Aug. 30, 1966 A. J. STAINES 3,269,723

SHEET STRETCHING AND SEPARATING APPARATUS

Filed Dec. 23, 1963 4 Sheets-Sheet 1

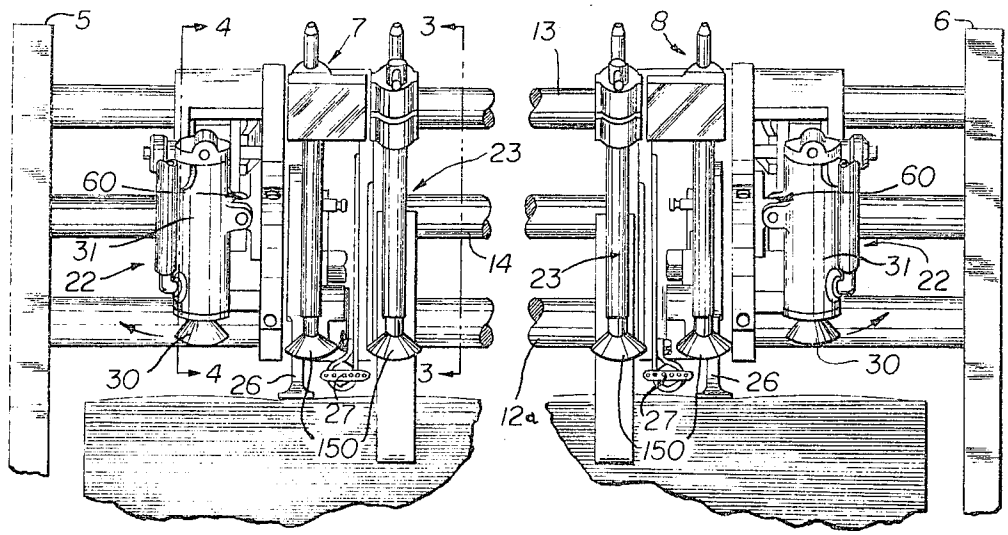


FIG. 1

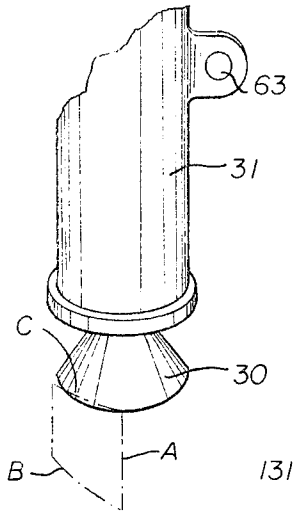


FIG. 10

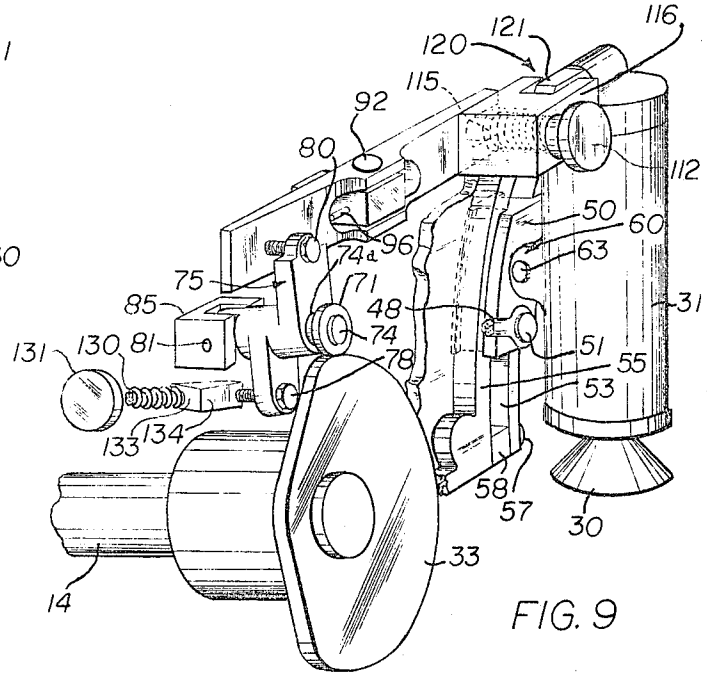


FIG. 9

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SHEET STRETCHING AND SEPARATING APPARATUS

Filed Dec. 23, 1963 4 Sheets-Sheet 2

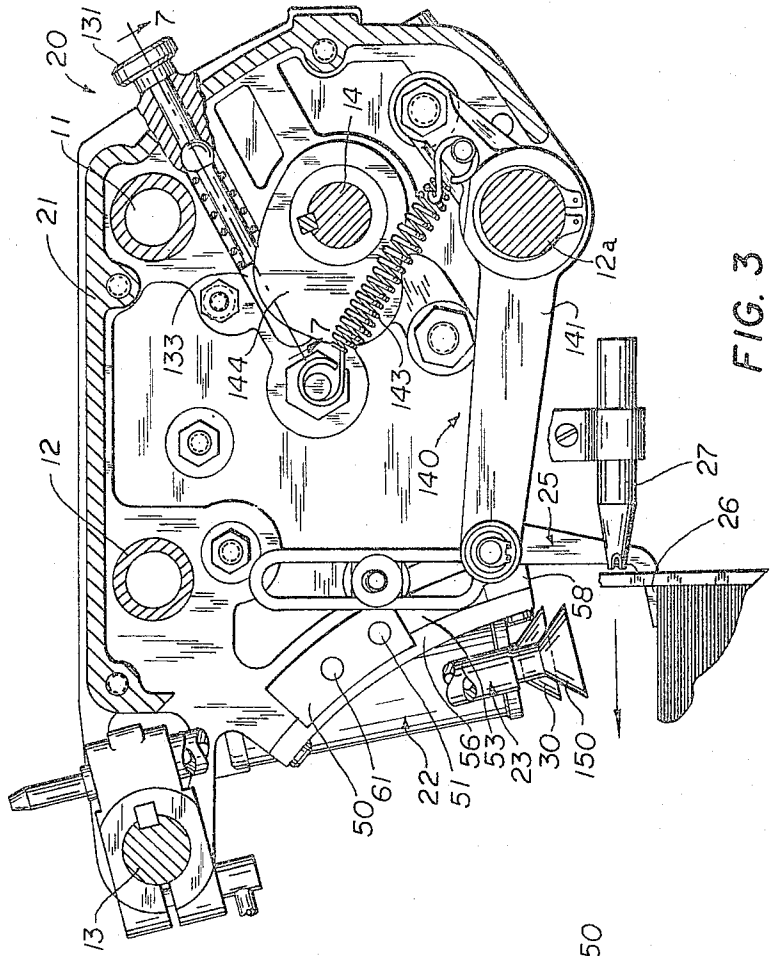


FIG. 3

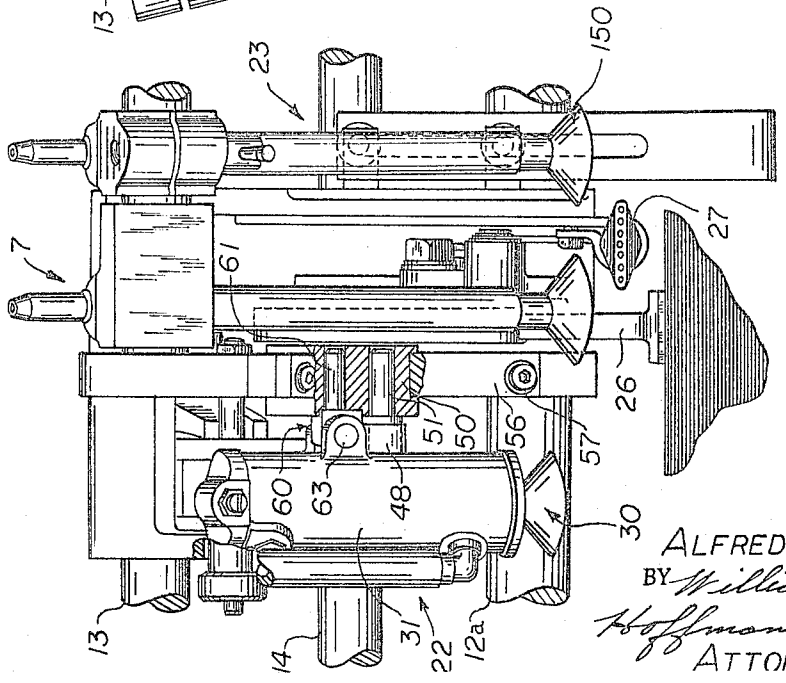


FIG. 2

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SHEET STRETCHING AND SEPARATING APPARATUS

Filed Dec. 23, 1963 4 Sheets-Sheet 3

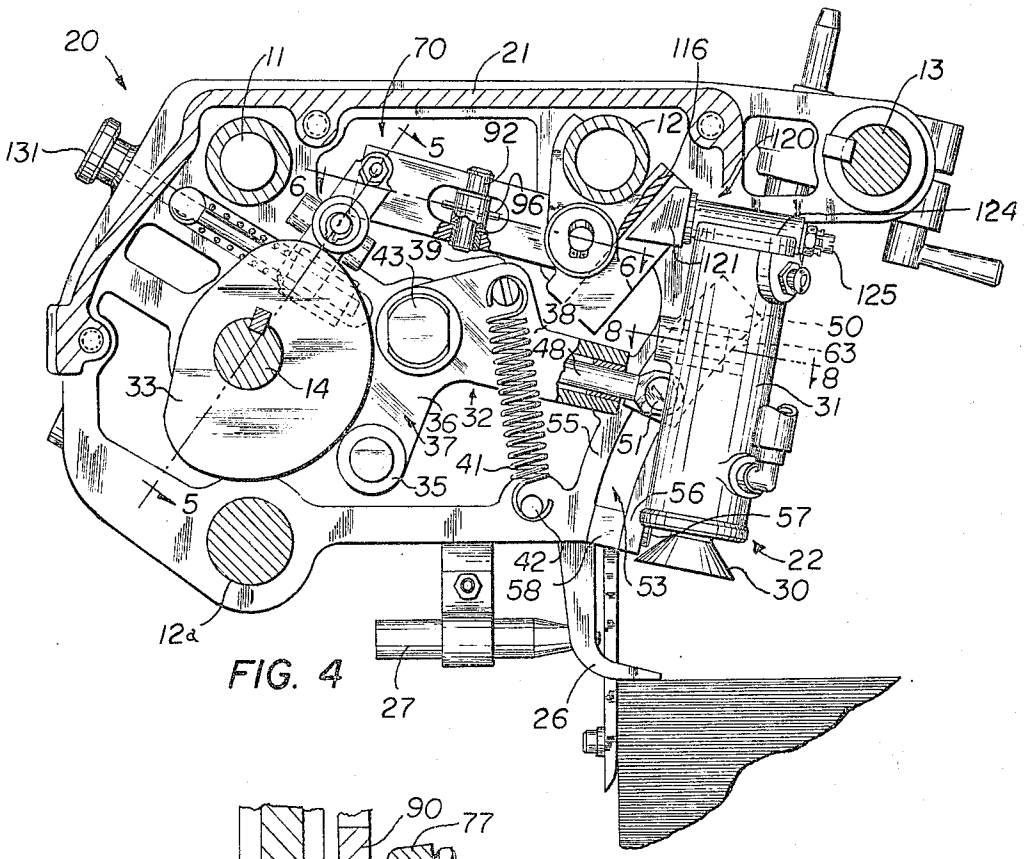


FIG. 4

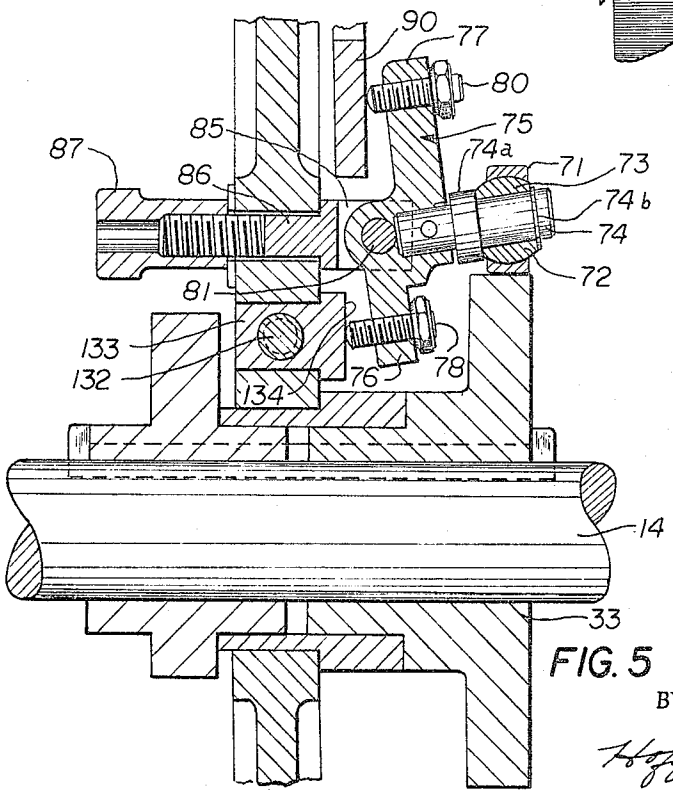


FIG. 5

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SHEET STRETCHING AND SEPARATING APPARATUS

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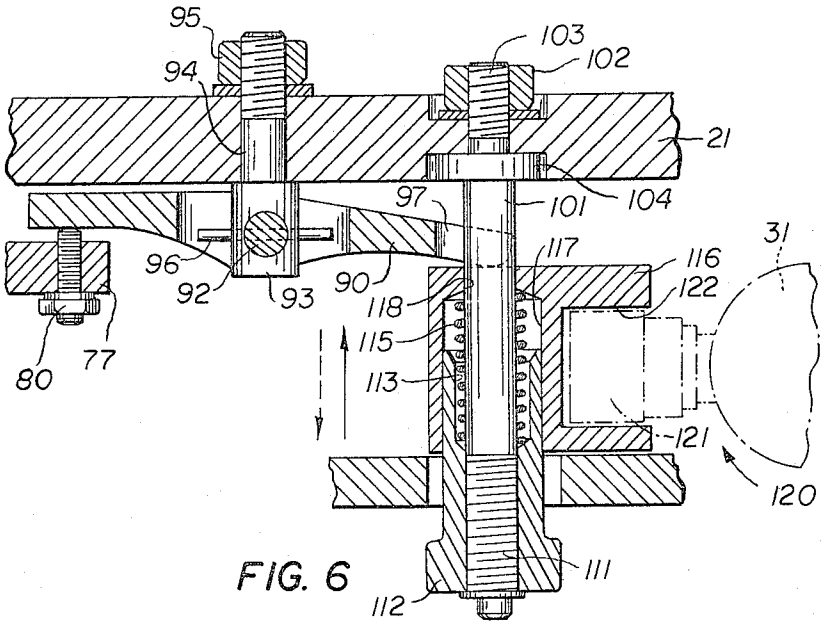


FIG. 6

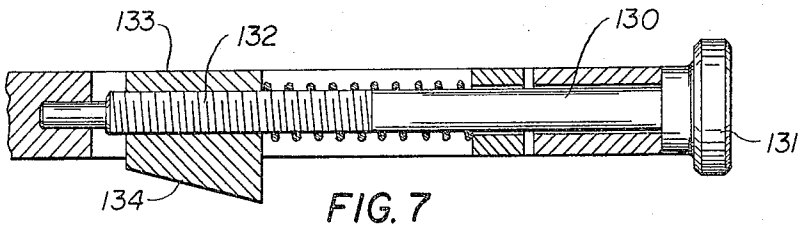


FIG. 7

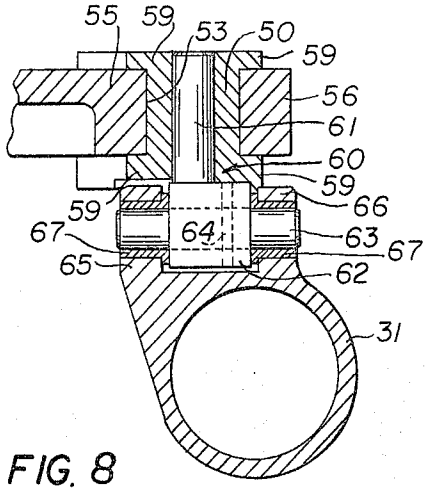


FIG. 8

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SHEET STRETCHING AND SEPARATING APPARATUS

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Filed Dec. 23, 1963, Ser. No. 332,596
11 Claims. (Cl. 271—27)

The present invention relates to a flexible sheet handling apparatus and, more particularly, to a sheet separating mechanism including sheet gripper members for taking the top sheet from a pile of sheets and for stretching or tautening the sheet as it is removed from the pile.

Prior art sheet separating mechanisms of the above-noted type normally include a pair of sheet gripping members which grip a sheet a spaced locations and separate or raise the sheet from the pile. The gripper members, while moving a direction to raise the sheet, move in opposite directions transverse to the direction of raising movement so as to stretch or tauten the portion of the sheet located between the gripper members. These prior art sheet separating mechanisms are relatively slow and complex, and extremely difficult to adjust to vary the amount of stretch when the mechanism is operating.

Accordingly, the principal object of the present invention is the provision of a new and improved sheet separating mechanism operable to stretch a sheet while separating it from a pile and which is more simple in construction, faster in operation, and more easily adjusted than known prior art sheet separating and stretching mechanisms.

A further object of the present invention is to the provision of a new and improved separating mechanism operable to stretch a sheet while separating it from a pile and wherein the stretching of the sheet occurs substantially immediately with the raising movement thereof so that the sheet is substantially stretched relatively quickly so that a sheet pressure foot can move under the stretched sheet and down into engagement with the pile quickly and thereby provide for fast operation.

A further object of the present invention is the provision of a new and improved sheet separating mechanism including sheet gripper members for separating the sheet from a pile and for stretching or tensioning the sheet while moving the sheet relative to the pile, and wherein the force applied to the gripper members to stretch the sheet may readily be adjusted for handling different materials to minimize sliding of the gripper members relative to the materials when stretching the sheet.

A further object of the present invention is the provision of a new and improved sheet separating mechanism operable to stretch a sheet while separating the sheet from a pile and including a stationary or non-running adjustment means for varying the amount of stretch to permit ready adjustment while the separating mechanism is operating.

A further object of the present invention is to the provision of a new and improved sheet separating mechanism operable to stretch or tauten a sheet while separating the sheet from a pile and including a spring means for effecting movement of a sheet gripping member to effect stretching of the sheet and adjusting means for varying the tension of the spring means to vary the force or pressure applied by the gripping member to the sheet during the stretching thereof to minimize sliding of the gripping member relative to the sheet.

A more specific object of the present invention is the provision of a new and improved sheet separating mechanism wherein a spring means is utilized for moving a sheet gripping member in a direction to stretch a sheet, and wherein a limit or stop means is provided for blocking

stretching movement of the sheet gripping member, which stop may be moved or withdrawn a given distance to permit a corresponding movement of the sheet gripping member to stretch the sheet.

A further specific object of the present invention is the provision of a new and improved sheet separating mechanism wherein a limit or stop means is moved under the control of a cam member to actuate the stretching movement of a sheet gripping member and wherein adjustment means is provided for varying the length of movement of the limit or stop means so as to adjust the amount of stretching movement of the sheet gripping member.

A further object of the present invention is the provision of a new and improved sheet separating mechanism wherein a single cam member is provided for controlling the stretching movement of a sheet gripping member and separating movement of the sheet gripping member, thus providing a highly simplified sheet feeding mechanism.

A still further object of the present invention is the provision of a new and improved sheet feeding apparatus including a sheet raising gripper member movable in an arcuate track by a suitable linkage mechanism so as to raise the sheet and present portions of the sheet at the proper angle to be gripped by forwarding sucker members for moving the sheet forwardly.

Further objects and advantages of the present invention will be apparent to those skilled in the art to which it relates from the following detailed description thereof made with reference to the accompanying drawings forming a part of this specification and in which,

FIG. 1 is a front elevational view of a sheet feeding apparatus embodying the present invention;

FIG. 2 is a front elevational view of a portion of the sheet feeding apparatus as shown in FIG. 1;

FIG. 3 is a sectional view with parts broken away of the sheet feeding apparatus of FIG. 1 taken approximately along section line **3—3** of FIG. 1;

FIG. 4 is a sectional view of the sheet feeding apparatus shown in FIG. 1 taken approximately along section line **4—4** of FIG. 1;

FIG. 5 is a fragmentary sectional view of the sheet feeding apparatus shown in FIG. 4 taken approximately along the section line **5—5** of FIG. 4;

FIG. 6 is a fragmentary sectional view of the sheet feeding apparatus shown in FIG. 4 taken approximately along the section line **6—6** of FIG. 4;

FIG. 7 is a framentary sectional view of the sheet feeding apparatus shown in FIG. 3 taken along the section line **7—7** of FIG. 3;

FIG. 8 is a fragmentary sectional view of the apparatus shown in FIG. 4 taken approximately along section line **8—8** of FIG. 4;

FIG. 9 is a perspective view of parts of the apparatus shown in FIG. 1; and

FIG. 10 is a schematic view illustrating the path of movement of one of the sheet gripper members forming a part of the apparatus shown in FIG. 1.

The present invention is preferably embodied in a sheet feeding apparatus operable to successively feed sheets from a pile of sheets forwardly of the pile and in an underlapped relation. The invention may be embodied in a sheet feeding apparatus wherein the sheets are overlapped or wherein there is no lapping of the sheets. A sheet feeding apparatus embodying the present invention is primarily used for feeding flexible paper sheets to a printing press wherein the sheets are printed, however, the apparatus may be used to feed sheets of any flexible material to any type of processing machine or work station.

The sheet feeding apparatus forming the preferred embodiment of this invention includes a pair of spaced side frame members **5, 6** located on opposite sides of a pile

of sheets to be fed to a printing press. A pair of sheet separating mechanisms 7, 8 are supported between the side frame members 5, 6 and above the rear portion of the pile of sheets and are operable in timed relation to raise or separate individual sheets from the pile, to stretch the sheets while separating them from the pile, and to feed the sheets forwardly toward the printing press.

The sheet separating mechanisms 7, 8 are supported by a plurality of hollow support rods 11, 12 extending between the side frame members 5, 6 and supported thereby. A plurality of shafts 12*a*, 13, and 14 are rotatably supported by the side frame members 5, 6 and extend therebetween. The sheet separating mechanisms 7, 8 are identical in construction, and therefore only the sheet separating mechanism 7 will be described hereinbelow in detail, and similar reference numbers will be used to designate the same parts of each sheet separating mechanism.

The sheet separating mechanism 7 includes a housing 21 suitably supported on the support rods 11, 12 and through which the shafts 12*a*, 13, and 14 extend. The housing 21 carries a sheet raising means 22 operable to engage the rear portion of the top sheet on the pile and raise it from the pile in a generally vertical direction. The housing 21 also supports a sheet forwarding sucker means 23 to which the sheet is transferred from the sheet raising sucker means 22, and which is operable to take the sheet from the sheet raising sucker means 22 and move the sheet forwardly of the pile in a direction generally indicated by the arrow shown in FIG. 3.

The sheet separating mechanism 7 also includes a conventional presser foot mechanism 25 including a presser foot member 26 which is operable to engage and hold stationary the sheet directly under the topmost sheet while the topmost sheet of the pile is being raised along its rear edge by the sheet raising means 22. Suitable conventional comber wheels, not shown, are also provided and are preferably driven from shaft 12*a*. A separating air nozzle 27 is provided and is supported by the housing means 21 and extends beneath the housing means 21 adjacent the rear portion of the pile of sheets. The separating air nozzle 27 is positioned so as to direct a flow of separating air beneath the topmost sheet of the pile as it is being raised from the pile to facilitate separation of the sheet from the pile.

The sheet raising means 22 comprises a sheet gripper or sucker member 30 and a cylinder member 31 which supports the gripper member 30 and which is connected to a suitable source of vacuum in order to apply vacuum to the sheet gripper 30. The sheet raising means 22 further includes a suitable linkage arrangement 32 for moving the sheet gripping sucker member 30 and cylinder member 31 in a generally vertical direction to effect the raising movement of the sheet. The linkage mechanism 32 is actuated by a suitable cam member 33 which is keyed to the camshaft 14 and is located interiorly of the housing 21.

The linkage 32 may be of any suitable detailed construction, preferably it includes a cam follower 35 which runs in engagement with the cam 33. The cam follower 35 is suitably supported on one leg 36 of a bell crank 37 preferably rotatably supported on a support pin or shaft 43 extending substantially parallel to the camshaft 14 and located in the housing 21. The other leg 38 of the bell crank 37 has an ear portion 39 extending upwardly therefrom and to which one end of a coil spring 41 is suitably attached. The other end of the coil spring 41 is attached to a pin 42 supported by a portion of the housing 21. The spring 41 biases the bell crank 37 for rotation in a clockwise direction, as viewed in FIG. 4, about the axis of the support pin or shaft 43 and thereby holds the cam follower 35 in engagement with the periphery of the cam 33. From the above description it should be readily apparent that upon rotation of the cam 33, the bell crank 37 rotates. The bell crank 37 is rotated about the shaft 43 in a clockwise direction by the spring 41 when a decreasing radius portion of the cam is running past the follower 35 and in a counterclockwise direction by the cam 33 when an increasing radius portion of the cam is running past the follower 35.

The leg 38 of the bell crank is provided with a passage therein extending substantially perpendicular to the shaft 43, and a connecting rod 48 is slidably received in the passage and includes an end portion located outwardly thereof. The end of the connecting rod 48 which is located outwardly of the passage in the bell crank arm 38 carries a pin 51 fixedly connected thereto and extending parallel to shaft 43 and perpendicular to rod 48. The end of the pin 51 opposite the end connected to rod 48 is rotatably received in a block member 50. The block member 50 is supported for movement relative to the housing 21 and is suitably connected to the gripper means 22 to effect movement thereof in response to movement of the block 50. From the above description, it should be apparent that the block 50 moves under the control of cam 33 to effect movement of the gripper means 22.

Movement of the block 50 is guided by means of an arcuate guide track 53 formed in the forward portion of the housing 21 and in which the guide block 50 is slidably received. The guide track 53 is defined by an arcuately shaped forward support member 55 of the housing means 21 and a separate arcuately shaped track member 56 which is secured by suitable bolt members 57 to the forward end of housing 21. The separate track member 56 is spaced outwardly from the housing 21 by suitable block members 58 interposed between track member 56 and support member 55 and through which the bolt members 57 extend. The support member 55 and the track member 56 have correspondingly curved arcuate surfaces facing each other and define the track 53 therebetween. The guide block 50 has curved arcuate sides which correspond to the curve of the track 53 and, as best shown in FIG. 8, is slidable in the track 53 and retained therein by projecting portions 59 of the guide block which engage the opposite sides of the support member 55 and track member 56 so as to hold the guide block 50 from movement out of the track 53.

As mentioned above, the guide block 50 is secured to the sheet raising means 22 so that the sheet raising means 22 moves with the guide block 50. More specifically, the guide block 50 is secured to the cylinder member 31 of the sheet raising means 22 by means of a suitable connection 60 best shown in FIG. 8. The connection 60 includes a pin 61 fixedly secured in the guide block 50 and extending in the same direction as pin 51. The pin 61 has a block portion 62 supported on the outer end thereof. The block portion 62 has an opening therein extending transverse to the pin 61 and through which a pivot pin 63 extends. A suitable conventional spring pin 64 fixedly secures the pivot pin 63 to the block portion 62. The pivot pin 63 extends perpendicular to pin 61 and through ear portions 65 and 66 of the cylinder member 31 which each portions are rotatable relative to the pin 63. Suitable bearing sleeves 67 encircle the outer end of the pin 63 and are located between the pin 63 and the ears 65, 66.

From the above description it should be readily apparent that the sheet raising sucker members 30 are moved vertically in an arcuate path upon rotation of the cam member 33 which causes movement of the block member 50 in the arcuate track 53 and which, in turn, effects movement of the cylinder 31. Moreover it should be readily apparent that the cylinder member 31 is supported in position for pivotal movement about the axis of the pin 63. The pivoting movement of the cylinder 31 about the axis of pin 63 causes the cylinder 31 to be pivoted, as indicated by the arrow as shown in FIG. 1, in a direction transverse to the direction of raising movement. Pivoting movement in the direction transverse to the direction of raising movement effects stretching of the sheet, as will be described in detail hereinbelow.

A suitable means 70 is provided for effecting pivotal movement of the cylinder 31 about the axis of pin 63 to effect stretching of the sheet. As above described, there are two sucker members 30 spaced laterally of the sheet and pivoting movement of the sucker members 30 in opposite directions about the axis of their respective pins 63 causes the sucker members to stretch the portion of the sheet positioned between the sucker members. The stretching movement of the sucker members begins substantially immediately with the raising or separating movement thereof. This effects substantial stretching of the sheet before it has been raised substantially. The presser foot 26 can thus be readily moved under the stretched sheet and into engagement with the next sheet on the pile. The stretching permits the movement of the presser foot quickly into engagement with the next sheet and provides a fast operation for the feeding apparatus, as will be apparent from the description hereinbelow.

The mechanism 70 for moving each sheet gripping sucker member 22 in a direction outwardly toward the adjacent side frame member for effecting stretching of the sheet is controlled from the cam member 33 which is effective upon rotation to cause the sheet gripping sucker member 30 to separate the sheet from the pile, as described above. Thus, a single cam member 33 effects not only the raising or separating movement of the sheet gripping member 30, but the stretching movement of the gripping member as well.

Specifically the mechanism 70 includes a cam follower 71 which runs in engagement with the cam 33. The cam follower 71 is a ring-shaped member having a concave inner surface 72 which is positioned in encircling engagement with a ball member 73. The ball member 73 is slidably received on the outer end of a shaft 74 and is held on the shaft 74 in engagement with a shoulder 74*a* thereon by a suitable split ring 74*b*. The ball member 73 is pivotal universally relative to the cam follower 71 and forms a ball and socket connection therewith wherein the ball member 73 is free to pivot universally relative to the cam follower 71.

The rod member 74 is connected at its end opposite the end carrying the cam follower ring 71 with a rocker lever 75 having oppositely directed arms 76 and 77, both of which extend substantially perpendicular to the rod member 74. The ends of arms 76 and 77 carry adjusting secrews 78 and 80, respectively, the function of which will be described in detail hereinbelow. Intermediate the ends of the rocker lever 75 is a pivot pin 81 extending through the rocker lever 75 and forming the pivot point about which the rocker lever 75 pivots. From the above description it should be readily apparent that, upon rotation of the cam 33, the cam follower 71 moves radially inwardly and outwardly thereof, and the lever 75 pivots about the pivot pin 81 in a direction depending upon the direction of movement of the cam follower 71. The pivot pin 81 is suitably supported in the mechanism and extends through a slotted block member 85 which is supported in the housing 21 on the end of a threaded rod member 86. The threaded end of the rod member 86 extends through a portion of the housing 21, and a nut member 87 is threaded thereon.

The adjusting screw 80 carried by the arm 77 is normally held in engagement with one end of a lever 90 which extends forwardly from the cam 33 toward the sheet raising gripper means 22. The lever 90 is mounted for pivotal movement about a vertical axis in the housing 21 and is supported in the housing 21 on a pivot pin 92 best shown in FIG. 6. The pivot pin 92 extends vertically and is supported in a terminal block portion 93 of a threaded rod 94. The rod 94 extends through an opening in a portion of the housing 21 and is secured therein by a nut member 95 which threadedly engages a threaded end portion of the rod member 94 opposite the terminal block portion 93. The block portion 93 is located in an opening in the central portion of the lever 90, and a suitable roll pin member 96 extends through the terminal block portion 93 and through the vertically extending pivot pin 92 to secure the pivot pin in the block portion 93 with the opposite ends of the pivot pin extending beyond the block portion 93. The opposite ends of the pivot pin 92 are reecived in openings in the lever 90, and the lever 90 is pivotal relative thereto.

The end of the lever 90 opposite the end which engages the adjusting screw 80 is bifurcated providing an opening 97 therethrough. A suitable rod member 101 extends through the opening 97 and is suitably clamped to a portion of the housing 21. The rod 101 is clamped to the housing 21 by means of suitable nut 102 which is threaded onto a threaded end portion 103 of the rod 101. The nut 102, when threaded onto the threaded end portion 103, draws the rod 101 and in particular the shoulder portion 104 of the rod 101 into engagement with one side of a portion of the housing 21 while the nut 102 is in clamping engagement with the other side of the portion of the housing 21.

The end of the rod 101 opposite the threaded end portion 103 is threaded at 111 and carries an elongated threaded adjusting nut or member 112 which is threadedly received on the threaded end portion 111 and may be moved axially of the rod 101 upon turning of the adjusting member 112. The member 112 is provided with an enlarged opening which extends axially thereof at one end thereof and which lies in encircling relation with the rod 101 and is spaced therefrom and defines an annular pocket 113 therewith.

A spring means in the form of a suitable coil spring 115 is positioned in the annular pocket encircling rod 101 and has one end thereof engaging the adjusting nut 112. The other end of the spring 115 engages a portion of a suitable block member 116 slidably supported on the rod 101. The block member 116 is slidable axially along rod 101 and is held or biased into engagement with the bifurcated end portion 97 of the lever 90 by the spring 115. The block 116 is provided with a passageway 117 therethrough which lies in encircling relation to the spring 115 and a portion of the adjusting nut 112 and is slidable thereover upon sliding movement of the block 116 relative to the rod 101. The passage 117 has a narrow portion 118 which closely engages the periphery of the rod 101 and guides the movement of the block 116 axially relative to the rod 101.

From the above description it should be readily apparent that the block 116 is held in engagement with the bifurcated end portion of the lever 90 by the spring 115 and, upon movement of the bifurcated end portion of the lever 90, the block 116 will move therewith due to the action of the spring means 115. The force of the movement of the block 116 may be readily adjusted by adjusting the compression of the spring means 115 by rotating the adjusting member 112. Upon rotation of the adjusting member 112 the spring means 115 is compressed or expanded depending upon the direction of rotation and, of course, the compression of the spring 115 is varied thereby. If the spring means 115 is compressed by relative movement of the adjusting member 112 and the rod 101, the biasing force of the spring 115 is increased and the block 116, when free to move, will be moved by the spring 115 at a force greater than the force would have been had the spring means 115 not been compressed. On the other hand if the spring means 115 is expanded by relative movement of the adjusting member 112 and the rod 101, the force of the spring 115 tending to move the block 116 is decreased and the block 116 is moved by the spring 115 at a lesser force than if the spring means had not been expanded. Thus, the spring 115 is a variable force applying means for moving the block 116. The function of this adjustment will be further described in detail hereinbelow.

Moreover, from the above description, it should be readily apparent that the cam 33 controls the position of the bifurcated end portion of the lever 90 through the rocker arm 75, as described above, and that if the bi-

furcated end portion of the lever **90** is moved in the direction of the arrow shown in FIG. 6, namely in a direction away from the block **116**, the spring means **115** causes the block **116** to move with the bifurcated end portion of the lever **90** and to remain in engagement therewith. More specifically and by way of example, if the cam follower **71** moves inwardly of the cam **33** and the rocker lever **75** rotates in a clockwise direction as viewed in FIG. 5 about the pivot pin **81** causing the lever **90** to rotate in a counterclockwise direction as viewed in FIG. 6 causing the bifurcated end portion of the lever **90** to move away from the block **116** and in a direction as indicated by the arrow in FIG. 6, the spring means **115** causes the block **116** to remain in engagement with the bifurcated end portion of the lever **90** and move in the direction of the arrow shown in FIG. 6. On the other hand when the cam follower **71** moves outwardly of the cam **33**, the rocker lever **75** is pivoted in a counterclockwise direction causing the lever **90** to be rotated in a clockwise direction about its pivot pin **92** and causing the bifurcated end portion of the lever **90** to move the block **116** against the bias of the spring **115** and in a direction opposite the direction of the arrow shown in FIG. 6.

The movement of the block **116** effects stretching movement of the gripper members **30** and specifically causes pivotal movement of the gripper cylinder **31** about the axis of the pivot pin **63**. Accordingly, the upper end portion of the cylinder **31** of the sheet gripping means **22** carries a suitable connection **120** connecting the cylinder **31** of the sheet gripping means **22** with the block member **116** to effect pivotal movement of the sheet gripper cylinder **31** about the axis of the pin **63** upon movement of the block **116**. The connection **120** comprises a suitable block member **121** which is received in a slot or groove **122** formed in the block member **116**. The block member **121** is connected to the upper end of the cylinder **31** and specifically is connected to the outer end of a shaft member **124** which extends through the upper end of the cylinder **31** and carries a suitable eccentric member, not shown. The end of the shaft **124** opposite the end carrying the block **121** is rotatable by means of a suitable tool and has a suitable tool connection **125** on the end thereof. Rotation of the shaft **124** causes rotation of the eccentric carried thereby and changes the angular disposition of the cylinder **31**. Thus the cylinder **31** may be adjusted so as to extend at an angle to the vertical when in its operating position or it may extend vertically as shown.

From the above description it should be readily apparent that, upon movement of the block **116**, the block **121** will move therewith and cause the upper end of the cylinder **31** to be moved in the direction of movement of the block **116**. The lower end of the cylinder and the gripper members **30** carried thereby will be moved in a direction opposite the direction of the movement of the upper end because of the location of the pin **63** intermediate the cylinder **31**. Thus upon movement of the block member **116** and the block member **121** in the direction of the arrow shown in FIG. 6, the cylinder member **31** is rotated in a clockwise direction as shown in FIG. 2 about the axis of the pivot pin **63**. This action effects stretching of a sheet as mentioned hereinabove. Upon movement of the block member **116** and the block member **121** in the direction of the dotted arrow in FIG. 6, the cylinder member **31** is moved in a counterclockwise direction about the pivot pin **63** and effects return of the cylinder member **31** to a vertical position.

The sheet separating mechanism **7** includes a means for varying the amount of stretch which is applied to the sheet. This means includes a suitable adjusting screw **130** best shown in FIG. 7 having one end which extends outwardly of the housing **21** and carries an adjusting knob **131** which is stationary during operation of the mechanism and may be termed a non-running adjustment and may be engaged and turned to rotate the screw **130** relative to the housing **21** to effect adjustment of the amount of stretch while the mechanism is operating. The screw **130** has a threaded end portion **132** which engages a suitable cam member **133** and which is movable axially relative to the screw threads **132** upon rotation of the knob **131**. The cam **133** has a cam surface **134** which is engaged by the adjusting screw **78** which is carried by the end of the rocker lever **75**. The cam **133** can be adjusted so that the adjusting screw **78** engages the cam surface **134** of the cam **133** and holds the cam follower **71** from following the radius of the periphery of the cam **33** and holds the cam follower **71** out of engagement with a portion of the cam **33**. The adjusting screw **80** is then limited in its clockwise movement about the axis of the pin **81** by engagement of the screw **78** with the cam surface **134** and thereby the lever **90** is limited in its movement, thus limiting the movement of the block **116** and thereby limiting the movement of the gripper members **30**. By adjusting the position of the cam surface **134** the amount of movement of the gripper members **30** in a stretching direction can be varied to vary the amount of stretch. The adjusting screws **78** and **80** are primarily for manufacturing adjustment to compensate for manufacturing tolerances.

FIG. 10 illustrates in dot-dash lines a typical path of movement of a gripper member **30** under the control of cam **33** to effect stretching of one sheet and separating of the sheet. It should be noted that the gripper member **30** moves downwardly along a vertical path A to engage the sheet. The gripper member, after taking the sheet, moves along a path B which is the resultant of the stretching and raising movement of the gripper member. The gripper member then moves vertically to complete the raising of the sheet. Stretching of the sheet begins immediately with the raising of the sheet and the sheet is stretched in a substantial manner before the sheet has been completely raised. After the gripper member **30** completes its raising and stretching movement, it is returned to its normal position for subsequently lowering movement along a path C which is an arc of a circle having the pin **63** as its center. It should be understood that by adjusting the amount of stretch the path traversed by the gripper member will be substantially different than the path illustrated in FIG. 9, and for certain applications the adjusting mechanism for adjusting the tension and amount of stretch can be adjusted to a position wherein stretch is completely eliminated so that the sheet is not stretched while it is being separated. The gripper member **30** may be of the type which moves relative to the cylinder **31** when suction is applied thereto, but this movement is not under the control of cam **33** and is not shown in the drawings.

From the above description it should be readily apparent that the present invention provides a new and improved sheet separating mechanism operable to effect stretching of the sheet being separated and wherein the amount of stretch and the force or pressure of the stretch is adjustable while the mechanism is operating. The elements adjusted by the operator are stationary, however. These adjustments are desirable to properly adjust the mechanism for handling different types and sizes of sheet stock. By turning the adjusting screw **131** the position of the cam **133** can be varied to vary the extent of movement of the cam follower **71** under the action of the cam **33** and thus vary the stretching movement of the gripper members **30**. The force or pressure applied to the sheets by the gripper members **30** for stretching thereof can be varied by turning the stationary adjusting screw knob **112** to vary the compression of the spring means **115** as described above. For example, if the spring means **115** is compressed greatly, the spring will move the grippers **30** with a great force causing the sheet to be tensioned with a greater force than if the spring means **115** is not so compressed. By adjusting the force of movement of the grippers **30**, relative sliding movement of the grippers along a sheet can be minimized thereby minimizing wear of the grippers and providing effective stretching. For example, when handling a glossy stock having a smooth

surface, the grippers **30** would tend to slide thereon and, by adjusting the force of movement thereof, this tendency can be minimized.

As mentioned hereinabove, one of the advantages of stretching the sheet while it is being separated is that the sheet presser member **26** can be moved into engagement with the next sheet of the pile earlier than if the sheet was not stretched. The stretching of the sheet provides room for the sheet presser member **26** to move under the sheet being separated whereas, without the stretching, the sheet would droop in the area where the sheet presser member **26** is to move under the sheet and thus the sheet presser member **26** would have to be slowed so that the presser members would not engage the drooping sheet being separated. By stretching the sheet and eliminating this droop the sheet presser members can be moved into engagement with the next sheet at an earlier point in the cycle of operation and thus the speed of the sheet separating mechanism can be increased.

The sheet presser members **26** are of conventional construction and are operated by a conventional mechanism well known to those skilled in the art and designated **140** in the drawings. The mechanism **140** will not be specifically described in detail since it is conventional and well known. It should suffice to say that the presser member **26** of each sheet separating mechanism is supported by a lever **141** which is mounted for pivotal movement about the axis of shaft **12***a* and is rotated about the axis of the shaft **12***a* in a counterclockwise direction by a spring member **143** and is rotated about the axis of the shaft **12***a* in a counterclockwise direction by a suitable cam **144** mounted on the camshaft **14** and spaced axially along the camshaft **14** from the cam **33**. Upon rotation of the cam **144** the highest point of the cam **144** causes movement of the lever **141** in a clockwise direction about the axis of the shaft **12***a* and causes raising movement of the presser member **26** out of engagement with the sheets. When the cam **144** runs out of engagement with the cam follower the spring **143** effects movement of the lever **141** in a counterclockwise direction about the axis of shaft **12***a* and causes the presser members **26** to move downwardly into engagement with the top sheet of the stack while the topmost sheet is being separated therefrom. The movement of the presser members **26** can be effected at a faster rate due to the stretching of the sheet, as described hereinabove.

Each of the sheet separating mechanisms **7** and **8** include a pair of sheet forwarding sucker members **150** which are positioned to receive the sheet from sheet raising sucker members **30** and forward the sheet in the direction of the arrow of FIG. 3. The sheet raising sucker members **130** are supported for pivotal movement in response to pivotal movement of the camshaft **13**, and the specific mounting of the sheet forwarding sucker members **150** will not be described here in detail since it is conventional. The camshaft **13** is rotated in order to move the sheet forwarding sucker members **150** in a direction to forward the sheets in response to suitable cam actuated linkage, not shown in the drawings.

The sheet forwarding members **150** are disposed at an angle to the horizontal when they take the sheet from the gripper members **30**, as shown in FIG. 3. Due to the arcuate movement of the raising gripper members **30** as described above, the gripper members **30** are disposed at an angle to the horizontal which is substantially the same as the angle of disposition of the forwarding members **150**. Thus, the rear portion of the sheet when raised is disposed properly and at an angle of the forwarding sucker members **150** so as to be readily gripped thereby for forwarding movement.

From the above description the general operation of the sheet feeding apparatus **10** should be apparent. The sheet sucker members **30** engage the topmost sheet at spaced points and begin raising the sheet and stretching the portions of the sheet located between the sucker members while they are raising the sheet from the pile. As the sheet is being raised from the pile the presser members **26** move downwardly into engagement with the next sheet on the pile to hold the next sheet on the pile while the topmost sheet is being separated therefrom. The sheet is then transferred from the sheet raising and stretching gripper members **30** to the sheet forwarding grippers **150** which are moved in a direction to forward the sheet from the pile to a suitable feeding mechanism, not shown, for feeding the sheets away from the pile.

While the preferred embodiment of the present invention has been described hereinabove in great detail, it should be understood from the above description that certain modifications, adaptations and changes in structure may be made by those skilled in the art, and it is intended hereby to cover all changes, adaptations and modifications coming within the scope of the appended claims.

Having described my invention, I claim:

1. A sheet separating mechanism comprising a sheet raising means including a sheet gripper member movable relative to a pile of sheets and operable to grip the topmost sheet of a pile and separate the sheet from the pile, first linkage means providing for movement of said gripper member to effect raising movement thereof, second linkage means providing for movement of said sheet gripper member in a direction transverse to said separating direction while said gripper member is moving in said separating direction so that said sheet gripper member moves along a path which is the resultant of the effect of operation of said first and second linkage means, and a single cam member operatively associated with said first and second linkage means to effect operation of said first and second linkage means in timed relation.

2. A sheet separating mechanism comprising a housing, sheet raising means supported by the housing including a sheet gripper member movable relative to a pile of sheets and operable to grip the top most sheet of a pile and separate it from the pile, means for moving the sheet gripper member relative to the topmost sheet of a pile in an arcuate path to effect raising of the topmost sheet from the pile and disposition of a portion of the topmost sheet at an angle above the pile including a block member operatively connected to said gripper member and movable relative to said housing to effect raising and lowering movement of said gripper member, arcuate track means slidably receiving said block member and guiding movement of said block member relative to said housing whereby said gripper member is moved in an arcuate path for separating the sheet from the pile, and sheet forwarding means including a gripper member disposed at an angle which is substantially the same as the angle at which said sheet gripper member disposes said sheet and operable to grip said sheet and move it forwardly of the pile.

3. A sheet separating mechanism as defined in claim **2** further including connecting means connecting said block member to said gripper member and providing for pivotal movement of said gripper member in a direction transverse to the direction of raising movement of said block member.

4. A sheet separating mechanism as defined in claim **2** further including connecting means connecting said block member to said gripper member and providing for pivotal movement of said gripper member in a direction transverse to the direction of raising movement of said block member, means for pivoting said gripper member in a direction transverse to the direction of raising movement including a member operatively connected to said sheet gripper member at a point spaced from said point of the pivotal connection of said gripper member to said block member and spring means for moving said member to effect movement of said gripper member about said pivotal connection.

5. A sheet separating mechanism comprising sheet raising means including a sheet gripper member movable

relative to a pile of sheets and operable to grip the topmost sheet of a pile and separate the sheet from the pile, means for moving said sheet gripper member relative to the topmost sheet of the pile to effect raising of the topmost sheet from the pile and stretching of the sheet as it is separated from the pile including separating means for moving said sheet gripper member in a separating direction and stretching means for moving said sheet gripper in a direction transverse to said separating direction while said gripper member is moving in said separating direction so that said sheet gripper member moves along a path which is the resultant of the operation of said separating and stretching means, said means for moving said gripper member in said transverse direction comprising a spring means operatively connected to said gripper member and biasing said gripper member to effect stretching movement thereof, a limit means blocking the operation of said spring means and movable to provide for operation of said spring means, means for adjusting the tension of said spring means to vary the force applied by the spring means to move the gripper member in said transverse direction, a block member operatively connected to said gripper member to effect movement of said gripper member upon movement thereof, said spring means biasing said block member for movement in a direction to effect said transverse movement of said gripper member, said limit means including a member engaging said block member and preventing movement thereof by said spring means, a cam actuated linkage mechanism for moving said limit member to effect movement of said gripper member by said spring means, means for adjusting the length of movement of said limit member to thereby adjust the amount of movement of said gripper by said spring means, said cam actuated linkage including a cam follower and a rocker lever movable in response to movement of the cam follower inwardly and outwardly of said cam, and said means for adjusting the length of movement of said limit member includes a stop means adjustable to vary movement of said rocker lever.

6. A sheet separating mechanism as defined in claim **5** wherein said stop means comprises a cam member movable relative to the rocker lever and in the path of movement of the rocker lever to block movement thereof and an adjusting knob operatively connected to said cam member and stationary during the operation of said mechanism and for varying the position of said cam member.

7. A sheet separating mechanism comprising a sheet raising means including a sheet gripper member movable relative to a pile of sheets and operable to grip the topmost sheet of a pile and separate the sheet from the pile, first linkage means providing for movement of said gripper member to effect raising movement thereof, second linkage means providing for movement of said sheet gripper member in a direction transverse to said separating direction while said gripper member is moving in, said separating direction so that said sheet gripper member moves along a path which is the resultant of the effect of operation of said first and second linkage means, a single cam member operatively associated with said first and second linkage means to effect operation of said first and second linkage means in timed relation, said first linkage means including an arcuate shaped member operatively connected to said cam member and movable upon rotation of said cam member to effect raising of said gripper member, and connecting means operatively connecting said gripper member to said arcuate shaped member to

effect raising movement of said gripper member with said arcuate shaped member and including a pivotal connection supporting said gripper member for pivotal movement relative to said arcuate member about an axis transverse to the direction of separating movement of the gripper member.

8. A sheet separating mechanism as defined in claim **7** wherein sheet separating mechanism further comprises an arcuate track in which said arcuate member is slidably received and in which said arcuate member moves upon operation of said first linkage means causing arcuate movement of said sheet raising gripper member.

9. A mechanism for feeding sheets comprising sheet separating means for raising a sheet from a pile and feeding the sheet in a first direction forwardly of the pile including a sheet gripper member movable vertically relative to a pile of sheets and operable to grip the topmost sheet of a pile and raise the sheet from the pile, means for moving said sheet gripper member relative to the topmost sheet of the pile to effect raising of the topmost sheet from the pile and stretching of the sheet as it is separated from the pile including separating means for moving said sheet gripper member in a separating direction and stretching means for moving said sheet gripper in a second direction substantially perpendicular to said first direction and transverse to said separating direction while said gripper member is moving in said separating direction so that said sheet gripper member moves along a path which is the resultant of the operation of said separating and stretching means, said stretching means for moving said gripper member in said second direction comprising a movable member operatively connected to said gripper member to effect movement thereof upon movement of the movable member, spring means for moving said movable member to thereby effect movement of said gripper member to stretch said sheet, limit means holding said member against movement by said spring means and movable a predetermined distance to provide for movement of said member a predetermined distance by said spring means, and means separate from said spring means for moving said limit means to provide for movement of said member by said spring means.

10. A mechanism for feeding sheets as defined in claim **9** further including means for adjusting the length of movement of said limit means to thereby adjust the amount of movement of said gripper member by said spring means and including an adjusting knob stationary during the operation of said mechanism.

11. A mechanism for feeding sheets as defined in claim **9** further including means for adjusting the tension of said spring means to vary the force applied by the spring means to move the gripper member in said second direction including an adjusting knob stationary during the operation of the mechanism.

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