May 19, 1959 F. S. TOBEY 2,887,316

MECHANISM AND METHOD FOR DELIVERING THIN FLAT ELEMENTS SINGLY FROM A STACK OF THE SAME

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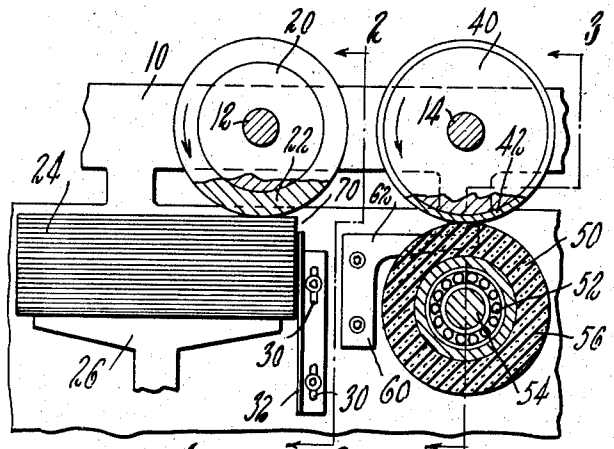

Fig. 1.

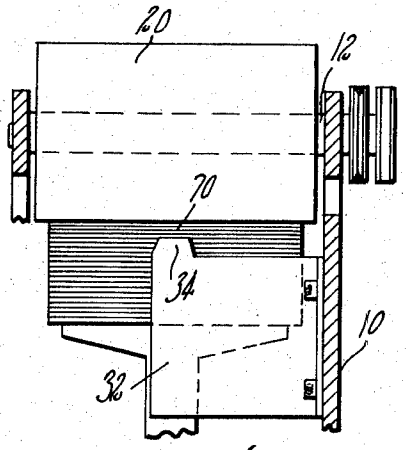

Fig. 2.

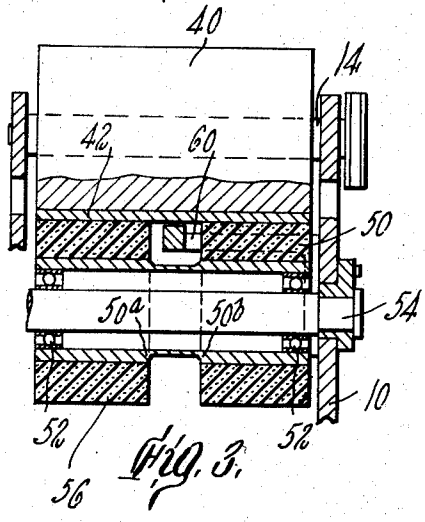

Fig. 3.

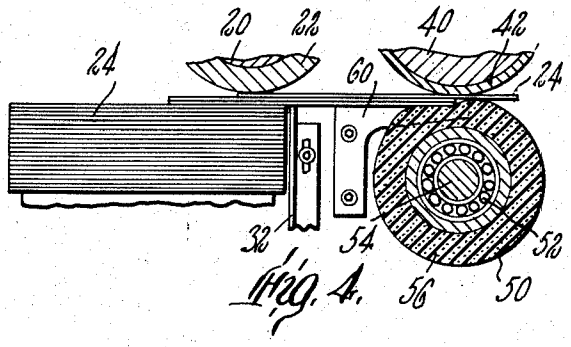

Fig. 4.

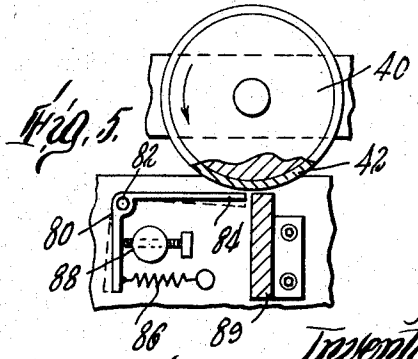

Fig. 5.

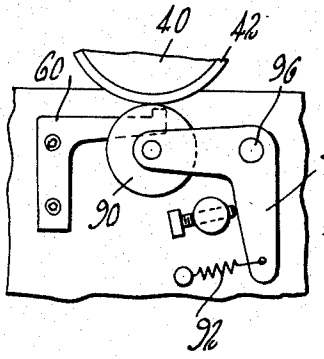

Fig. 6.

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MECHANISM AND METHOD FOR DELIVERING THIN FLAT ELEMENTS SINGLY FROM A STACK OF THE SAME

Frederic S. Tobey, Sharon, Mass.

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13 Claims. (Cl. 271—36)

This invention relates to machines such as business machines which handle stacks of sheets or cards, and more particularly to a mechanism and method for feeding cards, sheets of paper or other material from the top or bottom of a stack for purposes of counting, printing or any other purpose requiring the sheets to be fed rapidly, one at a time.

It is an object of the invention to provide a positive barrier for all cards or sheets of the stack except the one being fed, so that it shall be impossible for more than one card or sheet to be fed at one time.

It is another object of the invention to provide positive separation of the cards or sheets so that each will be fed singly in turn despite any tendency of the next and succeeding cards or sheets to restrict the movement of the first card due to friction, or due to "nesting" caused by punched holes, or a variety of other reasons which commonly cause cards or sheets to be restricted in sliding over each other.

It is a further object of the invention to provide means for neutralizing or offsetting the effect of the unequal distribution of pressure which results from pressing on the top of a thick stack in order to feed sheets singly through a "gate" at the bottom (or vice versa); which unequal distribution commonly makes it impossible to feed and separate any but very thick cards or sheets in this manner.

It is a still further object of the invention to provide means for feeding and separating, in the above manner, cards or sheets which may be bent, warped or otherwise out of plane.

It is a still further object of the invention to provide a means for feeding and separating cards or sheets, including very thin sheets such as tissue, without fraying, scuffing, cutting or in any way injuring or changing any edge of the sheets.

Experience has shown that very thick cards can successfully be fed singly from a deep stack through a single gate or aperture. A card thickness in the neighborhood of 1/32" may be sufficient, depending on the nature of the material of which the cards consist. However, when an attempt is made to feed a deep stack of thinner cards or sheets singly through such a gate, the distribution of pressure through the stack, being uneven, causes there to be sometimes too much pressure and sometimes too little pressure on the card or sheet at the point where it is desired to pass it through the gate or aperture, with the result that sometimes two cards will jam in the opening, and sometimes the single card will be obstructed by the gate due to insufficient pressure on the card, and it will not pass through. The deeper the stack of cards, the greater the variations in distribution of pressure through the stack, and so the greater the difficulty of achieving the proper pressure on the card or sheet desired to be driven through a gate or opening.

However, I have discovered that when the gate is set wide enough to allow two or more cards to pass freely, all jamming is eliminated. In a given stack, there will almost never be a time when more than three adjacent cards or sheets will be so arranged in contact with each other that neither the first, second, nor third will separate readily from any of the others.

When a relatively few cards or sheets, such as two or three cards have passed through the first gate, it is then possible to apply even pressure on both sides of this thin "stack" of a relatively few cards to get even pressure distribution, therethrough, with the result that the topmost can be very positively separated from the others by a second gate.

Generally speaking, my invention involves successively feeding cards or sheets from the top or bottom of a stack through a pair of apertures or gates, the first being wide enough to permit the passage of two or more cards or sheets at a time, and the second being only wide enough to permit the passage of a single card or sheet.

Even if the stack consists of stiff cards and contains many that are warped and bent, my invention enables the entire stack to be fed, one card at a time, without interruption.

These and further objects and advantages of the invention will become apparent from the following detailed description, taken in connection with the accompanying drawings, in which like numerals refer to like parts in the several views, and in which:

Fig. 1 is a side elevational view, partially broken away, partially in section, and partially diagrammatic, of a preferred embodiment of mechanism according to my invention;

Fig. 2 is a sectional view taken at 2—2 of Fig. 1;

Fig. 3 is a sectional view taken at 3—3 of Fig. 1;

Fig. 4 is a view corresponding to Fig. 1, except that it is further broken away, showing a different stage in the feeding of sheets through said mechanism;

Fig. 5 is a side elevational view, partially broken away and partially in section of a modification in the secondary portion of such mechanism; and

Fig. 6 is a side elevational view, partially broken away, illustrating another modification in the secondary portion of mechanism according to my invention.

Referring now to the drawings, there is shown in Figs. 1 through 4 a frame **10** carrying therein shafts **12** and **14**, which are rotatably driven by means not shown.

Carried on shaft **12**, and driven rotatably thereby, is a primary driving means or roll **20**, having around the periphery thereof a layer of material of high frictional value such as rubber **22**. The layer **22** is sufficiently thick to have some resilience so as to increase the area of contact thereof with cards or sheets **24** pressed up thereagainst by the support plate **26**, which is urged upwardly by any suitable means, such as a spring, not shown.

Cards or sheets in contact with a support for the stack are referred to herein as the "innermost" cards or sheets, while the card or sheet farthest from the support in the stack is referred to as the "outermost." This terminology is used whether the support is at the top of the stack, so as to have bottom feeding, or at the bottom of the stack, so as to get top feeding.

Also mounted on the frame **10**, by means of screws extending through slots **30** to provide for vertical adjustment, is the primary stop plate **32**, against which the forward edges of most of the cards or sheets **24** in the stack supported by the plate **26** rest. The uppermost portion of the stop plate **32** is an extremity **34** which is narrow in width, so that the effect of curvature in the sheets or cards is minimized. The plate **32** and the driving roll **20** are so positioned on the frame **10** that the driving roll **20** engages the top sheet or card of the stack substantially rearwardly of its leading edge, so that full advantage may be taken of the increased frictional

effect of the resilience in the driving roll **20** which permits flattening thereof and so greater area for applying frictional force on said top sheet or card.

The driving roll **20**, stop plate **32**, and support plate **26** may be referred to as a whole as constituting the primary portion of the mechanism of this embodiment, of which they are respectively the primary driving means, the primary stop plate, and the primary support means.

The stop plate **32** is spaced far enough below the driving roll **20** to define a gate therebetween such that in operation, with the said driving roll operatively flattened consonant with the resilience thereof and the force applied to the plate **26**, at least two sheets or cards may pass freely between said stop plate **32** and said driving roll **20**.

Cards or sheets driven through the gate or aperture or opening **70** defined by the stop plate **32** and driving roll **20** are forced by said driving roll **20** between a secondary driving roll **40** and an idler roll **50**.

The secondary driving roll **40** is mounted on the shaft **14** for rotation thereby, said shaft being powered by any suitable means (not shown). A thin layer **42** of material of high frictional value such as rubber is provided around the periphery of the secondary driving roll **40**, to improve the ability of the same to drive cards or sheets in the desired direction.

The idler roll **50** is mounted on ball bearings **52** on a stationary shaft **54** set in the frame **10**, and has around the periphery thereof a relatively thick layer of resilient material **56** capable of easy deformation downwardly to accommodate the total thickness of the number of sheets or cards allowed to pass forward through the opening **70** between the primary driving means **20** and the primary stop plate **32**. The idler roll **50** is divided by an external annular groove into two portions **50***a* and **50***b*.

Projecting into the groove between the portions **50***a* and **50***b* is the secondary stop **60**, which is mounted on the frame **10** by any suitable means. The rearward portion **62** of said stop **60** acts as a guide for forwardly moving sheets or cards.

The stop **60** and the secondary driving roll **40** define therebetween a secondary opening or gate through which cards or sheets pass, and are set at such a distance from each other that one card or sheet can freely pass therethrough, but no more than one such card or sheet may pass therethrough.

The secondary driving roll **40**, idler roll **50**, and stop **60** constitute the secondary portion of my mechanism, and may be regarded as embodiments of a secondary driving means, secondary support means, and secondary stop means respectively. A secondary opening is defined between the secondary driving roll **40** and the stop **60**.

The layer **42** of material of high frictional value is sufficiently thin to prevent an amount of deformation which would permit the secondary opening defined in part thereby to vary to an undue extent. The secondary opening must permit only a single card or sheet to pass even when the layer **42** is deformed to the maximum extent.

In operation of the embodiment just described, cards are initially in a stack as shown in Fig. 1, pressed against the primary driving means **20** by the support **26**. Rotation of the primary driving means by virtue of friction between the surface thereof and the top card or sheet of the stack moves the said card or sheet through the opening **70** between the primary stop plate **32** and the primary driving roll **20**. If no card adheres to said top card or sheet, it simply is guided along the surface **62** of stop **60** until driven between the secondary driving means **40** and the idler roll **50**, the latter urging it up against the secondary driving roll **40** which in turn drives it on through the opening defined between said secondary driving roll **40** and the stop **60**, for delivery of a single sheet or card. If a card adheres to the lower surface of said top card as the latter is driven by the primary driving

roll, the adherent card too will pass through the opening **70** therewith, and will be guided therewith between the idler roll **50** and the secondary driving roll **40**. The idler roll will of course be deformed an extra amount corresponding to the thickness of the extra card. The second card will however come up against the stop **60**, permitting the top card to be stripped therefrom and passed through the opening between said secondary stop **60** and secondary driving roll **40** by the driving action of the latter. The sudden stop of the second card when it hits the stop **60** will increase the separating tendencies, by virtue of inertia effects. As soon as the top card passes through the opening and is delivered, the resilient idler roll urges the second card up against the driving roll **40**, and it is forced through the opening and delivered. If the first opening **70** is set to allow more than two cards to pass, as in Fig. 4, and if more than a single card adheres to the top card as it is forced through by the primary driving means, operation is similar, all the cards which went through the primary gate in a group being successively delivered one by one from the top down through the second gate past stop **60**. As shown in Fig. 4, the primary driving means **20** continues to operate against the original top card until it is delivered, and will then successively scuff against successive cards in the group which has already passed through the first opening **70** until all of these are delivered, whereupon it will send another card or group of cards through the opening **70**.

In the modification of the secondary portion shown in Fig. 5, a generally angle-iron shaped member **80** is mounted in the angle thereof on a pivot **82**, about which a generally horizontal portion **84** thereof is urged toward the secondary driving roll **50** by spring **86**. An adjustable stop indicated generally at **88** may suitably be included to limit the extent of movement toward said secondary driving roll, if desired. In this embodiment the same element performs the urging resiliency of the cards against the secondary driving means and the guiding of said cards toward said secondary driving means. The stop element **89** does not in this embodiment perform any guiding function, but rather merely the function of defining the secondary opening.

In the modification of the secondary portion shown in Fig. 6, the idler roll **50** has been replaced with an idler roll **90** having a non-resilient surface, for example of steel, and the desired resilience is supplied by the spring **92**, which urges the bearing **94** about the pivot **96** so as to urge the idler roll, carried by said bearing, toward the secondary driving roll **40**. The idler roll **90** is divided by a groove to accommodate the stop **60**, as was the idler roll **50**.

If desired, of course, two or more physically separate idler rolls mounted in side by side relation would serve, and the expression "idler roll" is used herein to refer generically to an idler rolling mechanism, whether made up of physically unified or physically separated rolling parts. If more than two separate idler rolls or idler roll portions were used, two or more stops **60** might be introduced, one between each idler roll or each section of the same.

The modifications of the secondary portion of the embodiments of my invention do not result in any different mode of operation than was characteristic of the embodiments of Figs. 1 through 4.

It will be apparent that many other embodiments of my invention will occur to those skilled in the art, the embodiments shown and described in the drawings and specification being illustrative only.

Additional desirable features may if desired be incorporated for useful operation with the invention.

It will occasionally be found that such considerable force must be exerted on the surface of the top card by the driving means, particularly the secondary driving means, to achieve separation, that any lower adherent cards are urged against the secondary stop with such great force that friction between said secondary stop and

the edges of such lower adherent cards makes it difficult for resilient secondary support means to move the cards vertically, as required, to engage the secondary driving means. In this situation, added vertical force may be applied momentarily so as to achieve the desired vertical movement of the card or cards without increasing seriously the frictional tendency of cards to stick together. One suitable way to do this is to provide a lever which is actuated by cards delivered from the secondary opening. Movement of this lever by a first card passing thereby closes a microswitch to energize a capacitor from a source of electric current, so that if a card thereafter fails to pass through the secondary opening to retain said lever in said actuated position, it returns to its unactuated position, at the same time discharging energy from said capacitor through a solenoid which momentarily urges movement of a core mechanically associated with the secondary support means, so that the latter is momentarily urged much more strongly than normally against any cards thereabove. As cards once more pass out the secondary opening, the lever is again actuated to again energize the capacitor.

Instead of giving a momentary additional urge against those parts of the card or sheet already supported by said secondary support means, fingers could be provided adapted to momentarily engage and push upwardly portions of the card or sheet between sections of idler roll momentarily. Thus some upward movement could be urged across substantially the entire width of the card or sheet. This technique has especial applicability when very thin sheets are to be handled.

In cases where it may be desired to synchronize the feeding of the cards with subsequent operations to be performed upon them, the continuously rotating primary driving roll **20** may be replaced as the primary driving means by a device such as the familiar reciprocating "card-picker," which presses against the rearmost edge of each outermost card in turn. To adapt my invention for use of the "card-picker" as driving means, no other driving means is used until cards or sheets have passed through the secondary gate. Rolls corresponding to the primary and secondary driving rolls in other embodiments may be retained, in the form of idler rolls rather than driving rolls, for support; or similar support function may be obtained by use of plates, or a single plate somewhat longer than the distance between primary gate and secondary gate and defining one side of each of said gates. Such plates should be smooth enough to permit easy sliding of the cards or sheets. Further, in use of the "card-picker" as driving means, provision should be made for the case where lower sheets or cards adhere to the card being driven by the card-picker, whereby when one or more cards are stacked up at the secondary gate when the card-picker is beginning its stroke, the card-picker is made to pass above the top card of the main stack, and then to engage the top card of the small group stacked up at the secondary gate. This might be done for example by using a microswitch, actuated by the thickness of the card or cards stacked up at the secondary gate, to operate a solenoid which would draw back the hook of the card-picker until it has progressed too far in its stroke to engage the edge of any card in the main stack, but then allow it to move toward the top card, or remaining single card, in the secondary stack, at the secondary gate, to drive the same through said secondary gate. The hook may suitably be made to slide along an inclined surface held in place by the solenoid in such case. Mechanical rather than electrical means for this purpose may be used, particularly in connection with the feeding of thick cards. Cards which have passed through the secondary gate are grasped and carried along by further suitable mechanism, as in the cases of the other embodiments previously shown and described.

Various modifications within the spirit and substance of my invention will occur to those skilled in the art, the embodiments shown and described herein being illustrative and showing the presently preferred embodiments only.

I claim:

1. Mechanism for feeding thin flat elements one by one from a stack of such elements in a direction of feed which comprises primary support means engaging the innermost element of said stack of elements for supporting the said stack of elements, primary driving means for engaging the outermost element of said stack of elements and urging the same in the said direction of feed, primary stop means adapted to permit movement in the direction of feed of at least two of the outermost elements of said stack, secondary support means mounted to accept and support elements moved past said primary stop means by said primary driving means, secondary driving means cooperating with said secondary support means to urge the single element nearest said secondary driving means in said direction of feed, and a secondary stop means adapted to allow passage thereby of a single element only.

2. Mechanism for feeding thin flat elements one by one from a stack of such elements in a direction of feed which comprises primary support means engaging the innermost element of said stack of elements for supporting the said stack of elements, a frictional surfaced driving roll for engaging hte outermost element of said stack of elements and urging the same in the said direction of feed, a primary stop plate mounted to cooperate with said frictional surfaced driving roll to form a first gate permitting movement therethrough of only a few of the outermost elements of said stack, secondary support means mounted to accept and support elements moved past said primary stop plate by said frictional surfaced driving roll, secondary driving means cooperating with said secondary support means to urge the single element nearest the said secondary driving means in said direction of feed, and a secondary stop means adapted to allow passage thereby of a single element only.

3. Mechanism for feeding thin flat elements one by one from a stack of such elements in a direction of feed which comprises primary support means engaging the innermost element of said stack of elements for supporting the said stack of elements, a frictional surfaced primary driving roll for engaging the outermost element of said stack of elements and urging the same in the said direction of feed, a primary stop plate mounted to cooperate with said primary driving roll to form a first gate permitting movement therethrough of only a few of the outermost elements of said stack, secondary support means mounted to accept and support elements moved past said primary stop plate by said primary driving roll, a secondary driving roll provided with a frictional surface and cooperating with said secondary support means to urge the single element nearest the said secondary driving roll in said direction of feed, and a secondary stop cooperating with said secondary driving roll to define a secondary gate adapted to permit movement therethrough of a single element only.

4. Mechanism as in claim 3 in which said frictional surface of said secondary driving roll is relatively insusceptible to deformation, whereby the width of said secondary gate is accurately maintained to permit passage of a single said element.

5. Mechanism as in claim 4 in which said secondary support means is resilient and may be easily deformed to accept and resiliently support said elements moved past said primary stop plate by said primary driving roll and to urge said moved elements successively against said secondary driving roll.

6. Mechanism as in claim 5 in which said secondary support means is an idler roll mounted for rotation and having around its periphery a relatively thick layer of resilient easily deformable material.

7. Mechanism as in claim 5 in which said secondary support means is a movably mounted flat plate of non-

resilient material, and in which a spring is associated with said flat plate so that the latter may be easily deflected to accept and resiliently support said elements moved past said primary stop plate.

8. Mechanism as in claim 5 in which said secondary support means is an idler roll of non-resilient material, and which includes additionally a movably mounted bearing in which said idler roll is rotatably mounted and means for urging said bearing in a direction such that said idler roll is easily moved to accept elements moved past said primary stop plate, and to resiliently urge said elements toward said secondary driving roll.

9. Mechanism as in claim 3 in which said primary and secondary support means are adapted to accept said elements on top thereof, elements being fed from the tops of the resultant stacks.

10. Mechanism for feeding thin flat elements one by one from a stack of such elements in a direction of feed which comprises primary support means adapted to urge in an upwardly direction a stack of elements supported thereabove, a primary driving roll for limiting the extent of upward movement of said stack and for engaging the uppermost element thereof and urging the same in the said direction of feed, said primary driving roll having around the periphery thereof a material of high frictional value, and being mounted to engage said uppermost element along a line substantially behind the forward edge thereof, a primary stop plate mounted to cooperate with said primary driving roll to form a first gate, said primary stop plate being spaced sufficiently from said primary driving roll to permit at least two of said elements to pass therethrough, a secondary support plate for accepting and supporting elements moved past said primary stop plate by said primary driving roll, a secondary driving roll provided with a frictional surface and relatively insusceptible to deformation for cooperation with said secondary support plate to urge the single element nearest the said secondary driving roll in said direction of feed, said secondary support plate being mounted to resiliently press elements supported thereby against said secondary driving roll and to be downwardly moved by elements moving between said secondary driving roll and said secondary support plate, and a secondary stop cooperating with said secondary driving roll to define a second gate, said secondary stop being spaced so close to said secondary driving roll that no more than a single said element may pass therebetween.

11. Mechanism for delivering thin flat elements one by one from a stack of such elements which comprises primary driving means for urging the outermost of such elements in a delivery direction, a primary stop cooperating with said primary driving means to form a primary gate allowing free passage therethrough of at least two such elements, secondary driving means for urging the outermost of such elements passing through said primary gate in a delivery direction, secondary support means for urging such elements passing through said primary gate against said secondary driving means, and a secondary stop cooperating with said secondary driving means to form a secondary gate wide enough to allow free passage therethrough of one such element but not wide enough to permit simultaneous passage therethrough of two such elements.

12. Mechanism for delivering thin flat elements one by one from a stack of such elements which comprises means defining a primary opening wide enough to permit passage of a relatively small number and a minimum of at least two such elements, means spaced beyond said first-named means in a delivery direction and defining a secondary opening wide enough to permit passage of only one such element and incapable of yielding responsive to the movement of said elements to permit more than one such element to pass therethrough, said second opening providing a positive barrier to passage of more than a single such element, means to guide any elements passing through said primary opening toward said secondary opening and resiliently hold the same in compression thereat, and driving means for successively urging said elements through said openings.

13. The mechanism of claim 12 in which said means defining said secondary opening is adapted to suddenly interrupt movement of any elements adherent to an element guided into said secondary opening.

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