United States Patent [19]

Schulze

[11] **3,815,900**

[45] **June 11, 1974**

[54] **HIGH SPEED DOCUMENT FEED**

[75] Inventor: **Erwin F. Schulze,** Novelty, Ohio

[73] Assignee: **Addressograph-Multigraph Corporation,** Cleveland, Ohio

[22] Filed: **Feb. 2, 1973**

[21] Appl. No.: **328,971**

[52] **U.S. Cl.** **271/118**

[51] **Int. Cl.** **B65h 3/06**

[58] **Field of Search** 271/118, 117, 114, 115, 271/126, 127, 109, 116, 110, 111

[56] **References Cited**

UNITED STATES PATENTS

640,368 1/1900 Cross 271/111

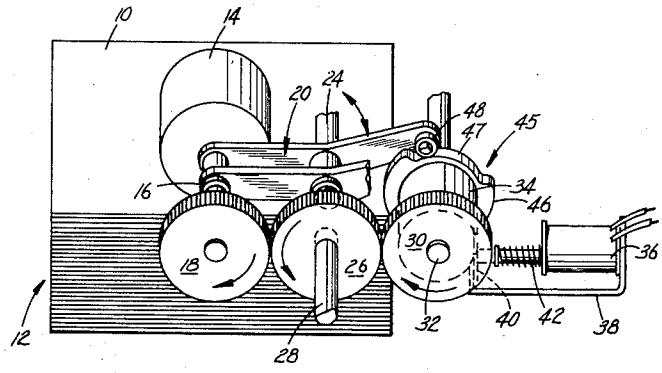
1,441,271 1/1923 De Escobales 271/118

Primary Examiner—Evon C. Blunk
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney, Agent, or Firm—Ray S. Pyle

[57] **ABSTRACT**

An apparatus for the seriatim feeding of documents from a stack at high speeds. A friction feed roller is arranged to move in and out of contact with a stack of documents. As the roller approaches the stack of documents there is little or no relative movement between the roller and a document in a feed direction. On contact with the document, the roller begins to accelerate causing a smooth transition from standing to moving as the document is fed.

2 Claims, 3 Drawing Figures



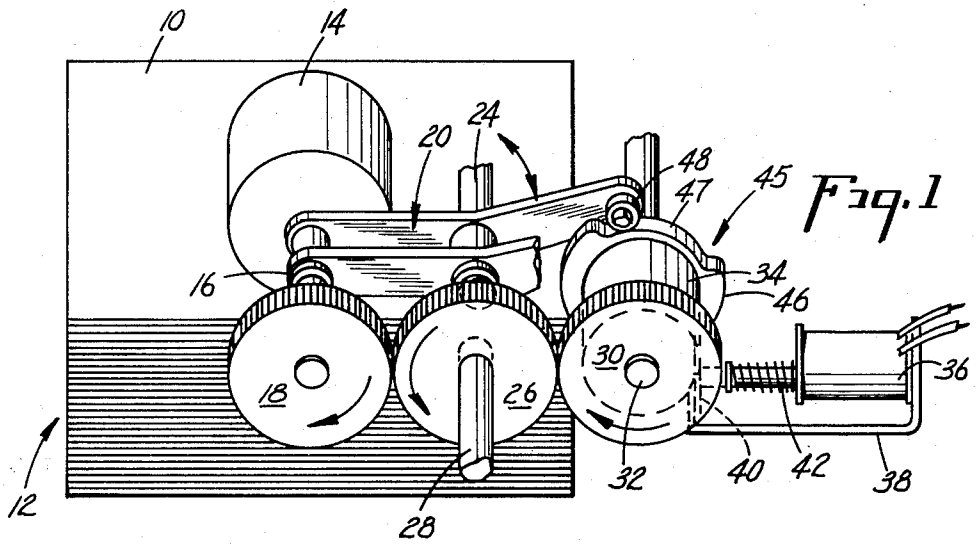


Fig. 1

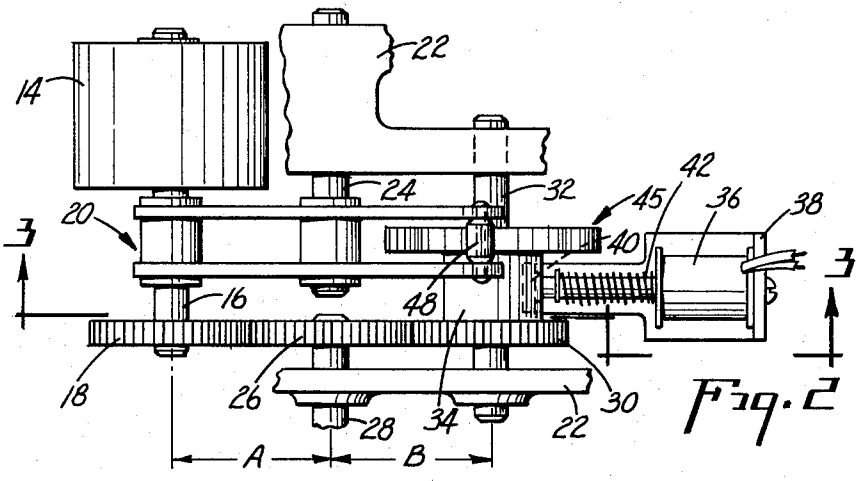


Fig. 2

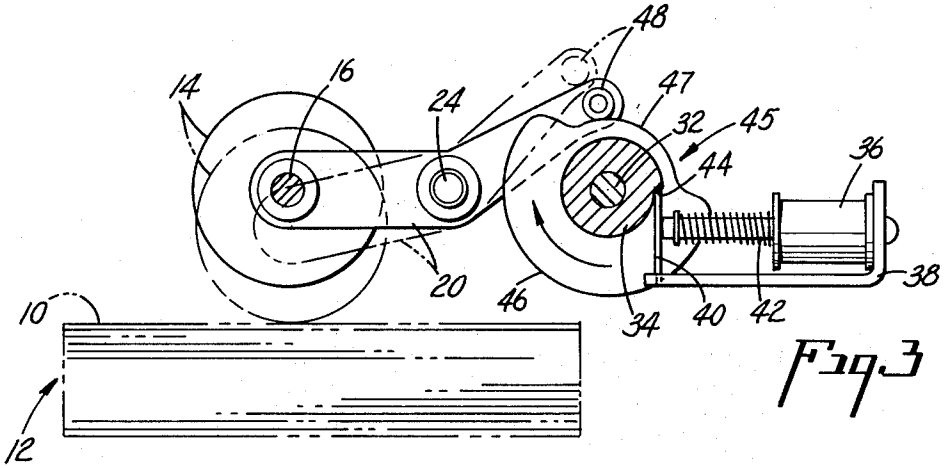


Fig. 3

HIGH SPEED DOCUMENT FEED

BACKGROUND OF THE INVENTION

This invention relates in general to apparatus for handling documents and more particularly, to the seriatim, high speed feeding of documents.

The use of a friction feed roller in document handling devices is well known. The term "friction feed roller" is generally meant to imply a cylindrical shaped element mounted for rotation about its central axis having an exterior surface composed of hi-friction material allowing minimum spillage between the surface of the roller and the surface of a document to be fed. In prior art concepts, the roller is either continually turning and moved into contact with a document, or constantly in contact with the documents and periodically activated.

The former of these two concepts results in difficulties due to the speed at which the roller contacts a document. Either more than one document at a time is effected by the moving roller or slippage occurs between the roller and the documents causing inefficient feeding of any documents.

Devices of the latter concept are generally more expensive to manufacture. In order to allow continual contact with a document while feeding only on demand, a clutch is generally incorporated into the roller. The clutch allows rolling contact in one direction and sliding or dragging contact in the other direction. However, of more importance in this case, they are not meant to function as high speed feeding devices.

SUMMARY OF THE INVENTION

Therefore, it is an object of this invention to improve the high speed feeding of documents.

A further object is to feed only one document at a time in a seriatim manner.

Another object of the invention is to cause positive engagement of the first document in a stack without inefficient slippage.

Other objects of the present invention will become apparent through a detailed discussion of the preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the document feeding apparatus.

FIG. **2** is a plan view from the top of the document feeding apparatus.

FIG. **3** is a cross sectional view of the document feeding apparatus taken substantially along the line **3—3**, looking in the direction of the arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENT

When a normally moving friction feed roller is lowered onto a stack of documents in a manner to cause the roller to stand still or even practically stand still, the effect as the roller is allowed to accelerate to its normal moving speed is a quick, efficient transfer of one document from the stack.

In FIG. **1**, a document **10** is positioned on the top of a stack of documents shown generally as **12.** A friction feed roller **14** for contacting a document to be fed is permanently attached to a shaft **16.** A first gear **18** is also attached to shaft **16.** A rocker arm **20** is positioned to support the friction feed roller and the first gear. The rocker arm **20** is mounted to a support surface **22** for rotation about a mounting pin **24.**

The support surface **22** serves to permanently mount the various components of the document handling apparatus. A number of arrangements of the support surface are possible. The support surface may be permanently attached to the frame of the machine which is being used in conjunction with the document handling apparatus. In this case, the stack of documents will have to be arranged to move in the direction of the handling apparatus. This is necessary in order that the first document be in the correct position with respect to the friction feed roller for each feeding of a document.

Another possible arrangement of the support surface allows the entire apparatus to ride the surface of the first document on the stack. Here, the spacing of the friction feed roller with respect to the first document is critical. In this case, the stack of documents would not need to be moved.

Still another arrangement of the support surface results in the positioning of the stack of documents **12** on edge. In this case, the document feeder contacts a document **10** on its side surface. Feeding of the document is edgewise in any of four possible directions. Although this arrangement might prove to be less than acceptable for paper sheet documents, feeding card stock and thicker documents would be particularly advantageous by such an arrangement. This would be a result of shock waves set up in the stack of documents **12** due to the striking of documents by the feeder. These shock waves cause document separation in the stack, a highly desired consequence in document feeding.

The arrangement of the support surface has not been indicated in the accompanying drawings, since this is thought to have no bearing on the inventiveness of this disclosure.

A drive gear **26** is directly attached to a motor shaft **28** of an electrical drive motor, not shown in the Figures. The first gear **18** is positioned to be in constant engagement with the drive gear **26.** A second gear **30** is likewise positioned to be in constant engagement with the drive gear **26.** The second gear **30** is mounted on a clutch shaft **32** which is permanently mounted in the support surface **22.** These three gears **18, 26** and **30** constitute a continuously driven gear drive. The arrows in FIG. **1** are indicative of the direction of movement of these gears in this particular embodiment.

A one revolution clutch **34** is directly coupled to the second gear **30.**

When the electrical solenoid **36** is activated, a solenoid clapper **40** is pulled away from the clutch **34** allowing movement. The electrical signal to the solenoid **36** is of short duration so that the clapper **40** is almost immediately returned to its restraining position by a spring means **42.** As the clutch **34** continues to turn, the clapper **40** rides on the surface of the clutch until a recessed slot **44** engages the clapper and restrains the clutch movement.

A cam shown generally as **45** is coupled to the one revolution clutch **34** for rotation with the clutch when the electrical solenoid activates the clutch. The cam **45** has a lobe **46** and an inoperative dwell portion **47.** The height of the lobe **46** on the cam **45** determines how far the friction feed roller **14** will move in the direction of the document stack **12,** and the shape will determine the point of maximum speed known as the point of inflection. At this point the rocker arm **20** will be moving

at maximum speed, and will carry gear **18** around the center of shaft **28** at maximum speed. When gear **18** revolves around gear **26,** a counterclockwise drive component is produced. The lobe design and drive speed are coordinated to substantially balance the counterclockwise component against the clockwise drive component of gear **26,** and thereby produce a movement of shaft **16** toward the stack **12,** but with the roller at a substantially stationary peripheral speed, i.e., no rotation. By design according to objectives, therefore, the cam will cause the friction roller to move to the stack **12** at substantially a static drive condition. Thus, as the follower traverses the remainder of the cam, the rocker arm will drive the the roller into tighter contact with the sheet as the roller begins to rotate, first slowly and then accelerating rapidly to kick the top sheet away with a snap action.

A cam follower **48** coupled to the rocker arm **20** causes the rocker arm to follow the contour of the cam **45.** Since the rocker arm is mounted to the support surface **22** by way of mounting pin **24,** the rocker arm is caused to oscillate about the mounting pin by the cam follower **48** riding the surface of the cam **45.**

As the rocker arm rotates about mounting pin **24,** the shaft **16** causes the friction feed roller **14** and the first gear **18** to also oscillate about mounting pin **24** in such a way that the first gear moves through an arc while remaining constantly engaged to the drive gear **26.** In order that the first gear and the drive gear be maintained in engagement throughout the movement of the rocker arm, a number of factors in the design become important.

The relative sizes of the gears **18, 26,** and **30** of course determine the speed at which the friction feed roller contacts the documents. However, once the speed of the friction feed roller **14** is decided upon, any combination of gear sizes which produce the desired speed may be used. In the preferred embodiment, the three gears are the same size making the friction feed roller angular speed equivalent to the drive motor speed.

Whatever the relative sizes of the gears are to be, the distance A between the centers of shaft **16** and mounting pin **24** must be equal to the sum of the radii of the first gear **18** and the drive gear **26.** This requirement is necessary so that the two gears **18** and **26** will remain in constant engagement as the rocker arm **20** is rotated.

The distance B between the centers of mounting pin **24** and cam follower **48** is also important. This distance B will determine the up and down movement of the friction feed roller. It may easily be understood that when the distances A and B are identical, the upward movement of the cam follower **48** is equivalent to the downward movement of the roller **14.** If the distance A is greater than the distance B, the movement at the roller **14** is amplified. However, if the distance B is greater than the distance A, the movement at the roller **14** is deamplified. For the most efficient operation of the device, the distance A should be at least as large as the distance B, but certainly not less. In the preferred embodiment, the distances are substantially equal.

As the arrows in FIG. **1** indicate, in this embodiment the drive gear must turn counterclockwise. With the gears engaged as shown in the figures, the first gear **18** and the second gear **30** must turn clockwise. The direction of rotation of the gears is dictated by the desired direction of document feed. In this embodiment, feeding the documents to the left in FIG. **1** necessitates a counterclockwise rotation of the drive gear **26.**

In the operation of the apparatus, an electrical signal is received by the solenoid **36** at the appropriate time. Initially, the cam follower **48** rests on the portion of the cam **45** designated above as the inoperative dwell **47.** The energization of this solenoid causes the clapper **40** to release the one revolution clutch **34** causing the cam **45** to turn with the second gear **30.** As the cam follower **48** rises onto the cam lobe **46,** the rocker arm **20** rotates causing the friction feed roller **14** and first gear **18** to be lowered towards the document stack **12.** When the first gear moves downward around the mounting pin **24,** which has the same effective center line as the motor shaft **28,** engagement with the drive gear **26** is maintained.

Since the driving force of the first gear is turning counterclockwise and the rotation of the shaft **16** is also counterclockwise about the same effective axis, the rotations will cancel to some degree. The degree to which the two rotations cancel is directly dependent upon both the speed of rotation of the shaft **16** about the motor shaft and the speed of rotation of the motor shaft **28.** The result of this cancelling of rotations is that the friction feed roller **14** decelerates as the first gear moves through an arc in the direction of the stack of documents **12.** This cancellation is due to the direction of the arc, through which the roller **14** and first gear **18** travel, and rotation of the drive gear **26** being identical.

When the cam follower **48** has risen entirely onto the lobe **46** of the cam **45,** the rocker arm **20** will have rotated towards the stack of documents **12** as far as is possible. At this point, the rotations will no longer cancel and the first gear **18** accelerates after the friction feed roller **14** encounters a first document **10** of the stack. The result is a smooth transition of a single document from standing on the stack to moving to the left, in the case of the present embodiment.

As stated more fully above, the height and rise of the cam lobe **46** determines the speed with which and the distance through which the friction feed roller travels. The length of the lobe, in terms of the extent of the circular arc is important in that the friction feed roller must be disengaged from the stack of documents before more than one document is effected.

When the cam follower **48** reaches the trailing edge of the cam lobe, a single document has been moved a sufficient distance to encounter the feed apparatus of a machine being utilized with the document feeder. At this point the friction feed roller is removed from contact with the document stack by the cam follower **48** encountering the trailing edge of the cam lobe.

Since the rocker arm **20** causes the shaft **16** to rotate about the motor shaft **28** in a direction opposite to the rotation of the drive gear **26,** the rotations will add. Thus the friction feed roller will accelerate as the cam **45** causes the rocker arm to rotate away from the stack of documents. The friction feed roller will again return to its normal driven speed once the cam follower reaches the inoperative dwell portion **47** of the cam.

What is claimed is:

1. A document handling apparatus for feeding documents from a stack, comprising:

a pivot mount;

an arm swingably mounted on said pivot mount;

a friction feed roller carried by said arm and movable thereby to a position for contacting a document to be advanced, or to an inactive position;

a driven gear carried by said arm;

means drivingly connecting said feed roller to said driven gear;

a drive gear rotatably mounted concentric with said pivot; said drive and driven gears being meshed and said gears and their distances between centers being proportioned such that pivotal swing of said driven gear will maintain the gears in meshed relationship;

means to impart a uniform rotation to said driving gear in a direction to rotate said friction roller in a sheet feeding direction;

means to pivot said arm about said pivot mount from inactive position towards document contacting position at a speed and in the direction to cause the axis of said driven gear to substantially counteract the rotational speed of said drive gear as the friction feed roller makes first contact with a document to be fed;

whereby, the friction feed roller and the paper to be fed first come into static frictional engagement, to avoid the skidding and smearing tendencies of a moving contact.

2. Apparatus as defined in claim **1** in which said arm is a rocker mounted at its center on said pivot mount, and a primary drive gear carried on the opposite end of said rocker arm, said primary drive gear and said drive gear being meshed and the distance between their centers being proportioned such that pivotal swing of said primary driven gear will maintain the gears in meshed relationship.

* * * * *