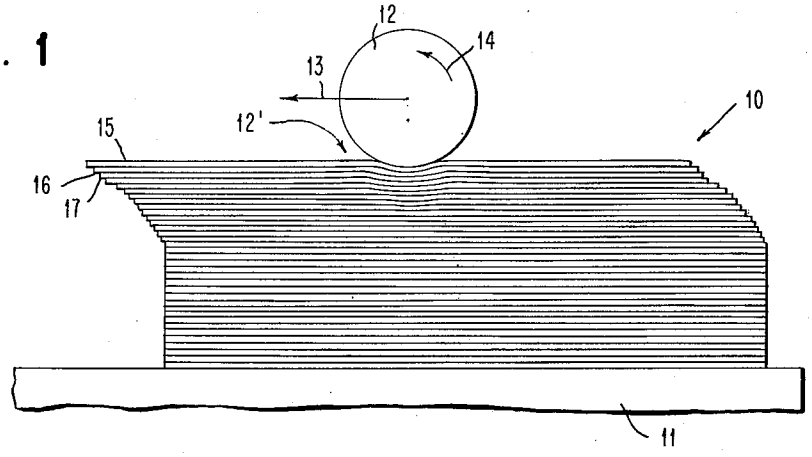
Nov. 14, 1961 W. S. BUSLIK 3,008,709

SHEET SEPARATING AND FEEDING APPARATUS

Filed Oct. 6, 1958 3 Sheets-Sheet 1

FIG. 1



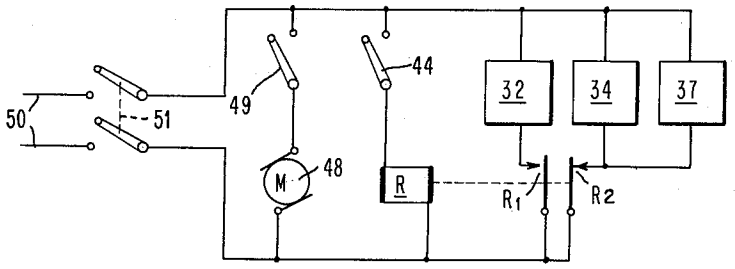


FIG. 3

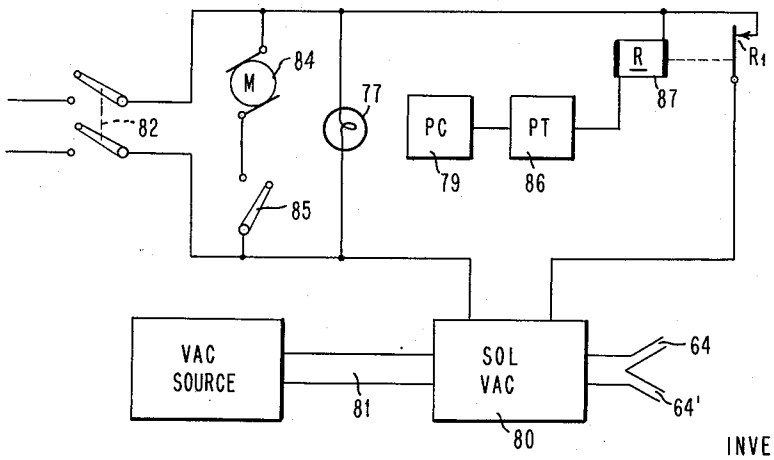


FIG. 6

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SHEET SEPARATING AND FEEDING APPARATUS

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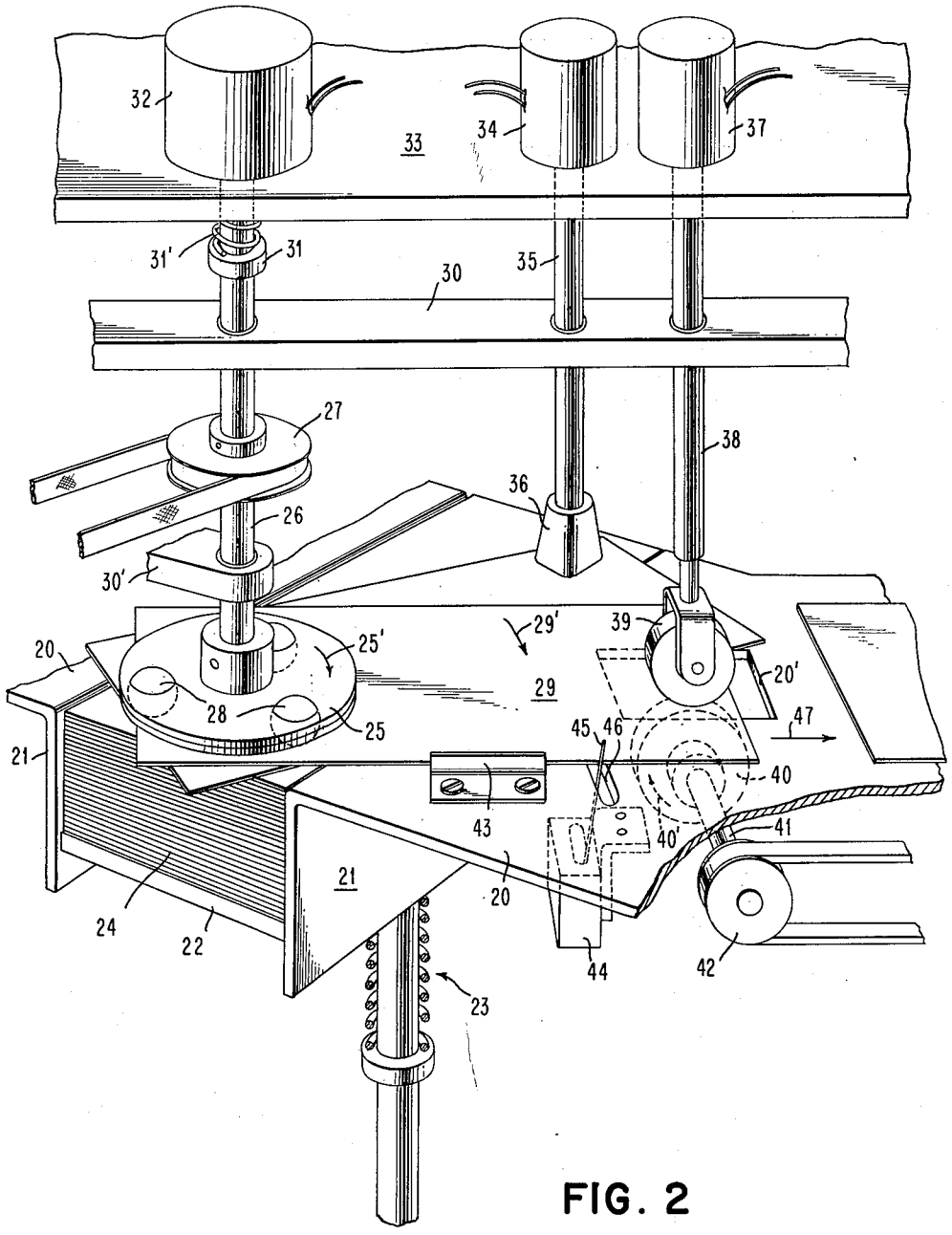


FIG. 2

Nov. 14, 1961 W. S. BUSLIK 3,008,709

SHEET SEPARATING AND FEEDING APPARATUS

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FIG. 4

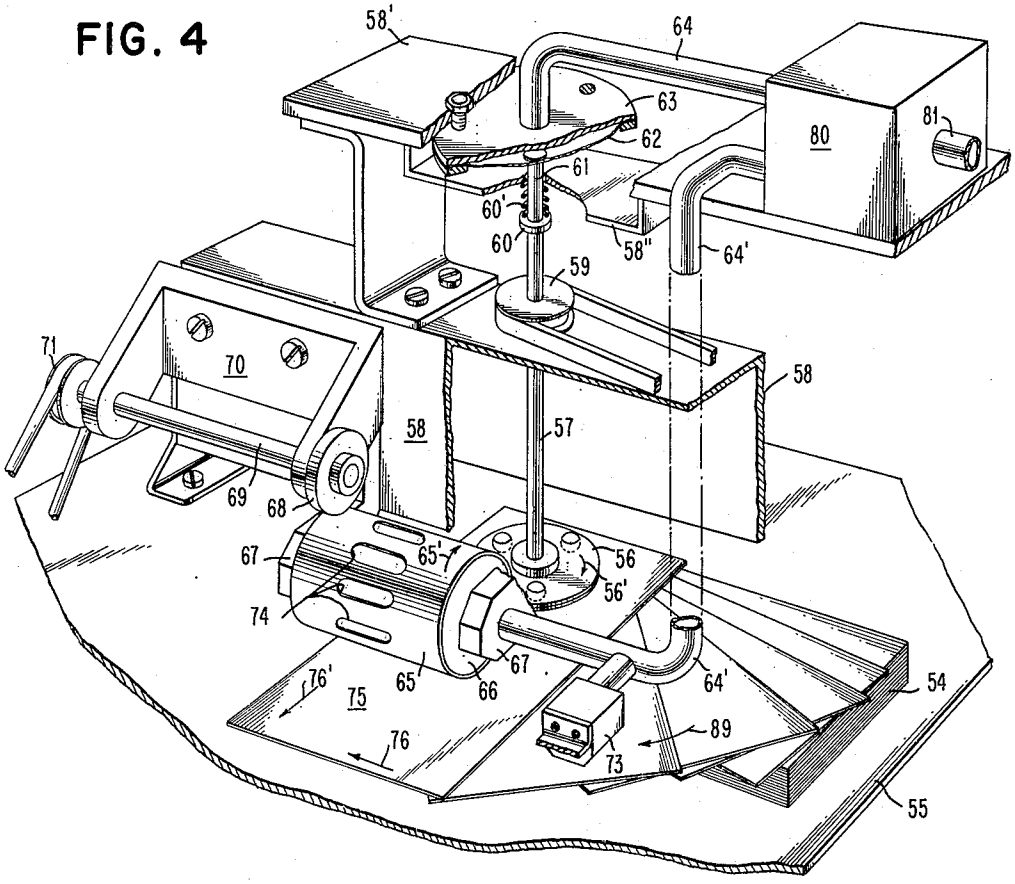
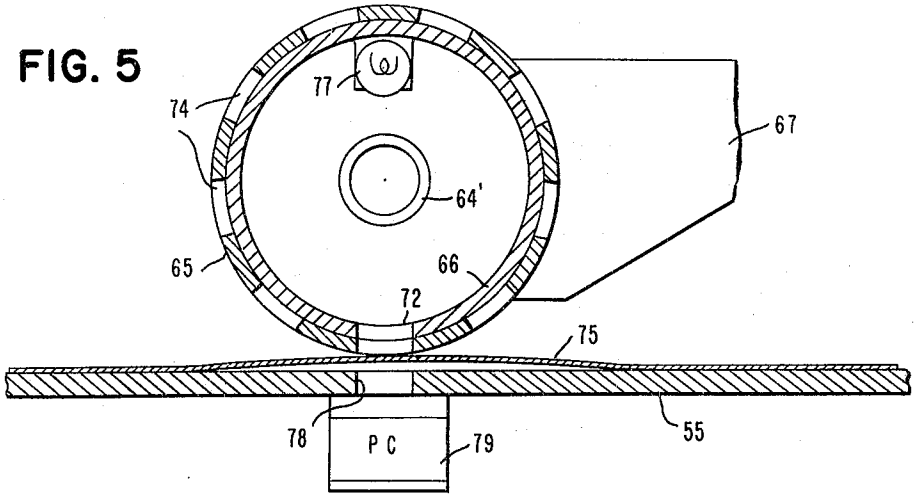


FIG. 5



United States Patent Office 3,008,709 Patented Nov. 14, 1961

3,008,709
SHEET SEPARATING AND FEEDING APPARATUS

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Filed Oct. 6, 1958, Ser. No. 765,530
6 Claims. (Cl. 271—10)

This invention relates to sheet separating and feeding apparatus and more particularly to apparatus for successively separating the top sheets of a stack of sheets and for feeding the successively separated sheets from the stack.

Heretofore there have been disclosed numerous devices for separating sheets from a stack thereof and for feeding the separated sheets. Generally each of the prior art devices is particularly adapted to accommodate sheets of a single type of material of uniform dimensions and weight.

It is the primary object of the present invention to provide sheet separating and feeding apparatus capable of handling a stack of mixed sheets in which the sheets may be of various materials of non-uniform dimensions and weights.

The present disclosure is directed primarily to sheets the sizes of bank checks which are generally formed of paper varying in thickness from that of the conventional punched card to the thicknesses of relatively thin printed paper stock. While the invention is particularly adapted for use with sheets of this type, it should be noted that the invention may be employed to feed sheets of various materials including, for example, sheets of rubber, and apparatus embodying the invention may be adapted to handle sheets of a wide variety of sizes if the proportions of the mechanical elements of the apparatus are properly adjusted.

Broadly, it is the object of the invention to feed a succession of sheets from the top of a stack thereof at a high rate of speed while at the same time effecting reliable separation of the sheets.

The accomplishment of the foregoing objects requires basically two operations. One being the separation of a succession of sheets from a stack thereof and the second being the successive feeding of the successively separated sheets from the separating means.

More specifically, it is the object of the invention to provide apparatus for accomplishing both of these results.

These and other objects of the invention relating particularly to the construction and operation of the disclosed embodiments thereof will become evident from the following description when read in conjunction with the accompanying drawings in which:

FIGURE 1 is a diagrammatic showing of a basic concept involved in the invention.

FIGURE 2 is a showing of apparatus representing one embodiment of the invention.

FIGURE 3 is an electrical diagram of electrical components involved in the operation of the apparatus shown in FIGURE 2.

FIGURE 4 is a showing of alternative apparatus embodying the invention.

FIGURE 5 is a vertical section taken through a portion of the apparatus shown in FIGURE 4.

FIGURE 6 is an electrical diagram of electrical components involved in the operation of the apparatus shown in FIGURE 4.

In FIGURE 1 there is indicated generally at **10** a stack of sheets positioned on a platform **11**. Rolling means **12**, which may be in the form of a ball or in the form of a roller, is indicated as moving to the left of FIGURE

1 as shown by the arrow **13** and rotating in a counterclockwise direction as shown by the arrow **14**. The ball or roller **12** is pressing upon the sheets causing the uppermost sheets to be deformed as indicated generally at **12**. It will be evident, however, that the uppermost sheet is most highly deformed and the successive sheets below the uppermost sheet are successively less deformed.

The deformation of the sheets coupled with the advancement of the rolling means thereover serves to displace the sheets successively to the left as indicated by the uppermost sheet **15** which is shown extending to the left of the next successive sheet **16** which is in turn shown extending to the left of the next successive sheet **17**. It will also be noted that the degree of displacement of each of the sheets from its next lower adjacent sheet varies with the greatest displacement existing between the sheets **15** and **16**, lesser displacement between sheets **16** and **17**, and a still lesser displacement between sheets **17** and the next lower sheet.

This displacement is not the result of a frictionally induced sliding but is rather the result of the deformation of each sheet around its neutral horizontal axis causing an actual physical displacement as a result of the progressive deformation occurring as the rolling means is moved along the sheets. Thus the rolling means will be effective to displace sheets of a stack regardless of the coefficients of friction of the sheets. Therefore, sheets of rubber having surfaces of high coefficients of friction will be relatively displaced in the same manner as will sheets which may be formed, for example, of smooth, hard glossy papers having low coefficients of friction.

Referring now to the embodiment of the invention shown in FIGURE 2, there is included a plate **20** formed with spaced downwardly extending flanges **21** within which there is positioned a platform **22** yieldingly supported by spring loaded support means as indicated generally at **23**. A stack of sheets **24** such as, for example, bank checks is positioned upon the platform **22** and urged upwardly by the yielding support means indicated at **23**.

A disc **25** is positioned above the stack of sheets **24** and is affixed to a shaft **26** which is adapted to be rotated by means of a driven pulley **27**. The means for driving the pulley is not shown but may be a conventional motor and belt drive system.

The disc **25** mounts a plurality of balls **28** which extend below the disc and are adapted to roll over the uppermost check **29** of the stack of sheets **24**.

The shaft **26** is rotatably mounted in suitable bearings in support brackets **30** and **30'** which are attached to frame means not shown. The upper end of the rotatable shaft **26** is coupled through suitable bearing coupling means **31** to the non-rotatable armature of a solenoid **32**. The solenoid **32** is mounted on a support plate **33** which is in turn supported by a suitable frame means not shown. A spring **31'** acting between the coupling means **31** and the plate **33** urges the shaft **26** downwardly. As will be hereinafter described in greater detail when the solenoid **32** is de-energized the balls **28** will be urged downwardly by the spring **31'** into engagement with the topmost sheet **29** of the stack of sheets and when the solenoid **32** is energized the shaft **26** and the plate **25** will be raised sufficiently to relieve the pressure of the balls **28** from the sheet **29**.

A solenoid **34** mounted on the plate **33** has its armature shaft **35** extending downwardly slidably through bracket **30** and to the lower end of the shaft is affixed a member **36** positioned over the stack of sheets **24**. When the solenoid is de-energized the member **36** is resting upon the stack of sheets with sufficient weight that,

due to its coefficient friction, movement of the sheets will be substantially restrained. When, however, the solenoid 34 is energized the member 36 will be lifted permitting free movement of the sheets thereunder.

A solenoid 37 is also mounted on the plate 33 and has its armature shaft 38 extending downwardly slidably through bracket 30 and supporting a roller 39. When the solenoid 37 is de-energized the roller 39 is resting upon a roller 40 positioned below the plate 20. A hole 20' in plate 20 permits this engagement between rollers 39 and 40. The roller 40 is affixed to a shaft 41 which is supported by suitable journal bearings not shown and is rotatably driven by a driven pulley 42 which may be connected by belts or other suitable means to a conventional motor drive.

The rate of speed of operation of the solenoids 34 and 37 may, if desired, be increased by the employment of relatively light weight parts and spring means similar to spring 31' for urging the member 36 and the roller 39, respectively, downwardly.

A stop 43 is affixed to the top of the plate 20. A switch 44 is mounted below the plate 20 and has a switch arm 45 extending upwardly through a hole 46 in plate 20 adjacent to the stop 43.

With the solenoid 32 de-energized and with the pulley 27 being driven in a direction to rotate the disc 25 in the direction of the arrow 25', the uppermost sheets of the stack 24 will be separated in a fanning manner with the uppermost sheet moving in the direction indicated by the arrow 29' and with successive lower sheets moving to lesser degrees in the same direction. When the sheet 29 has moved to engage the stop 43 it will have displaced the contact arm 45 of the switch 44 sufficiently to have closed the switch contact.

In FIGURE 3, there is shown a relay R having contacts R1 and R2 for connecting the solenoids 32, 34 and 37, as will be hereinafter described, across power lines connected to a source of power 50 through a disconnect switch 51. The relay R is connected across the power lines by the switch 44. A motor 48, for driving the pulleys 27 and 42, is connected across the power lines by conventional motor starter means, indicated by the switch 49.

Energization of relay R by closure of switch 44 will close relay contact R1 and open relay contact R2. Closure of relay contact R1 will energize solenoid 32 relieving the pressure of the balls 28 from the check 29, thus arresting further displacement of the sheets. Simultaneously, therewith opening of relay contact R2 de-energizes solenoids 34 and 37. De-energization of solenoid 34 permits the holding member 36 to move downwardly and hold the sheets other than the uppermost sheet 29 in their existing positions. De-energization of solenoid 37 permits the roller 39 to drop into engagement with the upper surface of the sheet 29 which is now positioned between the roller 39 and the roller 40. The roller 40 is being driven in the direction of the arrow 40' and thus the uppermost sheet 29 is driven to the right as viewed in FIGURE 2 in the direction as indicated by the arrow 47.

When the left hand most end of the sheet 29 passes beyond the end of the switch lever 45 the switch 44 will open, de-energizing the relay R, opening the contact R1 and closing the contact R2, and resulting in the roller 39 and the holding member 36 being raised upwardly and the rotating disc 25 being dropped downwardly, thus causing a resumption of the separation of the uppermost sheets of the stack by the fanning separation as indicated by arrow 29'. It will be evident that this cycle of separation and feed will be repeated successively resulting in separation and delivery of the successive uppermost sheets from the stack thereof positioned on the platform 22.

In FIGURE 4 there is shown an alternative embodiment of the invention involving a plate 55 supported by framing means not shown. A stack of sheets 54 is supported by plate 55 and a rotating disc and ball assembly 56 is positioned above the stack of sheets. The disc and ball assembly 56 is supported and rotated by a shaft 57 mounted in bearings in a frame member 58. The shaft 57 is driven by means of a driven pulley 59 to rotate the disc and ball assembly in the direction of the arrow 56'. The upper end of the shaft 57 is connected through rotatable coupling means 60 to a post 61 affixed to the center of a diaphragm 62 mounted in a housing 63 which is connected to a source of vacuum through a line 64, as will be hereinafter described, serving to effect raising and lowering of the diaphragm 62, shaft 57 and rotating ball and disc assembly 56.

The housing 63 is affixed to a plate 58' mounted on the frame member 58. A spring 60' acting between the coupling 60 and a bracket 58'' supported from the underside of the plate 58' acts to urge the shaft 57 downwardly.

A cylindrical member 65 is rotatably mounted on a drum 66 which is supported by means of brackets 67 from the frame member 58. The cylinder 65 is rotated on the drum 66 by a friction drive roll 68. The friction drive roll 68 is fixedly mounted on a shaft 69 rotatably supported by a bracket 70 mounted on the frame member 58. The shaft 69 is driven by a drive pulley 71 in a direction to cause the cylinder to rotate in the direction indicated by the arrow 65'.

A vacuum line 64' extends into the drum 66 and serves to connect the interior of the drum to a source of vacuum, as will be hereinafter described.

The stationary drum 66 is shown in radial section in FIGURE 5 and is provided, in the bottom thereof, with an opening 72. The opening 72 is elongated and is of substantially the same dimensions as each of a plurality of circumferentially spaced longitudinally elongated openings 74 in the rotatable cylinder 65. The lowermost surface of the drum 65 is positioned with a small clearance from the top surface of the plate 55 and sheets such as the sheets 75 can pass freely between the cylindrical member 65 and the plate 55.

A lamp 77 is positioned internally of the drum 66 and provides a light source directing a ray of light through the opening 72 and through an aligning opening 78 in the plate 55. A photocell 79 is positioned below the plate 55 in alignment with the openings 72 and 78 and is adapted to receive light from the light source 77 when no sheet is positioned between the cylinder 65 and the plate 55.

A solenoid valve 80 is mounted on the plate 58' and has its valve inlet connected to a conventional vacuum source through a line 81 and its outlet connected to vacuum lines 64 and 64' which are in turn connected to the diaphragm assembly 63 and to the drum 66, respectively, as previously described.

FIGURE 6 shows the control diagram for the embodiment of the invention shown in FIGURES 4 and 5 in which a disconnect switch 82 connects the electrical system to a source of power. A motor 84, which is connected to drive the rotating cylinder and the ball and disc assembly in conventional fashion, is controlled by a conventional motor start switch indicated at 85. The lamp 77 inside of the drum 66 is illuminated whenever the main control switch is closed and, when a sheet is not interposed between the lamp 77 and the photocell 79, a photo transistor 86 is energized, actuating a relay 87 having a normally closed contact R1 which, when open, results in the solenoid 80 being de-energized, thus serving to disconnect the vacuum lines 64 and 64' from the source of vacuum.

In operation of the apparatus shown in FIGURES 4, 5, and 6 a stack of sheets 54 are positioned upon the plate 55 below the rotating ball assembly 56. It will be evident, however, that check feed means such as were described in connection with FIGURE 2 or various other

sheet feed means may be employed to provide a substantially continuous delivery of sheets upwardly for continuous separating and feeding operation. Rotation of the ball assembly causes a fan wise operation of the sheets, as is indicated generally by the arrow **89** in FIGURE 4, and the uppermost sheet **76**, having its outer end moving in the direction of the arrow **76** in FIGURE 4, passes through the space between the rotating cylinder and the plate **55** until the edge of the sheet passes between the light source **77** and the photocell **79**. It should be noted that the opening **78** in the plate **55** is positioned in alignment with the end, i.e., the left hand most portion, as viewed in FIGURE 4, of aligning slots **72** and **74**. Thus the sheet does not interrupt the light beam until it has reached substantially the position of the sheet **75** shown on FIGURE 4.

Upon interruption of the light beam the solenoid valve **80** is energized through the normally closed relay point R1 and the vacuum lines **64** and **64'** are thereby connected to the source of vacuum. This operation of the solenoid valve **80** serves to raise the diaphragm **62** lifting the rotating ball assembly upwardly relieving pressure thereof upon the stack of sheets and simultaneously provides for an inflow of air through the slot **74** in the rotating cylinder which is in alignment with the slot **72** in the drum. This inflow of air serves to lift the sheet **75** from the plate **55** into engagement with the rotating drum, as shown in FIGURE 5, whereby the sheet is advanced in a direction extending tangentially to the direction of rotation of the rotating drum and away from the stack of sheets in the direction of the arrow **76'** in FIGURE 4.

When the trailing end of the sheet clears the hole **78** and light is received by the photocell **79** the solenoid valve is de-energized, vacuum is removed from the lines **64** and **64'** the diaphragm **62** drops permitting the rotating ball assembly to bear with its full force upon the stack of sheets. The vacuum is also relieved from the rotating cylinder **65** which thus has no effect upon sheets passing thereunder. There now follows a repetition of the fanning operation until the next successive sheet interrupts the passage of light from the lamp **77** to the photocell **79** whereupon a next successive sheet is delivered from the separating means.

A hold-back device is desirably provided in order to prevent displacement of any of the other sheets when the uppermost sheet is being advanced by the vacuum drum **65**. Such a device is shown at **73** and provides a perforated surface slightly displaced from the plate **55** and vacuum is applied from the vacuum line **64'**. Thus, the second sheet of a stack is held in position against the device **73** while the first sheet of the stack is being advanced by the drum **65**. When the solenoid valve **80** is energized both the drum **65** and the hold-back device **73** are disconnected from the vacuum source and the sheets pass freely thereunder.

It will be noted that in the two above described embodiments of the invention, a rotary fanning separation is employed rather than a linear shingling separation. The fanning separation has the advantage that when the rotary separating means is positioned adjacent to one end of an elongated document, the rate of travel of the other end of the document is increased due to the radial displacement thereof. Thus, while a linear type of separation could be employed, the rotary separation is preferable.

It will be evident that the arrangement of rotary balls described in connection with FIGURES 2 and 4 may be replaced by numerous arrangements providing circularly moving rotating members in engagement with the uppermost sheet of a stack and that this and other modifications may be made to the embodiments of the invention disclosed herein without departing from the scope of the invention as set forth in the following claims.

What is claimed is:

1. Sheet handling apparatus, comprising a sheet supply station and a feed station, means for supporting a stack of sheets at said supply station, a sheet separator having a rotatable shaft and an associated member concentrically affixed thereto, said separator being mounted for movement between an active position and an inactive position and further being mounted adjacent said stack so that said member is rotatable in a plane substantially parallel with the sheets in said stack but not in contact therewith, a plurality of freely rolling sheet contacting elements, said elements having low coefficient of friction characteristics and being supported by said member with their respective peripheries being depressingly engaged with an uppermost sheet of said stack when said separator is in its active position, and means for rotating said shaft and its associated concentrically affixed member at a substantially high rate of speed so that a plurality of the uppermost sheets of said stack are simultaneously displaced in varying degrees about the axis of rotation of said shaft by the combined low frictional and high speed depression actions of all of said elements, whereby said sheets are positioned for rapid successive entry into said feed station with minimum chafing during the process of separation.

2. Sheet handling apparatus, comprising a sheet supply station and a feed station, means for supporting a stack of sheets at said supply station, a sheet separator having a rotatable shaft and an associated member concentrically affixed thereto, said separator being mounted for movement between an active position and an inactive position and further being mounted adjacent said stack so that said member is rotatable in a plane substantially parallel with the sheets in said stack but not in contact therewith, a plurality of freely rolling spherical sheet contacting elements, said elements having low coefficient of friction characteristics and being supported by said member with their respective peripheries being depressingly engaged with an uppermost sheet of said stack when said separator is in its active position, and means for rotating said shaft and its associated concentrically affixed member at a substantially high rate of speed so that a plurality of the uppermost sheets of said stack are simultaneously displaced in varying degrees about the axis of rotation of said shaft by the combined low frictional and high speed depression actions of all of said spherical elements, whereby said sheets are positioned for rapid successive entry into said feed station with minimum chafing during the process of separation.

3. Sheet handling apparatus, comprising a sheet supply station and a feed station, means for supporting a stack of sheets at said supply station, a sheet separator having a rotatable shaft and an associated member concentrically affixed thereto, said separator being mounted for movement between an active position and an inactive position and further being mounted adjacent said stack so that said member is rotatable in a plane substantially parallel with the sheets in said stack but not in contact therewith, a plurality of freely rolling sheet contacting elements, said elements having low coefficient of friction characteristics and being supported by said member with their respective peripheries being depressingly engaged with an uppermost sheet of said stack when said separator is in its active position, means for rotating said shaft and its associated concentrically affixed member at a substantially high rate of speed so that a plurality of the uppermost sheets of said stack are simultaneously displaced in varying degrees about the axis of rotation of said shaft by the combined low frictional and high speed depression actions of all of said elements, whereby said sheets are positioned for rapid successive entry into said feed station with minimum chafing during the process of separation, means at said feed station for removing the uppermost displaced sheet from said stack, and means responsive to a predetermined displacement of said uppermost sheet for actuating said removing means.

4. Sheet handling apparatus, comprising a sheet supply

station and a feed station, means for supporting a stack of sheets at said supply station, a sheet separator having a rotatable shaft and an associated member concentrically affixed thereto, said separator being mounted for movement between an active position and an inactive position and further being mounted adjacent said stack so that said member is rotatable in a plane substantially parallel with the sheets in said stack but not in contact therewith, a plurality of freely rolling sheet contacting elements, said elements having low coefficient of friction characteristics and being supported by said member with their respective peripheries being depressingly engaged with an uppermost sheet of said stack when said separator is in its active position, means for rotating said shaft and its associated concentrically affixed member at a substantially high rate of speed so that a plurality of the uppermost sheets of said stack are simultaneously displaced in varying degrees about the axis of rotation of said shaft by the combined low frictional and high speed depression actions of all of said elements, whereby said sheets are positioned for rapid successive entry in to said feed station with minimum chafing during the process of separation, means for disengaging said separating means from said stack, means at said feed station for removing the uppermost displaced sheet from said stack, and means responsive to a predetermined displacement of said uppermost sheet for actuating said disengaging means and said removing means.

5. Sheet handling apparatus, comprising a sheet supply station and a feed station, means for supporting a stack of sheets at said supply station, a sheet separator having a rotatable shaft and an associated member concentrically affixed thereto, said separator being mounted for movement between an active position and an inactive position and further being mounted adjacent said stack so that said member is rotatable in a plane substantially parallel with the sheets in said stack but not in contact therewith, a plurality of freely rolling sheet contacting elements, said elements having low coefficient of friction characteristics and being supported by said member with their respective peripheries being depressingly engaged with an uppermost sheet of said stack when said separator is in its active position, means for rotating said shaft and its associated concentrically affixed member at a substantially high rate of speed so that a plurality of the uppermost sheets of said stack are simultaneously displaced in varying degrees about the axis of rotation of said shaft by the combined low frictional and high speed depression actions of

all of said elements, whereby said sheets are positioned for rapid successive entry into said feed station with minimum chafing during the process of separation, means at said feed station for removing the uppermost displaced sheet from said stack, means for retaining sheets of said stack other than said uppermost sheet, and means responsive to a predetermined displacement of said uppermost sheet for actuating said retaining means and said removing means.

6. Sheet handling apparatus, comprising a sheet supply station and a feed station, means for supporting a stack of sheets at said supply station, a sheet separator having a rotatable shaft and an associated member concentrically affixed thereto, said separator being mounted for movement between an active position and an inactive position and further being mounted adjacent said stack so that said member is rotatable in a plane substantially parallel with the sheets in said stack but not in contact therewith, a plurality of freely rolling sheet contacting elements, said elements having low coefficient of friction characteristics and being supported by said member with their respective peripheries being depressingly engaged with an uppermost sheet of said stack when said separator is in its active position, means for rotating said shaft and its associated concentrically affixed member at a substantially high rate of speed so that a plurality of the uppermost sheets of said stack are simultaneously displaced in varying degrees about the axis of rotation of said shaft by the combined low frictional and high speed depression actions of all of said elements, whereby said sheets are positioned for rapid successive entry into said feed station with minimum chafing during the process of separation, means for disengaging said separating means from said stack of sheets, means at said feed station for removing the uppermost displaced sheet from said stack, means for retaining sheets of said stack other than said uppermost sheet, and means responsive to a predetermined displacement of said uppermost sheet for actuating said disengaging means, said removing means and said retaining means.

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