

Dec. 18, 1962

R. E. MERSEREAU ET AL
DOCUMENT HANDLING APPARATUS

3,069,157

Filed Sept. 27, 1960

4 Sheets-Sheet 1

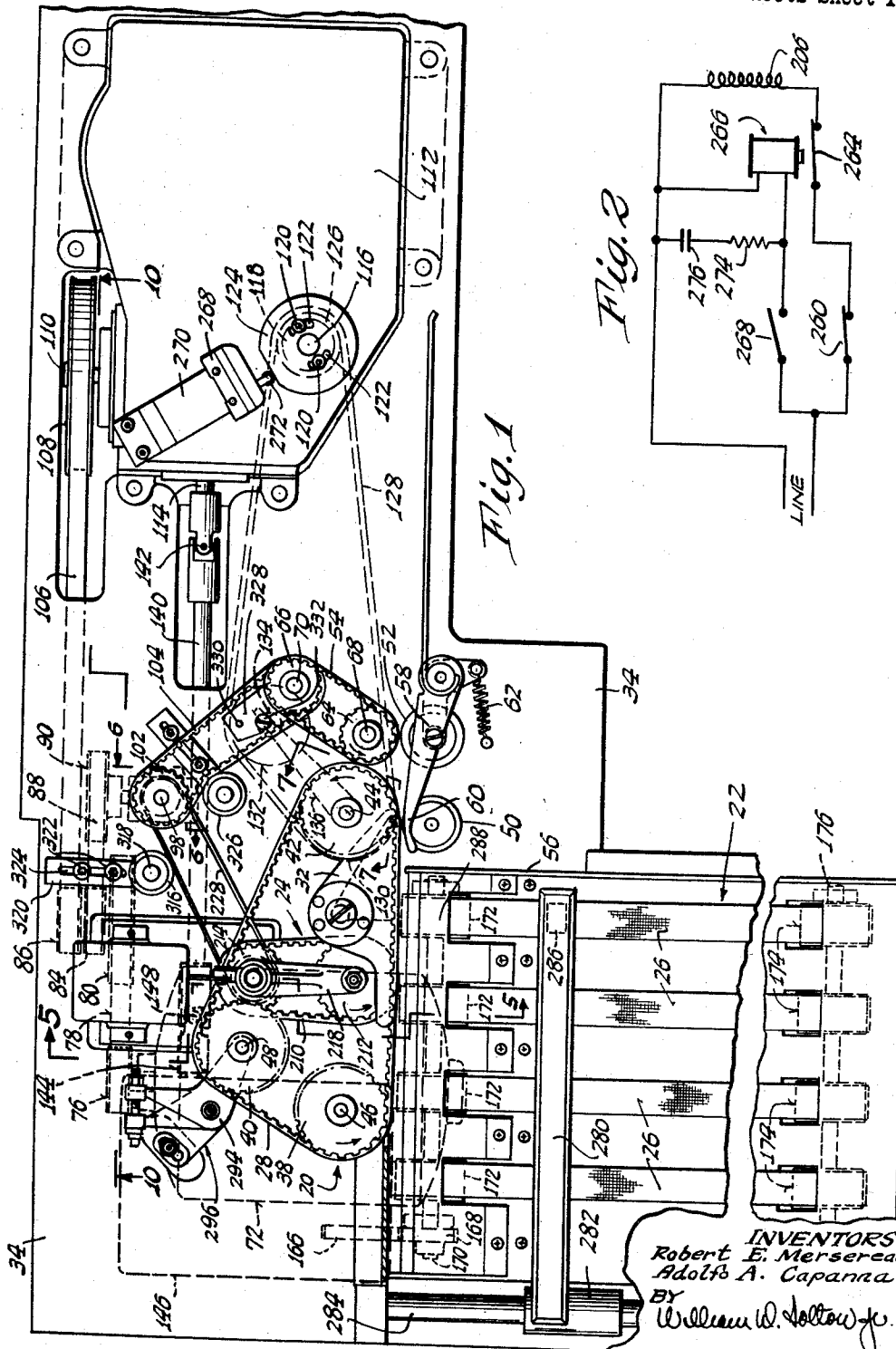
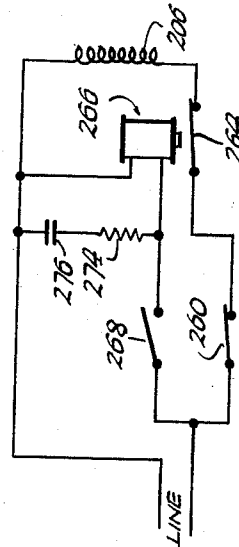


Fig. 2



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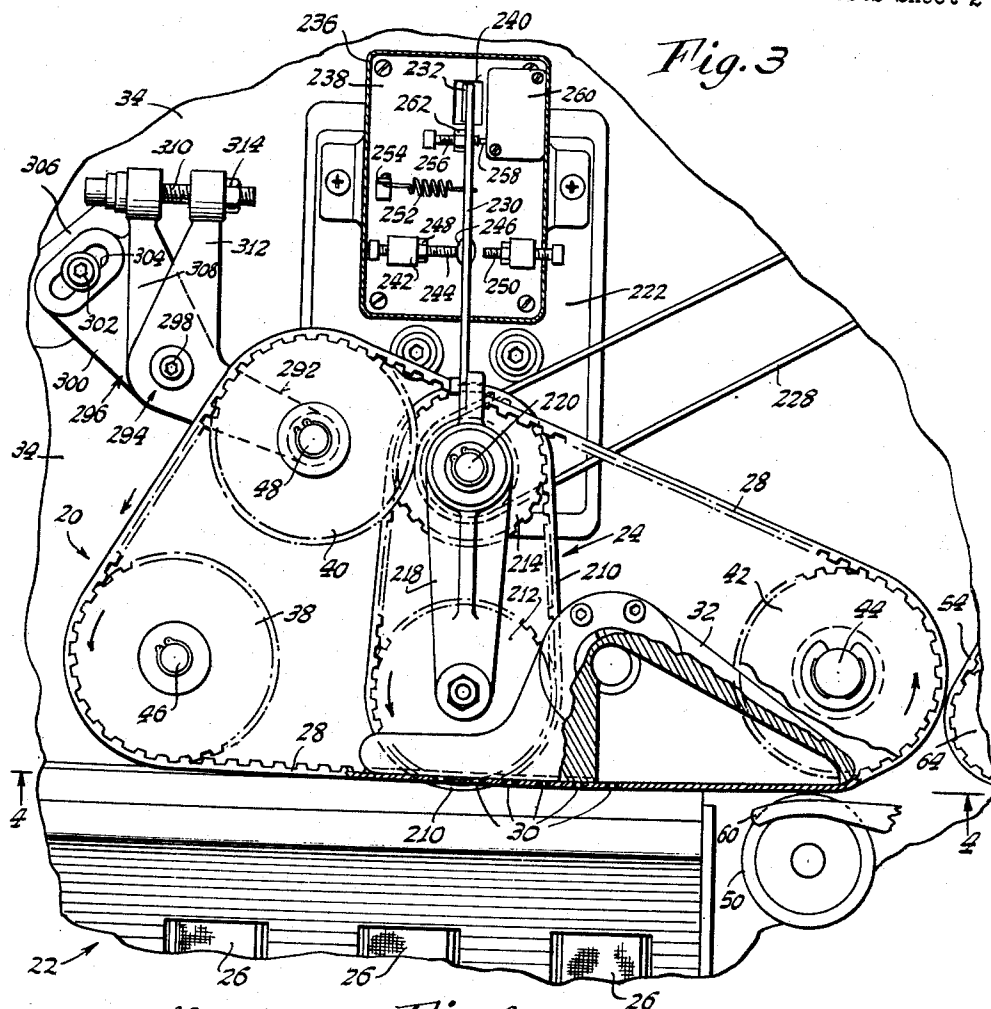
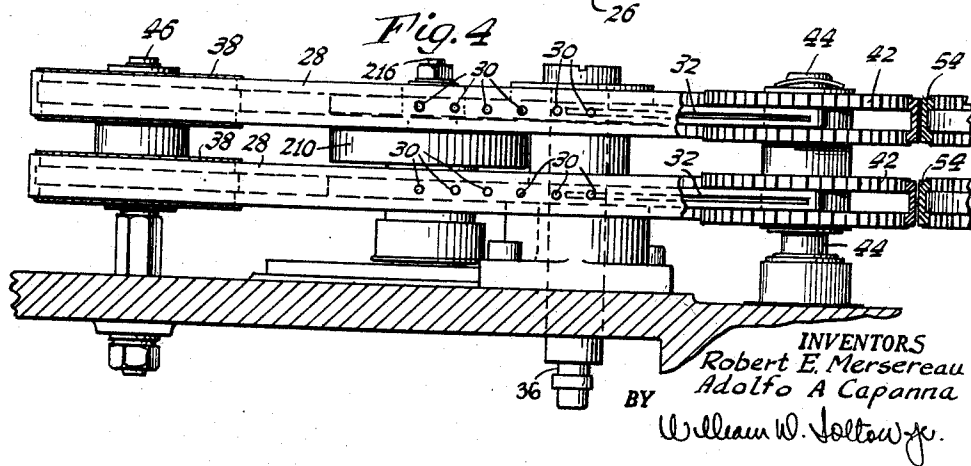
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Fig. 5

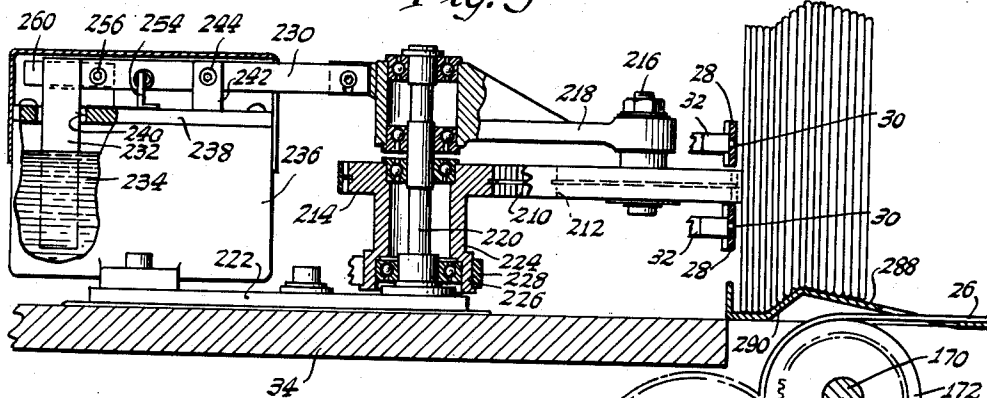


Fig. 6

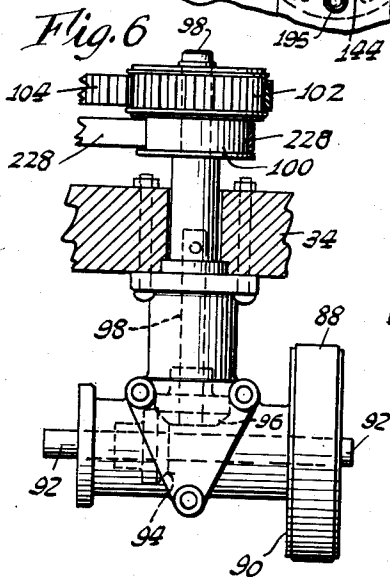
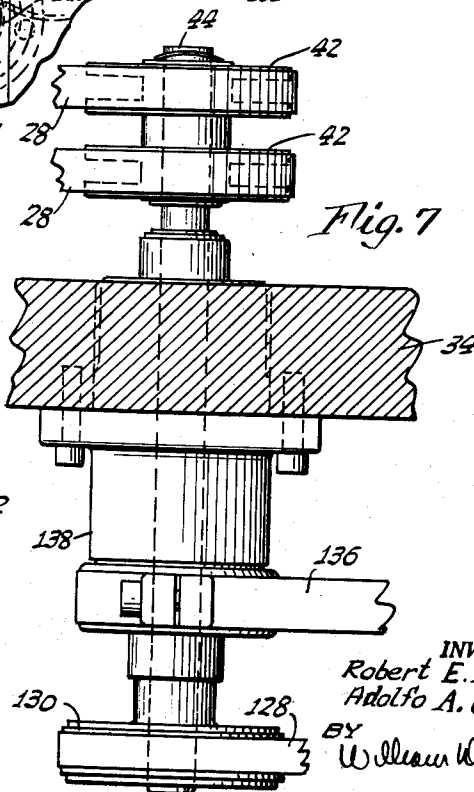


Fig. 7



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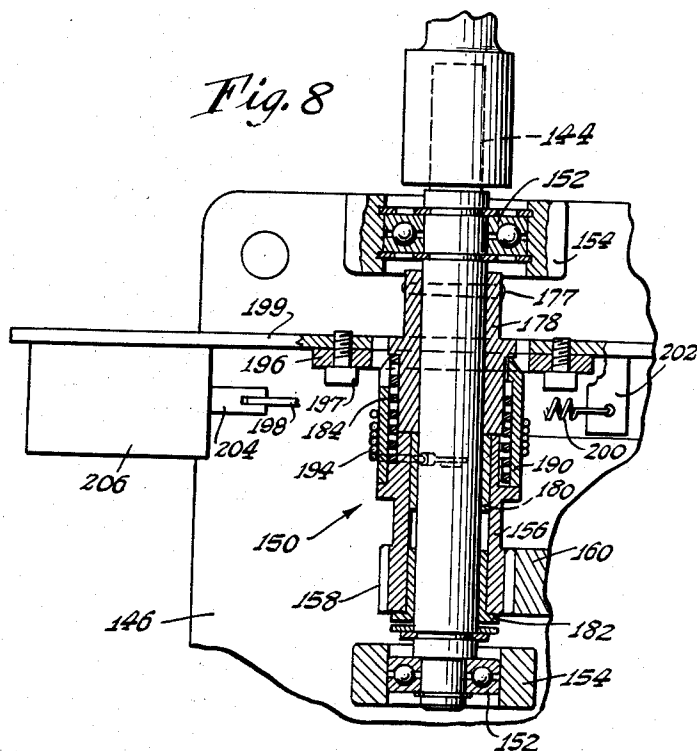
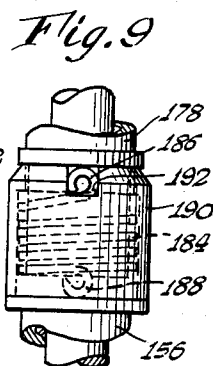
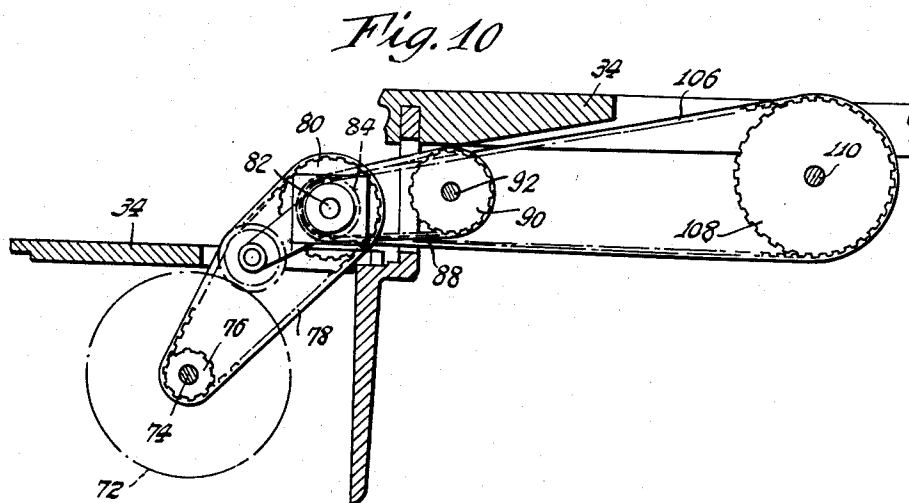
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Filed Sept. 27, 1960

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DOCUMENT HANDLING APPARATUS

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Filed Sept. 27, 1960, Ser. No. 58,666
6 Claims. (Cl. 271—28)

This invention relates to apparatus for advancing a stack of documents toward a feeding location at which the documents are successively fed from the stack, and more particularly, to such an apparatus including means for regulating the advance of the stack of documents.

In many cases, the advance of a stack of documents toward such a feeding location must be regulated to ensure that the stack is advanced sufficiently to bring the foremost letter of the stack to the proper position to be fed from the stack, while also ensuring that the stack is not overly advanced, for example, to the point that the foremost letter is jammed at the feeding location. Regulation of the advance of the stack of documents must be carried out to accommodate, for example, variations in the rate of feeding from the stack, variations in the document thickness from one stack to another and from document to document of a single stack, and variations in the compactness of each respective stack. By way of illustration, it will be clear that if the document thickness varies from document to document of a stack, a greater advance must be made by the stack after the feeding of one or more comparatively thick documents therefrom as compared with the amount of advance required after the feeding from the stack of the same number of comparatively thin documents.

This invention utilizes the well known principle that the frictional force exerted by a first body on a second body, when the two bodies are in sliding contact with each other, is proportional to the normal force by which the first body is urged against the second. According to the invention, an endless member is disposed in the path of advance of a stack of documents from which the documents are successively fed. The endless member provides a friction surface and is driven about a closed path whereby the frictional force exerted by the foremost document of the stack on the driven endless member is proportional to the normal force by which the foremost document is urged against the endless member. This normal force is a function of the advance of the stack required to prevent over-advancing and under-advancing; it being clear that no over-advance or under-advance occurs so long as the magnitude of this normal force remains within predetermined limits. The resulting frictional force being a function of this normal force, the desired control of the stack advance is achieved according to the invention by providing means responsive to the magnitude of this frictional force to slow-down or stop the stack advance when this frictional force exceeds a predetermined value and to speed-up or start the stack advance when this frictional force becomes less than a predetermined value. According to the disclosed embodiment of the invention, the endless member is supported, in part, by a supporting member which is resiliently biased in the direction opposite to this frictional force whereby this supporting member tends to deflect in the direction of the frictional force when the latter increases and tends to deflect in the direction opposite to that of the frictional force when the latter decreases. Means is provided for stopping the stack advance when the supporting member deflects past a predetermined point in the direction of the frictional force and for starting the stack advance when the supporting member deflects past a predetermined point in the opposite direction, thereby regulating the stack advance to prevent over-advancing and under-advancing.

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Accordingly, an object of this invention is to provide a new and improved apparatus for regulating the advance of a stack of documents as the latter are successively fed from one end of the stack.

5 A further object of the invention is to provide such an apparatus which also urges each document to a pre-fed position before feeding from the stack.

10 Another object of this invention is to provide such an apparatus which is automatic in operation, dependable, simple and economical to construct.

Further objects and advantages will become apparent as the description proceeds.

An embodiment of the invention is shown in the accompanying drawings wherein:

15 FIG. 1 is a plan view, broken away in part, of a document-feeding and stack-advancing apparatus embodying the invention;

FIG. 2 is a schematic wiring diagram for the stack-advancing control means according to this embodiment;

20 FIG. 3 is a fragmentary plan view, partly in section and on a scale enlarged over that of FIG. 1, showing details of the document-feeding means and the stack-advancing control means;

25 FIG. 4 is a fragmentary front sectional view taken along lines 4—4 in FIG. 3;

FIG. 5 is a fragmentary side sectional view taken along line 5—5 in FIG. 1;

30 FIG. 6 is a fragmentary side sectional view taken along line 6—6 in FIG. 1 and showing a portion of the drive transmission for the document-feeding means and the stack-advancing control means, this portion including a pair of meshing bevel gears;

FIG. 7 is a fragmentary side sectional view taken along line 7—7 in FIG. 1;

35 FIG. 8 is a fragmentary plan view partly in section of a clutch mechanism through which the stack-advancing means is driven;

40 FIG. 9 is a fragmentary plan view of a portion of the clutch mechanism of FIG. 8, this portion being shown in full in FIG. 9; and

FIG. 10 is a fragmentary front sectional view taken along line 10—10 in FIG. 1.

Referring particularly to FIG. 1, the disclosed embodiment of the invention includes a document-feeding means, a stack-advancing means, and a stack-advancing control means generally designated at 20, 22 and 24, respectively. Documents, in this case pieces of letter mail, are stacked on edge on a plurality of endless advancing belts 26 of the stack advancing means 22. Although the articles operated upon by the apparatus of the invention will hereinafter be referred to as letters, it will be clear that other documents such as cards, sheets of paper, etc. are fully capable of being so operated upon. The stack of letters is advanced forwardly (upwardly as viewed in FIG. 1) by belts 26 to bring the foremost letter of the stack into engagement with the outer periphery of a pair of intermittently movable, endless feed belts 28, 28 of the feeding means 20. The outer periphery of feed belts 28, 28 is formed of a frictional material. Each of the feed belts 28, 28 is provided with at least one series of spaced holes 30 which, when the belts are in a rest position between feeding intervals of the feeding means 20, are disposed rearwardly (to the left as viewed in FIG. 3) of a vacuum shoe 32. As feed belts 28, 28 move in the direction of the arrow in FIG. 3, holes 30 move past the vacuum shoe 32 and communicate with the hollow interior thereof. Vacuum shoe 32 is mounted on a table 34 and is connected to a suitable vacuum source (not shown) through a hollow conduit 36 as shown in FIG. 4. During operation, a negative pressure is constantly maintained within the vacuum shoe 32. Consequently, when the foremost letter of the stack

engages feed belts 28, 28, and the holes 30 move into alignment with the vacuum shoe 32, the foremost letter is retained against, and forwardly fed by these feed belts.

Feed belts 28, 28 are intermittently movable about a closed path defined by three pairs of supporting pulley wheels 38, 38, 40, 40 and 42, 42. Pulley wheels 42, 42 are fixedly carried by a shaft 44 driven intermittently in the counterclockwise direction as viewed in FIG. 1. Idler pulley wheels 38, 38 are rotatably supported by a shaft 46 fixedly mounted on table 34. Each of idler pulley wheels 40, 40 is supported by a separate stub shaft 48. Each time shaft 44 and pulley wheels 42, 42 are driven in said counterclockwise direction, the lower reach of feed belts 28, 28 (as viewed in FIG. 1) feeds the foremost letter retained thereagainst to the right (again as viewed in FIG. 1) past a friction separator 50 and into the bite between an idler take-away roller 52 and a pair of continuously driven take-away belts 54. Friction separator 50 is covered with a friction material such as rubber and is supported in a conventional manner by means not shown for yieldable urging toward feed belts 28, 28. When the foremost letter of the stack is fed by feed belts 28, 28, the latter retain the foremost letter thereagainst with sufficient force to overcome the frictional force exerted by separator 50, but any additional letters carried along with the foremost letter will be prevented by the separator from being fed to take-away roller 52 and take-away belts 54, 54. In this manner, feeding of the letters from the stack in one-by-one succession is ensured. A side wall 56 of the stack-advancing means prevents more than a very few letters from being carried with the fed foremost letter to the friction separator.

Idler take-away roller 52 is rotatably mounted on a shaft 58, the latter being carried by an L-shaped guide 60. As can be seen in FIG. 1, one end of a tension spring 62 is connected to the shorter leg of the guide 60 and the other end of this spring is fixed to table 34. In this manner, the longer leg of the guide 60 and idler take-away roller 52 are yieldably urged upwardly as viewed in FIG. 1. The distal end of the longer leg of guide 60 diverges away from feed belts 28, 28 to guide the leading end of the fed letters into the bite between belts 28, 28 and separator 50.

Endless take-away belts 54, 54 are supported by pulley wheels 64 and 66. Pulley wheels 64 are rotatably supported by a shaft 68 carried by table 34 in a manner identical to that of pulley wheels 38. Pulley wheels 66 are fixed on a shaft 70 rotatably supported by table 34 in a manner identical to that of pulley wheels 42.

The drive for feed belts 28, 28 and take-away belts 54, 54 originates with a continuously running electric motor 72 whose shaft 74 drives a pulley wheel 76 as shown in FIGS. 1 and 10. An endless belt 78 is driven by pulley wheel 76 and drives a pulley wheel 80 fixed on a shaft 82. Shaft 82 is rotatably supported by table 34 and fixedly carries two additional pulley wheels 84 and 86. An endless belt 88 driven by pulley wheel 84 drives a pulley wheel 90 fixed on a shaft 92. Shaft 92, as shown in FIG. 6, carries a bevel gear 94 in mesh with another bevel gear 96 carried by a shaft 98. Shaft 98 fixedly carries two pulley wheels 100 and 102. Pulley wheel 102 drives an endless belt 104 in turn to drive a pulley wheel fixed on shaft 70. This pulley wheel driven by belt 104 cannot be seen in FIG. 1 but is identical to pulley wheels 66 and is disposed directly below the latter. In this manner, the pulley wheels 66 are driven to drive take-away belts 54, 54, thereby completing the drive to the latter from motor 72.

Referring to FIGS. 1 and 10, the pulley wheel 86 drives an endless belt 106 in turn to drive a pulley wheel 108 fixed on the input shaft 110 of a gear box 112. Gear box 112, in a conventional manner, includes reduction gearing (not shown) to drive a first output shaft 114 and to drive a Geneva gear arrangement (not shown)

for intermittently driving a second output, one-revolution shaft 116. Fixed to one-revolution shaft 116 is a hub 118 threadedly engaged by a pair of headed screws 120 which extend through arcuate elongated slots 122 provided by a cam 124. By turning cam 124 about shaft 116 and then tightening down screws 120, 120, angular adjustment of the cam about shaft 116 is effected. The function of cam 124 will be set forth later in this description.

A pulley wheel 126 is adjustably secured to shaft 116 below table 34 in a manner identical to that by which cam 124 is secured to shaft 116 above the table. An endless belt 128 is supported below the table 34 by the pulley wheel 126 and by pulley wheels 130 and 132. Pulley wheel 130 is fixed on shaft 44 as shown in FIG. 7. Pulley wheel 132 is rotatably mounted on a shaft 134 carried by a bracket 136 angularly adjustable about a bearing support 138 for the shaft 44 as best shown in FIGS. 1 and 7. In this manner, the drive from motor 72 to the pulley wheels 42, 42 and feed belts 28, 28 is completed.

The drive for the stack-advancing belts 26 of the stack-advancing unit 22 will now be described. Referring to FIG. 1, the output shaft 114 of gear box 112 drives a shaft 140 through a universal joint 142. Shaft 140 drives the input shaft 144 of a gear box 146 through a universal joint 148. With reference to FIG. 8, the input shaft 144 of gear box 146 is also the input shaft of a clutch disposed within this gear box and generally designated at 150. Input shaft 144 is rotatably mounted in bearings 152, 152 carried by brackets 154, 154. A hollow output shaft 156 of the clutch 150 has a gear 158 fixed thereon which meshes with a gear 160 mounted on a shaft 162 supported within the gear box 146 by a side wall 164. Gear 160, through conventional reduction gearing contained within gear box 146 and which is not shown, drives an identically mounted gear 166.

Gear 166 meshes with and drives a gear 168 fixed on a shaft 170. Referring to FIG. 1 along with FIG. 5, shaft 170 is rotatably supported by table 34 and fixedly mounts four pulley wheels 172. Each of the endless advancing belts 26 is trained about one of the pulley wheels 172 and about one of four pulley wheels 174 at the other end of the stack advancing means 22. Pulley wheels 174 are supported on a shaft 176 in a manner identical to that by which pulley wheels 172 are mounted on shaft 170. It will be seen that when clutch 150 is engaged, the upper reaches of advancing belts 26 are moved forwardly to advance the stack of letters toward the feed belts 28, 28. When clutch 150 is disengaged, forward movement of belts 26 and advancing of the stack of letters is stopped.

Referring to FIGS. 5, 8 and 9, the input shaft 144 of clutch 150 is driven in the clockwise direction (as viewed in FIG. 5) from the gear box 112. Input shaft 144 is pinned at 177 to a sleeve 178. Hollow output shaft 156 of the clutch 150 is supported by two anti-friction members 180, 182 about input shaft 144 and in alignment with sleeve 178. A coil spring 184 extends from one end 186, in the counterclockwise direction (as viewed in FIG. 5) about adjacent portions of sleeve 178 and hollow shaft 156, and terminates at the other end 188. When the clutch 150 is engaged, said clockwise rotation of input shaft 144 tightens the turns of coil spring 184 about sleeve 178 and output shaft 156 to clutch input shaft 144 and output shaft 156 together. To disengage the clutch, a braking sleeve 190 is disposed in surrounding relation to coil spring 184 and provides a slot 192 through which the end 186 of this coil spring projects. So long as braking sleeve 190 is free to rotate with input shaft 144, no braking effect is exerted thereby. By forcibly stopping rotation of braking sleeve 190, the end 186 of coil spring 184 engages and is stopped from rotating by one side of slot 192 thereby opening or loosening the turns of this coil spring about sleeve 178 and output shaft 156. The

effect is to de-clutch output shaft 156 from input shaft 144 whereby the clutch 150 is disengaged.

To forcibly stop rotation of braking sleeve 190, a flexible wire 194 is wrapped about the braking sleeve and terminates at one end which is secured at 195 to a circular plate 196 retained in rotatably adjusted position by a plurality of screws 197 tightened in threaded engagement with a side wall 199 of the gear box 146. The other end of flexible wire 194 is secured to a link 198, the latter being urged to the right (as viewed in FIG. 5) by a tension spring 200. Spring 200 is attached to a bracket 202 provided by the gear box 146. Link 198 is secured to a plunger 204 operated by a solenoid 206. Spring 200 is effective to tighten the coils of wire 194 about braking sleeve 180 forcibly to prevent rotation of the braking sleeve thereby to maintain the clutch 150 in disengaged condition. When solenoid 206 is energized, link 198 is pulled to the left (as viewed in FIGS. 5 and 8) to loosen the coils of wire 194 about braking sleeve 180 thereby to cause engagement of the clutch 150. Clutch 150 is therefore normally disengaged and is engaged by energizing solenoid 206.

The control means 24 by which the stack-advancing means 22 is regulated will now be described. Referring to FIGS. 1 and 3-5, this control means 24 includes an endless belt 210 supported for movement about a closed path by pulley wheels 212 and 214. Pulley wheel 212 is supported for rotation about a stub shaft 216 by a bracket arm 218, and bracket arm 218 as well as pulley wheel 214 is supported for rotation about a shaft 220. Shaft 220, as can best be seen in FIG. 5, is fixedly supported by a mounting plate 222 secured to table 34. In this manner, pulley wheel 212 is supported for pivotal deflection in opposite directions about the axis of shaft 220.

Endless belt 210 is formed of a material such as rubber providing an outer friction surface. Pulley wheel 212 is disposed at a level between feed belts 28, 28 so as to support endless belt 210 with a portion extending beyond the feed belts 28, 28 as best shown in FIGS. 3 and 5. Accordingly, a portion of the radially outer frictional surface of belt 210 is disposed in the path of advance of the stack for engagement by the foremost letter of the stack.

Referring particularly to FIG. 5, pulley wheel 214 is integral with a cylindrical section 224 and with a pulley wheel 226. An endless belt 228 drives pulley wheel 226 in the counterclockwise direction (as viewed in FIG. 3) and is driven by the pulley wheel 100 secured to shaft 98 (see FIG. 6). Shaft 98 is driven by motor 72 through transmission means previously described. In this manner, endless belt 210 of the stack-advancing control means 24 is continuously driven in the counterclockwise direction (as viewed in FIGS. 1 and 3).

It will be apparent that since endless belt 210 is continuously driven in said counterclockwise direction, any force exerted by the foremost letter of the stack against the friction surface of belt 210 in the direction of the advance of the stack tends to cause deflection of pulley wheel 212 and the portion of belt 210 engaged thereby to the left (as viewed in FIGS. 1 and 3). This is due to the frictional force between the foremost letter of the stack and the friction surface of belt 210. The magnitude of this frictional force is a function of the normal force exerted by the foremost letter of the stack against the friction surface of belt 210. This conforms, of course, to the well known principle that the frictional force exerted by a first body on a second body, when the two bodies are in sliding contact with each other, is directly proportional to the normal force by which the first body is urged against the second.

A rearward extension of bracket 218 fixedly carries an arm 230. The distal end of arm 230 supports a paddle 232 which extends into a quantity of viscous oil 234 disposed in a container 236. The top 238 of container 234 provides a slot 240 through which paddle 232 extends. This arrangement acts to dampen the sensitivity of the

stack-advancing control means 24 whereby this control means is responsive only to significant changes in force exerted against endless belt 210.

The top 238 of container 236 mounts a block 242 which threadably receives an adjusting screw 244. Screw 244 acts as a stop engageable with a button 246 carried by arm 230 to define the limit of pivotal deflection of arm 230 and belt 210 in the counterclockwise direction about shaft 220 (as viewed in FIG. 3). Screw 244 is secured in adjusted position by tightening down a lock-nut 248. In identical fashion an adjusting screw 250 limits the pivotal deflection of arm 230 and belt 210 in the clockwise direction about shaft 220. A tension spring 252 is connected at one end to arm 230 and at its other end to a bracket 254 supported by container top 238 whereby arm 230 is resiliently biased in the counterclockwise direction to the position of engagement with screw 244 as shown in FIG. 3. Upon clockwise deflection of arm 230 against the bias of spring 252, one end of an adjusting screw 256 depresses an actuating member 258 of a normally-closed electrical switch 260 to open the latter. Adjusting screw 256 is in threaded engagement with arm 230 and is secured in adjusted position by tightening a lock nut 262. It will be clear, then, that when the stack of letters has forwardly advanced sufficiently that the frictional force between the endless belt 210 and the foremost letter of the stack is great enough to cause the pulley wheel 212 and the portion of belt 210 engaged by the foremost letter to deflect to the left against the action of spring 252 (as viewed in FIGS. 1 and 3) and effect actuation of switch 260, the latter will be opened. The opening of switch 260 results in disengagement of the clutch 150 (FIGS. 5, 8 and 9) to stop the forward movement of stack-advancing belts 26. As letters are fed from the stack, this frictional force decreases to the point that pulley wheel 212 and the engaged portion of belt 210 deflect to the right under the action of spring 252 to effect closing of switch 260. The closing of switch 260 results in engagement of the clutch 150 to start the forward movement of stack-advancing belts 26. By appropriate selection of the characteristics of spring 252, the advance of the stack will be regulated by the control means 24 to keep the respective foremost letter of the stack in proper position to be fed by the feed belts 28, 28 (i.e., to prevent over-advancing and under-advancing of the stack by the stack-advancing means 22).

The use of the control belt 210 has the advantage over a friction-material covered roller substantially equal in size to the pulley wheel 212 that wear is more greatly distributed over the greater outer surface of the belt 210.

The stack-advancing control means 24 as described thus far is operative whether the feed of the letters while in contact with the endless belt 210 of this control means is intermittent (as is the case with feeding means 20 as described herein) or continuous, and whether this feed is at variable speed (as with feeding means 20 due to the previously mentioned Geneva gear arrangement) or at constant speed. This is the case because the previously noted principle to the effect that the frictional force between two relatively sliding bodies is directly proportional to the normal force therebetween, remains true regardless of changes in the rate or speed of relative sliding between the two bodies (see, for example, page 75 of the book "Analytic Mechanics" by Chambers and Faires, published by The MacMillan Co., 1949). However, a given installation to which the invention is applied may present effects making it desirable that the stack-advancing control means be "blanked out" (i.e. rendered ineffective) periodically. By way of example, the endless belt 210 of stack-advancing control means 24 is continuously driven about its closed path in the direction such that the portion of this belt that engages the foremost letter of the stack deflects in the same direction as the feed of the foremost letter from the stack.

If, for any reason, endless belt 210 is driven at a peripheral speed slower than the maximum speed attained by the respective foremost letter (while the latter is being fed in contact with the former), it will be clear that the direction of relative movement between this endless belt and the foremost letter will be reversed as the foremost letter reaches and then exceeds the peripheral speed of the endless belt. The result would be to cause counterclockwise rather than clockwise pivotal deflection of pulley wheel 212 and the engaged portion of endless belt 210 with an increase in said frictional force, thereby falsely indicating that the stack should be advanced. This result could be avoided, for example, by rotatably driving endless belt 210 in the opposite direction from that described herein or by driving endless belt 210 at a peripheral speed exceeding the maximum feeding speed of the respective foremost letter while in contact with this belt. Other factors may prevail, however, militating against such modifications and favoring periodic blanking-out of the stack-advancing control means 22 when such false indications may or do occur. Another effect that may occur rendering it desirable to blank-out the control mechanism periodically would be that resulting when the periodically applied force by which the foremost letter is retained against the feed belts 28, 28 under the influence of the negative pressure within vacuum shoe 32 causes an undue increase in the normal force by which the foremost letter of the stack is urged against the endless belt 210 such as might upset the action of the control means 24. To accommodate these and/or any other such factors, the electrical circuitry of the stack-advancing control means 24 is arranged, as will now be described.

Referring to the schematic wiring diagram of FIG. 2, switch 260 and the clutch-operating solenoid 206 along with the normally closed switch 264 of a relay generally designated at 266 are electrically connected in series relation across a line source of current. Accordingly, whenever at least one of switches 260 and 264 opens, solenoid 206 is de-energized to effect disengagement of clutch 150 resulting in stopping of the forward movement of the stack-advancing belts 26 to stop the advance of the stack.

As previously explained, opening of switch 260 indicates that advancing of the stack is to be stopped by de-energization of solenoid 206 to prevent an over-advance of the stack. Opening of relay switch 264, however, de-energizes solenoid 206 to stop the advance of the stack regardless of whether switch 260 is open or closed, thereby to blank-out the stack-advancing control means 24. To accomplish the latter, a switch 268 (FIG. 1) is arranged to be opened during each cycle of the feeding means. In this regard, switch 268 is carried by a bracket 270 mounted on gear box 112 to dispose an actuator 272 of this switch in the path of the large-diameter portion of the previously mentioned cam 124. As has been noted, cam 124 is fixed, along with the pulley wheel 126 which ultimately drives feed belts 28, on one-revolution shaft 116. Accordingly, each time shaft 116 rotates its one revolution, the large-diameter portion of cam 124 rides against actuator 272 to close switch 268 and then past this actuator to open the switch 268. Referring again to the schematic wiring diagram of FIG. 2, the normally-open electrical switch 268 is electrically connected in series relation with the coil of relay 266 across the line source of current. When switch 268 is closed, relay 266 picks up to open switch 264 resulting in de-energization of solenoid 206 and stopping of the stack-advancing belts 26. In this manner, stack-advancing control means 24 is blanked-out during a portion of each feeding cycle so that no forward movement of advancing belts 26 occurs during this portion of the letter feed even though switch 260 may be closed to demand such forward movement of the advancing belts 26.

It was found desirable, with the feeding means 20 as described above, to blank-out the stack-advancing con-

trol means for a short time beyond the point at which the actuator 272 of switch 268 is released by cam 124 to the switch-open position. Referring to FIG. 2, this was accomplished in a conventional manner by electrically connecting a resistor 274 and a condenser 276 in series relation with each other across the terminals of relay 266. This operates to provide a proper time-delay between re-opening of switch 268 and drop-out of the relay. In this regard, condenser 276 charges when switch 268 is closed, and then discharges through the coil of relay 266 when switch 268 re-opens, to delay the drop-out of the relay. The desired length of time delay is achieved by selecting a resistor 274 and condenser 276 of the proper electrical parameters.

One reason why pulley wheel 212 and endless belt 210 are driven in the counterclockwise direction (as viewed in FIGS. 1 and 3) rather than in the opposite or clockwise direction as previously suggested, is that, thereby, belt 210 acts not only as a part of the stack-advancing control means but also as a pre-feeder. In this regard, by driving endless belt 210 in said counterclockwise direction, the portion of this belt in contact with the respective foremost letter of the stack moves in the direction of the feed of the successive letters from the stack. As previously noted, at the rest position of feed belts 28, 28, holes 30 therein are disposed short of vacuum shoe 32 so that the only force by which the respective foremost letter of the stack is urged against the belt 210 is that effected by the advance of the stack. Consequently, each successive foremost letter is substantially free to be pre-fed by the continuously driven belt 210 into the bite between friction separator 50 and feed belts 28, 28 just prior to feeding by the feed belts 28, 28. This pre-feeding feature is advantageous among other reasons, because, thereby, each letter is fed by the feed belts 28, 28 from a registered (pre-fed) position regardless of whether or not the letters in the stack are registered against the side wall 56 of the stack-advancing means 22 during advancing of the stack.

In connection with the stack-advancing means 22, the letters of the stack are supported in upright position at the rear of the stack by means of a movable support 280 as shown in FIG. 1. Support 280 is carried at one end by a sleeve 282 which is freely slidable and pivotable on and about a bar 284 of circular cross-section. Bar 284 extends the length of stack-advancing unit 22. Support 280 has a rubber or other friction-material pad 286 secured to its underside and engageable with one of the advancing belts 26. In operation, support 280 is pivoted upwardly about bar 284 to disengage friction pad 286 from the respective advancing belt 26, a stack of letters is disposed on the belts 26, support 280 is moved longitudinally relative to bar 284 to a point just behind the last letter of the stack, and the support is then pivoted downwardly about bar 284 to engage friction pad 286 with the respective advancing belt 26. By virtue of the frictional contact of the pad 286 with the respective advancing belt 26, along with the sliding connection between sleeve 282 and bar 284, support 280 is advanced against the rear of the stack along with advancement of the stack by the advance of belts 26 whereby the upright condition of the letters of the stack is maintained.

Referring to FIG. 5, the surface of the stack-advancing unit 22 on which the letters of the stack advance next adjacent feed belts 28, 28 and control belt 210, is inclined upwardly at 288 and then more sharply downwardly at 290. As will be clear, this has the effect of causing the letters at the forward end portion of the stack to remain upright in the proper altitude for engagement with belts 28, 28 and 210 rather than to incline rearwardly from their lower edges.

With the exception of the advancing belts 26 and the drive belt 228, each of the endless belts described above is a so-called timing belt having ribs or teeth meshing with either two or three toothed pulley wheels. Take-up means is provided where desired to tension certain of the

belts. Referring particularly to FIG. 3 in this regard, the upper one of the two pulley wheels 40 about which a respective feed belt 28 is trained is carried by its stub shaft 48 mounted at the free end of one leg 292 of an integral two-legged bracket generally designated at 294. The lower one of the two pulley wheels 40 is carried by its stub shaft 48 mounted at the free end of one leg identical to leg 292 and integral with a three-legged bracket generally indicated at 296. Both of brackets 294 and 296 are pivoted about a pin 298 fixed to table 34. A second leg 300 of bracket 296 is secured in adjusted pivotal position about pin 298 by tightening down a bolt 302 whose shank extends through a slot 304 provided by leg 300 and into threaded engagement with a block 306 secured to table 34. This adjustment, of course, properly tensions the lower one of feed belts 28. A third leg 308 of bracket 296 rotatably supports an adjusting screw 310 threadedly received by a second leg 312 of bracket 294. Bracket 294 is pivotally adjusted about pin 298 and relative to bracket 296 by rotating screw 310. By tightening down a lock-nut 314, the upper one of feed belts 28 is maintained in proper tension.

The drive belt 228 is tensioned by an idler roller 316 (FIG. 1) rotatable about a shaft 318 carried by a bracket 320. The desired tension on belt 228 is achieved by moving bracket 320 in the directions toward or away from belt 228 and securing this bracket in adjusted position by tightening down screws 322 which extend in threaded engagement with table 34 through slot 324. An idler roller 326 is utilized to adjust the tension on drive belt 104 in a manner identical to that by which the tension on belt 228 is adjusted by roller 316. The tension on belt 104 is adjusted after adjusting the tension on take-away belts 54. The latter is accomplished by adjustably pivoting a bracket 328, which carries the shaft 70 for pulley wheels 66, about a pin 330 secured to table 34, and then tightening down a screw 332 which extends through a slot in bracket 328 into threaded engagement with table 34.

Briefly to recapitulate the operation of the disclosed apparatus, a stack of letters is advanced endwise toward and against the feed belts 28, 28 and the stack-advancing control belt 210 by forward movement of the advancing belts 26. Advancing belts 26 are moved forwardly when the clutch 150 (FIGS. 5 and 18) is engaged, and forward movement of these advancing belts is stopped when the clutch 150 is disengaged. Referring to the schematic wiring diagram of FIG. 2, the clutch 150 is engaged when the solenoid 206 (FIGS. 5 and 8) is energized and is disengaged when this solenoid is de-energized. The solenoid 206 is de-energized when the switch 260 is open and, so long as switch 264 of relay 266 is closed, the solenoid 206 is energized when the switch 260 is closed. Assuming that switches 260 and 264 are closed to energize solenoid 206 to engage clutch 150 to drive advancing belts 26 and a stack of letters thereon forwardly, the frictional force exerted by the foremost letter of the stack against the continuously driven stack-advancing control belt 210 increases as a function of the increase of the normal force exerted by said foremost letter against the control belt 210. When this frictional force exceeds a predetermined value, pulley wheel 212, and the portion of control belt 210 engaged by the foremost letter pivot in the clockwise direction (as viewed in FIGS. 1 and 5) substantially perpendicular to the direction of advance of the stack the small amount required to cause arm 230 to open switch 260 thereby stopping the forward advance of the stack by the stack-advancing means. The frictional force exerted by the respective foremost letter of the stack against the engaged portion of the control belt 210 decreases as the letters are successively fed from the stack to a predetermined value at which the pulley wheel 212, the engaged portion of the control belt 210 and arm 230 pivot under the influence of the spring 252 in the counterclockwise direction the small amount required to effect closing of switch 260 again to start forward advancing of the ad-

vancing belts 26. The switch 268 is provided if and when it is desired to energize relay 266 to open relay switch 264 periodically during each letter feeding cycle to blank-out the stack-advancing control means 24.

It will be noted that the force necessary to be exerted by control arm 230 to open switch 260 of the stack-advancing control means 24, is determined (along with other factors such as the friction of the bearings which pivotally support bracket 218 about shaft 220, etc.) by the cumulative force of spring 252 and the conventional return spring (within the casing of switch 260 and which is not shown) for the actuator 258 of this switch. By the proper selection of a conventional actuator return spring to provide a force equal to this cumulative force, spring 252 could be eliminated. Also, rather than a start-stop control over the forward movement of advancing belts 26 as herein described, this forward movement could be regulated by a variable-speed mechanism responsive to the pivotal position of pulley wheel 212 and the portion of control belt 210 engaged by the respective foremost letter of the stack since the amount of this pivotal movement is a function of the required advance of the stack.

The particular feeding, stack-advancing and control apparatus disclosed herein forms part of an input station for a letter sorter machine but it will be obvious that the invention is applicable to many other installations. Furthermore, since many changes can 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 exemplary and that the invention not be limited except as warranted by the following claims.

What is claimed is:

1. In an apparatus for feeding letters in succession from a stack; means for advancing the stack endwise as the letters are fed therefrom; an endless member having a continuous friction surface; means supporting said endless friction-surfaced member for movement about a closed path; said supporting means including a member supporting a portion of said endless member in the path of advance of the stack of letters for engagement of the friction surface of said portion of the endless member with the foremost letter of the stack; means operatively connected for driving said endless member about a closed path; means mounting said supporting member for deflection in opposite directions substantially perpendicular to the direction of advance of the stack of letters; means resiliently biasing said supporting member in one of said opposite directions against any force exerted on said friction surface in the other one of said opposite directions by the foremost letter of said stack whereby said supporting member tends to deflect in said one of the opposite directions with a decrease in said force and tends to deflect in said other one of the opposite directions with an increase in said force; and means operatively connected to said stack-advancing means and responsive to the deflection of said supporting member in said opposite directions to regulate the advance of said stack by said stack-advancing means.

2. In an apparatus for feeding letters in succession from a stack; means for advancing said stack of letters endwise as the letters are fed therefrom; a friction separator disposed at a pre-fed position; an endless member having a friction surface disposed in the path of advance of said stack to engage the foremost letter of the stack; means operatively connected to drive said endless friction surface about a closed path and in a direction to frictionally urge the foremost letter of the stack to said pre-fed position against said friction separator; means mounting said endless friction-surfaced member for deflection of the portion of said endless member engaged by said foremost letter in opposite directions substantially perpendicular to the direction of advance of said stack and resiliently biasing said friction-surfaced member in one of said opposite directions against any frictional force exerted on the

endless friction-surfaced member by the foremost letter of said stack whereby said friction-surfaced member tends to deflect in said one of the opposite directions with a decrease in said frictional force and tends to deflect in said other one of the opposite directions with an increase in said frictional force, and means responsive to the deflection of said friction-surfaced member in said opposite directions to regulate the advance of said stack.

3. In combination: means for feeding letters in one-by-one succession from a stack; an endless belt having a friction surface; means for advancing a stack of letters in a direction toward said endless belt; means supporting said endless belt for movement about a closed path; said supporting means including a pulley wheel supporting a portion of said belt in the path of advance of the stack of letters for engagement of the friction surface of the belt with the foremost letter of the stack; means operatively connected for driving said endless belt about a closed path; means mounting said pulley wheel for deflection in opposite directions substantially perpendicular to the direction of advance of the stack of letters; means resiliently biasing said pulley wheel in one of said opposite directions against any force exerted on said friction surface in the other one of said opposite directions by the foremost letter of said stack whereby said pulley wheel tends to deflect in said one of the opposite directions with a decrease in said force and tends to deflect in said other one of the opposite directions with an increase in said force; and means responsive to the deflection of said pulley wheel in said opposite directions to regulate the advance of said stack by said stack-advancing means as the letters are fed therefrom.

4. In an apparatus for feeding letters in succession from a stack; means, when actuated, for advancing the stack endwise as the letters are fed therefrom; an endless member having a continuous friction surface; means supporting said endless friction-surfaced member for movement about a closed path; said supporting means including a member supporting a portion of said endless member in the path of advance of the stack of letters for engagement of the friction surface of the endless member with the foremost letter of the stack; means operatively connected for driving said endless member about a closed path; means mounting said supporting member for deflection between two positions and substantially perpendicular to the direction of advance of the stack; means resiliently biasing said supporting member with a predetermined force from one of said positions to the other position; an electrical switch operatively arranged to be actuated by deflection of said supporting member from said other position to said one position when the frictional force exerted by the foremost letter of the stack against said endless member exceeds said predetermined force, and means electrically connected to said switch for de-actuating said first-named means so long as said switch is actuated.

5. In an apparatus for feeding letters in succession

from a stack; means, when actuated, for advancing said stack of letters endwise as the letters are fed therefrom; an endless member having a continuous friction surface; means supporting said endless friction-surfaced member for movement about a closed path; said supporting means including a member supporting a portion of said endless member in the path of advance of the stack of letters for engagement of the friction surface of the endless member with the foremost letter of the stack; means operatively connected for driving said endless member about a closed path; means mounting said supporting member for deflection between two positions and substantially perpendicular to the direction of advance of the stack; means resiliently biasing said supporting member with a predetermined force from one of said positions to the other position; a first electrical switch operatively arranged to be actuated by deflection of said supporting member from said other position to said one position when the frictional force exerted by the foremost letter of the stack against said endless member exceeds said predetermined force; a second electrical switch operatively arranged to be actuated during the time interval while each letter being fed from the stack engages the friction surface of the endless member; and means electrically connected to both of said electrical switches for de-energizing said first-named means so long as either one or both of said electrical switches is actuated.

6. In an apparatus for feeding letters in succession from a stack; means for advancing said stack of letters endwise as the letters are fed therefrom; an endless member; means supporting said endless member in the path of advance of said stack; said endless member providing a continuous friction surface engageable with the respective foremost letter of the stack; means operatively connected for continuously driving said endless member to move said continuous friction surface about a closed path whereby the resulting frictional force between said friction surface and the respective foremost letter of the stack is proportional to the normal force therebetween; said supporting means including a member mounted for deflection in response to changes in said frictional force; the deflection of said last-named member being proportional to said frictional force; and means responsive to said deflection of said last-named member and operatively connected for controlling said stack-advancing means to maintain said deflection within predetermined limits whereby over-advancing and under-advancing of said stack are prevented.

References Cited in the file of this patent

UNITED STATES PATENTS

2,660,430	Ribich	Nov. 24, 1953
2,956,801	Coakley	Oct. 18, 1960
2,992,820	Tarback et al.	July 18, 1961