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Songer

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[54] **SHEET MATERIAL FEEDER**

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[52] **U.S. Cl.** **271/42;** 221/268; 271/251

[51] **Int. Cl.²** **B65H 3/36**

[58] **Field of Search** 271/42, 128, 130, 109, 271/18, 120, 119, 19–25, 251, 266, 267, 140; 221/268, 270, 272–274

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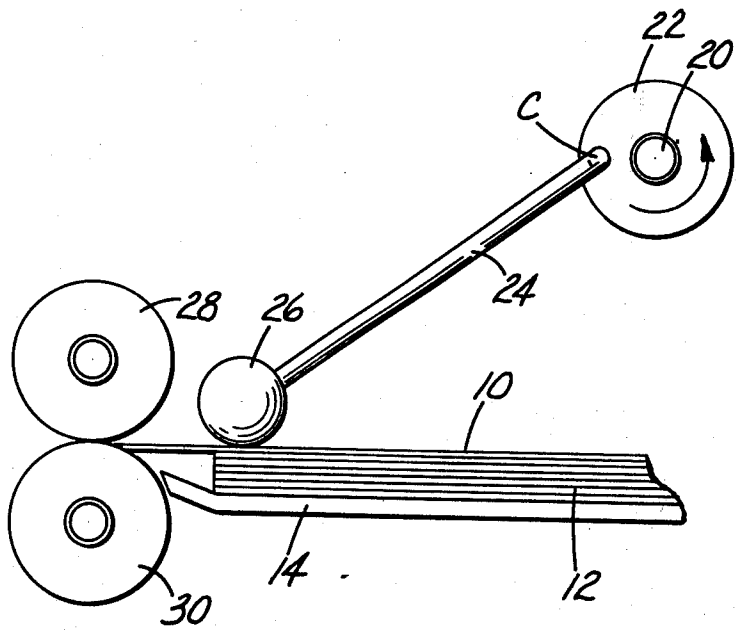
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Attorney, Agent, or Firm—Russell L. Root; Sol L. Goldstein; Ray S. Pyle

[57] **ABSTRACT**

A sheet material feeding device includes a rotatable driver member axially supported at a position spaced above a top sheet of a stack of sheets in a sheet tray. A feed member is pivotally connected to the driver member in an eccentric relationship relative to the axis of the driver member. In operation, the driver member moves the feed member in a forward feed stroke during a portion of each revolution of the driver member and moves the feed member in a rearward return stroke during the remaining portion of the revolution. The feed member extends outwardly and angularly downwardly from the driver member towards the top sheet of the stack in the direction of movement of the sheet. The free end of the feed member adjacent the top sheet is provided with a frictional element for engaging and advancing the sheet in response to a forward stroke of the feed member and is raised out of engagement with the sheet in response to a rearward stroke of the feed member to avoid retrograde movement or streaking of the sheet being fed.

5 Claims, 5 Drawing Figures



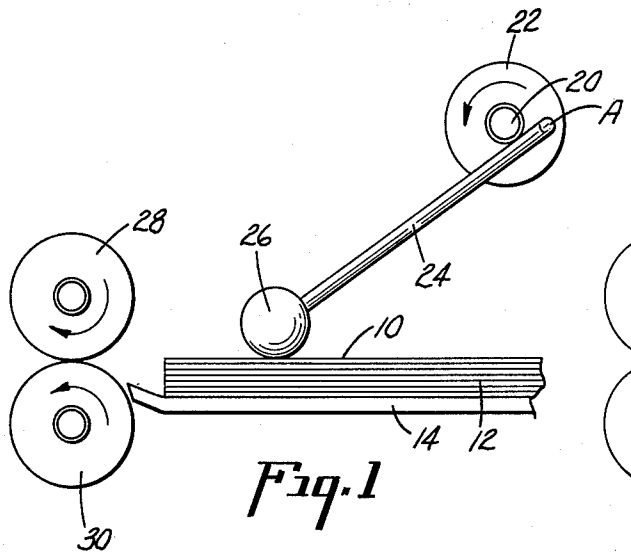


Fig. 1

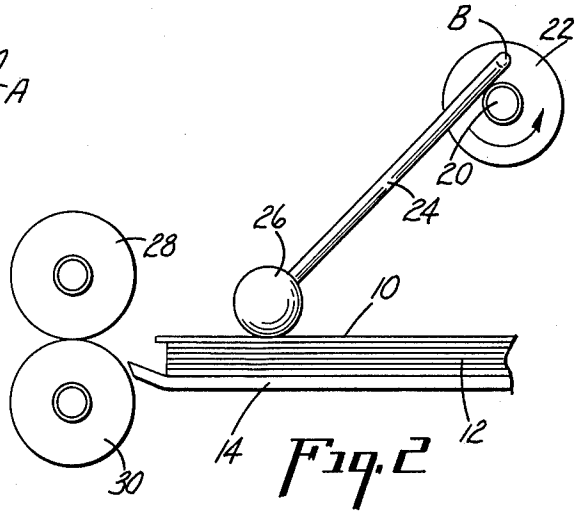


Fig. 2

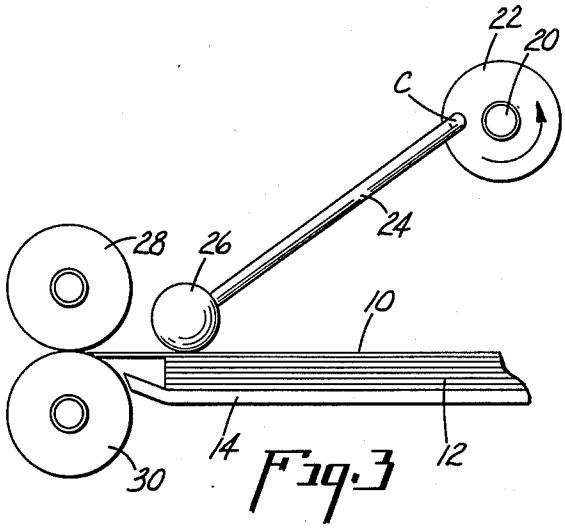


Fig. 3

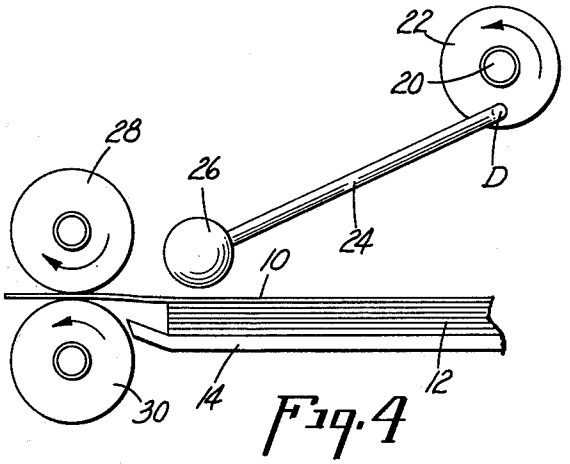


Fig. 4

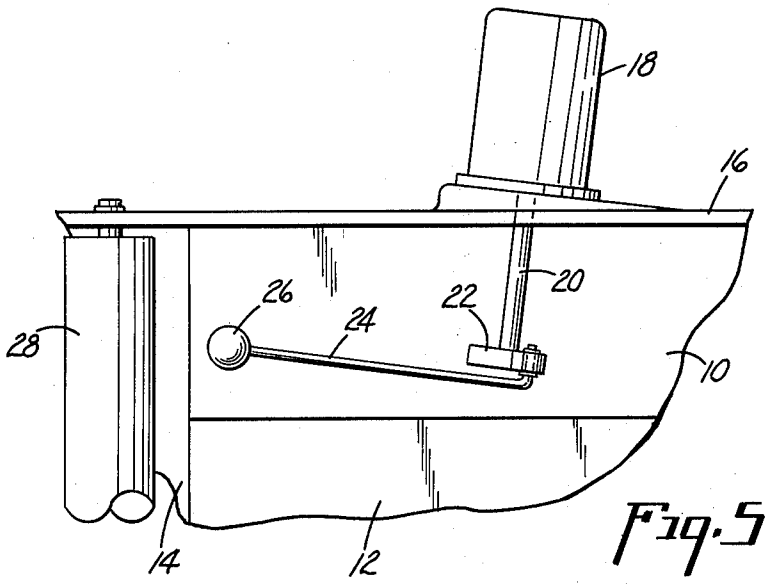


Fig. 5

SHEET MATERIAL FEEDER

BACKGROUND OF THE INVENTION

Devices for feeding single sheets from a stack disposed in a stack receiving tray into various types of utilization devices are well known. Such sheet feeding devices frequency are equipped with a pair of driven friction wheels or rollers mounted in axially spaced positions on a shaft which is disposed transverse to the direction of movement of the sheet. The wheels which rest on the top of the stack or which can be spring biased toward the stack are intermittently driven by suitable gearing or flexible connections to a drive means in the utilization device to feed individual sheets to the device at time spaced intervals. These sheet feeding devices are mounted on the frame of the apparatus adjacent the feed-in station in a fixed position. The platform of the stack receiving tray lies in a plane parallel to the plane passing through the contact points between the feed wheels and the top sheet.

One of the problems of known sheet feeding apparatus is the skewed feeding of the sheet into the utilization device. This skewed feeding frequently results from moving one side of the sheet at a faster speed than the other side. This causes the leading edge of the sheet to be presented at an angle to the feed-in station with the result that it frequently becomes fouled in the various transporting means within the apparatus.

There are a number of conditions in both the paper stack and the tray which cause skewed feeding. The condition and the location of the feeder wheels can cause the defective feeding. For example, a lack of uniformity in the wear of the wheel surfaces results in changing the peripheral speed of each of the wheels so that one side of the sheet is moved at a different speed than the other. Also, if the wheels are not symmetrically placed along the transverse width of the sheet, improper feeding can occur.

In addition, the surface finish of the sheet bears an important relationship to the uniformity of feeding because the greater the coefficient of friction between the sheet surfaces, the more critical the adjustment of the feeder wheels. The stiffness and the basic weight of the sheet are important factors since limp sheets or thin material will more readily yield and buckle along a line parallel to the direction of the movement of the sheet in response to improperly adjusted feeder wheels.

While these known types of sheet feeders have been more or less satisfactory for operation under certain conditions, they are, to a greater or lesser extent, relatively difficult to service and maintain in proper adjustment, cumbersome, and costly to manufacture.

SUMMARY OF THE INVENTION

This invention relates to sheet feeding apparatus and, more particularly, to a device for advancing individual sheets from the top of a stack of sheets to feed-in mechanism of a utilizatin device.

An object of the invention is to provide a new and improved sheet feeder device which is inexpensive, compact and capable of feeding intermixed sheets of different weights and sizes.

Another object of the invention is to provide a sheet feeder which includes only a single moving element which provides simplified operator adjustment, minimum servicing requirements and avoids skewed feeding of the sheets.

Another object of the invention is to provide a sheet feeder which, with but minor modifications, provides a wide range of feed rates i.e., the distance and the speed at which the sheet is advanced from the stack to the feed-in rollers of a utilization device.

Another object of the invention is to provide a sheet feeder comprising a single feed member. The feed member is mounted at a lateral angle with respect to a vertical side guide of the sheet tray so as to urge a side edge of the sheet being fed against the side guide to maintain accurate registration of the sheet during its advancement from the stack.

Another object of the invention is to provde a sheet feeder in which a rotary driver moves the feed member through a forward feed stroke and a return rearward stroke during each revolution of the driver. During the forward stroke a frictional element on the feed member engages and advances the top sheet of the stack and during rearward movement the frictional element is raised out of engagement with the sheet by virtue of the velocity at which the driver is rotated.

Another object of the invention is to provide a sheet feeder in which the feed member may be arranged for advancing a sheet from the stack to a feed-in mechanism in each forward stroke of the feed member, or it may be arranged to apply a series of strokes to the sheet to cause the sheet to advance with a stop and start motion.

The foregoing objects of the invention are attained by providing a sheet feeding device comprising a rotary driver member supporting an eccentrically mounted feed member having a frictional element thereon. Through the rotary drive and the eccentric motion, the feed member is moved through a forward stroke to urge the frictional element downwardly and forwardly to engage and advance the top sheet to be fed from the stack. During the rearward or return stroke of the feed member the frictional element is raised out of engagement with the sheet to avoid streaking or disturbing the sheet being fed. The raising of the frictional element out of engagement with the sheet during the rearward stroke of the feed member results from the relatively high velocity of rotation of the driver member, thereby eliminating the need for any additional controls or mechanism for raising the frictional element during the rearward stroke of the feed member.

IN THE DRAWING

FIGS. 1 – 4 are schematic side elevations of a sheet material feeding device in accordance with the practice of the present invention showing in sequence a complete feed cycle for advancing a top sheet from a stack of sheets; and

FIG. 5 is a top plan, partially broken away, showing the mounting and drive arrangement of the sheet feeding device in a start position.

DESCRIPTION OF THE PREFERRED EMBODIDMENT

The sheet feeding device is capable of feeding intermixed sheets of various weights and sizes and, as shown in FIG. 5, will be described for feeding narrow sheets **10** from the top of a stack of wider sheets **12** positioned on a sheet tray **14**.

The tray **14** is provided with a pair of side guides **16** (only one shown in FIG. 5) for maintaining both sides of the stack of sheets **12** in alignment, and the narrow

sheets **10** are positioned with only one side edge in alignment against the side guide **16** shown in FIG. **5.**

A drive motor **18** is mounted on the outer surface of the side guide **16** and includes a drive shaft **20** projecting through an opening in the side guide **16** extending over the stack of sheets. The motor **18** is angularly mounted with respect to the side guide **16** (see FIG. **5**) such that the shaft **20** and the side guide **16** form an acute angle therebetween in a direction of movement of the sheet, for a purpose to be explained hereinafter.

A driver member or disc **22** is secured on the drive shaft **20** such that the axis of the driver member **22** is substantially transverse to the direction of movement of the sheet. A feed member **24** is pivotally connected at one end to the driver member **22** in an eccentric relationship relative to the axis of the driver member **22.** The feed member **24** is provided at its other end with a frictional element **26** for engaging and advancing the top sheet to be fed.

The feed member **24** extends downwardly from the driver member **22** and forwardly in the direction of sheet feed towards the lead edge of the stack of sheets to provide a feed angle ranging from 10° to 45° between the feed member **24** and the top of the stack of sheets. The frictional element **26** normally rests by gravity on the top sheet of the stack at a point substantially displaced from a point beneath the axis of the driver member **22.** In operation, rotation of the driver member **22** imparts to the free end of the feed member **24** and, specifically, to the frictional element **26** an only partially constrained orbital motion having a reciprocatory component along the plane of the top of the stack of sheets. If the sheet feeder is used in association with a sheet tray that is periodically raised to maintain the height of the stack at a proper feeding level, the feed angle will remain fairly constant. However, if the sheet tray is fixed, the feed angle will vary as the stack is depleted or replenished and the feed member **24** will effectively advance the top sheet so long as the feed angle is within the above range.

The frictional element **26** may be made of any suitable material having a high coefficient of friction, such as silicone rubber, and it may be shaped in the form of a sphere, disc, tube, flat pad or any other desirable configuration.

Referring now to FIGS. **1 – 4,** there is shown a complete sheet feed cycle in response to a single revolution of the driver member **22.** Thus, as the driver member **22** is rotated in the direction of the arrow the pivotal connection of the feed member **24** is moved from a position A shown in FIG. **1** through positions B, C and D shown in FIGS. **2 – 4** respectively, and returns to the position A.

With the pivotal connection of the feed member **24** at the position A, the feed member **24** is in a start or neutral position and the frictional element **26** rests on the top sheet **10** of the stack. As the driver member **22** is rotated and the pivotal connection moved to the position B (FIG. **2**) the feed angle of the feed member **24** is increased such as to urge the frictional element **26** downwardly into feeding engagement with the sheet **10.**

During continued rotation of the driver member **22,** as the pivotal connection moves from the position B towards the position C, the feed member **24** is moved through a forward stroke and the top sheet is advanced slightly by the frictional element **26** as illustrated in FIG. **3.** When the pivotal connection arrives at the position C (FIG. **3**) the feed member **24** has completed its forward stroke and the lead edge of the sheet **10** has been advanced a sufficient distance to be gripped by a pair of feed-in rollers **28** and **30.**

Further rotation of the driver member **22** moves the pivotal connection to the position D (FIG. **4**) and raises the frictional element **26** out of engagement with the sheet **10** to thereby avoid streaking or disturbing the top sheet in its travel through the nip of the feed-in rollers **28** and **30.** As the driver member **22** completes the revolution, moving the pivotal connection from the position D to the position A of FIG. **1,** the feed member **24** is moved in a rearward stroke while maintaining the frictional element **26** out of contact with the top sheet.

Arrival of the pivotal connection at the position A restores the feed member **24** to the start position of FIG. **1,** with the frictional element **26** lowered into contact with the next sheet at the top of the stack in readiness for a subsequent sheet feed operation.

The lifting or raising of the frictional element **26** out of engagement with the top sheet during the rearward stroke of the feed member **24** is achieved as a result of the relatively high velocity of rotation of the driver member **22.** Thus, with the motor **18** operating at approximately 300–400 R.P.M., the velocity at which the driver member **22** is rotated is sufficiently high so that the frictional element **26** tends to be drawn towards the pivotal connection of the feed member **24** and in so doing is caused to raise up and out of contact with the stack of sheets.

As shown in FIG. **5,** the angular mounting of the motor **18** referred to above provides for also angularly mounting the feed member **24** such that it extends forwardly towards the front of the stack and outwardly towards the side guide **16.**

Because both side edges of the narrow sheets **10** are not held in alignment by the side guides **16,** as are the side edges of the wider sheets **12,** the angular position of the feed member **24** is effective to urge the side edge of the narrow sheet tight up against the side guide **16** of FIG. **5,** to thereby maintain alignment of the narrow sheet during its advancement from the stack.

While the foregoing describes a feeding operation in which a sheet is fed in each cycle or revolution of the driver member **22,** the feeding device may also be utilized for feeding a sheet by applying a series of strokes thereto to advance the sheet with a stop and start motion.

In those instances, for example, wherein the feed-in rollers **28** and **30** of a utilization device are spaced a substantial distance from the lead edge of the sheets in the stack, a single revolution of the driver member **22** and a single forward stroke of the feed member **24** might fail to advance the top sheet a sufficient distance so as to present the lead edge of the sheet into the nip of the feed-in rollers. In such as case the feed member **24,** during continued rotation of the driver member **22,** applies a series of feed strokes to the sheet. Thus, the sheet is advanced during the forward stroker and it is at rest during the rearward stroke because of the frictional element being raised out of contact with the sheet. By applying a series of strokes in this manner during continued rotation of the driver member **22,** the sheet continues to be advanced until its lead edge arrives at and is gripped by the feed-in rollers.

The sheet feeding device is susceptible to several modifications for increasing the feed rate (distance and speed at which the sheet is advanced) and for providing a larger capacity for the stack of sheets to be fed from the tray **14.**

In this regard, the feed rate may be increased by increasing the size of the driver member **22** so that the pivotal connection of the feed member **24** is positioned a greater distance from the axis of the driver member. Alternately, the feed rate may be increased by increasing the R.P.M. of the driver member **22** and the weight of the frictional element **26.**

To provide for the reception of a larger stack of sheets in the tray **14** it is merely necessary to increase the distance of the drive shaft **20** above the stack and, of course, lengthen the feed member **24** accordingly to maintain a proper feed angle of the feed member **24** with respect to the stack.

It will be appreciated that the sheet material feeding device of the present invention provides a compact feeder providing simplified operator adjustment and minimum servicing requirements. The single moving sheet feed member **24** is positive in operation to advance the top sheet and to register and maintain the sheet in alignment during its movement from the stack, while avoiding skewed feeding of the sheet. Additionally, streaking or disturbing the sheet being fed is precluded as a result of the frictional element **26** being raised out of contact with the sheet during the rearward stroke of the feed member **24.**

What is claimed is:

1. A sheet material feeding device for advancing a top sheet from a stack of sheets, comprising:

a driver member supported for rotation about an axis transverse to the direction of movement of the sheet at a position spaced above the stack of sheets;

an elongate feed member connected at one end eccentrically to the driver member solely by a pivotal connection and extending downwardly and forwardly from the driver member in the direction of feed of the sheet to normally rest at its other end by gravity upon the top surface of the sheet at a point substantially displaced from a point beneath the driver member axis;

said feed member being movable through a forward feed stroke and a rearward return stroke and including at said other end a frictional element for advancing the top sheet from the stack; and

means for rotating the driver member at a velocity sufficient to impart to the frictional element a partially constrained orbital motion having a reciprocatory component along the plane of the top of the stack of sheets for moving the frictional element into engagement with the top sheet during the forward stroke of the feed member and for moving the frictional element out of engagement with the top sheet during substantially the complete rearward stroke of the feed member in each revolution of the driver member.

2. A sheet material feeding device as set forth in claim **1** in which the downwardly and forwardly extending feed member forms a feed angle of between 10° and 45° with the top of the stack of sheets.

3. A sheet material feeding device as set forth in claim **1** in which the frictional element comprises silicone rubber.

4. A sheet material feeding device as set forth in claim **1** in which the means for rotating the driver member includes a motor having a drive shaft for axially supporting the driver member.

5. A sheet material feeding device as set forth in claim **1** in which the stack of sheets is positioned in a sheet tray having a side guide for registering one side of the stack; and

said feed member extends in the direction of movement of the sheet and angularly outwardly towards the side guide to urge a side edge of the top sheet into alignment against the side guide during advancement of the sheet from the stack.

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