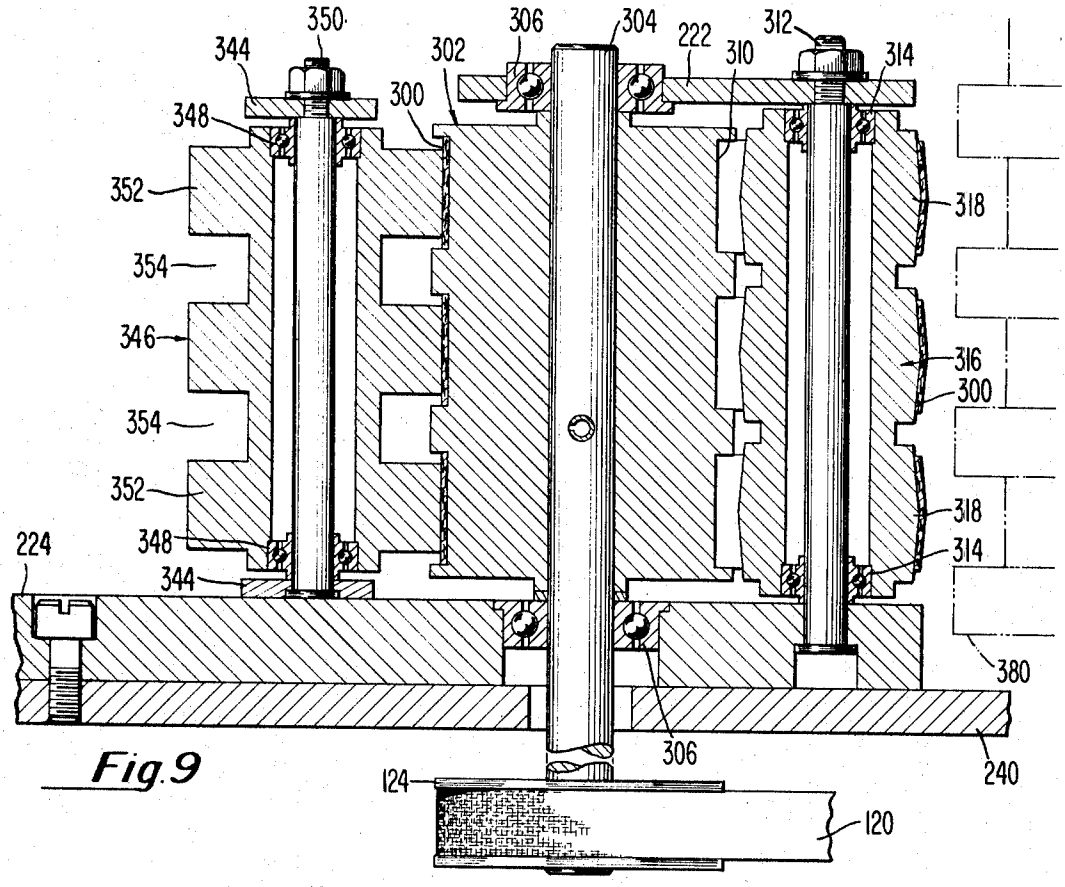


Fig. 9

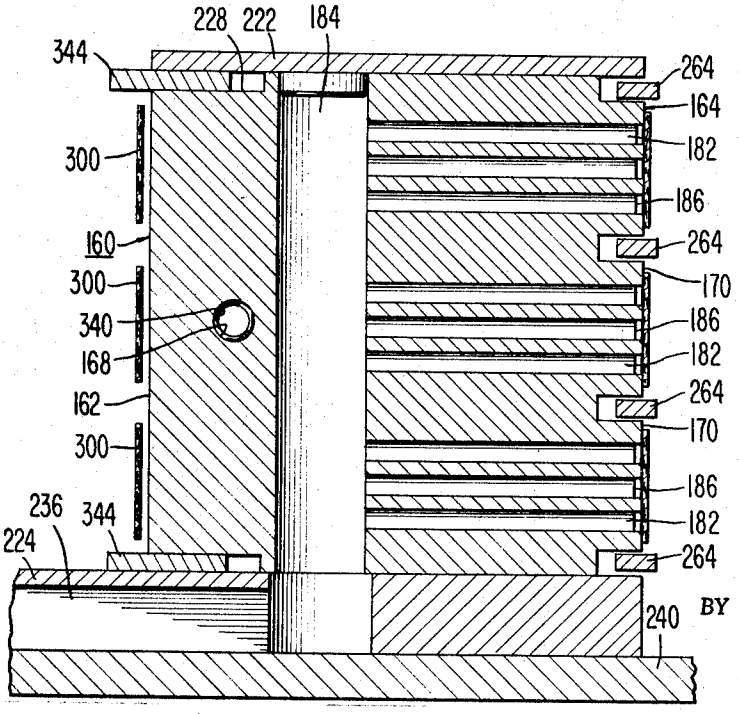


Fig. 10

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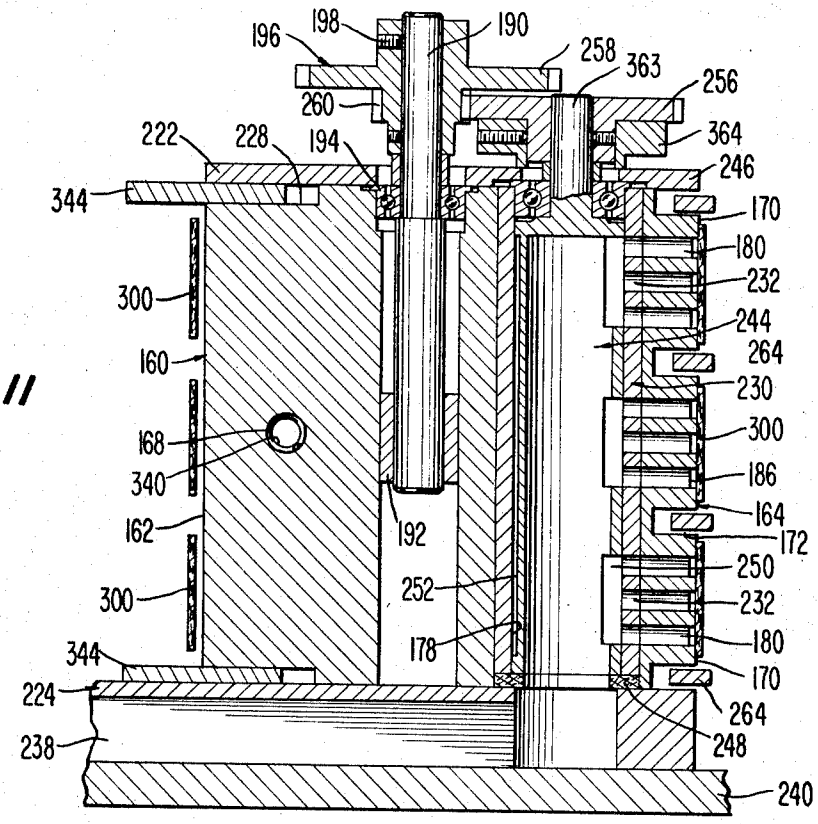
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June 4, 1968 D. E. KAPLAN 3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

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Fig. 11



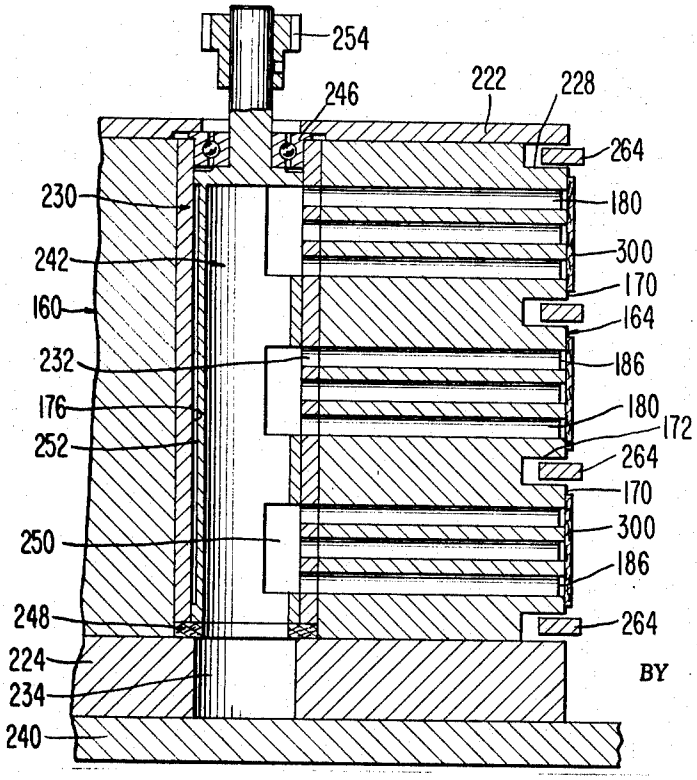


Fig. 12

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June 4, 1968 D. E. KAPLAN 3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 10

Fig.13

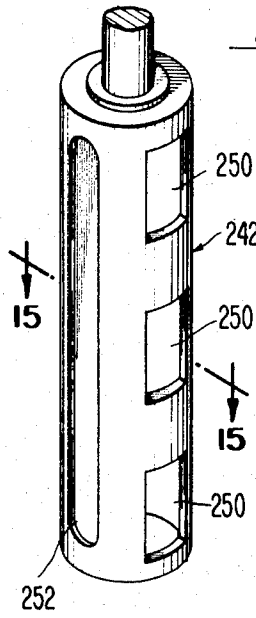
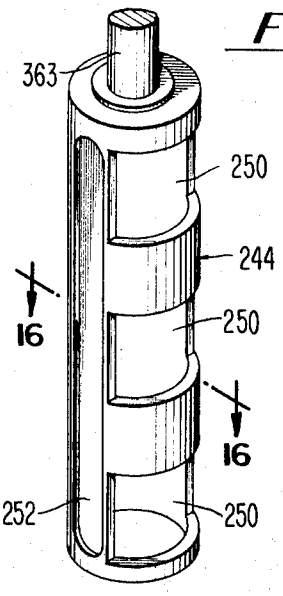


Fig.14



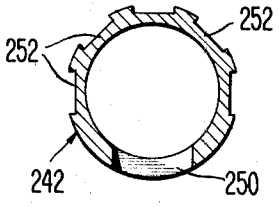


Fig.15

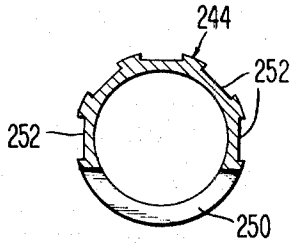


Fig.16

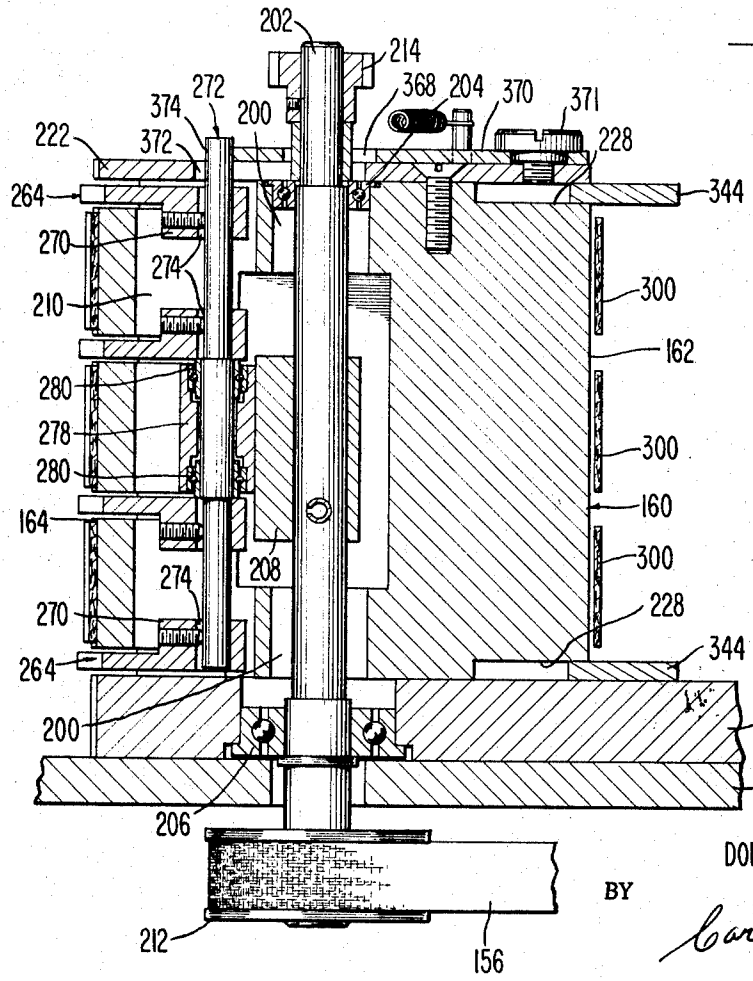


Fig.17

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HIGH SPEED ITEM HANDLING APPARATUS

Filed Dec. 14, 1965 12 Sheets-Sheet 11

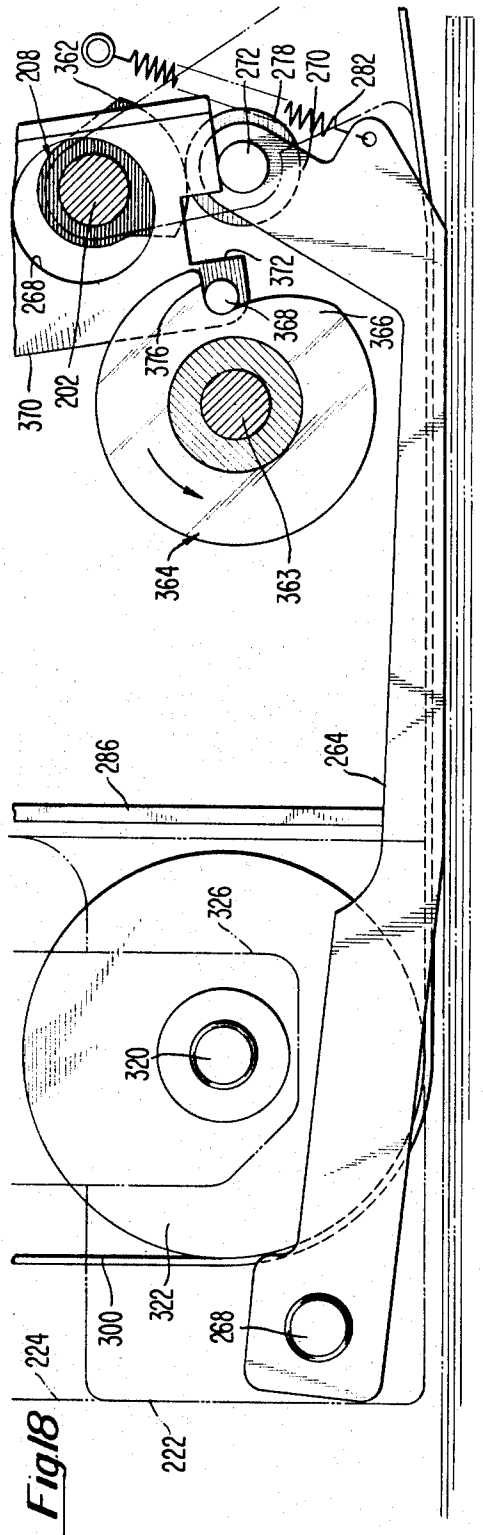


Fig 18

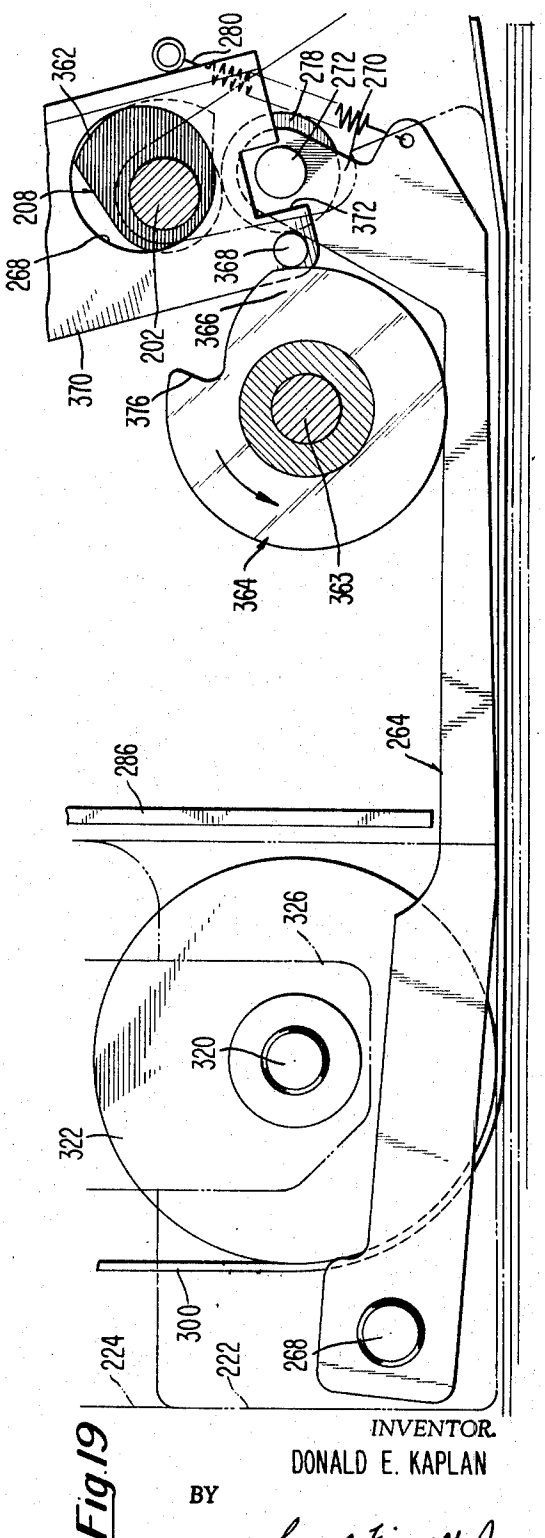


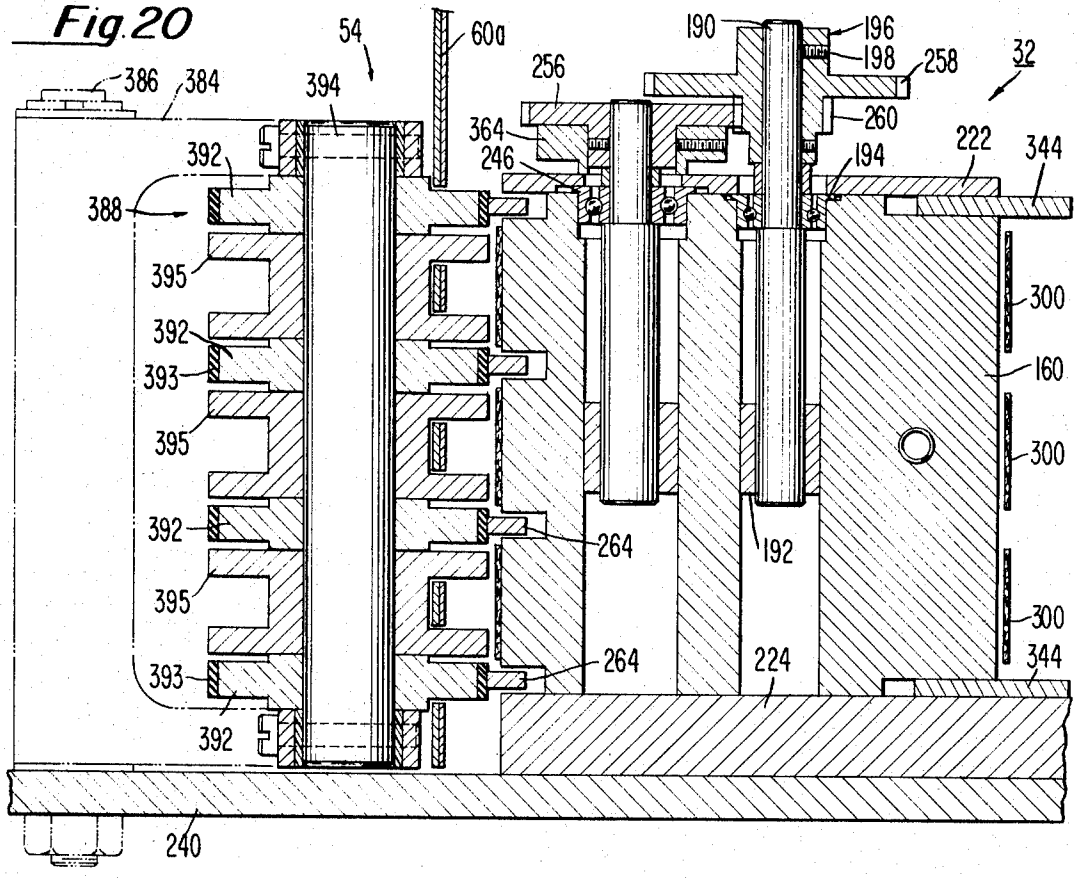
Fig 19

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HIGH SPEED ITEM HANDLING APPARATUS

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Fig. 20



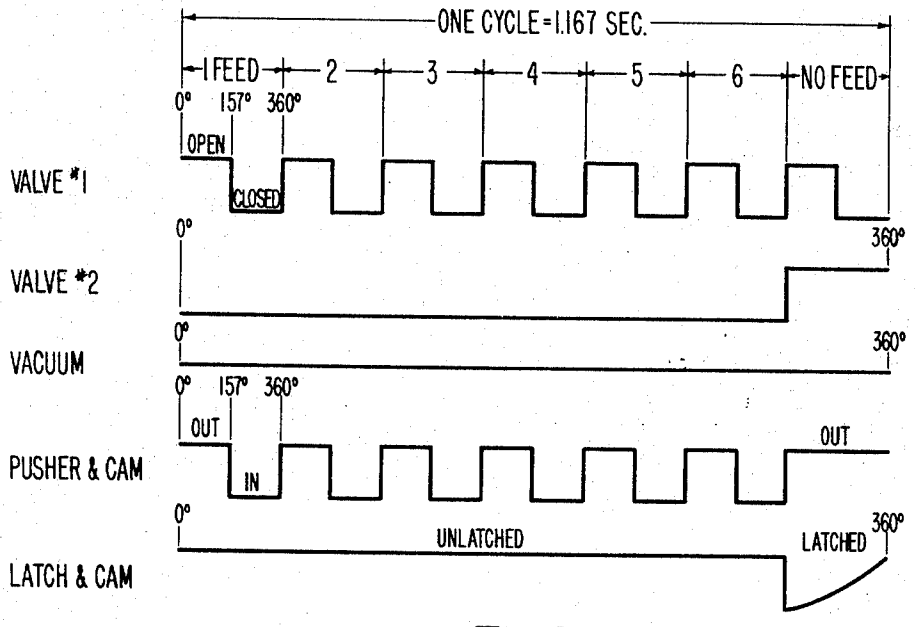


Fig. 21

United States Patent Office 3,386,574 Patented June 4, 1968

3,386,574

HIGH SPEED ITEM HANDLING APPARATUS

Donald E. Kaplan, Philadelphia, Pa., assignor to Burroughs Corporation, Detroit, Mich., a corporation of Michigan

Filed Dec. 14, 1965, Ser. No. 513,700
8 Claims. (Cl. 209—73)

ABSTRACT OF THE DISCLOSURE

The present invention relates to an electro-mechanical high speed item handling apparatus wherein there is provided a pair of pneumo-mechanical belt driven item feeders, each of which is capable of operation in either of two opposite item confronting positions, which are disposed on opposite sides of an item pathway extending between an input hopper and an output hopper. The item feeders are separated from one another by a confined guideway. Each item feeder includes a plurality of air and vacuum inlets and outlets operably associated with synchronously actuated rotary valves for opening and closing ports on each feeder face, and each is provided with means conjointly operable with the feeder control means for preventing multiple item feeds. The second of the two feeders includes a stopping mechanism located within the guideway and arranged to prevent item overlaps or multiple feeds.

The present invention relates to item handling appartus, and more particularly, although not necessarily exclusively, to high speed item handling apparatus, including means for intermittently moving each item of a group of items from an input hopper to an output hopper and/or to other destinations for further handling of the item. With still more specificity, the invention has to do with item transport apparatus for feeding items such, for example, as letter mail, etc., one by one without overlap or doubling of items to designated locations or to other associated handling apparatus.

The present invention relates still further to transport system means for sequentially moving individual items from a stack, one at a time, and transporting them in a vertical "on edge" position past electronic scanning or reading apparatus to other destinations for further handling.

It is an important object of the present apparatus to provide a new, novel and heretofore unknown combinational arrangement of feeding, transporting, indicia scanning and handling apparatus for automatically moving items at high speed.

Another object of the invention is to provide automatic means for edge-aligning and handling individual, relatively thick items for transport through the system without jamming.

Another object of the invention is to provide novel high speed item feeding apparatus for item transport effective to feed one item at a time without overlap or doubling of items.

Still another object of the invention is to provide demountable, self-contained, item feeding apparatus for automatically feeding items from an input hopper to the next adjacent item handling position.

It is a further object of the invention to provide an item transport system including means for preventing simultaneous double feed of items.

It is also an object of the invention to provide a dual item feeder system including means for automatic start-stop item movement.

In accordance with the foregoing objects and first briefly described, the present invention comprises an item transport system including an input hopper, a pair of substantially symmetrical feeding means, a reading station to which the items are fed and including apparatus for detecting information carried by each item, means for accelerating the speed of movement of the item and an output stacker hopper to which otherwise unreadable items may be directed, and means for feeding properly identified items from the present apparatus into further apparatus with which it is or may be operably associated.

In accordance with other and different objects, the invention comprises a pair of substantially identical item feeding means, each of which includes pressure differential means for automatically removing an individaul item from a stack of items and subsequently feeding this item from an input station to an output station. The two feeding means are arranged on opposite sides of the item feed pathway and operate synchronously at relatively high speed effectively preventing double feeding of items.

In accordance with still other objects, the invention comprises feeding means including means for causing letter mail to be attracted thereto for movement therepast by operably associated porous drive means and pressure differential means operable in a predetermined time sequence effective to move a letter at a time from a stack to the next operating station without jams or double feeds.

In accordance with other and additional objects, the present invention includes a pair of substantially symmetrical item feeder units. Each feeder unit is a self-contained, demountable, operational, unitary assembly having means for automatically moving individual items one by one from an input to an output position and for automatically, cyclically interrupting the item feeding cycle in response to prearranged signals.

In accordance with still further objects of the invention there is provided means for accelerating and decelerating the items as they are passed from the item feeder to the reading and stacking positions. Angular cant of the feeder guide plates enables the item base feeder mechanism to move the items along the item pathway in orderly, stop-start fashion.

These and other objects and advantages of the present invention will be best understood from a reading of the appended specification and claims when taken in conjunction with the associated drawings, in which:

FIGURE 1 is a perspective view of a preferred embodiment of the present invention as applied to apparatus for scanning letter mail;

FIGURE 2 is a schematic plan view of the apparatus of FIGURE 1 illustrating the system concept therein;

FIGURE 3 is a plan view of the dual feeder portion of the apparatus of FIGURE 2;

FIGURE 4 is a top plan view of a single feeder apparatus of FIGURE 3;

FIGURE 5 is a side elevational front view of the feeder of FIGURE 4;

FIGURE 5A is an isometric view of the feeder block of the apparatus of FIGURE 4;

FIGURE 5B is a leftside view of the block of FIGURE 5;

FIGURE 5C is an isometric view of a valve spool insert for the apparatus of FIGURE 4;

FIGURE 6 is a view along the line 6—6 of FIGURE 4;

FIGURE 7 is a view along the line 7—7 of FIGURE 4;

FIGURE 8 is a detail view along the line 8—8 of FIGURE 7;

FIGURE 9 is a view along the line 9—9 of FIGURE 4;

FIGURE 10 is a view along the line 10—10 of FIGURE 4;

FIGURE 11 is a view along the line 11—11 of FIGURE 4;

FIGURE 12 is a view along the line 12—12 of FIGURE 4;

FIGURE 13 is an isometric view of the left valve spool of the apparatus of FIGURE 4;

FIGURE 14 is an isometric view of the right valve spool of the apparatus of FIGURE 4;

FIGURE 15 is a sectional view along the line 15—15 of FIGURE 13;

FIGURE 16 is a sectional view along the line 16—16 of FIGURE 14;

FIGURE 17 is a sectional view along the line 17—17 of FIGURE 4;

FIGURES 18 and 19 are operational top plan views of the pusher latching mechanism of the present invention;

FIGURE 20 is a sectional view of the stopping mechanism along the line 20—20 of FIGURE 3; and

FIGURE 21 is a timing diagram for the feeder apparatus.

Referring very briefly to FIGURE 1 wherein a preferred embodiment of apparatus embodying the present invention is illustrated, it can be seen that high speed item handling apparatus 10 includes a substantially C-shaped, box-like cabinet 12 having a plurality of demountable covers or panels 14 located variously at the front, sides, back (not shown) and top for ease of maintenance and repair. A switch monitor and indicator assembly 16 arranged on a short pedestal on the upper left end of cabinet 12 includes various off-on-start-stop switches, lights and function indicators 18, for aid in efficient operation of the apparatus.

On the left side of the cabinet 12, located on the forwardly extending portion 20, is an input hopper 22 into which items, e.g., letter mail, etc., may be disposed in parallel stacks, on their edges, for automatic handling and processing. The hopper 22 is provided with a flat bed 24 having a plurality of apertures therein and a plurality of operably associated feed belts 26 for moving items edgewise (front to rear in FIGURE 1) to the rear wall 28. Feeding means 30 (one of two such pieces of apparatus, the second being identified later on herein) is arranged adjacent the wall 28. The items are fed rightwardly, FIGURE 1, from hopper 22 to the second feeder 32 (FIGURE 2) for automatic transport to either an operably associated letter sorter apparatus (not shown) or to a reject output hopper 34, located in the rightward extension 36 of cabinet 12.

Each of the two hoppers 22 and 34 is provided with two independently forwardly and rearwardly movable stack followers 38*a* and 38*b* and 40*a* and 40*b*, respectively, which provide means for continuous reloading and unloading of stacked items. One of the indicator means 18 signals the operator that the hoppers are filled or empty, as the case may be.

In the schematic diagram of FIGURE 2 of the drawings, there is shown a preferred embodiment of the present invention wherein each of the portions of the transport system apparatus are shown diagrammatically. Raw, unsorted items, e.g., letter mail of varying size, weight and thickness, is deposited in input hopper 22. Items are carried by a plurality of longitudinally extending front belts 42 forwardly, in the direction of arrow 44, along the registration edge 46 (the right side of the hopper in FIGURE 1) toward a set of intermediate belts 48. Belts 48 are angled rightwardly so as to move the items rightwardly against the registration edge 46, and in the direction of a set of rear belts 50. At this point (i.e., when the items meet belts 50) the items are moving at the proper rate of speed to be directed by means of feeder 30, rightwardly, through a set of accelerating pinch rollers 52 to a stopping mechanism 54. A plurality of belts 56, driven by rollers 58 and arranged along the rightward wall 46, serve to prevent drag on the surface of registration edge 46.

The letters or items are contained and guided during their further transport between a pair of spaced upright, parallel, wall members 60*a*, 60*b*, to a second feeder 32. The latter feeds the items into a decelerating and vertical aligning mechanism 62, via a set of pinch rollers 64 disposed adjacent the rightward end of feeder 32. Oppositely disposed pairs of canted alignment belts 66 and 68 cause the individual items to move vertically downwardly so that their lower or bottom edges are aligned along the flat bed of the item pathway. The items are thereby fed from the decelerating and aligning station into a scanning station 70. Oppositely disposed pairs of aligning, handling and guiding rollers 72, 74 and 76, respectively, adjacent the scanning station 70, position the items for information pick-up therefrom. Two pairs of oppositely disposed, angled, photomultiplier tubes 78 for measuring the reflected light from the information area of each item are arranged adjacent this area, as shown. A cathode ray tube 80 is arranged with its output end or face axially aligned with the center of an angled mirror 82 so that information from the tube may be reflected by the mirror through a lens system 84 onto the data so as to be reflected from the data, in scanning fashion, to the data tubes. These tubes pick up the information and feed it to other associated electronic equipment for handling of such information. The optical system is enclosed in a light-tight shroud or black box 88.

At the termination of the reading operation in the scanning position, the item is next forwarded to an acceleration station 90 where a plurality of accelerating rollers 402 accelerate the items through a gating device 94, while rollers 92, which are of low friction material, permit slippage of the rear of the envelope. Disposed adjacent gating device 94 is output stacker hopper 34. The gating device 94 executes a decision as to which items are to be passed onto the next station and which items are to be rejected and stacked in the stacker-output-hopper. This decision is made electronically by virtue of the scanner reader operation in which a determination is made as to whether or not proper coded geographical area indicia has been read or not. If proper information has been read, the item is passed along the transport line of movement to the next adjacent station, in this case a letter sorter, not shown, via a pusher chain 96. If a decision is made that the item is to be rejected, it is deflected via the gate 404 of mechanism 94 into the stacker output hopper 34 wherein it is again stacked in a sequential manner without jamming.

As previously described, the present apparatus contains what is hereinafter characterized as envelope handling apparatus, and feeds letter envelopes directly into the next adjacent apparatus which is characterized as the letter sorting device (not shown). Faced mail, i.e., mail with the addresses all facing in one direction, is operator loaded into the input hopper at the left end of the apparatus and rejected mail is automatically stacked in the output hopper at the right end of the apparatus. The input hopper 22 and associated mechanism is substantially similar to that described and claimed in copending U.S. patent application Ser. No. 386,967, filed Aug. 3, 1964, now Patent 3,285,389, in the name of Donald E. Kaplan, entitled "Item Handling Apparatus," and assigned to the same assignee as the present invention. The output hopper 34 and associated mechanism is substantially similar to that described and claimed in U.S. patent application Ser. No. 418,071, filed Dec. 14, 1964, now Patent 3,342,481, in the name of Donald E. Kaplan, entitled "Sheet Item Handling and Stacking Apparatus," and assigned to the same assignee as the present invention.

The item stream of incoming mail thus moves continuously from the reloadable input hopper 22 through the two feeders 30 and 32, through the vertical alignment and deceleration station past the read station. As this

point, items containing a recognizable set of data flow into the sorter-inserter, not shown, by way of the transport transfer station, where the items are picked up by the pusher chain. Items which do not contain a recognizable indicia are gated out of the through pathway into the output hopper.

As before mentioned, in the input hopper, the mail rests vertically on edge on the three sets of flat motor driven belts. An item detector senses the position of the front of the stack and provides signals to drive the belts and thus control stack motion by means of a magnetic clutch and brake, not shown. A relatively low horse-power driving motor (not shown) drives a 100 to 1 gear reducer which in turn drives the brake and clutch which drive the front belts. These belts in turn drive the intermediate and rear belts. The belt speed is just fast enough to assure reliable delivery of the letters to the first feeder **30**, to further improve response and minimize brake and clutch wear.

The forward component of velocity of the three belt systems are arranged to be progressively faster the nearer they are to the feeder head. The rearmost belt system, i.e., closest to the feeder head, is 22% faster than the intermediate and 50% faster than the front belt system, i.e., at front of apparatus, as viewed from the front of the equipment, FIG. 1. The velocity changes increase the average letter spacing or pitch by 50% from the loaded condition, resulting in a reduction in the letter-to-letter coupling force. This reduction decreases the probability of double feeds. An additional gain attained by the 22% increase in the forward velocity component from the front to intermediate belts is that the canted intermediate belt system will deliver an increased proportion of the documents to the right-hand registration edge resulting in improved letter edge registration. This gain is attained because some items, which were not initially down on the belts will drop as a result of the increased pitch of the stack.

While the feeder is designed to operate with minimal document edge registration, this feature further reduces double feeding and provides increased accommodation to operational variables. The belts **56** along the hopper registration edge move at a speed equal to the forward component velocity of the intermediate belts to eliminate drag on the registration surface. The letter detector consists of a sensor plate which, when deflected by the letters, moves a plunger, the rear of which interrupts a light beam to a photocell. The amplified output of the photocell operates the brake. The stack follower is used to keep the rear of the stack vertical. The follower rides on a shaft and is carried forward with the letters by the belts. Continuous reloading is possible since items can be loaded directly behind the first stack follower and maintained vertically by the second follower. The first follower can then be returned to a position just in front of the second without interrupting the flow.

In the preferred and illustrated embodiment of the present invention a novel synchronous feeding system is employed. This system, FIGURE 3, comprises two substantially identical feeder mechanisms **30** and **32** arranged (FIGURES 2 and 3) on opposite sides of the item transport pathway **60***a* and **60***b*. Items, such as letter mail, are fed from feeder number one (**30**) to feeder number two (**32**) at the rate of six per second. Each feeder mechanism is provided with pressure differential means (vacuum and pressurized air) operable in cooperation therewith to feed items at high speed one at a time, without overlap, jams or double feeds. Each feeder mechanism is arranged to be symmetrical about its horizontal center line so that identical parts can be placed on the opposite side of the item pathway merely by turning the mechanism upside down. Feeder number two (**32**) differs from feeder number one (**30**) (except for timing and base plate differences) in that the means in the feeder for preventing the feeding of every seventh letter (as will be described hereinafter) is omitted, e.g., by plugging the opening into which it would be received. Thus, if the second feeder receives on the seventh cycle, a letter from the first feeder, or if it has stored a double fed document, then on the seventh cycle this document will be fed and rejected by the gate mechanism **94** following the accelerating station.

The feeding of items must be interrupted in order to maintain synchronism in the system. Two operating mechanisms are utilized to provide this function. Cam actuated pusher means, operably associated with each feeder, identified and described in detail later on herein, are arranged and operably associated with each feeder so as to push the face of the item stack backwardly away from the face or front portion of the feeder a slight but sufficient distance to avoid item feeding. This minimizes the dynamic problems of getting the items to the starting point in the item pathway and also minimizes the amount of vacuum force which is required, as hereinafter described. This slight distance aforementioned is only the distance of travel of the pusher mechanism as a portion thereof projects outwardly away from the front face of the feeder.

Simultaneously with the removal of vacuum from vacuum cavities in the feeder (which mechanism tends to draw the letter item against the feeding mechanism and so as to aid in the removal of the vacuum), positive air is injected into and through the feeder and against the confronting surface of the leading item. Positive air is utilized since a maximum pressure differential of only one atmosphere is obtainable in terms of removing the vacuum. Whereas, with positive air pressure the pressure is almost unlimited. The net effect of this function is that the vacuum can be removed almost instantaneously, whereas to turn off the vacuum would mean a time delay, albeit small, to permit the atmosphere to build up.

As the items are fed out of the first feeder, they are directed into the area of the second feeder. At this point each item in turn is stopped by a mechanism, hereinafter described in detail, disposed between the front edge of the feeder and the item pathway. Should a second item or letter enter the second feeder before the previous item has been fed out therefrom, the second item is "stored" in the second feeder as a result of the operation of this mechanism. The foregoing functions will be described in much more detail hereinafter with reference to various figures of the drawings wherein each item is specifically identified.

As seen most clearly in FIGURE 3, a central drive motor **100** drives a pulley **102** (one of two on this shaft) driving belt **104** and transmitting rotary torque to double pulley **105**, transmitting torque via belt **106** to pulley **108**. Pulley **109** through belt **110** transmits torque to pulley **112** rotating gear wheels **114***a* and **114***b* in opposite directions (as indicated by the arrows). Power take-off for each feeder comprises pulleys **116** and **118** and belts **120** and **122** associated therewith. As will now be described, each feeder is provided with a separate drive means for the associated air valving arrangement and for the item driving mechanism. Pulley wheel **124**, on feeder **30**, is rotated by drive belt **120**. Pulley **126** on feeder **32** is rotated by drive belt **122**. This arrangement, as described hereinafter, causes the items to move continuously, rightwardly, FIGURES 1, 2, 3 and 4.

A second pulley **128** on the driving shaft of motor **100** drives a belt **130** transmitting torque to transmission gear box **132**. Belt **134** from gear box **132** drives pulley **136** rotating gear **138**. Gear **140**, in mesh with gear **138**, rotates pulley **142** driving belt **144** transmitting actuating torque to pulley **146**, for purposes hereinafter described. Belt **148** on pulley **150** driven by belt **134**, drives pulley **152** for transmitting rotary torque to pulley **154** via belt **156**, for purposes to be described herein presently. Belt **157** from pulley **158** drives pulley **159**, as will be described later on herein.

Turning now to a detailed description of the feeder

mechanism per se, attention is directed generally to FIGURES 4 through 17 inclusive. First, briefly with respect to FIGURES 5A, 5B and 5C, it is seen that feeders 30 and 32 each comprise a central, irregularly shaped, rigid, feeder body member 160, e.g., brass, aluminum, etc., including a rear plane surface portion 162 and a front surface shoe portion 164. The left side, as viewed in FIGURE 5B, is provided with two parallel, spaced, shallow, elongated grooves or channels 166 and a horizontal aperture 168 extending into member 160, FIGURES 4 and 5B, for purposes to be explained presently. The right side of member 160 is irregularly shaped for celarance purposes and general weight reduction. The front shoe portion 164 of member 160 is generally, substantially flat and is provided with three relatively wide land portions 170 separated by two intermediate horizontally extending grooves 172. The rightward portion of each of the lands 170 is tapered or angled rearwardly out of the plane of the lands as indicated by reference character 174.

Extending vertically from top to bottom of member 160 are two relatively large air control valve apertures 176 and 178. Orifices 180, arranged in vertically disposed spaced rows of three each, three rows per land 170, FIGURE 5A, extend rearwardly, horizontally through member 160. The opposite end rows of openings 180 communicate with openings 176 and 178 as seen in FIGURE 11. Intermediate openings 182, extending horizontally, rearwardly communicate with a third vertically disposed constant vacuum control opening 184, FIGURE 10, in similar fashion to openings 180, for purposes to be explained presently.

Three rows of shallow, spaced grooves 186 extend across each of the lands 170 communicating with and interconnecting the vertical rows of holes 180–182 for purposes still to be described.

Opening 188, extending vertically through member 160, provides mounting access means for an idler shaft 190, FIGURE 11, mounted therein on press-fitted bushing 192 and bearings 194. Shaft 190 extends above the top surface of member 160 and carries a gear wheel hub 196 secured thereto as by set screws 198, for purposes still to be explained. Adjacent shaft opening 188 (rightward in FIGURES 5A and 11) are two coaxial drive shaft openings 200—200 (one above the other) into and through which drive shaft 202, FIGURE 17, extends. Shaft 202 is journalled in upper and lower bearings 204–206, FIGURE 17. A cam member 208, pinned to shaft 202, is disposed intermediate the ends thereof and is operably received within the irregularly shaped open area 210, FIGURE 5A, for purposes soon to be described. The lower end of shaft 202 carries external belt drive pulley wheel 212. The upper end of shaft 202 is provided with a drive pinion gear 214 secured thereto, as by a set screw, for purposes described later on herein.

Oppositely disposed locating holes 216 and 218 are provided in member 160 and extend from top to bottom thereof, as seen in FIGURES 5A and 7. Holes 220 in both top and bottom surfaces of member 160 permit irregularly shaped upper and lower mounting and cover plate members 222 and 224, respectively, to be attached thereto, FIGURES 5 and 7, as by bolts 226. The front and rear, upper and lower edges of member 160 are provided with ledge portions 228 as by casting, milling, etc., for purposes to be described presently. A valve bearing insert 230, FIGURE 5C, having three sets of holes 232 therein, is press-fitted into each of the air valve apertures 176 and 178, in block 160, with the holes 232 aligned with the apertures 180 and 182 therein, FIGURES 11 and 12.

The lower cover plate member 224 is channeled or grooved, as indicated by the dashed outlines 234, 236 and 238, FIGURE 4. One end of each groove or channel terminates in a circular area or opening arranged so as to be disposed adjacent to and coaxial with a respective opening 176, 184 and 178 when block member 160 is secured to plate 224. The opposite end of each channel opens into a circular area 234*a*, 236*a* and 238*a* respectively, for interconnecting to a continuously activated vacuum pump and a source of controlled pressurized air, not shown. A shroud or closure member 240 attached to the bottom of the structure, FIGURE 5, as by bolts, seals the grooves or channels from the atmosphere thereby providing separate and independent tubes, tunnels or channels for application of air and vacuum to the apparatus embodying the invention.

As seen most clearly in the sectional views of FIGURES 11 and 12, and in the isometric views of FIGURES 13 and 14, an individual valve body or spool 242 is rotatably journalled within the valve liner 230 in aperture 176 while valve spool 244 is rotatably journalled in valve liner 230 in aperture 178. Each valve spool 242 and 244 is provided with an upper set of bearings 246 while the lower extremity thereof rests on and is sealed by means of a packing ring 248 of suitable flexible sealing material. Valve spools 242 and 244 are each provided with three substantially rectangular spaced air outlet openings 250 and an elongated "cleaning" relief opening 252 extending longitudinally, substantially from end to end thereof. The openings 250 in valve spool 244 are approximately twice the size of those of spool 242, as will be explained in detail later on herein.

The upper end of air control valve spool 242 (left center FIG. 4 and FIG. 12) has a pinion gear 254 secured thereto as by a set screw. Likewise air control valve spool 244 is provided with a large gear 256 (center FIG. 6 and FIG. 11) attached thereto by a set screw. Pinion 254 is in mesh with and is driven by a large gear 258, FIG. 5, integral with gear hub 196 (FIG. 11) while gear 256 is in mesh with and driven by the small gear 260 also integral with hub 196. Pinion 214 is the input drive means for this drive train. Rotary torque for each of the valves is transmitted from gear 214 (driven by shaft 202 from pulley 212). Gear 214, meshing with large gear 258 of gear wheel 196, drives gear 254 meshing therewith, and via gear 260 on wheel 196 drives gear 256 meshing therewith.

An item pusher arm assembly 262, FIGURE 5, is seen to include four parallel, elongated arms 264, spaced apart by members 266 and pivoted at one end (left in FIGURE 4) on a vertically disposed shaft 268 secured for arcuate rocking movement between upper and lower plate members 222 and 224. The opposite end (right in FIGURE 4) of each of the members 264 are each provided with an enlarged boss 270. A vertically disposed shaft or pin 272, FIG. 17, extends through respective apertures 274 in each boss. Set screws 276 in the bosses effectively tie the four arms together, as seen in FIGURE 17. A cam follower roller 278 journalled in bearings 280 on shaft 272 is disposed in rotatable surface contact with cylindrical cam 208 on shaft 202. Springs 282, FIGURES 4 and 5, bias arms 264 into slots or grooves 172 and 228 for purposes still to be described.

A timing fork shaped pusher rod 284, FIGURE 7, has its parallel spaced leg portions 286 arranged within the grooves 166, FIGURE 5B, of the left side of block 160, so that the extremities 288 thereof engage the flat surface of the two center arms 264, as seen most clearly in FIGURES 4 and 7. A cover plate 290 having a clearance hole 292 coaxial with the hole 168 in block 160 retains the member 284 in the block 160. The opposite plunger shaped end 294 (left in FIGURE 7) extends a short distance leftwardly to be received within the electrical windings of an associated control solenoid 296, FIGURE 3, for control purposes to be described later on herein.

Referring to FIGURE 5, it is seen that the feeder apparatus of the present invention utilizes a plurality of porous webs or belts 300, e.g., three, of suitable flexible material, e.g., cloth, plastic foam, etc., for moving items such as letter mail from the input hopper 22 to the various operating stations, etc. A large drive roller 302, FIGURES 4 and 9 (located at the right center of FIGURE

4) carried by shaft **304** journalled in bearings **306** in upper and lower plates **222** and **224**, carries the input drive pulley **124** at its lower end for providing rotative torque for the belts **300**. Roller **302** is shaped to provide three spaced grooves **310** for receiving and retaining a respective belt **300** therein. A fixed shaft **312**, FIGURE 9, journalled by bearings **314** between plates **222** and **224**, adjacent to and in front of roller **302**, carries an idler roller **316**. The periphery of idler **316** is provided with three substantially barrel-shaped surface portions **318** for entraining and maintaining belts **300** in close surface contact therewith.

On the left front portion of the feeder assembly, FIGURE 4, there is positioned a fixed vertical shaft **320**, FIGURE 6, journalled between plates **222** and **224**. Shaft **320** carries three large barrel-shaped rollers **322** arranged in spaced relation thereon by means of spacers **324** over which the belts **300** pass in surface contact, as shown in FIGURES 4 and 6.

A yoke shaped member **326**, FIGURES 4, 5 and 6, having upper and lower flat plate portions **328** and **330**, has its end portions **328***a* and end **328***b* mounted for arcuate rocking, pivotal movement on shaft **320**. A vertical shaft **332**, secured between the opposite ends of members **328** and **330**, carries an elongated roller **334** provided with three spaced belt receiving grooves **336**. A plunger member **338**, FIGURES 4 and 7, biased (leftwardly in FIGURE 4) by means of a spring **340**, maintains suitable pressure against the vertical interconnecting, integral plate portion **342** of member **326** so as to provide a desired degree of tension on drive belts **300**. The rocking arcuate movement of this member permits the belts **300** to be easily and efficiently removed and replaced as desired for maintenance and repair.

As seen in FIGURES 4, 7 and 9, a pair of upper and lower bell crank members **344** are arranged adjacent to the rear surface of the feeder block **160**. A pressure idler roller **346** is rotatably journalled on bearings **348** on shaft **350** disposed between the rightward ends of members **344**. Roller **346** is shaped to provide pressure lands **352** and clearance grooves **354**, as seen most clearly in FIGURE 9, for operative association with drive belts **300**. Springs **356** bias the roller lands **352** into surface contact with the belts **300**. The leftward extending portion of each bell crank **344** is provided with a latching notch **358** engageable with the rear locating pin or stud **360** extending from top to bottom of member **160** through respective apertures in upper and lower plates **222** and **224**. Arcuate clockwise movement of the bell cranks moves the latter from their position overlying the belts **300** thereby facilitating belt removal. Elongated pins **360** effect arcuate registration location of blocks **160** with respect to the lower cover member **240** as well as the operably associated valve and vacuum openings and channels **234**, **236** and **238**.

As earlier described herein, the feeder is adapted to feed items at the rate of six per second. At the end of the sixth feed it stops feeding during the seventh time interval. Thereafter feeding is resumed at the rate of six per second and so on continuously until halted by signal or manual intervention.

During each item feed the pusher arms **264** are retracted within the appropriate groove or channel **172** in block **160** permitting the item to be driven into contact with the porous belts traveling over the front face **164** of block **160**, enabling the continuous vacuum from ports **182** through the porous belts **300** to adhere the items to the belts and be moved along thereby. The pusher arm assembly is cammed forwardly and rearwardly, as viewed in FIGS. 4, 18 and 19, by means of the conjoint operation of the cam **208** and the follower **278**, e.g., rotating at six revolutions per second. As the large lobes **362** of the cam moves against follower **278** carried on shaft **272**, the pusher arm assembly is caused to move out of the grooves in block **160**, FIGURE 18, thereafter moving back within the grooves, FIGURE 19, as the cam moves off the follower. Continuous rotation of the cam shaft **202** creates an oscillatory six per second movement of the pusher arms for purposes hereinafter described.

In order to assure the non-feed of the seventh item, the gear train coupled to each of the valves **242** and **244** is arranged in such a manner that valve **242** rotates seven times for every one rotation of valve **244** (see timing diagram FIG. 21). Secured to the stub shaft **363** of valve **244** on the hub of gear **256** is a cam **364**. The operating lobe **366**, FIGS. 4, 18 and 19, of cam **364** is operably associated with a pin **368** on latch **370** arcuately pivoted on upper plate **222** by means of bolt **371**. A notch **372** cut in latch **370** permits the upper end **374** of shaft **272** to clear the latch as the pushers are moved into and out of the grooves in the block **160** due to the rotation of drive shaft **202** and cam **208**. Rotation of cam **364** causes latch **370** to move leftwardly, FIGURES 4 and 18, engaging pin **368** in the cam notch **376** causing shaft **272** to abut the edge of latch **370** disabling the pushers from swinging back and forth as seen in FIGURE 18. A clearance hole **368**, for driving shaft **202**, is provided in latch **370** to bring rotary torque to the drive train hereinafter described.

Vacuum for feeding items is continuously supplied to aperture **184** and thence to cavities **182** in block **160** from a source of vacuum, e.g., vacuum pump, see upper left FIG. 2. The vacuum is destroyed during non-feed cycles by admitting pressurized air controlled by the rotary valve **242**. The cam operated mechanical pushers **264** keep the envelope stack away from the belts **300** to further insure that no letter or item will be fed during the period in which the vacuum in the cavities is destroyed. These mechanical pushers are of low mass and travel only a short distance, thus minimizing wear on cam and cam follower. Since the cam shaft **202** is normally rotated at 360 r.p.m., solenoid **296** is used to quickly interrupt feeding when necessary by permitting the plunger **294** to act directly on the mechanical pushers.

The area over which the vacuum exists is made large to permit modest vacuums which minimize the effects of document porosity. The vacuum area is located above the floor of the input hopper and back some distance from the registration edge. This novel configuration minimizes the horizontal and vertical document edge registration requirements. The combination of this feature and the unique input hopper approach virtually eliminates double feeds due to the vacuum accelerating device simultaneously applying force to more than one document.

The coefficient of friction between the letters and the belts and the mass of the letters are among the largest system variables. These variations tend to make the time required to accelerate the letters to belt speed somewhat uncertain. To compensate for this uncertainty, this time variation is minimized to a small fraction of the total time by providing only a portion of the acceleration at the belts, the remainder is provided by means of the two pinch rollers **52** adjacent thereto, which bring items up to full speed. Minimizing the variations in acceleration time permits destruction of the vacuum at an optimum time and thus minimizes the double feeds due to a short light-weight envelope being fed quickly and uncovering behind it an area of vacuum belt which would accelerate the document following thereafter. The volume of the block cavities is minimized to reduce vacuum "pump out" requirements and to keep the time required to evacuate the chamber small. Porous belts **300** are employed because of their economy. A counter rotating retarding wheel **380**, FIG. 4, with a high friction surface **382**, e.g., foam covering adjacent pinch roller **52** is also used to discourage double feeds. By positioning wheel **382** adjacent the face of the feeder so that the rim barely projects into the item path, it is effective in stripping any double items from one another and eliminates any tendency for the forward or leading edge of the item to curl.

The second rotary valve 244 together with cam 364 effectively admits pressurized air to the cavities in the block in order to prevent the feeding of every seventh letter. As earlier mentioned, each feeding mechanism is demountable from the machine as a unitary assembly for service and testing. In addition, the belts can be replaced without removing the feeder from the assembly.

The second feeding mechanism 32 is employed, as heretofore briefly described, in order to minimize the double feed rate of the system. In the second feeder the letter is completely stopped and then fed once again. The second feeder is positioned on the opposite side of the item path so that the item is accelerated using the back surface of the item rather than the front surface. The only difference between the two feeders except for timing difference and different base plates, as earlier noted herein, is that in the second feeder the second rotary valve which prevents the feeding of every seventh letter is plugged. Thus, if the second feeder receives on the seventh cycle a letter from the first feeder, or if it has stored a double fed document, e.g., the item or items remain in the area between plates 60*a* and 60*b*, then on the seventh cycle this latter document will be fed and rejected by the gate mechanism 44 located after the acceleration station.

Should a double feed occur in the first feeder, two envelopes will be "stored" in the second feeder for an average of three feeds before the seventh cycle when the remaining extra letter can be removed.

The stopping mechanism 54 comprises a low mass bracket 384 (FIGS. 3 and 20) pivoted on a fixed shaft 386 which carries a low mass wheel assembly 388. The bracket is spring loaded by spring 390 to keep the wheel assembly against the confronting face of the second feeder 32. The wheel assembly 388 consists of four wheels 392 with high friction surfaces 393, which line up with the four mechanical pushers of the feeder. The wheels are fixed to the shaft 394 which also carries three free running wheels 395 of a low friction material which in turn line up with the three porous belts 300 of the feeder. The shaft 394 is held in brake material 396 in the adjustable bracket. The seven above-mentioned wheels are all the same diameter.

As seen in FIG. 20, when the mechanical pushers of the second feeder are extended out past the surface of the belts 300, i.e., no feed position, they bear against the surfaces 393 of the four fixed wheels 392. A letter from feeder number one may cause the wheels of the shaft to rotate slightly in the brake material of the bracket as it slows and stops between them and the extended pushers. The entire assembly 388 pivots to accommodate items of different thicknesses, e.g., for a maximum thickness of ¼ inch.

When the mechanical pushers retract behind the belt surface to the feed position, the fixed wheels 392 no longer pinch the letter and it is free to feed. The three free running wheels 395 merely roll against the side of the item opposite the porous vacuum belts 300. This simple passive device works to stop a second letter, i.e., double feed, even if feeder number two is in the process of feeding.

A switch 396 having its actuator 398 bearing against bracket 384 actuates the solenoid 296 coupled to feeder 30 to automatically interrupt the item flow from feeder number one (by moving the pushers against the latter stack) should items accumulate between the stopping mechanism 54 and feeder number two (32).

The second set of pinch rollers 64 driven by the pulley 108, effective in the same manner as pinch rollers 54, bring the items to suitable acceleration for delivery to the vertical aligning station 62. Counter rotating wheel 400 with its high friction surface acts to prevent any double feeding in a manner similar to wheel 380.

Since the position of the "address block" on a general run of envelope mail exhibits considerable variations, the primary purpose of the vertical aligning mechanism 62 is to minimize envelope skew rather than to align the bottom edge of the envelope with the registration surface. The vertical aligner consists of the pair of canted belts 66 and 68 which drive the letter item down to the bottom registration surface of transport sysem 10. The pinch rollers 64 at the right end of feeder 32 prevents the belts 66 and 68 from having any effect on the letter until the trailing edge of the document has passed into them. At this time the letter is acted upon only by the belts and therefore moves down by translation rather than rotation. Once the item arrives at the bottom registration surface, it continues to move forward (right in FIGS. 2 and 3) due to the forward component of velocity of the belts. It is not crushed against the registration surface since the belt surfaces permit slippage. The pinch rollers 72 at the right end of the alignment station 62 are moving at a relatively slower "reading" speed. When the letter reaches the pinch rollers, it is immediately slowed and the alignment belts 66 and 68 slip on the letter until its trailing edge leaves them.

Jams in the read or scanning station 70 and in the accelerating station 62 are easily cleared. The operator, by moving a single handle (not shown) opens this entire section including one of the two guide plates, its mounting deck and all of the rollers and other equipment mounted on this deck. This gives the operator considerable clear space in which to work. A single motion of the same handle closes and locks the entire section. Two switches prevent starting of the machine should the section not be closed or locked.

The purpose of the read station 70 is to present the front face of the envelope item to the optical scanner 70 in a fixed plane moving at a constant speed. This is done by moving the documents with pairs of pinch rollers 72, 74 and 76 while keeping them pressed against a stainless steel backplate (not shown). This plate has an open window in it through which reading is accomplished. The pinch rollers on the optical side of the letter path are stainless steel, while those in the other side are of a non-slip material and spring loaded to compensate for variations in letter thickness. The relationship between the roller pairs is such that there is always at least a line of contact with the letter rather than a point. This type of control insures that no skew will be introduced in the position of the aligned letter. Long arms which hold small individual rollers are used to permit the small rollers to move back gradually for accommodation of thicker envelopes. This minimizes the effect of bounce.

The acceleration station 90 is used to accelerate the letter for purposes of increasing the letter-to-letter spacing. This increased spacing is required by the reject gate 94, the stacker 34, and the transport transfer 96. Two pairs of Teflon pinch rollers 92—92 run at the same speed as the last pair of pinch roller 72 in the read station. The last pair of rollers 402 in the accelerating station, however, run at a faster speed. When the leading edge of the letter reaches the latter rollers, it is accelerated to their speed, the Teflon pair 92—92 still driving the trailing edge of the letter permits slippage.

The purpose of the reject gate 94 is to deflect rejected documents from the identifiable output of the reader. It is anticipated that the rejects will consist primarily of non-coded items which will be stacked in the output hopper 24. The identifiable output will be items which had a recognizable code and which will continue through the system to the sorter mechanism not shown herein. The gate 94 consists of a low mass, low inertia, vane 404 operated by two rotary solenoids 406 and 408, one in each direction, to select one of the two letter paths. Guide plates 410 and 412 in both letter paths are easily removable for jam clearance using a single knob in each case. Switches (not shown) prevent restarting the machine until these plates are replaced in that these switches must be actuated before restarting.

The item driven into the stacker area by the pinch

rollers **416** adjacent to the stacker is pinched and stopped between the rotating hex wheel **418** and the letter stack already in the stacker. The stack is maintained by a follower, not shown, loaded against the stack by a negator spring and riding on a shaft. Continuous unloading during operation is possible by using the second follower to maintain the stack while the first follower is moved forward toward the hex wheel and then cut into the stack by the operator. A stream of high velocity air from a nozzle in the nozzle section of an air block associated therewith keeps the letter against the guide plate using the Bernoulli effect to create a reduced pressure between the envelope and guide plate, thereby preventing a collision with the rear end of a stack of short letters already in the stacker. When the rear end of the letters or items clears the pinch rollers in the hopper side plate, the same air blast serves to blow the letter over to prevent rear end collision with the closely following envelope. Switch controlled indicator lamps signal the operator that the stacker should be emptied as well as providing a means for stopping the machine.

There has thus been described a novel and efficient high speed item transport feeding and handling apparatus for use with items such, for example, as letter mail. The system as hereinbefore set forth permits the automatic feeding and transporting at extremely high speeds of individual letter items one at a time without overlap from a stack or bundle of such items in an input hopper to either a subsequent item handling station or to a reject output hopper located adjacent to the transport pathway.

What is claimed is:

1. Feeding apparatus for feeding individual items from a stack of items to a destination determining means in a controlled orderly fashion without double feeds or overlap comprising:

(a) a rigid block member having multiple operating surfaces each of which is provided with a plurality of elongated cavities therein arranged in the pathway of items to be handled thereby,

(b) vacuum means opening into certain of said cavities effective when energized to cause an individual item to be moved theretowards,

(c) a plurality of porous item moving members operably associated with said block member and movable over said cavities effective to move each item across the surface of said block member,

(d) a plurality of signal controlled pusher members operatively associated with said block member straddling said item moving members effective when energized to move the item in a direction opposite to that in which said vacuum means moves the same thereby nullifying the attractive effect of said vacuum means,

(e) air pressure output means conected to other of said cavities and operatively associated with said item moving means and operable in synchronism therewith for moving the stack of items into a position preventing the same from responding to said vacuum means,

(f) valve means operably associated with said vacuum means and said air pressure means for synchronously controlling the application of air and vacuum effective to feed only one item at a time from said stack, and

(g) cam means operably associated with said item moving means and said block member for actuating said valve means.

2. Feeding apparatus for feeding individual items from a stack of items to a destination determining means in a controlled orderly fashion without double feeds or overlap comprising:

(a) a rigid block member having an operating surface arranged in the pathway of items to be handled thereby and provided with a plurality of rows of elongated cavities therein,

(b) vacuum means connected to said cavities effective when energized to cause an individual item to be attracted theretowards,

(c) a plurality of horizontally disposed spaced parallel item moving porous belts operably associated with said block member and movable over said cavities effective to move each item normal to said block member,

(d) a plurality of signal controlled pusher members arranged to straddle said belts,

(e) cam means operable in synchronism with said vacuum means effective when energized to move said items in a direction opposite to that in which said vacuum means moves said items, thereby nullifying the attractive effect of said vacuum means,

(f) air pressure output means connected to said cavities and operatively associated with said feeding means,

(g) valve means for each air pressure means synchronized with said vacuum means for moving the stack of items into a position preventing the same from responding to said vacuum means,

(h) drive means for said belts and said valve means, and

(i) belt tension adjusting means enabling said belts to be removed and replaced as required.

3. The invention in accordance with claim **2** including synchronously operable latch means operably associated with said signal controlled pusher members effective upon signal energization thereof to terminate and prevent the feeding of items.

4. Item feeding, handling and transporting apparatus comprising:

(a) an input hopper within which items are stacked for automatic processing thereby, means in said input hopper to feed said items in a direction to orient the same against a registering member for further processing,

(b) an output hopper into which certain of said items may be directed in accordance with a prearranged accept-reject operation, said reject hopper including means for stacking said rejected items in serial order without overlap,

(c) an item pathway interconnecting said input hopper and said output hopper,

(d) a first feeder means located in said item pathway adjacent said input hopper,

(e) a second independent feeder means located in said item pathway laterally displaced from said first item feeder means and located on the opposite side of said item pathway relative to said first feeder,

(f) means adjacent said first feeder for moving items independently one at a time into an item guideway extending between said first and second feeders,

(g) stopping means adjacent said second feeder means for automatically terminating the forward movement of an item effective to prevent the feeding of more than one item at a time,

(h) an alignment station located in said item pathway having an input portion and on output portion and including means at the input portion for accelerating items fed thereto and means at the output portion for decelarating said items,

(i) an item reading station to which each of said items is presented,

(j) an item accelerating station adjacent said item reading station for accelerating said items as each item leaves said reading station for presentation to subsequent handling apparatus, and

(k) means in said item pathway adjacent said output hopper for controllably diverting rejected items from said item pathway into said output hopper.

5. Item feeding, handling and transporting apparatus comprising:

(a) an input hopper within which items are stacked

for automatic processing thereby, said input hopper having means to feed said items in a direction to orient the same against a registering member within said hopper for further processing,

(b) an output hopper into which certain of said items may be directed in accordance with a prearranged accept-reject operation, said reject hopper including means for stacking said rejected items in serial order without overlap,

(c) an item pathway interconnecting said input hopper and said output hopper,

(d) first feeder means located in said item pathway adjacent said input hopper, said feeder means including vacuum and pressure operable means for controllably moving items presented thereto relative to the item pathway,

(e) second independent feeder means located in said item pathway laterally displaced from said first item feeder and located on the opposite side of said item pathway from said first feeder, said second feeder means including vacuum and pressure operable means for controllably moving items presented thereto into the pathway,

(f) means adjacent said first feeder for moving items independently one at a time into an item guideway extending between said first and second feeders,

(g) an alignment station located in said item pathway including means at the input thereof for accelerating the items fed thereto and means at the output end thereof for decelerating said items,

(h) an item reading station to which each of said items is presented,

(i) an item accelerating station adjacent said reading station for accelerating said items as each item leaves said reading station for presentation to a subsequent handling apparatus, and

(j) means in said item pathway adjacent said output hopper for controllably diverting rejected items from said pathway into said output hopper.

6. Item feeding, handling and transporting apparatus comprising:

(a) an input hopper within which items are stacked for automatic processing thereby, said input hopper having means to feed said items in a direction to orient the same against a registering member within said hopper for further processing,

(b) an output hopper into which certain of said items may be directed in accordance with a prearranged accept-reject operation, said reject hopper including means for stacking said rejected items in serial order without overlap,

(c) an item pathway interconnecting said input hopper and said output hopper,

(d) a first feeder means including integral air pressure and vacuum operable means located in said item pathway adjacent said input hopper,

(e) a second independent feeder means including integral air pressure and vacuum operable means located in said item pathway and laterally displaced from said first item feeder means and located on the opposite side of said item pathway relative to said first feeder,

(f) means adjacent said first feeder for moving items independently one at a time into an item guideway extending between said first and second feeders,

(g) an alignment station located in said item pathway including means at the input end thereof for accelerating items fed thereto and means at the output end thereof for decelerating said items,

(h) an item reading station to which each of said item is presented,

(i) an item accelerating station adjacent said reading station for accelerating said items as each item leaves said reading station for presentation to subsequent handling aparatus, and

(j) means in said item pathway adjacent said output hopper for controllably diverting rejected items from said pathway into said output hopper.

7. Item feeding, handling and transporting apparatus comprising:

(a) an input hopper within which items are stacked for automatic processing thereby, said input hopper having means to feed said items in a direction to orient the same against a registering member within said hopper for further processing,

(b) an output hopper into which certain of said items may be directed in accordance with a prearranged accept-reject operation, said reject hopper including means for stacking said rejected items in serial order without overlap,

(c) an item pathway interconnecting said input hopper and said output hopper,

(d) first feeder means located in said item pathway adjacent said input hopper, said feeder means including vacuum and pressure operable means for controllably moving items presented thereto relative to the item pathway,

(e) second independent feeder means located in said item pathway laterally displaced from said first item feeder and located on the opposite side of said item pathway from said first feeder, said second feeder means including vacuum and pressure operable means for controllably moving items presented thereto into the pathway,

(f) a wedge shaped item guideway including a curvilinear portion extending from said first to said second feeder for guiding said items between said feeders effective to provide a storage area should overlap occur during feeding,

(g) means adjacent said first feeder for moving items independently one at a time into said guideway,

(h) an alignment station located in said item pathway including means at the input end thereof for accelerating the items fed thereto and means at the output end thereof for decelerating said items,

(i) an item reading station to which each of said items is presented,

(j) an item accelerating station adjacent said reading station for accelerating said items as each item leaves said reading station for presentation to a subsequent handling apparatus, and

(k) means in said item pathway adjacent said output hopper for controllably diverting rejected items from said pathway into said output hopper.

8. Feeding apparatus for feeding individual items from a stack of items to a destination determining means in a controlled orderly fashion without double feeds or overlap comprising:

(a) a rigid member having oppositely disposed complementary body portions and an operating surface provided with one or more cavities therein arranged in the pathway of items to be handled thereby,

(b) vacuum means extending between said complementary body portions and opening into said cavities effective when energized to cause an individual item selectively to be moved theretowards,

(c) a plurality of flexible, porous item moving means operably associated with said rigid member and movable over said cavities therein for moving each item normal to said rigid member,

(d) a plurality of signal controlled pusher members operatively associated with said rigid member and said moving means effective when energized to move said item in a direction away from said rigid member thereby nullifying the attractive effect of said vacuum means,

(e) air pressure output means extending between said complementary body portions connected to said cavities and operatively associated with said feeding apparatus and operable in synchronism therewith for moving the stack of items into a position preventing the same from responding to said vacuum means,

(f) valve means disposed within said rigid member and operably associated with said vacuum means and said air pressure means for synchronously controlling the application of air and vacuum effective to feed only one item at a time from said stack, and

(g) a demountable closure member coupled to said rigid member effectively providing inlet and outlet plenum chambers for said vacuum means and said air output means permitting said feeding apparatus to be operated in either of two opposite item confronting positions relative to said item pathway depending upon which of the two opposite complementary body portions is operably associated with said closure member.

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