United States Patent [19]

Wood

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[45] **June 17, 1975**

[54] **APPARATUS FOR EJECTING STACKS OF ARTICLES FROM CONTAINERS**

[75] Inventor: **David Wood,** Clevedon, England

[73] Assignee: **Masson Scott Thrissell Engineering Limited,** Bristol, England

[22] Filed: **Nov. 28, 1972**

[21] Appl. No.: **309,988**

[52] **U.S. Cl.** ..... **214/6 H;** 214/8.5 SS; 221/268; 271/122

[51] **Int. Cl.** **B65g 59/06**

[58] **Field of Search** ..... 214/8.5 F, 8.5 SS, 8.5 A, 214/6 H; 221/251, 268; 271/217, 219, 122, 125, 165, 169

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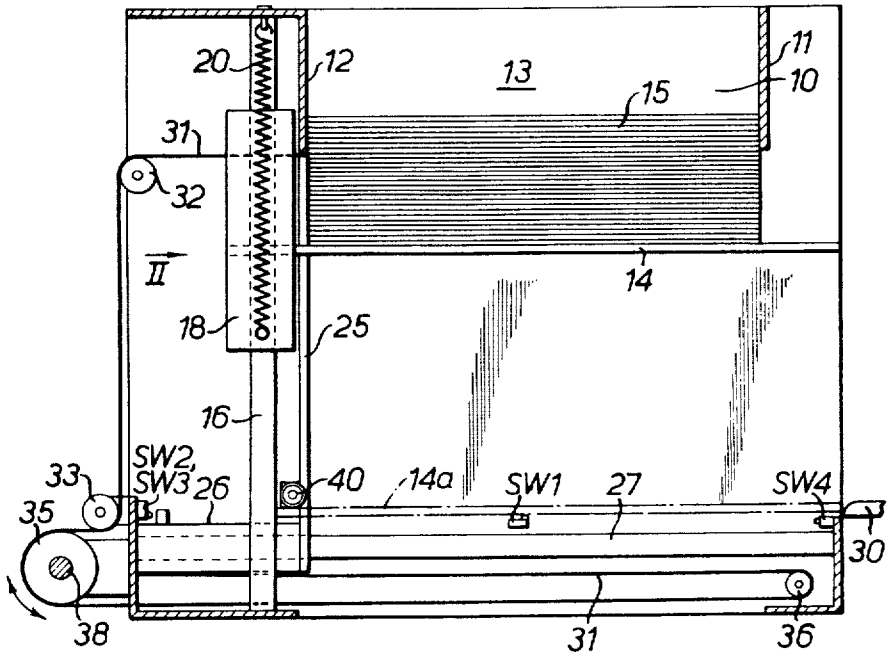
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Primary Examiner—Robert J. Spar
Assistant Examiner—George F. Abraham
Attorney, Agent, or Firm—Young and Thompson

[57] **ABSTRACT**

An automatic ejector system for ejecting stacks of mail deposited into individual sorter boxes in a mail sorting machine. The apparatus includes a vertically movable spring balanced platform located below a magazine, and a horizontally movable pusher plate which can move horizontally along a gap in the platform, the top of the pusher being attached to a flexible belt or rigid plate which moves across the bottom of the magazine when the pusher is actuated, so as to support any further items of mail in the magazine. An automatic control system including microswitches and mechanical interlocks controls the sequence of movement, and any excess articles in the magazine are retained by a power driven friction roller which drives back any item of mail that is not fully ejected.

5 Claims, 13 Drawing Figures



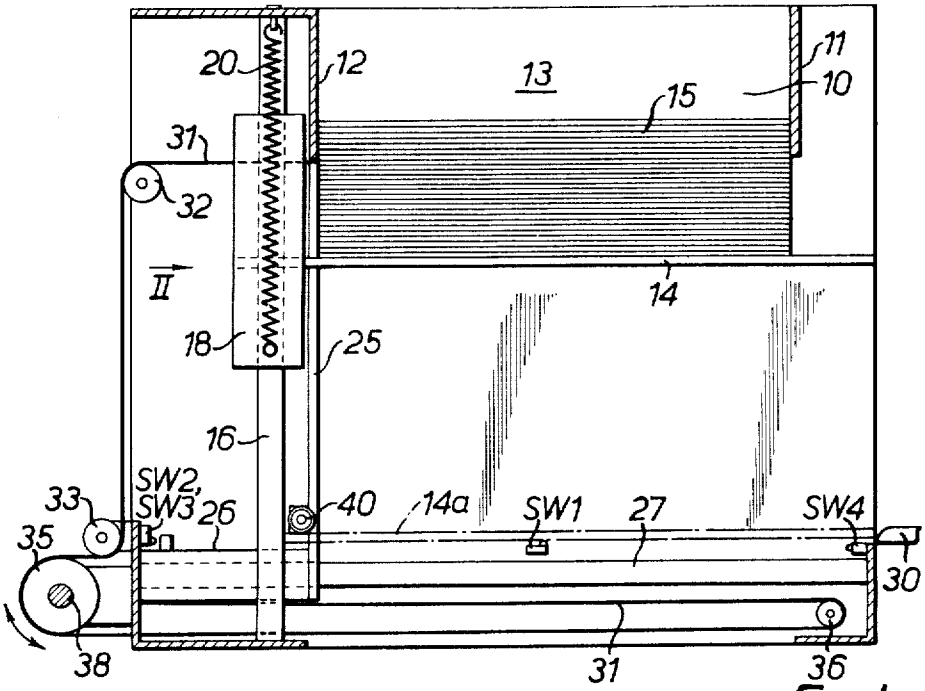

20
12
13
11
10
15
31
32
II
14
18
25
16
33
SW2,
SW3
26
40
14a
SW1
27
SW4
35
30
38
31
36

FIG. 1.

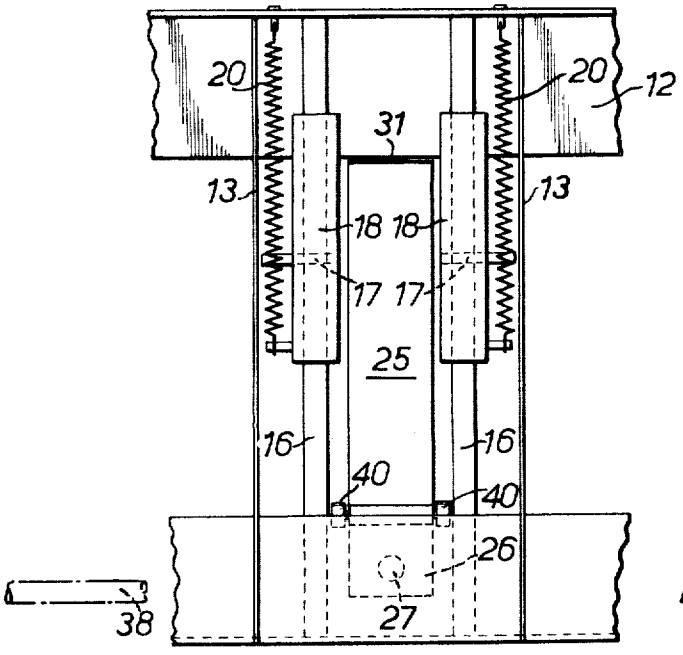

20
20
12
31
13
13
18
18
17
17
25
16
16
40
40
26
27
38

FIG. 2.

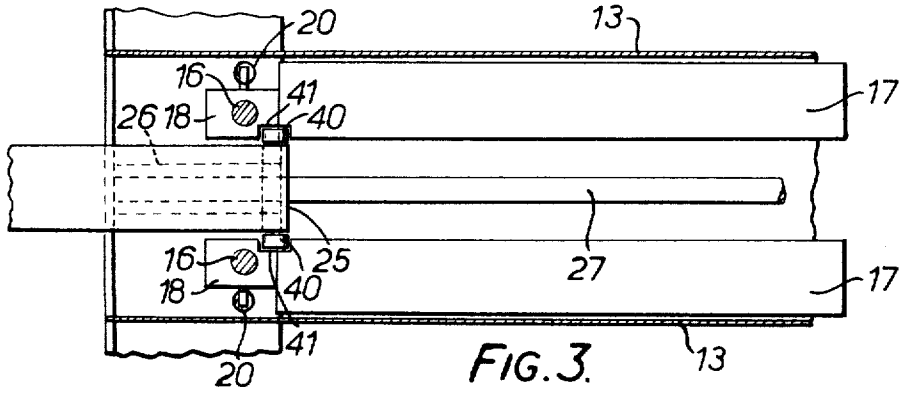

20
13
16
41
26
18
40
17
16
25
27
18
40
17
41
20
13

FIG. 3.

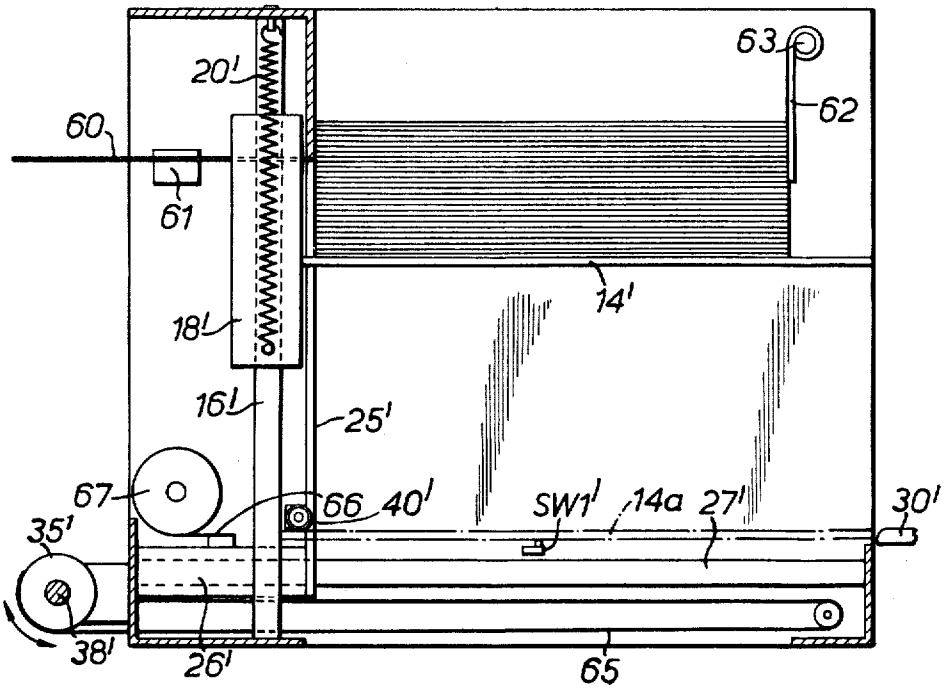

63
20'
62
60
61
14'
18'
16'
25'
67
66
40'
SW1'
14a
27'
30'
35'
38'
26'
65

FIG. 5.

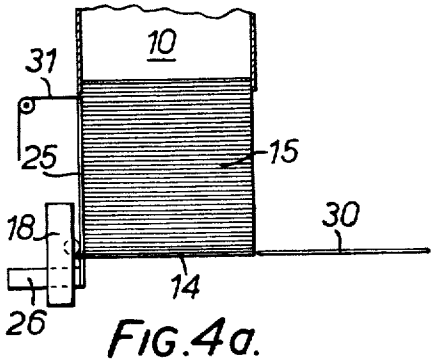


FIG. 4a.

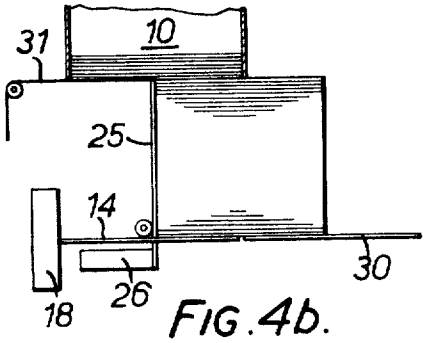


FIG. 4b.

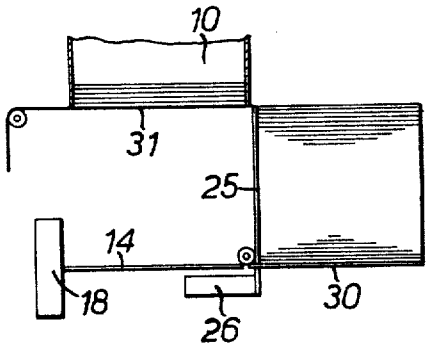


FIG. 4c.

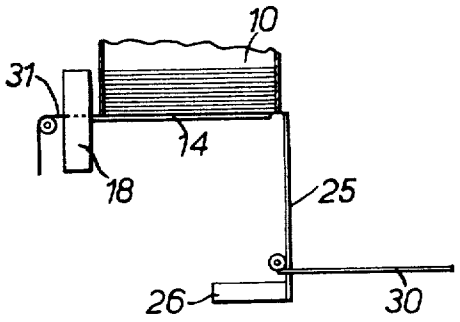


FIG. 4d.

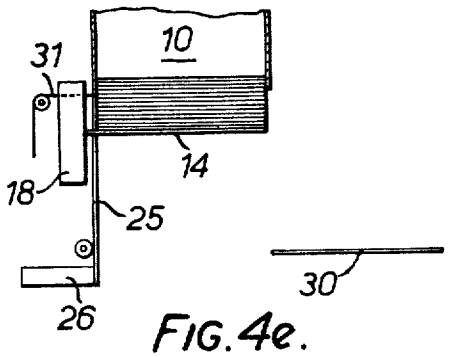


FIG. 4e.

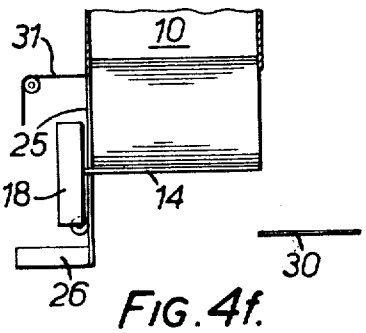


FIG. 4f.

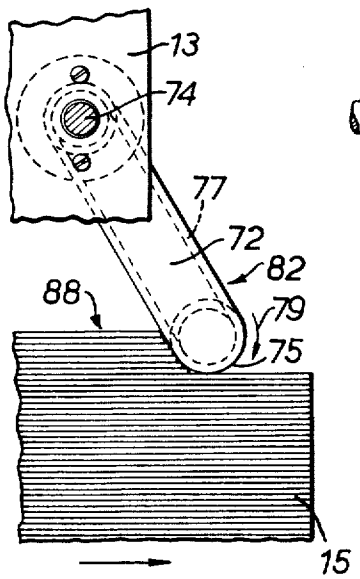


FIG. 6.

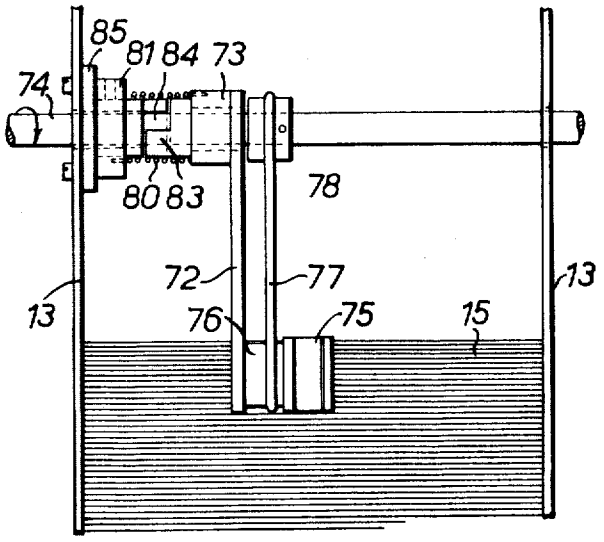


FIG. 7.

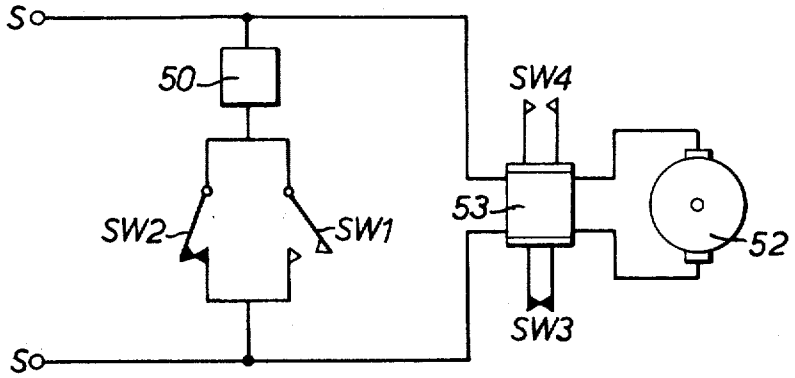


FIG. 8.

APPARATUS FOR EJECTING STACKS OF ARTICLES FROM CONTAINERS

This invention relates to apparatus for ejecting a stack of generally flat articles such as postal mail, cards, or like flat objects or sheets from a receptacle such as a magazine or container, and the invention is particularly though not exclusively applicable to a device for ejecting stacks of mail from the individual sorter destination boxes in an automatic mail sorting machine. In such a machine dimensional limitations are important since there are usually a large number of individual boxes and any increase in size in each box is greatly multiplied over the whole machine. Also for this reason any unnecessary expense or complexity in the design of the ejector mechanism is greatly magnified in the total machine. An important requirement in such automatic sorting machines is that the main sorting process should be able to proceed without interruption while stacks of mail are removed from individual boxes as they become full.

Accordingly it is an object of the present invention to provide an improved apparatus for ejecting stacks of mail or like articles from a receptacle, especially a sorter box in an automatic sorting machine, which will meet most or all of the operating requirements in a simple, effective and economic manner.

Broadly stated the invention consists in apparatus for ejecting a stack of postal mail, cards, or like flat articles, from a receptacle, including a generally vertical magazine, guide, or box having a generally vertically movable platform or support on which the stack of articles is built up, and means for controlling the vertical movements thereof, a laterally movable pusher of substantial height arranged to transfer a stack off the platform, an abutment or gate designed to retain in the magazine any articles in excess of a predetermined stack height, and a horizontal supporting surface connected to the pusher to support temporarily the excess articles in the magazine.

According to a preferred feature of the invention the platform is controlled by a resilient device such as a spring, and preferably the resilient device is so designed with respect to the average density of the articles in the stack as to maintain the top article in the stack at a substantially constant level, at least during normal operation. In order to provide the necessary travel of the platform and at the same time avoid increasing the length of the spring undesirably, the spring is preferably connected to a cord or like tension element passing around a pulley system arranged to provide a mechanical multiplication factor so that a relatively small movement of the spring corresponds to a relatively large movement of the platform. By so arranging that the spring is of appreciable length it can be arranged to produce an approximately constant "rate," which if properly selected will maintain the top of the stack at an approximately constant level.

The pusher is preferably a vertical plate or bar connected to a horizontal guide and actuator, and preferably the top of the pusher is connected to a horizontal supporting surface which may be in the form of a flexible belt extending aroung pulleys, or may be a relatively rigid plate extending horizontally from the top end of the pusher. The latter arrangement is relatively simple and economical and can be adopted where adequate horizontal space is available.

According to another preferred feature of the invention the apparatus includes means connected to the pusher and engaging the platform to prevent the platform rising until the pusher has ejected the stack. In this way the vertical movement of the platform is controlled automatically in response to the horizontal movement of the pusher without any additional complicated operating mechanism.

It will be seen that the apparatus is self actuating apart from the pusher and according to another preferred feature of the invention the apparatus includes means for actuating the pusher from a power operated drive, such as a drive shaft. Thus it is possible to arrange for a large number of similar ejector mechanisms to be driven from a common drive such as a transverse drive shaft driven by a reversible or continuously running motor, with clutch means for engaging the pusher with the drive when required. In a particular preferred arrangement the apparatus includes clutch means for connecting the pusher to the drive for ejector operating and spring means for returning the pusher when the clutch is disengaged.

The invention may be performed in various ways and two embodiments with a number of possible modifications will now be described by way of example with reference to the accompanying drawings, in which:

FIG. **1** is a diagrammatic side elevation, partly in section, illustrating the main essential componets of one form of mail ejector according to the invention,

FIG. **2** is a diagrammatic rear view of the apparatus as seen in the direction of arrow II in FIG. **1**,

FIG. **3** is a diagrammatic plan view of the vertical moving platform,

FIGS. **4**(*a*) to **4**(*f*) are diagrams illustrating six stages in the movements of the components of the ejector of FIGS. **1** to **3**,

FIG. **5** is a diagrammatic side view similar to that of FIG. **1** of a modified form of ejector device,

FIG. **6** is a side elevation on an enlarged scale illustrating a modified form of pack shearing device which may be incorporated in the ejector apparatus,

FIG. **7** is an end elevation of the pack-shearing device of FIG. **6**, and

FIG. **8** is a simplified circuit diagram illustrating the electrical control elements of the apparatus of FIG. **5**.

Referring first to FIG. **1** this illustrates an automatic ejector system for ejecting stacks of mail from a destination box in an automatic letter sorting machine. A large number of such destination boxes are arranged in rows at different levels and when each box is nearing the point of being full the ejector device is arranged to eject a stack onto a conveyor which transports the stack to an automatic bundling machine ready for despatch. The main sorting machine continues in operation uninterrupted during the emptying cycle and mail continues to be delivered vertically downwards into the sorter boxes, with each envelop lying generally horizontally in the stack.

The apparatus illustrated in FIG. **1** comprises a vertical sorter box or magazine **10**. having fixed front and rear walls **11,12**, and side walls **13**. A vertically movable platform **14** is arranged to support a stack of mail **15** and is slidably mounted on a pair of vertical guide rods **16**. The platform consists of a pair of parallel spaced plates **17** (see FIG. **3**) each attached to a block **18** sliding on one of the guide rods **16**, and the two

blocks may be interconnected by a bridge (not shown) to ensure that both move together. The platform is urged upwardly by a pair of springs **20** connected to the blocks **18** and to fixed point on the framework of the apparatus. The spring rate is selected to correspond to the weight/height relationship (i.e., density) of average mixed postal mail within the territory in which the sorting machine is operating. In this way the level of the top letter or envelope in the stack **15** is maintained approximately constant as the height of the stack increases. It will be noted that as shown in FIG. **1** the level of the top of the stack **15** is somewhat above the level of the bottom edge of the front wall **11** which acts to retain the top part of the stack within the magazine. The height of the stack being ejected is thus controlled by the vertical interval between the wall **11** and the platform **14.**

The stack of mail on the platform is ejected by a generally vertical pusher plate **25** attached to a block **26** which is slidably mounted on a horizontal guide rod **27.** Normally the pusher plate **25** is positioned on the extreme left side of the stack as illustrated in FIG. **1** but when traversed to the right the greater part of the stack of mail on the platform **14** is ejected onto a receiver plate **30.** Any mail in excess of the predetermined height of the stack is retained by the front wall **11.** This excess mail is supported temporarily by a flexible belt **31** attached to the upper end of the pusher plate **25** and passing around a pair of pulleys **32,33,** over a drive drum **35** and around a further pulley **36** at the front of the machine, the other end of the belt being attached to the block **26** at the bottom end of the pusher plate. The drum **35** is connected via an electro-magnetic clutch (not shown) to a common driveshaft **38** extending the full length of the machine so that the pusher plate of any selected sorter box can be actuated in either direction according to the instantaneous direction of rotation of the driveshaft, by engagement of the clutch. In this way any one of the pusher plates of the different ejector mechanisms can be actuated from the common driveshaft. The belt **31** acts both to support the stack and to operate the pusher plate.

As the weight of the stack **15** increases, the platform **14** automatically falls towards its bottom position illustrated at **14"** in FIG. **1.** When the pusher plate **25** then ejects the stack of mail to the right the load on the platform **14** is reduced and the platform would normally tend to rise under the influence of the springs **20** but during the ejection movement the platform is locked in its bottom position by a pair of locking rollers **40** attached to the rear of the pusher plate **25** and bearing on the top surface of the platform. When the locking rollers **40** reach the right hand end of their travel and the mail pack has been fully ejected from the magazine onto the plate **30,** the platform is then free to rise under the spring system **20.** Slots **41** in the platform blocks **18** allow the platform to pass downwards over the locking rollers **40** when the parts have returned to their left hand positions as seen in FIG. **1.**

The apparatus is fully automatic and incorporates four micro-switches SW1, SW2, SW3 and SW4 arranged to actuate as follows:

SW1 — positioned below the bottom position **14"** of the platform, and has normally-open contacts which are closed when the platform **14** is at the bottom, and the sorter box is full.

SW2 — positioned near the left hand position of the pusher plate block **26** and has normally-closed contacts which close when the pusher plate starts its ejection movement towards the right.

SW3 — at the same position as SW2 and has normally-closed contacts which are opened when the pusher plate is in its left hand position.

SW4 — positioned near the right hand position of the pusher plate, and has normally-open contacts which are closed when the pusher plate reaches its right hand position.

The main components of the electrical control equipment are illustrated in FIG. **8.** A solenoid-actuated clutch **50** for connecting the drive shaft **38** to the drive drum **35,** is connected across the supply SS with the switches SW1 and SW2 in parallel. A main motor **52** for driving the shaft **38** is connected across the supply through a reversing relay circuit **53,** which is controlled by the switches SW3 and SW4.

The sequence of operations is illustrated diagrammatically in the six views of FIGS. **4**(*a*) to **4**(*f*).

In the stage shown in FIG. **4**(*a*) the platform **14** has descended under the increasing height and weight of the stack of mail until at its predetermined bottom position switch SW1 closes and the clutch **50** is engaged to move the belt **31** and so cause the pusher plate **25** to move to the right as shown in FIG. **4**(*b*). During this ejection movement the rollers **40** hold the platform **14** down in its bottom position. In FIG. **4**(*c*) the stack of mail has been fully ejected and the roller **40** has moved clear of the platform, the excess mail being temporarily supported by the flexible belt **31.** The platform **14** starts to rise automatically under the action of the springs **20,** and switch SW1 opens, but the clutch **50** is still engaged by the normally closed switch contacts SW2. When the pusher plate reaches its right hand position switch SW4 is closed, thus actuating the reversing relay **53** to reverse the supply to the motor **52** and therefore also reverse the drive to the shaft **38** and pusher plate **25,** which returns to the left. The reverse movement is maintained by hold-on contacts (now shown) until the pusher plate reaches its left hand position, and opens the switch SW3, which de-actuates the reversing relay **53,** so that the motor is restored to forward drive. Simultaneously switch SW2 is opened to disengage the clutch **50,** and the cycle is ready to repeat. While these operations are occurring, mail continues to enter the top end of the sorter box **10** and this causes an increase in the height of mail as illustrated in FIG. **4**(*d*). By relating the speed of operation of the cycle to the speed of delivery of the mail this heightrise can be limited to acceptable values. In the unlikely event of excessive quantities of mail being received the machine may during this ejection cycle be arranged to direct mail to an overflow system.

As shown in FIG. **4**(*e*) when the pusher plate **25** has returned to its extreme left position switch SW2 opens and de-energises the clutch, and the weight of mail in the stack is then removed from the temporary supporting belt **31** and transferred to the platform **14** which moves downwards under its automatic spring system, thus maintaining the top of the stack at the standard level as shown in FIG. **4**(*f*). The height of stack progressively increases until the platform reaches its bottom position and the cycle recommences as described above.

The second embodiment illustrated in FIG. **5** is basically similar to that of FIG. **1** and similar parts are indicated by the same reference numerals with an added

suffix, and will not be described in detail except where differences are significant. This apparatus includes various modifications designed even further to simplify the construction and economise in cost. Firstly it will be noted that instead of the flexible belt **31** extending around the pulleys, the temporary supporting surface is provided by a rigid metal horizontal plate **60** attached to the upper end of the pusher plate **25.** This rigid plate is additionally supported by an anti-friction bearing block **61** and although it projects horizontally an appreciable distance it is found in practice that this horizontal projection is not inconvenient, and avoids the complexity of the flexible belt **31.**

Secondly it will be noted that the fixed front wall **11'** is replaced by a hinged flap **62.** The hinge **63** incorporates a resilient torsion device (not shown), or the whole of the lower part of the front wall may be formed by a rubber flap which combines the function of hinged plate and spring. The purpose of this resilient flap is to accomodate variations in the stacking angle of the top end of the stack **15** which tends to be irregular in practical operations.

Thirdly it will be noted that the pusher plate **25'** is connected to the drive drum **35'** by a single tension band or cord **65.** This is a one-way drive system and in this arrangement the shaft **38'** is continuously driven in one direction and each drum **35'** is connected to the shaft through an individual electromagnetic clutch, the return movement of the pusher plate **25'** being provided by another cord **66** connected between the pusher plate and a constant force rotary spring device **67.** At the extreme limit of travel of the pusher plate **25'** to the right the rollers **40'** move off the platform **14'**, which returns upwards, thus opening a switch **SW1'** which de-energises the clutch and allows the pusher plate to return to the left under the action of the spring **67.** Damping may be incorporated if necessary to limit the return speed. This arrangement avoids the need to provide a reversible drive for the main motor and enables any number of sorter boxes **10** to be emptied at any instant regardless of the phase relationship between the individual boxes.

The sequence of operations in the embodiment of FIG. **5** is basically similar to that of the previous example.

Figs. **6** and **7** illustrate an alternative pack shearing device which may be employed, in place of the fixed front wall **11** of FIG. **1** or the hinged flap **62** of FIG. **5.** This device is power-operated and designed to reduce the tendency for the top items of mail in the stack **15** to assume a partially ejected position, when the main stack is ejected to the right.

A lever **72** is attached to a sleeve **73** pivotally mounted surrounding a constantly rotating slow speed shaft **74.** The lower end of the lever supports a rubber-covered roller **75** attached to a pulley **76,** and a rubber belt **77** drives the roller from another pulley **78** fixed to the shaft **74,** the direction of rotation of the roller being indicated by arrow **79** in FIG. **6.** The sleeve **73** is attached to a helical spring **80,** whose other end is secured to an angularly adjustable fixed collar **81,** the spring tending to urge the lever in the direction of arrow **82** downwards onto the top of the stack. The lever **72** is normally located in an upright vertical position by a dog **83** engaging a dog **84** attached to a stationary boss **85,** but the lever can move against the spring to an inclined position as shown in FIG. **6.** In this FIG. a stack **15** is being ejected, and if any items of mail such as those shown at **88** do not move uniformly with the main stack the contra-rotating roller **75** will drive them back to their original position below the main sorter box **10.** It will be noted that if the resistance to movement of these mail items **88** increases, the pressure exacted by the roller **75** will also increase, thus providing a "positive feed back" effect.

I claim:

1. Sorting apparatus for mail, cards, or like flat articles, including a magazine for holding a stack of said articles, said magazine having a generally vertically movable platform on which the stack of articles is built up, means including a resilient spring device for controlling the vertical movements of said platform, said resilient spring device having a rate characteristic so related to the average density of the articles in the stack that the top article in the stack is maintained at a substantially constant level, a laterally movable pusher of substantial height arranged to transfer a stack off said platform, a gate device attached to said magazine and arranged to retain in the magazine any articles in excess of a predetermined stack height, and a horizontal supporting surface connected to said pusher to support said excess articles temporarily in the magazine, and wherein said sorting apparatus includes drive means for actuating said pusher comprising a power drive member clutch means for connecting said pusher to said drive member for ejector operations, and spring means for returning said pusher when the clutch is disengaged, and automatic control means for operating said platform and its pusher in a cycle wherein the platform descends under the weight of the stack to a predetermined level, the pusher moves horizontally to eject the stack off the platform, the said platform returns upwardly to its starting position below said magazine, and the said pusher returns horizontally to its original position.

2. Sorting apparatus according to claim **1** in which said gate device includes a power-driven rotary friction element arranged to engage all articles supported on said platform in excess of a pre-determined height, and acting to drive back said excess articles horizontally into vertical alignment with said magazine.

3. Apparatus according to claim **1,** in which said horizontal supporting surface is a flexible belt.

4. Apparatus according to claim **1,** in which said horizontal supporting surface is a rigid plate.

5. Apparatus according to claim **1,** including interlock means connected to said pusher and engaging said platform to prevent the platform rising until the pusher has ejected the stack.

* * * * *