

Jan. 14, 1969

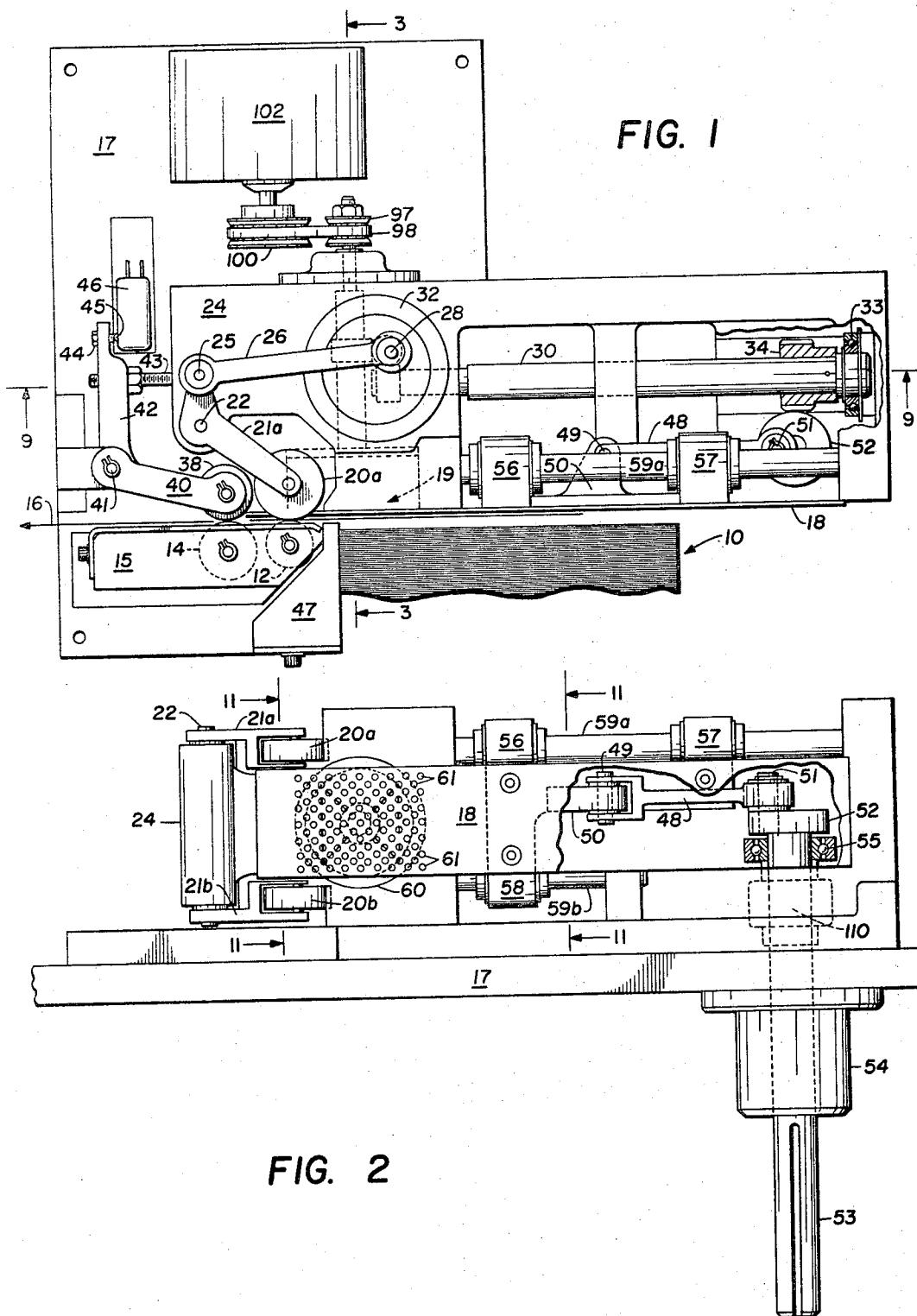
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3,421,753

VACUUM OPERATED DOCUMENT FEEDER SYSTEM

Filed July 11, 1967

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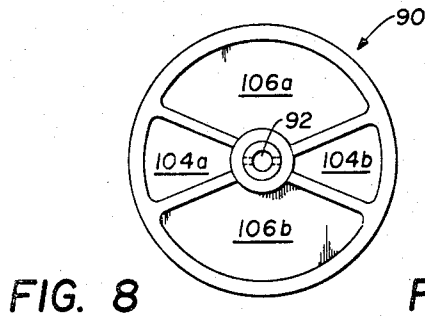
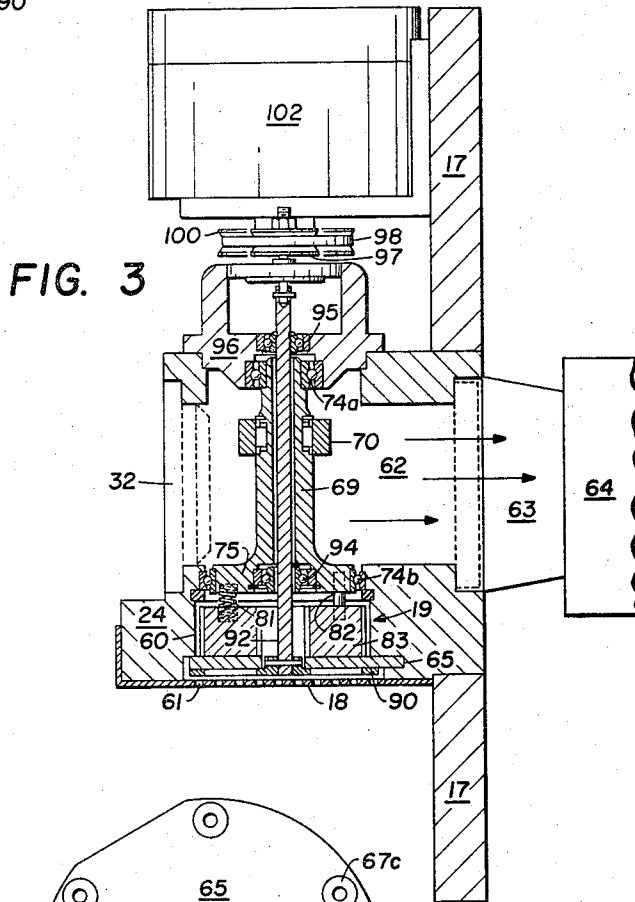
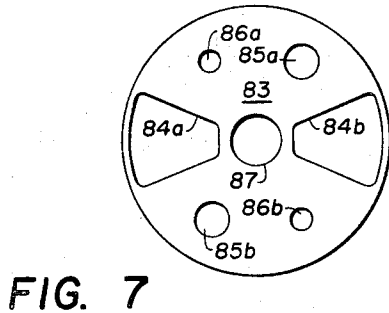
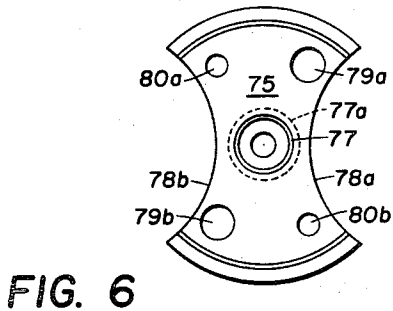
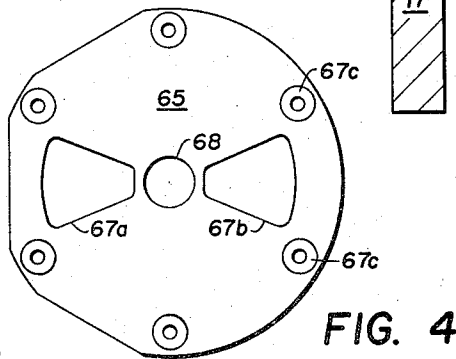
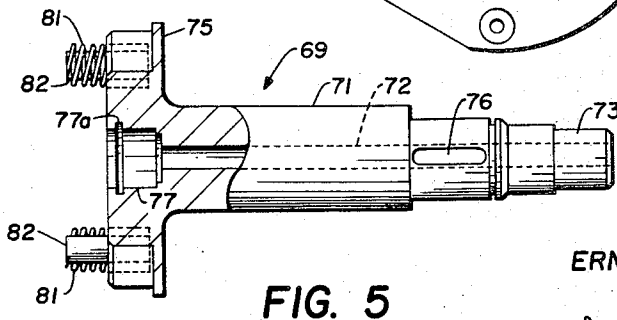
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Sheet 2 of 3



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Sheet 3 of 3

FIG. 9

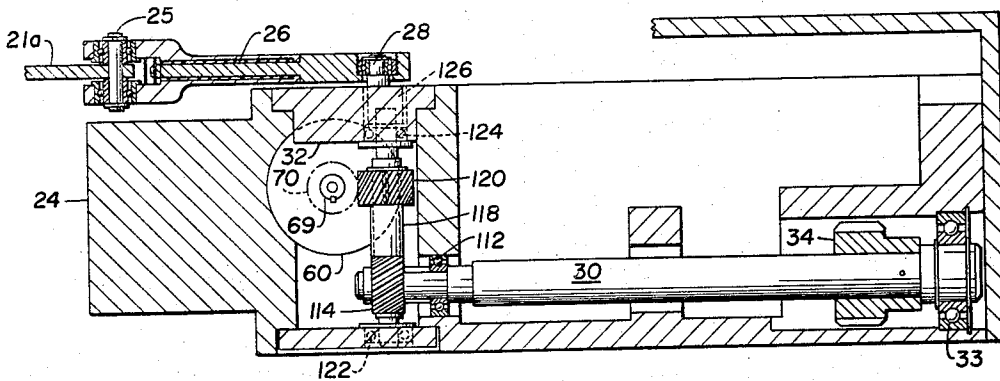


FIG. 11

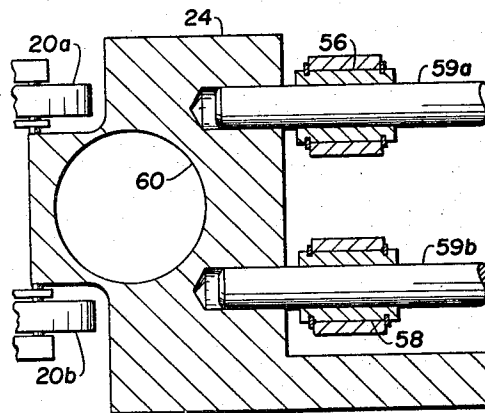
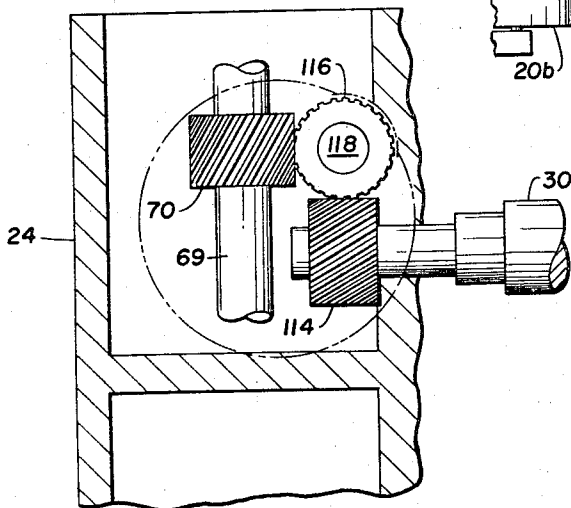


FIG. 10

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VACUUM OPERATED DOCUMENT FEEDER SYSTEM

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15 Claims

ABSTRACT OF THE DISCLOSURE

A rotary valve having a port therethrough rotates adjacent to a fixed registration plate having a corresponding port therethrough in order to periodically apply a vacuum to a perforated shuttle plate. The plate is laterally reciprocated adjacent to the end of a stack of documents to engage and laterally feed one document at a time to a conveyor. A rotary control disk may be selectively stepped to block the application of vacuum to the shuttle plate in order to positively stop the feeding action of the shuttle plate.

Cross reference to related patents

This application is an improvement of the system disclosed in U.S. Patent 3,300,207, issued Jan. 24, 1967.

Field of the invention

This invention relates to a system for serially feeding documents from a stack, and more particularly to a document feeder system which employs a reciprocating plate moving laterally at the end of the document stack to shift documents into a conveyor system. In a more specific aspect, this invention relates to a vacuum operated document feeder having rotary vacuum valve controls for sequentially applying a vacuum to the reciprocating plate and for positively blocking the application of vacuum to the plate when desired.

Description of the prior art

Systems have heretofore been developed for feeding documents into document handling systems such as document sorter devices or document reading devices. Such documents may take a variety of forms, such as relatively thick punched cards, relatively thin flexible bank checks, cardboard sheets, plastic plates, or the like. Such document feeders are usually operated at extremely high speeds and feed the documents one at a time through a conveyor to the handling system.

Document feeders have heretofore been advantageously operated by utilization of a vacuum which is applied through a reciprocating perforated plate to the top document at the stack of documents. Such a system is disclosed in the previously identified U.S. Patent No. 3,300,207. While such systems have been found to provide generally fast and efficient document feeding, problems have sometimes arisen when it is desired to stop feeding the documents to the handling system at a predetermined point in time. Because of the high rate of speed utilized in such document feeding system, a number of excess documents may be fed into the conveyor system before the feeding system can be completely deenergized. A need has thus arisen for a vacuum operated document feeder system wherein the feeding of documents may be selectively stopped within a very short interval of time.

Summary of the invention

In accordance with the present invention, a rotary valve having a port therein is adjacently disposed to and rotates in synchronism with a reciprocating perforated

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document shuttle. Vacuum is applied through the port in the valve to the shuttle plate. A fixed registration plate and a rotary control disk, each having a similarly configured port therethrough, are disposed between the valve and the shuttle plate. Drive means is provided to step the control disk to control positions in order to selectively block the application of vacuum to the shuttle plate and stop the feeding of documents by the shuttle plate.

Brief description of the drawings

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the following drawings in which:

FIGURE 1 illustrates a top view, partially broken away, of the present document feeder system;

FIGURE 2 is a front view of the system illustrated in FIGURE 1;

FIGURE 3 is a sectional view of the rotary vacuum control valve taken generally along the section lines 3-3 of the system shown in FIGURE 1;

FIGURES 4-8 are views of the various components of the rotary vacuum control valve according to the present invention;

FIGURE 9 is a sectional view of the feeder taken generally along the section lines 9-9 of FIGURE 1;

FIGURE 10 is an enlarged view of a portion of the driving system of the feeder shown in FIGURE 9; and

FIGURE 11 is a sectional view of the feeder, taken generally along section lines 11-11 of FIGURE 2.

Description of the preferred embodiments

Referring now to FIGURE 1, a feeder is illustrated which will serially deliver documents from the end of a document stack 10 into a document conveyor system which includes rollers 12 and 14. The rollers are driven by a suitable motor (not shown) and are mounted for rotation upon a suitable bracket 15. The documents will be delivered one at a time to the conveyor system for travel along a path represented by the arrow 16. A support plate 17 supports the feeder and may be mounted on a document handling system.

The stack of documents 10 is held at a suitable position relative to the feeder by means of a tray and delivery system (not shown). A suitable tray and motor driven delivery system is disclosed in the previously identified U.S. Patent 3,300,207. Such a system will maintain a constant supply of documents in close proximity to a perforated shuttle or feeder plate 18 which reciprocates laterally adjacent the top of the stack of documents. Vacuum from a plenum inside the feeder is periodically vented through the perforations in shuttle plate 18 by a rotating valve system shown generally by numeral 19, to be later described. The application of vacuum through plate 18 will periodically lift the top document from the stack 10, as shown in FIGURE 1, and the reciprocation of plate 18 will move the document into positive contact with the rollers 12 and 14 of the conveyor system for travel in the direction of arrow 16.

As shown in FIGURES 1 and 2, a pair of rollers 20a and 20b are rotatably supported by a pair of bifurcated arms 21a and 21b. Arms 21a and 21b are pivotally connected at a pivot 22 to the main body 24 of the document feeder system. The upper end of the arm 21a is connected at pivot 25 to an end of the lever arm 26. The other end of the lever arm 26 is rotatably connected to the eccentrically mounted crankpin 28. Crankpin 28 is rotated through connections with the drive shaft 30, to be later described in detail. Plate 32 is rigidly connected to the main body 24. The end of drive shaft 30 is rotatably mounted in bearings 33. Gear 34 is engaged by suitable

driving gears, to be later described, to rotate shaft 30. It will thus be seen that the lever 26 will be laterally reciprocated due to the eccentric movement of crankpin 28 in order to periodically raise and lower the rollers 20a and 20b to engage one document at a time against the driven rollers 12.

Another set of rollers 38 are rotatably connected at one end of a support arm 40. Arm 40 is connected at pivot 41 to a contact member 42 which is normally maintained at a predetermined distance from the main body 24 by an adjustable screw mechanism 43. A contact screw 44 is normally in contact with the contact point of a relay 46. Upon the introduction of a document between rollers 14 and 38, the arm 40 will be pivoted upwardly in order to move the contact screw 44 away from the contact point 45 of the relay 46. Relay 46 may thus provide indications of the number of documents being fed through the conveyor system, as well as providing other control functions. A plenum chamber 47 is provided adjacent the mouth of the conveyor system to prevent more than one document moving in the conveyor, in a similar manner as disclosed in U.S. Patent 3,300,207.

The shuttle plate 18 is reciprocated by the reciprocal motion of a lever 48 which is connected at a pivot 49 to an extension 50 rigidly connected to the upper face of the plate 18. As best shown in FIGURE 2, the end of the lever 48 is connected to a crankpin 51 which is rotated by a driven wheel 52. Wheel 52 is rotated by a drive shaft 53 which is journaled through a bearing box 54 and bearings 55. Shaft 53 is driven by a suitable motor in order to laterally reciprocate the lever 48, which in turn reciprocates the shuttle plate 18. In a manner similar to the device disclosed in U.S. Patent 3,300,207, plate 18 is connected to three bearing housings, 56, 57 and 58, which are slidably mounted on guide rods 59a and 59b in order to guide shuttle plate 18 along a predetermined path of reciprocation.

FIGURE 11 illustrates in detail the connection of the guide rods 59a and 59b to the main body 24, in addition to the sliding mount of the bearing housings 56 and 58 on the rods 59a and 59b. A circular opening 60 is defined through the body 24 in order to receive the rotary valve combination, to be later described, which controls the application of vacuum through the opening 60 to the shuttle plate 18.

FIGURE 2 illustrates the front detail of the shuttle plate 18, wherein a number of perforations 61 are defined in a predetermined pattern through an end portion of the shuttle plate. Although the perforations 61 are illustrated as having circular configurations, it will be understood that other configurations, such as a plurality of slots or the like, may alternatively be provided. In order that shuttle plate 18 may selectively engage the top document from the stack of documents 10, vacuum is applied through perforations 61.

FIGURE 3 illustrates a vacuum plenum 62 coupled by way of a manifold 63 to a vacuum blower 64. The blower 64 maintains a vacuum in the plenum chamber 62, a suitable vacuum magnitude being about 6 inches water column. Plate 32 serves as a front closure member for a vacuum plenum 62. Thus, vacuum can only be applied through the rotary valve system 19 to the perforated plate 18. The rotary valve system 19 comprises a fixed registration plate 65 which is fixedly connected by suitable screws to the main body 24 across the circular opening 60 in the body 24. Opening 60 forms the path between the vacuum plenum 62 and the shuttle plate 18.

The fixed registration plate 65, which may be constructed from any suitable material, such as a relatively thin plastic sheet, is shown in greater detail in FIGURE 4, wherein two ports 67a and 67b may be seen to be defined through the registration plate. A plurality of holes 67c accommodate suitable screws for connection to body 24. While the ports 67a and 67b are seen to have a generally triangular configuration, it will be understood that

other port configurations could be utilized if desired. A central opening 68 is also defined through the registration plate 65.

A rotary valve member 69 is synchronously rotated with the reciprocation of shuttle plate 18 by suitable drive gears which engage with gear 70, as will be later described in more detail. FIGURE 5 illustrates the rotary valve member 69, which includes an elongated shaft portion 71 having a central bore 72 therethrough. Member 69 may preferably be constructed from cold rolled steel and provided with a suitable oxide finish. An upper end portion 73 of member 69 is received by bearings 74a (FIGURE 3) to allow rotation thereof. An enlarged diameter end 75 is configured to receive a suitable bearing arrangement 74b (FIGURE 3) for rotation with respect to body 24. A slotted portion 76 is defined in the shaft portion of member 69 in order to allow connection with a gear member 70. The end portion 75 includes a counter-bore 77 defined in the center thereof, with an annular slot 77a adapted to receive a retaining washer as later described.

As best shown in FIGURE 6, the enlarged diameter end 75 includes two semicircular cutout portions 78a and 78b which define ports through which vacuum may be applied to the shuttle plate 18 from the vacuum plenum 62. A pair of countersunk bores 79a and 79b are defined in the end portion 75, in addition to a pair of smaller diameter countersunk bores 80a and 80b. As shown in FIGURES 3 and 5, a spring 81 is disposed in each of the countersunk bores 79a and 79b, while an elongated rigid pin 82 is disposed in each of the countersunk bores 80a and 80b. The two springs 81 and the two pins 82 are provided to connect the valve member 69 with a rotary valve disk 83 (FIGURE 3).

FIGURE 7 illustrates in detail the rotary valve disk 83, which may be constructed from a suitable plastic material or the like. Disk 83 includes a pair of ports 84a and 84b which have triangular configurations generally similar to the ports in the fixed registration plate 65. Disk 83 also includes a pair of spaced apart counter bores 85a and 85b and a pair of smaller diameter counter bores 86a and 86b. A central opening 87 is also defined completely through the disk 83.

As shown in FIGURE 3, the pins 82 disposed in the enlarged end portion of the valve member 69 will extend into the counter bores 86a and 86b of disk 83, while springs 81 will extend into the counter bores 85a and 85b of the disk 83. During rotation of the valve member 69, the rigid pins 81 will cause rotation of the disk 83. Springs 82 will force the disk 83 against the fixed registration plate 65 in order to prevent vacuum leakage.

Because of the periodic rotation of the ports 84a and 84b of the valve disk 83 past the fixed ports 67a and 67b of the fixed registration plate 65, it will be understood that the vacuum in the vacuum plenum 62 is periodically vented through the shuttle plate 18 when the ports are in substantial registration. When the ports in the rotating disk 83 are out of registration with the ports in fixed registration plate 65, no vacuum will be applied through the perforations in the shuttle plate 18.

The rotation of the rotary valve member 69 and the rotary valve disk 83 are synchronized with the reciprocating movement of the shuttle plate 18 so that vacuum is applied to the shuttle plate 18 only when it is desired to pick up the top document from the stack of documents 10 and until the edge of the document is fed into the conveyor system. The vacuum is then cut off until the shuttle reciprocates back over the stack of documents and is ready to pick up the next document at the top of the document stack.

As previously mentioned, it is often desirable to be able to quickly stop the feeding of documents into the document handling system at a predetermined point and time. This is best accomplished by quickly shutting off the application of vacuum to the shuttle plate 18 by the

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use of a stop feed disk 90. Disk 90 is disposed between the fixed registration plate 65 and the shuttle 18. The stop feed disk 90 is rigidly connected to one end of an elongated shaft 92 which extends through the central openings in the fixed registration disk 65, the synchro- 5
nously rotated valve disk 83 and valve member 69. Shaft 92 is journaled in suitable bearings 94 disposed within the counter bore 77 of the valve member 69 and held in place by a retaining washer inserted in the annular slot 77a. The opposite end of the shaft 92 is journaled in suitable 10
bearings 95 connected to a top support member 96. The upper end of the shaft 92 is connected to the axle of a drive wheel 97 which is rotated by a flexible belt 98 driven from a larger drive wheel 100. Drive wheel 100 is rotatively stepped by a stepping motor 102, which may be, for example, a conventional electrical stepping motor.

A more detailed view of the stop feed disk 90 is shown in FIGURE 8, wherein a pair of spaced apart ports 104a and 104b are defined through the disk. A pair of block- 20
ing areas 106a and 106b are disposed between the ports defined through the disk 90, the blocking areas being slightly relieved in thickness to assist in preventing leakage of vacuum. Disk 90 may be advantageously constructed from a relatively thin sheet of suitable plastic material. 25

In normal usage wherein it is desired to serially feed documents into a document handling system, the motor 102 is deenergized and the ports 104a and 104b of disk 90 are in substantial registration with the ports 67a and 67b of the fixed registration disk 65 so that the periodic application of vacuum to the shuttle plate 18 is not impeded. 30

When it is desired to stop the feeding of documents, stepping motor 102 is energized to selectively rotate the stop feed disk 90 approximately 90 degrees in order to move ports 104a and 104b out of registration with the 35
ports of the fixed registration disk 65. The relieved portions 106a and 106b will thus obstruct the path between the vacuum plenum 62 and the shuttle plate 18 so that, although the shuttle plate 18 continues to reciprocate, no vacuum is applied therethrough and no documents are fed from the system. Because of the small amount of rotative movement required to shut off the vacuum applied to the shuttle plate 18, it is possible to quickly stop the feed of documents from the present system. 40

FIGURE 9 illustrates the common drive which is applied to the lever arm 26 and to the valve member 69. Drive shaft 30 is rotated by means of engagement of gear 34 with the gear 110 (FIGURE 2) connected to the ro- 45
tating shaft 53. The rear end of shaft 30 is journaled in suitable bearings 33, while the forward end is journaled in suitable ball bearings 112. A worm gear 114 connected to the end of the drive shaft 30 interconnects with a mating gear 116 (FIGURE 10) to rotate shaft 118. A worm gear 120 spaced on shaft 118 from gear 116 interconnects 50
with the mating gear 70 on the valve member 69 to provide rotation thereto. 55

Shaft 114 is journaled at one end in bearings 122 and at the other end in bearings 124 for free rotation thereof. Crankpin 28 is fixedly connected eccentric to the axis of a member 126 which is rotated by shaft 114. It will thus be understood that rotation of shaft 30 rotatively drives the valve member 69 to periodically vent vacuum through the shuttle plate 18 and also rotatively drives the crankpin 28 in order to periodically operate the rollers 20a and 20b. Shaft 30 is driven by rotation of shaft 53, which also reciprocatingly drives the shuttle plate 18. The common drive provided by the present system assures proper sequential operation of the various portions of the system. 60

What is claimed is:

1. In a document feeder having a perforated shuttle plate reciprocated adjacent to the end of a stack of documents, the combination which comprises:
 - (a) a rotary valve element having a port therein dis- 65
posed adjacent to said shuttle plate and rotating 70
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in synchronism with the reciprocation of said shuttle plate,

- (b) a fixed registration plate disposed between said valve element and said shuttle plate and having a port therein of configuration generally corresponding to the port in said valve element,

- (c) a rotary control disk disposed between said registration plate and said shuttle plate and having a port therein with a configuration generally corresponding to the port in said registration plate, and

- (d) means for selectively rotating said control disk between a first and second control position in which said port in said disk is in and out of registration, respectively, with the port in said registration plate.

2. The combination defined in claim 1 and further comprising:

- a suction plenum, said rotary valve element being disposed between said suction plenum and said shuttle plate for sequentially opening and closing the path from said suction plenum to said shuttle plate.

3. The combination defined in claim 2 and further comprising:

- means for rotatively stepping said control disk between said control positions to selectively open or close the path between said suction plenum and said shuttle plate.

- (a) said rotary valve element comprises an elongated hollow shaft with a backup disk at one end of said shaft having wells in one face thereof and ports defined therein,

- (b) a valve disk having ports therein corresponding with the ports in said backup disk,

- (c) pin means for connecting said valve disk to said backup disk for rotation therewith, and

- (d) spring means disposed between said valve disk and said backup disk for biasing said valve disk against said fixed registration plate.

4. The combination defined in claim 2 wherein:

- (a) said rotary valve element comprises an elongated hollow shaft with a backup disk at one end of said shaft having wells in one face thereof and ports defined therein,

- (b) a valve disk having ports therein corresponding with the ports in said backup disk,

- (c) pin means for connecting said valve disk to said backup disk for rotation therewith, and

- (d) spring means disposed between said valve disk and said backup disk for biasing said valve disk against said fixed registration plate.

5. The combination defined in claim 4 wherein:

- (a) the ports in said backup disk comprise a pair of oppositely spaced semi-circular cutout zones,

- (b) the ports in said valve disk being fixed in registration with the ports in said backup disk and having generally triangular configurations, and

- (c) the adjacent faces of said backup disk and said valve disk including recesses for accommodating the ends of said pin means.

6. The combination defined in claim 4 wherein said rotary control disk includes an elongated drive shaft longitudinally extending through said fixed registration plate and said hollow shaft of said rotary valve, and means for stepping said shaft to selectively position the ports in said control disk.

7. The combination defined in claim 6 wherein said control disk includes two diametrically spaced apart ports having generally triangular configurations, and relieved portions defined in said control disk between said ports in the side thereof disposed adjacent to said fixed registration plate.

8. The combination defined in claim 3 and further comprising:

- roller means adjacently disposed to one end of said shuttle plate and operable in synchronism with the reciprocation of said shuttle plate to periodically en-

gage a portion of a document and laterally move the document from the stack of documents.

9. The combination defined in claim 8 and further comprising:

- (a) a rotating shaft having a crank means connected to one end thereof, and
- (b) an arm mounted between said crank means and said roller means for periodically moving said roller means into engagement with documents.

10. The combination defined in claim 8 and further comprising:

drive means for providing common drive to said shuttle plate, rotary valve and rotating shaft.

11. In a document feeder for feeding documents from the end of a document stack into a conveyor, the combination comprising:

- (a) structure forming a vacuum plenum,
- (b) a perforated shuttle plate laterally reciprocated across the end of the document stack,
- (c) a fixed registration plate having a port therethrough disposed between said vacuum plenum and said shuttle plate,
- (d) a rotary valve disk having a port therethrough with a configuration generally corresponding to the port in said registration plate,
- (e) means to rotate said valve disk in synchronism with the reciprocation of said shuttle plate for sequentially venting said plenum chamber through said shuttle plate to attach the end document on the document stack for transfer to the conveyor,
- (f) a rotary control disk disposed adjacent said registration plate and having a port therein of configuration generally corresponding to the port in said registration plate, and
- (g) means for rotatably stepping said control disk to selectively open or close the path between said vacuum plenum and said shuttle plate.

12. The combination defined in claim 11 and further comprising:

common drive means for providing rotation to said valve disk and reciprocation to said shuttle plate.

13. The combination defined in claim 12 and further comprising:

- (a) a rotating drive shaft,
- (b) crank means connected to an end of said drive shaft,
- (c) arm means connected between said crank means and said shuttle plate for reciprocating said shuttle plate, and
- (d) gear means connected between said drive shaft and said valve disk providing rotation to said valve disk in synchronism with the reciprocation of said shuttle plate.

14. The combination defined in claim 13 and further comprising:

roller means disposed adjacent to said shuttle plate and operable in synchronism with reciprocation of said shuttle plate to periodically engage a portion of a document for movement to said conveyor.

15. The combination defined in claim 14 and further comprising:

- (a) a rotating shaft driven by said gear means and having a crank connected to one end thereof, and
- (b) pivotally connected lever means connected between said crank and said roller means for periodically moving said roller means into engagement with documents.

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UNITED STATES PATENTS

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RICHARD E. AEGERTER, *Primary Examiner.*

U.S. Cl. X.R.

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