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J. P. WATSON ET AL

3,372,923

FEEDER APPARATUS

Filed Nov. 30, 1965

3 Sheets-Sheet 1

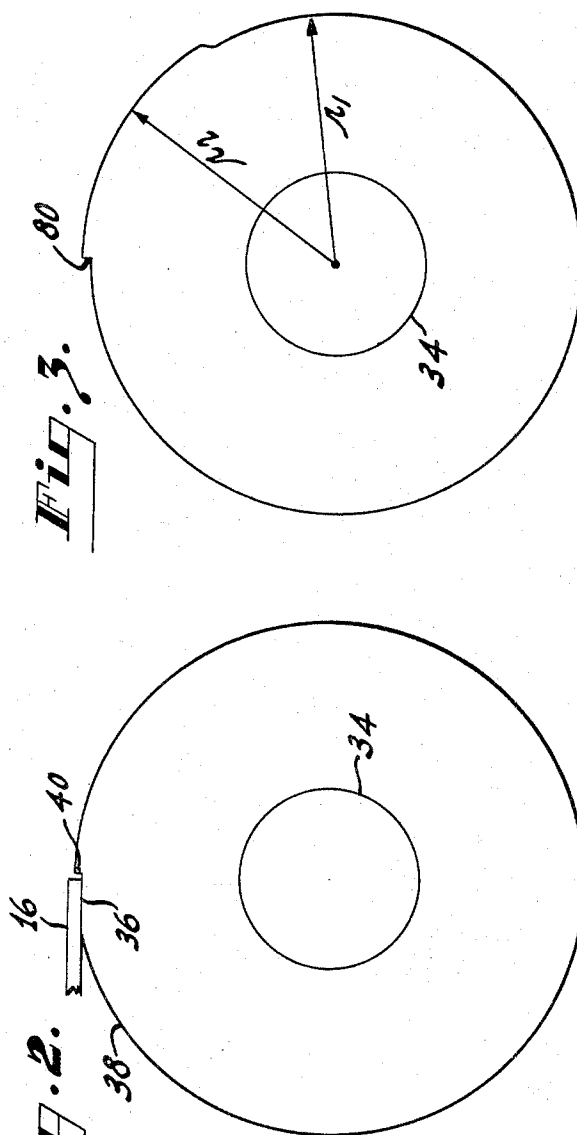
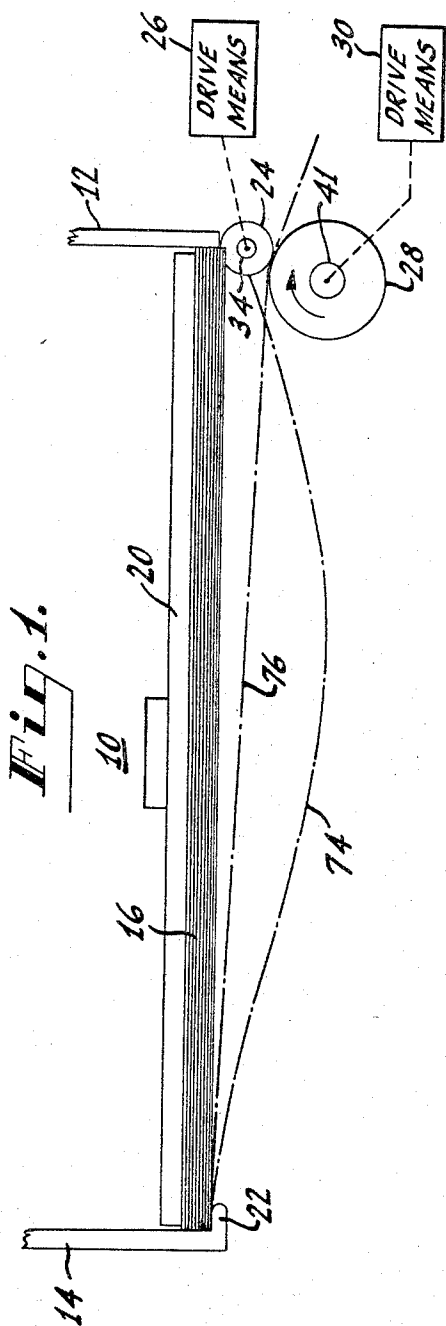
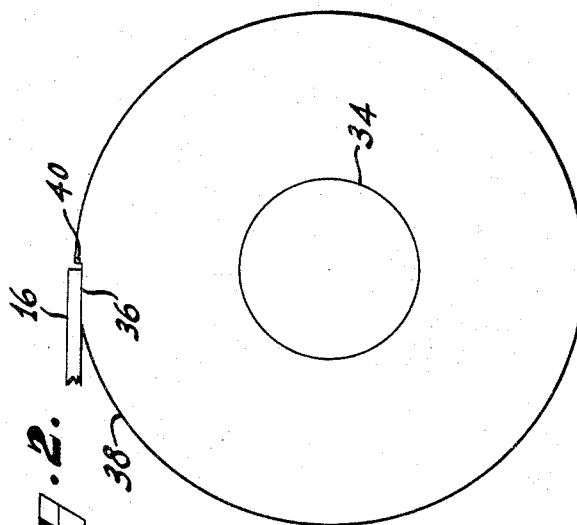


Fig. 3.



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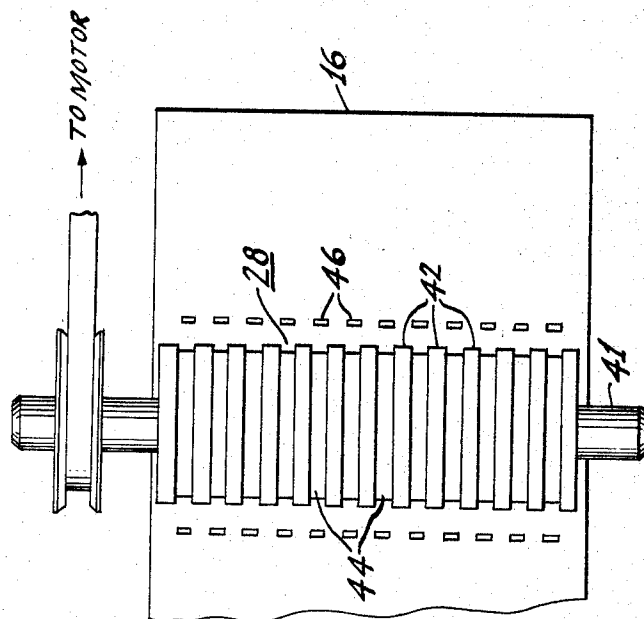
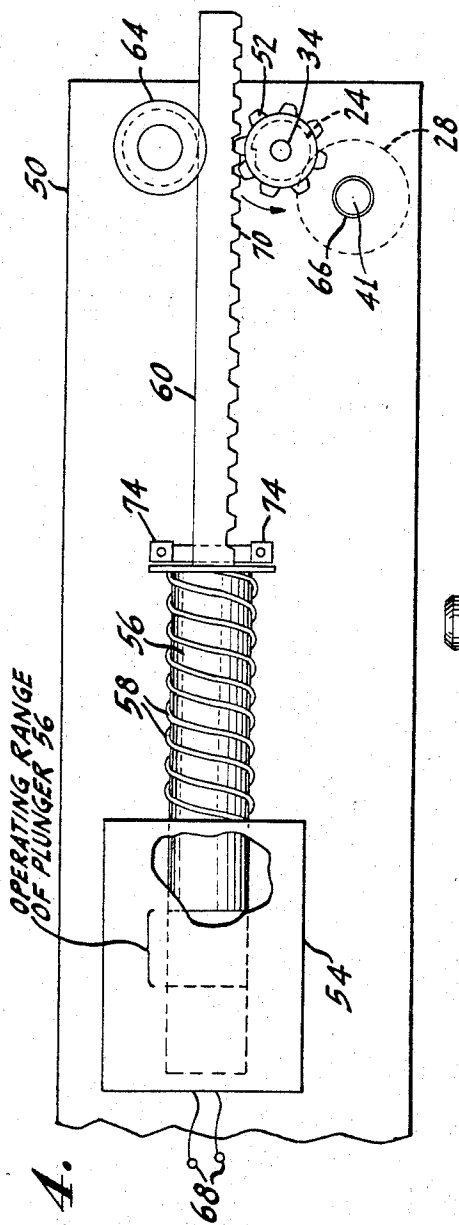
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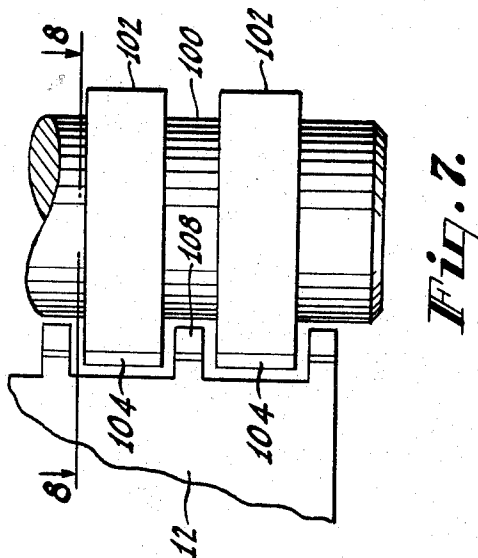
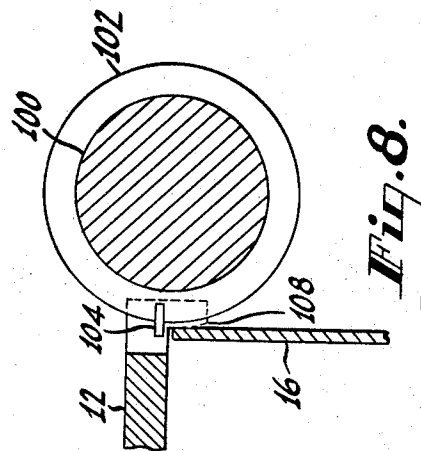
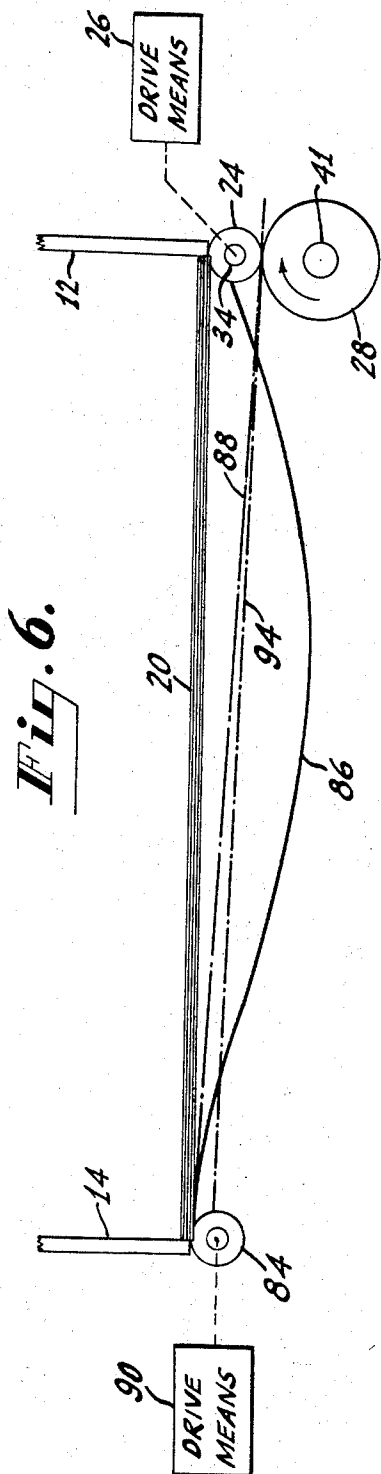
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3 Sheets-Sheet 3



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1

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FEEDER APPARATUS

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ABSTRACT OF THE DISCLOSURE

An apparatus for holding and feeding sheets of material such as documents and cards by means of a hopper and oscillating and rotating rollers wherein one sheet is separated from a stack of said sheets by a roller with a knife edge which causes the sheet to bow outwardly and away from the stack.

This invention relates to feeder apparatus and, in particular, to apparatus for feeding sheet material out of an input hopper.

In the usual type of feeder apparatus which employs a picker mechanism, a stack of sheet material, e.g., documents or cards, etc., is loaded into a hopper and biased toward one end thereof. A picker mechanism is located at that one end of the hopper, near a side thereof, and is operative to engage an edge of the endmost sheet and push that sheet out of the hopper through an opening, or throat, at the opposite side of the hopper.

Due to the biasing of the stack of sheets, there are large frictional forces between the faces of adjacent sheets. These frictional forces often result in undesirable double feeding of sheets, i.e., feeding of two sheets at the same time. When the sheets are punched record cards, double feeding also can result from the interlocking of cards, which arises when the edges of the punched holes in two adjacent cards engage one another. Double feeding can be prevented by adjusting the size of the throat opening to be greater than the thickness of one sheet but less than the combined thickness of two sheets. However, although such an arrangement prevents double feeding of sheets, it often gives rise to jamming at the throat, which occurs when two or more documents reach the throat at the same time.

It is one object of the present invention to provide an improved picker type feed apparatus in which double feeding does not occur.

It is another object of his invention to provide an improved picker type feed apparatus which does not require a throat for outgoing sheets, whereby the jamming of sheets is avoided.

It is still another object of this invention to provide an improved feed mechanism in which a sheet is separated from the stack prior to being fed out of the hopper.

In apparatus embodying the invention, the hopper is open at one end thereof parallel to the faces of the stacked sheets. The hopper has first and second side members which are substantially normal to the open end of the hopper and which are disposed adjacent first and second opposite edges, respectively, of the stacked sheets. A first roller and a stop member extend across the open end of the hopper at locations adjacent the first and second side members, respectively, with the endmost sheet resting against the first roller and the stop member. The roller has a sheet picker thereon for engaging the first edge of the endmost sheet. As the roller is turned, the first edge of the endmost sheet is driven toward the second, opposite edge thereof, causing the sheet to bow outwardly through the open end of the hopper and peel away from the other stacked sheets.

2

In the accompanying drawings, like reference characters denote like components, and:

FIGURE 1 is a plan view of a portion of a first apparatus embodying the invention;

FIGURE 2 is an enlarged plan view of one form of roller-picker mechanism;

FIGURE 3 is an enlarged plan view of another form of roller-picker mechanism;

FIGURE 4 is a plan view of a roller support and drive mechanism;

FIGURE 5 is a view in front elevation of the transport roller;

FIGURE 6 is a plan view of another apparatus embodying the invention;

FIGURE 7 is a view in left side elevation of a portion of a modified roller-picker mechanism and side member; and

FIGURE 8 is a plan view in cross section, of the modified roller-picker mechanism, taken along the line 8-8 of FIGURE 7.

Although the present invention has application in systems for feeding various types of sheet material, it has special advantages when used to feed perforated record cards of the type commonly used in business machines. For this reason, the invention will be described herein-after in connection with the feeding of punched record cards. It should be understood, however, that such description is not to be taken as a limitation of the invention.

In the apparatus of FIGURE 1, a hopper 10 has first and second side members 12, 14 respectively, which are shown in an upright position adjacent first and second opposite edges of a stack of cards 16. The hopper 10 is open at the front thereof, in a plane parallel to the faces of the stacked cards. The cards are loaded into the hopper at the back thereof and may rest on a bottom plate (not shown). The stack of cards is biased toward the front of the hopper, as by means of a spring biased plate 20, or by gravity due to a slight inclination of the hopper, e.g. about 10° from the horizontal, or by a combination of gravity and spring biasing.

An elongated stop member 22, adjacent second side member 14, extends across the open end of the hopper from the top thereof to the bottom. In the embodiment of FIGURE 1, the stop member 22 is shown as a lip or flange projecting from the front of second side member 14. A picker roller 24 is located at the opposite side of the hopper, adjacent first side member 12, and extends across the open end from the stop to the bottom of the hopper. Due to the biasing of the stack of cards 16, the front or endmost, card rests against the stop member 22 and the picker roller 24. Picker roller 24 is driven by a source represented schematically by a box 26.

A transport roller 28 has its axis parallel to the axis of the picker roller 24. The axis of picker roller 24, in turn, preferably lies in the same plane as the inner wall of the first side member 12. Transport roller 28, which may be driven at constant speed from a source 30, such as a synchronous motor, is spaced close to the picker roller 24, being separated therefrom a distance less than the thickness of a record card. As will be described hereinafter in connection with the operation of the apparatus, the space between rollers 24 and 28 forms a nip into which a record card is fed from the hopper.

One form of picker roller that may be used in practicing the invention is illustrated in enlarged view in FIGURE 2. The picker roller preferably extends, in an axial direction, from the top to the bottom of the hopper, spanning the stack of record cards in the vertical direction. A picker knife edge 40 is formed in the periphery of the roller by grinding a flat 36 in the circumference

3

38 thereof. The knife edge 40 spans the stack of cards, and projects above the flat 36 by an amount which is less than the thickness of the thinnest card to be transported. Thus, the picker knife edge 40 engages the righthand of the endmost card 16 in the stack, but never projects beyond the thickness of this card, whereby it does not engage the edges of two cards at the same time. In the rest, or reference, position of the picker roller, the knife edge 40 is either aligned with, or slightly to the right of, the plane of the inner wall of first side member 12 (FIGURE 1). The flat 36 on the roller then is substantially parallel to the front face of the leading card whereby the righthand end portion of the card 16 rests against the flat 36.

The surface of the picker roller is polished or coated to produce a minimum of friction between it and the successive cards as the record cards slide across it. The surface of transport roller 28 (FIGURE 1), on the other hand, has a relatively high coefficient of friction between it and the cards. Preferably, transport roller 28 has a resilient, high friction coating, such as rubber. Furthermore, transport roller 28 preferably is circumferentially grooved so as not to contact those areas of a card which are or may be punched. Thus, as illustrated in front elevation in FIGURE 5, the transport roller 28 is mounted on a shaft 41 and may comprise a plurality of rubber disks 42 which are separated or spaced along shaft 41 by spacers 44. The axial dimension of a spacer 44 is equal approximately to the height of a perforation 46 in the record card, and the spacers are aligned with the rows of perforations. The rubber disks 42 engage the record card 16 in the land areas between punched rows. Alternatively, the entire surface of the transport roller 28 could be rubber with grooves 44 cut therein.

When the picker roller has the form illustrated in FIGURE 2, the drive means 26 preferably is of a type which oscillates the picker roller 24 rather than driving it through one or more complete revolutions. The reason for this will become apparent as the discussion proceeds. An arrangement for oscillating the picker roller is illustrated in FIGURE 4. In FIGURE 4, the upper end of the shaft 34 of the picker roller projects through an aperture in a supporting plate member 50. A pinion gear 52 is mounted on the end of the shaft 34. Mounted on plate 50 is a solenoid 54 having a plunger 56. A spring 58 encircles the plunger to bias the plunger toward the right, as viewed in the drawing, when the solenoid is in the de-energized condition. Attached at the free end of the plunger 56 is a rack 60 which has teeth spaced to mate with the teeth of the pinion gear 52. A grooved wheel 64 is rotatably mounted on plate 50 to captivate the smooth end of the rack 60 to insure positive engagement between the rack and pinion.

Plate 50 also may serve as a support for the transport roller 28 (FIGURE 1) and, to this end, the shaft 41 of the transport roller is shown as projecting through plate member 50 and riding in a bearing 66 therein. Plate member 50 may be bolted or otherwise clamped at its opposite ends to the side members 12 and 14, at the top of the hopper. A similar plate may be clamped to the side members 12 and 14 at the bottom of the hopper to support the picker roller and transport roller shafts at their other ends.

When the solenoid 54 is in the de-energized state, the picker roller 24 has the position indicated in dashed lines in FIGURE 4. In particular, and as mentioned previously, the picker knife edge lies substantially in the plane of the inner wall of first side member 12 (FIGURE 1), or slightly clockwise thereof. When an energizing signal is applied across the leads 68 of the solenoid, the plunger 56 is attracted toward the left into the solenoid. The rack 60, in turn, translates to the left and turns the pinion gear 52 in the counterclockwise direction, as indicated by the arrow 70 (FIGURE 4). The pinion gear is fixedly at-

4

tached to the shaft 34 of the picker roller, whereby the picker roller also is turned in a counterclockwise direction when the solenoid becomes energized. Upon de-energization of the solenoid, the compression spring 58 forces the plunger 56 and the rack 60 toward the right, the rack, in turn, turning the pinion gear 52 and picker roller 24 in a clockwise direction. A stop member or members 74 set the limit of travel of the rack 60 when the solenoid becomes de-energized. The length of the plunger 56 is chosen to provide a desired angular rotation of the picker roller.

With the aforementioned features of the system in mind, consider now the operation of the apparatus shown in FIGURE 1. As the picker roller 24 is turned in a counterclockwise direction, the picker knife edge drives the righthand edge of the endmost card to the left. The lefthand edge of that card abuts the second side member 14 of the hopper, whereby the card is compressed endwise, causing the card to bow. The bowing of the card must be in an outward direction through the open end of the hopper, since the biasing of the stack of cards prevents inward bowing. As the picker roller 24 continues to turn in a counterclockwise direction, the endmost card is peeled away from the stack of cards in the hopper by the picker knife edge. The righthand end of the next document in the stack then moves forward into contact with the circumferential surface of the picker roller. However, this card does not become fed out of the hopper. (It will be recalled that the surface of the picker roller is selected to have a very low coefficient of friction.)

When the picker knife edge of the roller 24 has been advanced approximately 90° from the rest or reference position, the endmost card has attained a maximum bow, and has the position indicated by the curved phantom line 74. The righthand end of that card is still engaged by the picker knife edge when the card has this position. The picker roller 24 continues to rotate in a counterclockwise direction. When the picker knife edge has advanced to a point approximately 140° counterclockwise from the reference position, the angle between the flat 36 (FIGURE 2) and the righthand edge of the card has diminished to such a point that the endwise spring of the compressed card overcomes the friction between the righthand end of the card and the flat 36, allowing the righthand end of the card to snap forward (to the right) into the nip between the picker roller 24 and the transport roller 28. At the time the card end leaves the flat 36 and enters the nip aforementioned, transport roller 28 drives the card toward the right and tensions the card, as shown by the phantom line 76. Further rotation of the transport roller 28 withdraws the lefthand edge of the card from the stop member 22 and drives the card to the right to other apparatus (not shown).

The direction of rotation of the picker roller then is reversed, and the picker roller is returned to the reference position aforementioned. The righthand end of the next document in the stack then moves forward against the flat 36 into position to be engaged by the picker knife edge. The reverse rotation of the picker roller does not affect the movement of record card being driven by the transport roller 28 because of the relatively high coefficient of friction of the transport roller and the relatively low coefficient of friction in the picker roller. In essence, the card being transported is able to slide across the smooth surface of the picker roller.

As an alternative to the above-described method of operation, the picker roller 24 could be rotated through a complete revolution rather than being oscillated. This method of operation is inherently slower, however, since it is necessary to slow or stop the picker roller as the picker knife edge approaches the reference position to allow the next card to move against the flat surface 36 (FIGURE 2). It should be mentioned that, when the oscillatory method is employed, the distance between the front edge of first slide member 12 and the periphery of

5

the picker roller 24 should be less than the thickness of a record card. This will assure that the front card in the hopper cannot leave the hopper through the space between side member 12 and the picker roller as the picker roller is being rotated clockwise to its reference position.

Continuous rotation of the picker roller in a clockwise direction may be employed when the picker roller has the form illustrated in FIGURE 3. As shown there, the picker roller has a first circumferential portion of radius r_1 which extends through an angle of approximately 310° . The remaining circumferential portion has a radius r_2 which is greater than r_1 . The picker knife edge 80 is formed by an abrupt discontinuity at one junction between the circumferential portions of different radii. The difference between radii r_1 and r_2 is less than the thickness of a record card, whereby the knife edge 80 cannot engage the edge of two cards at the same time. This knife edge extends the length of the picker roller, across the face of a record card.

When this picker roller is employed in the FIGURE 1 system, the operation is substantially the same as that described previously for the picker roller of FIGURE 2. The main difference is that the picker roller of FIGURE 3 can be rotated continuously in a counterclockwise direction. This type of operation is possible because the circumferential portion of radius r_2 extends over an angle of only about 50° . Thus, as one card is being fed out of the hopper, the next card can immediately move forward into contact with the circumferential portion of radius r_1 and be in proper position to be engaged by the picker knife edge 80 as it arrives at the reference position.

An embodiment of another apparatus for practicing the invention is illustrated in plan view in FIGURE 6. This apparatus differs from the apparatus of FIGURE 1 in two respects. First, the stop member at the lefthand edge of the stack has the form of a picker roller rather than the fixed member shown in FIGURE 1. This picker roller 84 is similar to the picker roller 24, except that its picker knife edge is cut in the opposite direction so as to engage the endmost card at the lefthand edge and drive it toward the right. Secondly, the transport roller 28 can be of larger diameter than that shown in FIGURE 1, and can be relocated in a more counterclockwise direction relative to the picker roller 24, whereby there is less possibility of interference between the transport roller 28 and the endmost card when in its state of maximum bow.

In the operation of the FIGURE 6 system the righthand edge of the endmost card in the hopper is engaged by the picker knife edge of the picker roller 24 and the lefthand edge of the endmost card is engaged by the picker knife edge of the picker roller 84. During the first portion of the feeding cycle, picker roller member 84 is held in a stationary position, thereby fixing the position of the lefthand edge of the endmost card. Picker roller 24 is turned in a counterclockwise direction by the drive means 26, causing the card to bow. The card reaches a maximum bow, as illustrated by the curved phantom line 86. When the picker knife edge has been rotated through an angle of approximately 90° . As the picker roller 24 continues to rotate, the endwise spring of the card overcomes the friction between the righthand edge of the card and the flat adjacent the picker knife edge, whereby the righthand end of the card snaps toward the right toward the nip between picker roller 24 and transport roller 28. The card then has the position shown by the phantom line 88, the righthand edge being just short of the nip.

At this stage in the operation, or slightly prior thereto, the other picker roller 84 is turned in a clockwise direction by the drive means 90, thereby advancing the card to the right into the nip between the transport roller 28 and the picker roller 24. The position of the card after picker roller 84 has been rotated clockwise approximately 90° is indicated by the phantom line 94. The righthand

6

end of the card then is in position to be engaged by transport roller 28 and fed through the nip to other apparatus.

When two picker rollers 24 and 84 are employed, the transport roller 28 could be eliminated in some applications. By rotating the rollers 24, 84 concurrently in opposite directions, the endmost card would be flipped out of the hopper, for example, onto a vacuum belt. It will also be appreciated by those skilled in the art that two separate transport rollers could be employed, rotating in opposite directions, one adjacent each picker roller. By rotating the picker rollers alternately, cards could be fed alternately in opposite directions from the hopper to separate receiving apparatuses.

A portion of a modified form of picker-roller mechanism and side member 12 is shown in left side elevation in FIGURE 7. A view of this arrangement in plan view, taken along the line 8-8 of FIGURE 7, is illustrated in FIGURE 8. As shown in these drawings, the picker roller may be one having circumferential grooves 100. Each of the large circumferential portions 102 of the picker roller may have a knife edge 104 inserted radially therein, the projection of each knife edge beyond the periphery of the members 102 being less than the thickness of a record card.

The side member 12 is furcated or forked at its forward end to provide a series of fingers which ride in the grooves 100. Thus, there is no possibility that record cards 16 (FIGURE 8) can escape from the hopper between side member 12 and the picker roller mechanism. Additionally, a separate lip or flange 108 projects from each of the fingers and forms a stop surface for the righthand end of the stack of record cards. The stop faces of these flanges 108 preferably are curved to agree with the arc through which the picker knives 104 operate, whereby the area of contact between the picker knives and the card edge does not diminish as the picker roller is rotated from the reference position (shown in FIGURE 8). One advantage of this arrangement is that, as one record card is being fed out of the hopper by the picker knives 104, the next card in the stack may move forward into contact with the stationary flanges 108 rather than into contact with the circumferential portion of the rotating picker roller.

What is claimed is:

1. The combination comprising:

a hopper for holding a stack of sheets of material to be fed, said hopper being open at an end thereof which is parallel to the faces of the stacked sheets, and said hopper having first and second side members which are substantially normal to the open end and which are disposed adjacent first and second opposite edges, respectively, of the stacked sheets;

a first roller and a stop member extending across the open end of said hopper at locations adjacent the first and second side members, respectively, the endmost sheet at the open end of said hopper resting against the first roller and the stop member;

said first roller having a sheet picker knife edge formed by an elongated flat on the surface of said roller for engaging the first edge of said endmost sheet; and

means for rotating said first roller in a first direction to cause said knife edge to engage said first edge and drive said first edge of said endmost sheet toward said second edge thereof, thereby to cause said endmost sheet to bow outwardly through said open end and peel away from the other stacked sheets, and then in an opposite direction to return the roller to a position to receive the second sheet on its said flat.

2. The combination as claimed in claim 1, wherein the axis of said first roller lies substantially in the same plane as the inner surface of said first side member.

3. The combination as claimed in claim 1, including a second roller spaced from said first roller by a distance less than the thickness of a said sheet and having its axis parallel to the axis of said first roller, said first roller, when rotated, conveying said first edge of said endmost

sheet into the nip between said first and second rollers, and means for rotating said second roller.

4. The combination as claimed in claim 3, wherein the surface of said first roller has a relatively low coefficient of friction between it and said sheets and the surface of said second roller has a relatively high coefficient of friction between it and said sheets, whereby said sheets can slip along said first roller with ease but will be engaged more forcefully by said second roller.

5. The combination as claimed in claim 1, wherein the spacing between said first roller and said first side member and the spacing between said stop member and said second side member, each measured in a direction normal to the open end, are less than the thickness of a said sheet.

6. The combination as claimed in claim 1, wherein said stop member is a roller having a sheet picker edge thereon.

7. The combination as claimed in claim 1, wherein the axis of said first roller lies substantially in the same plane as the inner surface of said first side member, and wherein the spacing between said first roller and said first side member and the spacing between said stop member and said second side member, each measured in a direction

normal to said open end, are less than the thickness of a said sheet.

8. The combination as claimed in claim 7, including a second roller spaced from said first roller by a distance which is less than the thickness of a said sheet and having its axis parallel to the axis of said first roller, said first roller, when rotated, conveying said first edge of the endmost sheet into the nip between the first and second roller, the first roller having a relatively low coefficient of friction between it and a said sheet and said second roller having a relatively high coefficient of friction between it and a said sheet, whereby a said sheet can slip along said first roller with ease but will be engaged more forcefully by said second roller.

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