Oct. 2, 1956 W. R. SPILLER 2,765,166

SHEET FEEDER

Filed April 13, 1953 5 Sheets-Sheet 1

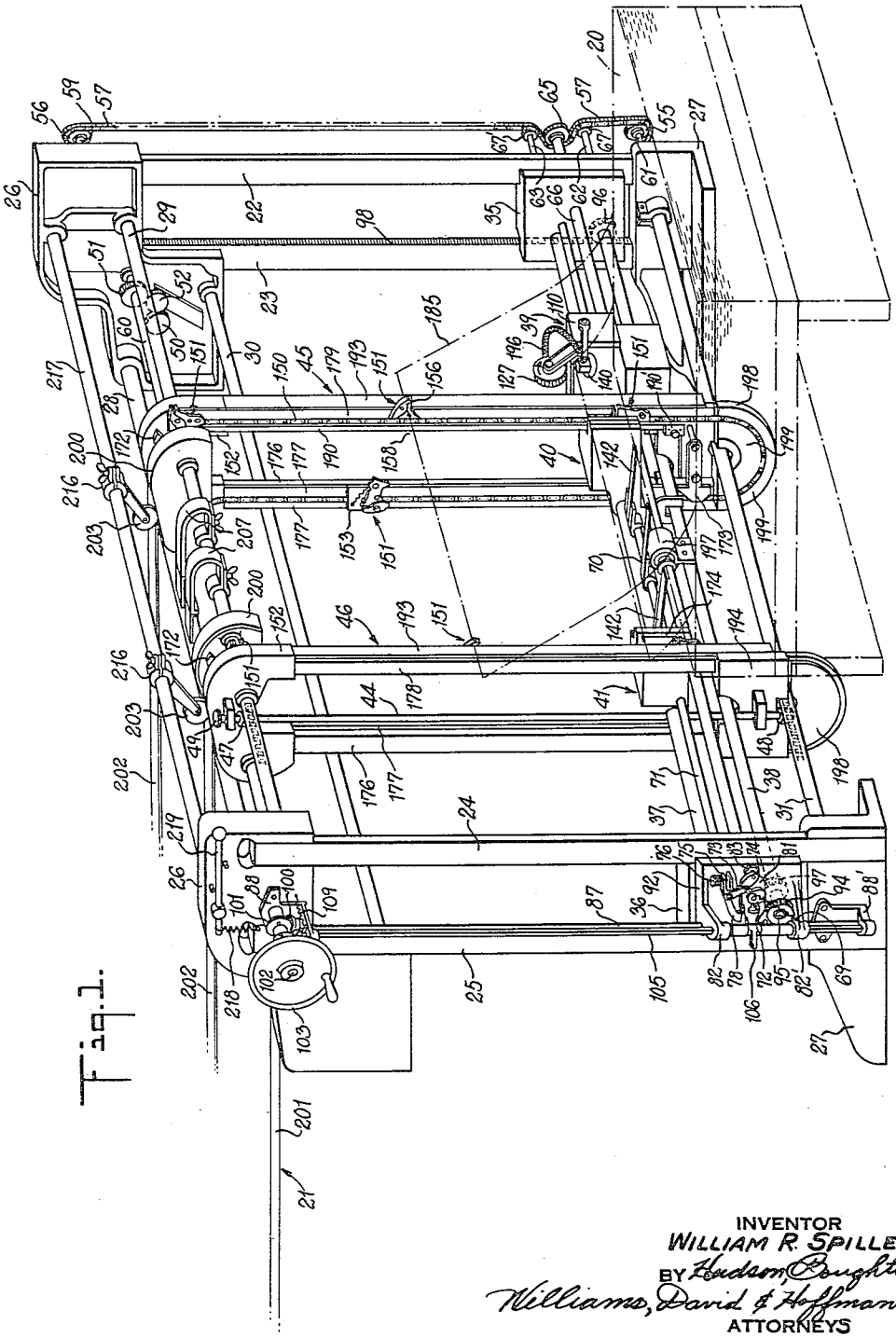


Fig. 1.

INVENTOR
WILLIAM R. SPILLER
BY Hudson Boughton,
Williams, David & Hoffmann
ATTORNEYS

Oct. 2, 1956 W. R. SPILLER 2,765,166

SHEET FEEDER

Filed April 13, 1953 5 Sheets-Sheet 2

Fig. 2.

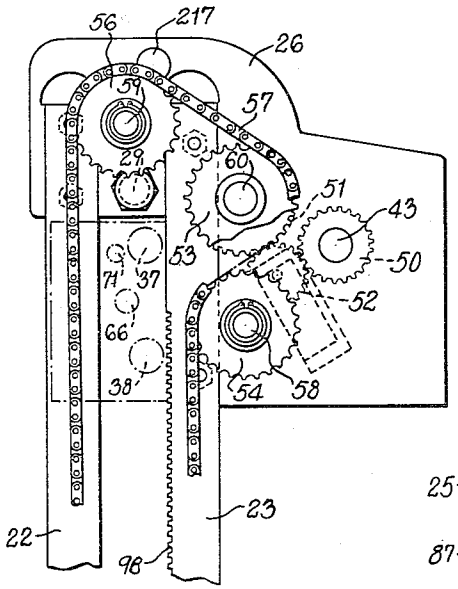


Fig. 3.

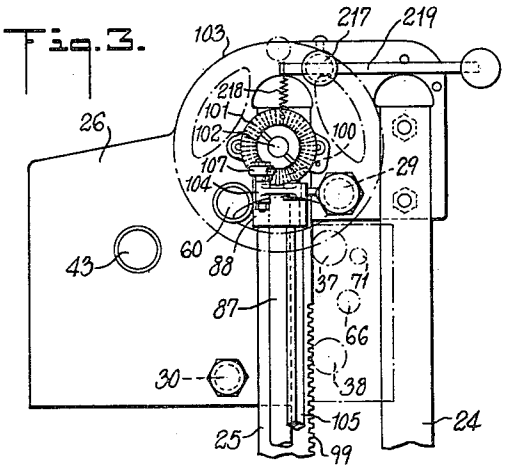
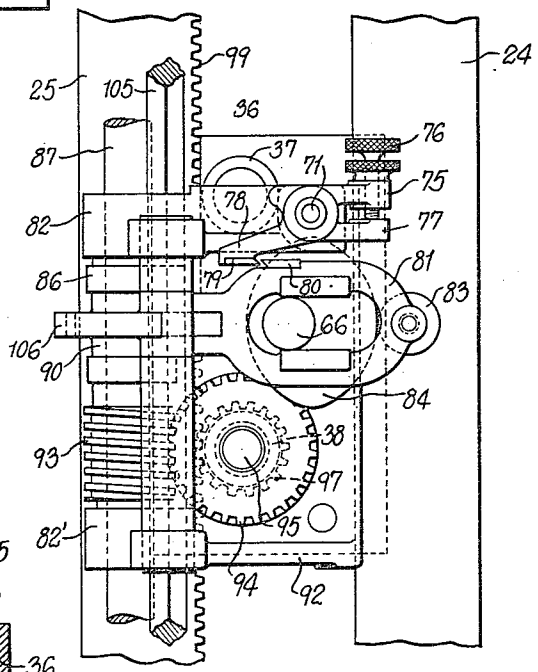


Fig. 4.



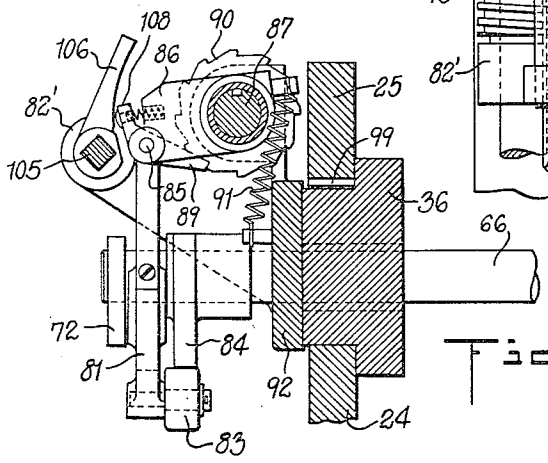


Fig. 5.

INVENTOR
WILLIAM R. SPILLER
BY Hudson, Boughton, Williams, David & Hoffmann
ATTORNEYS

Oct. 2, 1956 W. R. SPILLER 2,765,166

SHEET FEEDER

Filed April 13, 1953 5 Sheets-Sheet 3

Fig. 6.

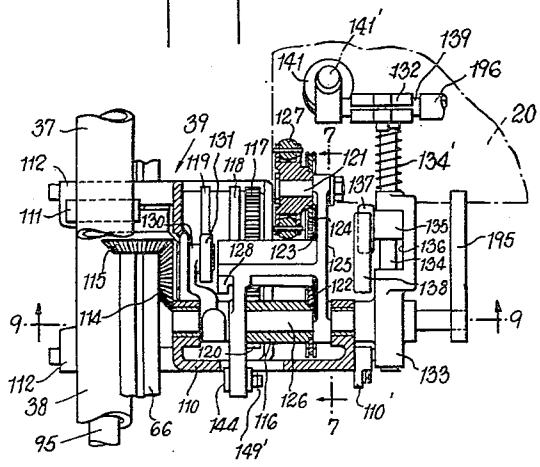


Fig. 7.

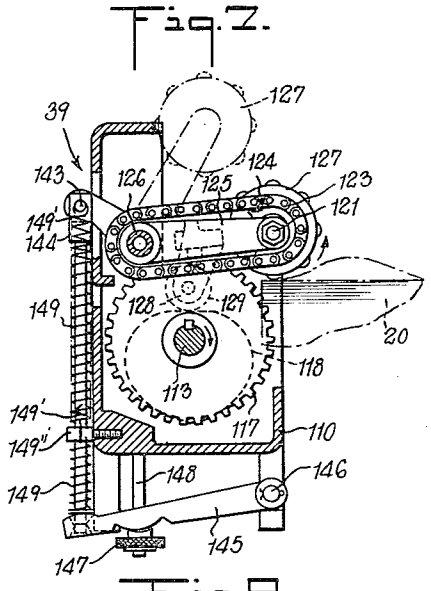


Fig. 8.

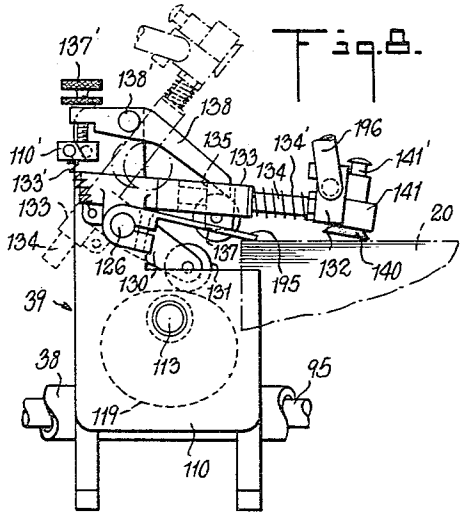
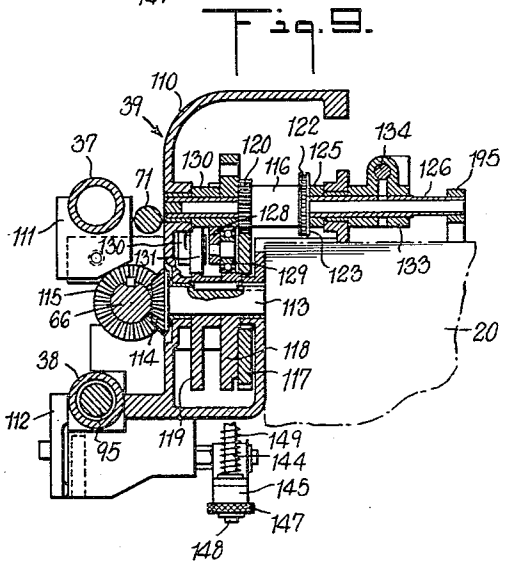


Fig. 9.



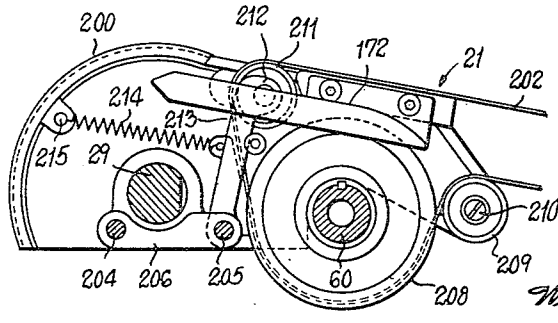


Fig. 18.

INVENTOR
WILLIAM R. SPILLER
BY Hudson, Boughton, Williams, David & Hoffmann
ATTORNEYS

Oct. 2, 1956 W. R. SPILLER 2,765,166

SHEET FEEDER

Filed April 13. 1953 5 Sheets-Sheet 4

Fig. 10.

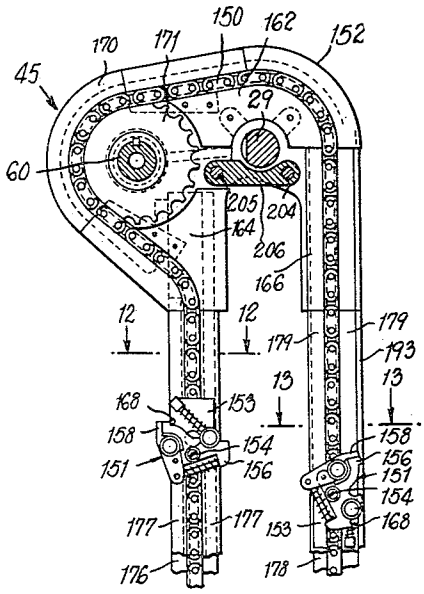


Fig. 11.

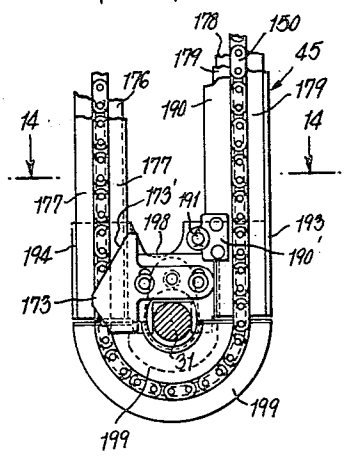


Fig. 14.

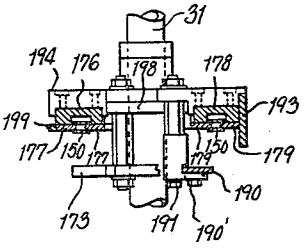


Fig. 12.

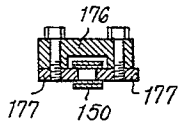


Fig. 13.

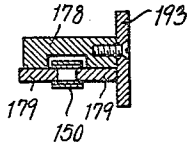


Fig. 15.

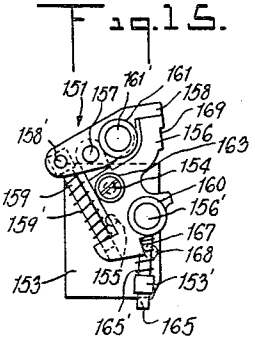
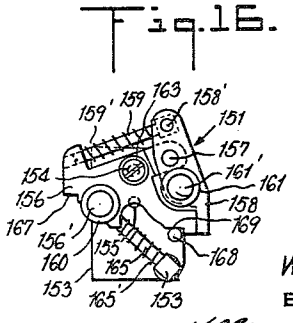


Fig. 16.



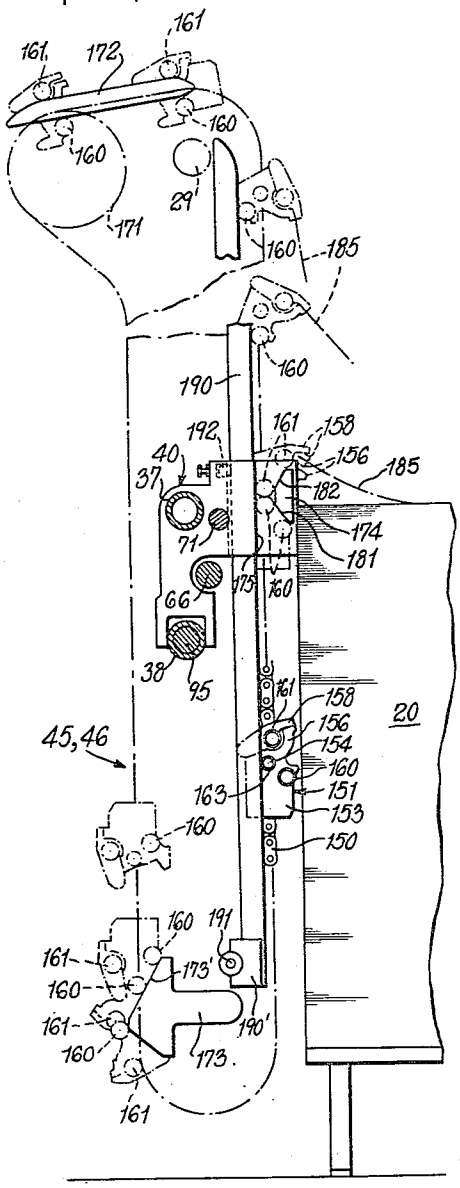
INVENTOR
WILLIAM R. SPILLER
BY Hudson, Boughton,
Williamson, David & Hoffmann
ATTORNEYS

Oct. 2, 1956 W. R. SPILLER 2,765,166

SHEET FEEDER

Filed April 13, 1953 5 Sheets-Sheet 5

Fig. 1Z.



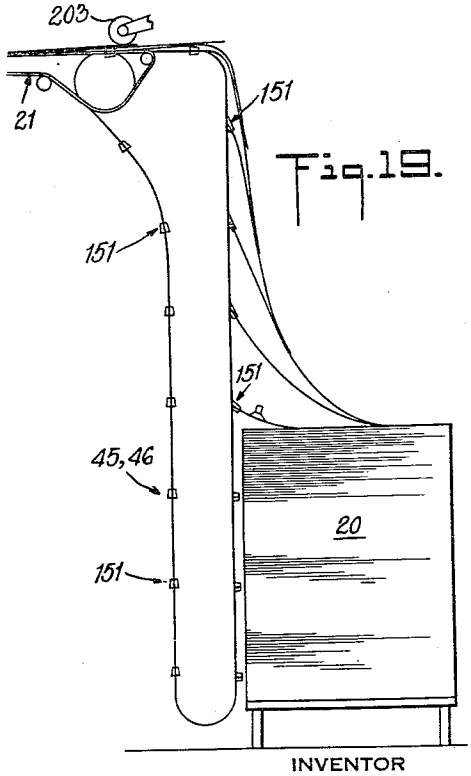


Fig. 1B.

INVENTOR
WILLIAM R. SPILLER
BY Hudson, Boughton
Williams, David & Hoffmann
ATTORNEYS

United States Patent Office

2,765,166

Patented Oct. 2, 1956

2,765,166

SHEET FEEDER

William R. Spiller, Shaker Heights, Ohio, assignor to Harris-Seybold Company, Cleveland, Ohio, a corporation of Delaware

Application April 13, 1953, Serial No. 348,569

15 Claims. (Cl. 271—12)

This invention relates to sheet feeders for feeding sheets of paper, cardboard, and other materials of a similar character, to printing presses and various other machines for acting on such sheets.

As is well known, in sheet feeders of the pile type, as distinguished from sheet feeders of the continuous fanned-out bank type, the mechanism or mechanisms which act on the sheets to successively separate and feed the same from the top of the pile are customarily located at a fixed elevation, and the pile of sheets is carried on an elevator which, during feeding of the sheets from said pile, is intermittently raised by controlled power means to maintain the top of the pile at the proper feeding level for action of said mechanism or mechanisms on the sheets. This pile supporting elevator requires a relatively strong and rigid feeder framework to safely support the same and the heavy pile load of sheets thereon, and together with the actuating and control means therefor complicates the feeder structure and adds materially to the cost of the feeder.

It is accordingly one object of the present invention to provide a more simplified and less expensive sheet feeder of the pile type which, through novel construction thereof, does not require a pile elevator and is capable of feeding sheets accurately and rapidly one after another in timed relation from the top of a stationary pile thereof.

Another object of the invention is to provide a novel pile type of sheet feeder which is more simplified in design, lighter in construction, and more economical to manufacture and operate.

Another object is to provide a novel sheet feeder of the above character which will effectively and reliably separate single sheets from the top of a stationary pile thereof and convey said sheets successively toward a printing press or other machine with substantially no variation in the distance between the leading edges of the successive sheets so that a sheet will be available in proper position at the start of each cycle of operation of said printing press or other machine.

It is also well known that in existing sheet feeders of various types the sheets separated from the top of the pile or supply thereof are fed from said pile or supply in a substantially horizontal direction. This horizontal movement of the sheets, in the case of stream feeding, necessitates the performance of the sheet separating and feeding operations on or near the rear edges of the sheets and does not readily lend itself to the desired performance of such operations on or near the front edges of the sheets. It is accordingly a further object of the invention to provide a novel sheet feeder so constructed and operated that the sheets are fed directly from the top of the pile or supply in a vertical or upward direction whereby a relatively wide space is immediately made available between the top sheet being fed and the next or underlying sheet on the pile or supply, which space advantageously enables the performance of the sheet separating and feeding operations on or near the front edges of the sheets and on each succeeding sheet while the preceding sheet is being fed and partly covers the succeeding sheet.

Another object is to provide a novel sheet feeder having sheet separating mechanism for separating sheets successively from the top of a stationary pile thereof, which is automatically lowered as the pile is consumed and is so controlled that the cyclic timing of the sheet separating operations thereof is progressively advanced as said mechanism descends whereby a substantially equal spacing between the leading edges of successive sheets on a receiving conveyor is assured.

Another object is to provide a novel sheet feeder having an arrangement and association of a downwardly moving sheet separating mechanism and an upwardly moving sheet conveyor of the endless type which cooperate with each other to feed sheets successively from the top of a stationary pile thereof to sheet receiving means, said conveyor having timed sheet taking gripper elements thereon, and said sheet separating mechanism being so controlled that the cyclic timing of the operations thereof is progressively advanced as it descends whereby the timing relationship between said mechanism and said gripper elements is always maintained to insure accurate engagement of each separated sheet by said gripper elements and feeding of said sheet from the pile.

Still another object is to provide novel mechanism for operating and timing a part or unit of a sheet feeder or any other machine or instrumentality.

A still further object is to provide a sheet feeder embodying a vertically movable sheet separating unit, and novel mechanism, including elements mounted on and movable with said unit and an independently mounted continuously driven endless element, for operating said unit through one complete cycle and for causing the timing of said cycle to be advanced as said unit descends and to be retarded when said unit is raised.

The above and further objects and novel features of the invention will more fully appear from the following detail description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

In the drawings wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a perspective view of a sheet feeder constructed in accordance with the present invention, said view being to some extent diagrammatic, and omitting certain of the feeder parts for purposes of clearer illustration;

Fig. 2 is a side elevational view of the upper portion of said sheet feeder looking at the gear side thereof or from the right of Fig. 1;

Fig. 3 is a side elevational view of the upper portion of said sheet feeder looking at the feed side thereof or from the left of Fig. 1;

Fig. 4 is a detail side elevational view of a worm and worm gear drive for lowering and raising the sheet separating mechanism, and including pawl and ratchet mechanism and control means for operating said drive to effect lowering of said sheet separating mechanism;

Fig. 5 is a top plan view, partly in section, of the structure shown in Fig. 4, with the control means omitted for purposes of clearer illustration;

Fig. 6 is a top plan view, partly in section, of the sheet separating unit located at the feed or left-hand side of the feeder;

Fig. 7 is a vertical transverse sectional view substantially on the line 7—7 of Fig. 6;

Fig. 8 is an end elevational view of said sheet separating unit looking from the right of Fig. 6;

Fig. 9 is a vertical longitudinal sectional view substantially on the line 9—9 of Fig. 6;

Fig. 10 is a side elevational view showing the upper portion of the mechanical gripper chain conveyor unit located at the gear or right-hand side of the feeder, said view being taken from the feed or left-hand side of the machine;

Fig. 11 is a view similar to Fig. 10, but showing the lower portion of said mechanical gripper chain conveyor unit;

Fig. 12 is a horizontal sectional view on the line 12—12 of Fig. 10;

Fig. 13 is a horizontal sectional view on the line 13—13 of Fig. 11;

Fig. 14 is a horizontal sectional view on the line 14—14 of Fig. 11;

Fig. 15 is a side elevational view of one of the sheet gripping devices showing the same in the position it occupies as it travels toward the top of the pile of sheets;

Fig. 16 is a view similar to Fig. 15, but showing the sheet gripping device substantially in the position it occupies as it approaches the upper end of its course with a sheet gripped thereby;

Fig. 17 is a diagrammatic side elevational view showing one set of sheet gripping devices and the operation of said devices at various positions along its course;

Fig. 18 is a detail side elevational view showing the rear portion of an endless tape conveyor at the top of the feeder; and

Fig. 19 is a side elevational view showing diagrammatically the manner in which the sheets are separated and forwarded in lapped relation from the pile.

Referring now to the drawings and particularly to Fig. 1 thereof, there is shown, by way of example, one form of sheet feeder constructed in accordance with the present invention, which is adapted for feeding sheets of paper, card stock, or the like, from the top of a stationary pile 20 thereof to a tape conveyor 21 in a manner such that the sheets are conveyed in the form of a stream of underlapped sheets to a printing or other machine for operating on the individual sheets of said stream.

The machine comprises a frame composed of four uprights 22, 23, 24 and 25 secured to pairs of top and bottom brackets 26 and 27, respectively, said top brackets being interconnected by crossbars 28, 29 and 30, and said bottom brackets being interconnected by a crossbar 31. Guided on the uprights 22 to 25 for vertical movement downwardly and upwardly is a carriage comprising guide blocks 35 and 36 interconnected by tubular crossbars 37 and 38. Supported on the carriage for vertical movement therewith are two similar sheet separating mechanisms 39, one only being shown in Fig. 1, which are slidably mounted on the crossbars 37, 38 for adjustment toward and away from each other in accordance with the various sizes of sheets being handled and to locate said mechanisms at the desired points with reference to their operation upon front corner portions of the sheets at the top of the stationary pile 20. Also supported on the carriage for vertical movement therewith are two similar cam units 40 and 41 which are also slidably mounted on and adjustable to various positions along the crossbars 37, 38 of said carriage.

Disposed between the sheet separating mechanisms 39 and forwardly of and in close proximity to the stationary pile of sheets 20 is an upright conveyor which, in the illustrated embodiment, is in the form of a plurality of transversely spaced endless chain gripper type units, two only being shown and indicated at 45 and 46 (Fig. 1). These units 45, 46 each have elements thereof, to be hereinafter described, slidably mounted on the crossbars 29 and 31 for adjustment of said units independently toward and away from each other by means of pinions 47 and 48 which have meshing engagement with rack teeth formed on said crossbars. The pinions 47, 48 for each unt 45, 46 are secured to the opposite ends of an upright shaft 44 which is journalled in a suitable manner on the respective unit and is rotated by means of a handwheel 49 secured to said shaft. The cam units 40, 41 are preferably arranged for lateral adjustment in unison with the chain gripper units 45, 46, and for this purpose the cam unit 40 has portions thereof disposed at opposite sides of an upright portion of its associated chain gripper unit 45, and the cam unit 41 has similar portions disposed at opposite sides of an upright portion of its associated chain gripper unit 46.

The drive for the feeder is taken from a suitable source of power (not shown) suitably connected to a main drive shaft 43 (Figs. 2 and 3) which extends transversely of the feeder and is journalled in suitable bearings in the upper side frame brackets 26. Fixed on the shaft 43 is a spur gear 50 (Figs. 1 and 2) which drives a similar gear 51 through a similar intermediate gear 52. The intermediate gear 52 is journalled in a suitable manner on the adjacent upper side frame bracket 26, and the driven gear 51 is fixed on and drives a shaft 60 which extends transversely of the feeder and is journalled in suitable bearings in the upper side frame brackets 26. The gears 50 and 51 are so proportioned that the shaft 60 will make one complete revolution for each cycle of operation of the feeder.

Fixed on the single revolution shaft 60 at the gear side end thereof and disposed exteriorly of the adjacent upper side frame bracket 26 is a sprocket 53 (Fig. 2) around a portion of which passes an endless chain 57. From the sprocket 53 the chain 57 passes downwardly over and around an idler sprocket 54 to the bottom of the feeder and then passes rearwardly under and around an idler sprocket or guide disk 55 (Fig. 1). From the sprocket or disk 55 the chain 57 passes upwardly then forwardly over and around an idler sprocket 67, then upwardly around and in front of a drive sprocket 65, then upwardly under and around a similar idler sprocket 67', and then upwardly and forwardly over and around another idler sprocket 56 to the driving sprocket 53.

The idler sprockets 54 and 56 are journalled on stub shafts 58 and 59, respectively, anchored in the adjacent upper side frame bracket 26, the stub shaft 59 being arranged for relative vertical adjustment whereby any slack in the chain 57 may be taken up and the desired degree of tightness of said chain may be obtained. The idler sprocket or disk 55 is journalled on a stub shaft 61 anchored in the adjacent lower side frame bracket 27, and the idler sprockets 67 and 67' which serve to hold the chain 57 in meshing engagement with the sprocket 65 are journalled on stub shafts 62 and 63, respectively, which are anchored in the guide block 35 of the vertically movable separator carriage. The drive sprocket 65 is fixed on the outwardly projecting gear side end of a shaft 66 which extends transversely of the feeder and is journalled in suitable bearings provided in the guide blocks 35 and 36 of the vertically movable separator carriage. The sprockets 53 and 65 are of the same diameter and hence shaft 66, like shaft 60, is driven to make one complete revolution for each cycle of operation of the feeder. The shaft 60 and sprocket 53 thereon are driven continuously in a clockwise direction, as viewed in Fig. 2, and hence the chain 57 will also be driven continuously by said sprocket and such that the rear vertically extending active reach thereof which meshes with and drives the sprocket 65 travels in an upward direction. Under these conditions, the shaft 66 which is carried by and vertically movable with the separator carriage will be driven by the chain 57 and sprocket 65 continuously and in a direction opposite to the direction of rotation of the shaft 60. The shaft 66 is utilized to drive the sheet separating mechanisms 39 and to operate other parts of the feeder, as will be hereinafter described.

The separator carriage is shown in broken lines in Figs. 2 and 3 in the extreme uppermost position which it occupies when a pile of sheets 20 of maximum ca-

pacity is loaded in sheet feeding position, and substantially when the sheet separating mechanisms 39 operate initially on the top of a pile 20 of maximum height. The separator carriage is shown in Fig. 1 in a lowered position after a major portion of the sheets have been fed from the top of the stationary pile 20 and said pile has depleted an appreciable amount. With a pile of sheets 20 loaded in feeding position, the separator carriage is lowered to properly locate the sheet separating mechanisms 39 with respect to the top of said pile for performance of the sheet separating operations thereon. As the sheets are separated and fed successively from the top of the stationary pile 20 during the normal operation of the feeder and said pile is consumed and decreases in height, the separator carriage and the sheet separating mechanisms 39 thereon are progressively lowered with the change in the level of the top of the pile to enable continued separation and feeding of sheets from said pile. It is thus to be noted that by virtue of the described arrangement and operation of the chain 57 and its driving connection with the sprocket 65 on shaft 66, rotation will be imparted to said shaft in all vertical positions that the separator carriage and sheet separating mechanisms 39 may occupy during normal operation of the feeder and feeding of sheets from the top of the stationary pile 20. It is also important to note that the sprocket 65 on the shaft 66 will roll along the upwardly travelling reach of the chain 57 upon vertical movement of the separator carriage. Accordingly, when the carriage and the sheet separating mechanisms 39 thereon are progressively lowered during the normal operation of the feeder, the shaft 66, due to the rolling action of the sprocket 65 along the chain 57, will be rotated in the direction of its normal rotation, thus progressively advancing the cyclic timing of the operations of the sheet separating mechanisms. Each time the separator carriage is lowered, the degree of relative advance rotation of the shaft 66 is commensurate to the extent of downward movement of said carriage so that when the latter has been lowered a distance equal to the spacing between the sheet gripping devices on the chain units 45, 46 of the upright conveyor, the shaft 66 will be advanced one complete revolution. To achieve this result, the sprocket 65 is so chosen that the circumference thereof on the pitch line is equal to the distance between the sheet gripping devices. In this manner, the timing relationship of the operations of the sheet separating mechanisms 39 with the operation and cycle of movement of the sheet gripping devices of the upright conveyor is maintained as said mechanisms descend so that separation of successive sheets at the proper time and proper engagement of said sheets by said gripping devices at the progressively changing level of the top of the pile is always assured. Similarly, when the separator carriage and the sheet separating mechanisms 39 thereon are raised, the shaft 66, due to the rolling action of the sprocket 65 along the chain 57, will be given a backward rotation, i. e., in the direction reversely to its normal rotation, thus retarding the cyclic timing of the operations of the sheet separating mechanisms relative to the operation and cycle of movement of the sheet gripping devices.

As previously stated, the separator carriage and the sheet separating mechanisms 39 thereon are lowered as sheets are fed from the top of the stationary pile 20, and in order to maintain said mechanisms at the proper level with respect to the top of the diminishing pile for continued separation and feeding of sheets from said pile, this lowering of the separator carriage is effected at suitable intervals under the control of the pile by mechanism constructed, mounted operated, and controlled as follows. Extending transversely of the feeder and carried by the separator carriage for vertical movement therewith is a shaft 95 (Fig. 1) which is rotatably mounted within the tubular crossbar 38 and projects beyond opposite ends of said crossbar. The feed side end of the shaft 95 also projects through and is further journalled in a suitable bearing provided in a bracket 92 (Figs. 1, 4 and 5) which is secured to the outer surface of the guide block 36 of the separator carriage. Fixed on the shaft 95 and disposed exteriorly of the guide blocks 35 and 36 are spur pinions 96 and 97 which mesh with rack teeth 98 and 99, respectively, formed on and along a major portion of the rear edges of the uprights 23 and 25, respectively, said guide blocks being suitably recessed to receive said pinions. Rotation of the shaft 95 in opposite directions will thus impart lowering and raising movements to the separator carriage and the sheet separating mechanisms 39 thereon.

The single revolution shaft 66 on the separator carriage also projects through and beyond the bracket 92 on said carriage (Figs. 1, 4 and 5), and fixed on the outwardly projecting end of said shaft is a cam 84 which engages a roller 83 journalled on a cam strip 81 engaged over the shaft 66. The cam strap 81 extends between the furcations of a bifurcated pawl carrier 86 and is pivotally connected as at 85 to said pawl carrier. The roller 83 is biased toward the cam 84 by a coil extension spring 91 having one end thereof connected to the pawl carrier 86 and the opposite end connected to the bracket 92. The pawl carrier 86 is disposed between vertically spaced bearing portions 82 and 82' of the bracket 92 and is pivotally mounted for oscillating movement on a vertically extending shaft 87 which passes through and is journalled in suitable bearings in said portions. The shaft 87 is held against axial movement in a suitable manner and is journalled at opposite ends thereof in suitable bearings in brackets 88 and 88' which are secured to the adjacent upper and lower side frame brackets 26 and 27, respectively. Pivoted at 85 on the pawl carrier 86 is a spring-pressed pawl 89 adapted to continuously and yieldingly engage a ratchet 90 which is disposed between the furcations of said pawl carrier. The ratchet 90 is mounted on the shaft 87 for sliding movement therealong and is drivably connected to said shaft as by a key and keyway connection to enable movement thereof along the shaft with the separator carriage and to impart rotation to said shaft in all axial positions thereof on the shaft.

Disposed between the pawl carrier 86 and the bearing portion 82' on the bracket 92 is a worm 93 (Fig. 4) which is mounted on the shaft 87 for relative sliding movement and is drivably connected, as by a key and keyway connection, to said shaft for rotation by the latter in all vertical positions of the separator carriage. This worm 93 meshes with and drives a worm gear 94 which is disposed exteriorly of the bracket 92 and is fixed on the outwardly projecting feed side end of the shaft 95. Through oscillation of the pawl carrier 86 by the cam 84 and spring 91, and engagement of the pawl 89 with the ratchet 90, the shaft 95 and pinions 96, 97 thereon are thus intermittently rotated in a clockwise direction, as viewed in Fig. 1, through the described worm and worm gear gearing between said shaft and the shaft 87, thereby imparting step by step downward movement to the separator carriage and the sheet separating mechanisms 39 thereon, including the shaft 66, cam strap 81, cam 84, pawl carrier 86, ratchet 90, bracket 92, worm 93, worm gear 94 and shaft 95, as well as the cam units 40 and 41.

During the normal operation of the feeder and as sheets are separated and fed from the top of the stationary pile 20, this step by step downward movement of the separator carriage and the sheet separating mechanisms 39 and other described parts thereon is controlled by a pile height determining feeler or finger 70 (Fig. 1) which is carried by said separator carriage and is preferably located to project over and engage the top of the pile of sheets at the front edge and substantially in the center thereof. The feeler 70 is adjustably secured to a rock

shaft 71 (Figs. 1 and 4) which extends transversely of the feeder and is journalled in suitable bearings in the guide blocks 35 and 36 of the separator carriage. The feed side end of the shaft 71 also projects through and beyond a suitable bearing in the bracket 92. Fixed on the outwardly projecting feed side end of the shaft 71 is an arm 73 having journalled thereon a roller 74 which engages a cam 72 (Figs. 1 and 5) that is fixed on the single revolution shaft 66 and serves to hold the cam strap 81 in operating position with respect to the cam 84. The roller 74 is biased toward the cam 72 by a coil extension spring 69 having one end thereof connected to the arm 73 and the opposite end connected to the bracket 92. Once during each cycle of operation of the feeder the shaft 71 will thus be rocked in one direction by the cam 72 to raise the feeler 70 out of engagement with and clear of the front edge of the pile of sheets 20, and in the opposite direction by the spring 69 to lower the feeler 70 into engagement with the top of said pile. The operations of the feeler 70 are so timed that just prior to and during separation of the front edge portion of the top sheet from the pile 20 said feeler is moved upwardly and forwardly from and clear of said pile and held in its actuated position until the separated sheet is transferred to and taken by the upwardly moving chain gripper units 45, 46, and is then returned under the separated sheet into engagement with the top of the pile and held in this position until just prior to separation of the front edge portion of the next or underlying sheet on said pile.

Fixed on the feeler shaft 71 or formed integrally with the arm 73 is another arm 75 (Figs. 1 and 4) having threaded therein an adjustable tappet 76 which is adapted, under certain conditions, to engage one arm 77 of a double-armed latch lever which is pivotally mounted on the feeler shaft 71. The other arm of the latch lever is indicated at 78 and has secured thereto a hardened steel latch plate 79 which is adapted to normally engage the bevelled forward end of a companion hardened steel plate 80 secured to the upper surface of the cam strap 81. Engagement of latch plate 79 with plate 80 holds the cam strap 81 against return movement by the spring 91, thus preventing the roller 83 from following the low part of the cam 84 and operation of the pawl carrier 86 to engage the pawl 89 with the next tooth of the ratchet 90. The plate 80 is so located on the cam strap 81 that when the roller 83 is engaged by the high part of the cam 84, said plate is moved clear of the latch plate 79 so as to free the latter for pivotal movement out of engagement with the plate 80 and out of the path of return movement of said cam strap.

When the shaft 71 is rocked in the proper direction by spring 69 to engage the feeler 70 with the top of the stationary pile of sheets 20, the arm 75 with the tappet 76 thereon is also rocked in the same direction toward the latch lever arm 77. As long as the sheet separating mechanisms 39 are disposed at the proper level with respect to the top of the pile of sheets 20, the feeler 70 will be prevented by the pile from moving downwardly a distance sufficient to enable the tappet 76 on arm 75 to engage the latch lever arm 77. The separator carriage and the sheet separating mechanisms 39 thereon will thus remain stationary because the pawl carrier 86, through engagement of the latch plate 79 with the cam strap 81, will be held in its power stroke position and prevented from returning to enable the pawl 89 to engage the next tooth of the ratchet 90.

When the height of the pile of sheets 20 decreases sufficiently through removal of sheets from the top thereof so that lowering of the separator carriage and the sheet separating mechanisms 39 thereon is necessary, the tappet 76 on arm 75, through increased downward movement of the feeler 70, is enabled to engage the latch lever arm 77 and swing the latch lever sufficiently to disengage the latch plate 79 from the cam strap 81, thus rendering the pawl and ratchet mechanism operative to lower the separator carriage and the sheet separating mechanisms, as well as the cam units 40 and 41 on said carriage. When the feeler 70 is subsequently raised out of engagement with the top of the pile of sheets 20, the tappet 76 on arm 75 is swung away from the latch lever arm 77, whereupon the latch lever is released and allowed to return by gravity, aided by a light spring if necessary, to its original position so that the latch plate 79 is again positioned in the path of return movement of the cam strap 81, thus rendering the pawl and ratchet mechanism inoperative to further lower the separator carriage and the sheet separating mechanisms thereon. Upon each operation of the pawl and ratchet mechanism, the sheet separating mechanisms 39 will be lowered an extent sufficient to enable separation and feeding of a number of sheets from the top of the pile 20 before lowering of said sheet separating mechanism is again necessary.

The operating level of the sheet separating mechanisms 39 with respect to the top of the stationary pile of sheets 20 may be varied as desired to accommodate different stock conditions, and this is accomplished by rotating the adjustable tappet 76 which may be effected while the feeder is in operation. Adjustment of the tappet 76 toward the latch lever arm 77 will cause said tappet to engage said arm sooner with the result that the normal level of the sheet separating mechanisms will be disposed in a lower plane with respect to the top of the pile of sheets. Similarly, when the tappet 76 is adjusted away from the latch lever arm 77, said tappet is caused to engage said arm later with the result that the normal level of the sheet separating mechanisms will be disposed in a higher plane with respect to the top of the pile of sheets. If it is desired to lower the separator carriage and the sheet separating mechanisms thereon once during each cycle of operation of the feeder, as when handling thick sheets, such as cardboard, this may be accomplished by adjusting the tappet 76 toward the latch lever arm 77 to a position such that it engages said arm and actuates the latch lever each time the feeler 70 is moved toward and into engagement with the top of the pile of sheets 20. In this case, the cam strap 81 will be released and the pawl and ratchet mechanism will be operated once during each cycle of operation of the feeder to lower the separator carriage and the sheet separating mechanisms thereon an appropriate amount as the sheets are fed one after another from the top of the pile 20.

The described worm and worm gear drive 93, 94 serves as an automatic brake and thus holds the separator carriage in all elevated positions and against sliding downward movement under the weight thereof. In lieu of the worm and worm gear drive, the separator carriage may, if desired, be attached to and suspended by suitable cables which are provided with suitable weights which tend to raise said carriage. In this case, a suitable self-locking type of pawl and ratchet mechanism is provided to check the separator carriage against upward movement by the weights, and to drive said carriage downwardly, said pawl and ratchet mechanism being drivably connected with the shaft 95 and being effective under the control of the feeler 70 in the manner above described. Also, if desired, the feeler 70 may be in the form of a blast nozzle connected with a source of compressed air so as to direct air under pressure rearwardly between each separated sheet and the pile and thereby completely separate and float said sheet while it is being removed or fed from the pile.

The separator carriage and the sheet separating mechanisms 39 and cam units 40 and 41 thereon may be manually raised and lowered to desired positions, and for this purpose the shaft 87 has fixed on the upper end thereof a bevel pinion 100 (Figs. 1 and 3) which meshes with a bevel gear 101 that is journalled on a short transversely extending shaft 102 fixed at the inner end thereof in the bracket 88. Rotatably mounted on the outer end of the shaft 102 is a handwheel 103 which is also axially slidable on said shaft so as to permit it to be brought

into clutching engagement with the hub of the bevel gear 101 to rotate the latter in either direction and thereby impart like rotation to the shaft 87 through the bevel pinion 100 to raise and lower the separator carriage. To free the ratchet 90 from the power operated mechanism when the handwheel 103 is employed to manually raise or lower the separator carriage, an arcuate pawl releasing arm 106 (Figs. 1, 4 and 5) is slidably fitted over a vertically extending square bar 105 and is held in operating relation to the pawl 89 between tubular extensions of the bearing portions 82, 82' of the bracket 92 on the separator carriage. The bar 105 passes through and is rotatable in the tubular extensions of the bracket 92, and is provided at the opposite ends thereof with reduced annular portions which are journalled in suitable bearings in the brackets 88 and 88' (Figs. 1 and 3). Fixed on the upper end of the bar 105 is an arm 104 which extends forwardly from said bar between the bevel gear 101 and the handwheel 103 and has journalled thereon a roller 107. The arm 104 is biased in the direction of the handwheel 103 by a coil extension spring 109 having one end thereof connected to said arm and the opposite end connected to the adjacent upper side frame bracket 26.

As the handwheel 103 is moved axially into clutching engagement with the bevel gear 101, the hub of said handwheel engages the roller 107 on arm 104 and rocks said arm toward the feeder frame, thus rocking the square bar 105 in the same direction and causing the pawl releasing arm 106 on said bar to engage a tail-piece 108 of the pawl 89 (Fig. 5) and swing said pawl out of engagement with and clear of the ratchet 90. The shaft 87 may then be rotated in opposite directions upon clutching engagement of the handwheel 103 with the bevel gear 101 and rotation of said handwheel to raise or lower the separator carriage. This manual raising and lowering of the separator carriage may be effected while the feeder is in operation and without disturbing the timing relationship of the various mechanisms. When the handwheel 103 is moved out of clutching engagement with the bevel gear 101, the arm 104 is released and said arm, the bar 105, and the pawl releasing arm 106 are then returned to their original positions by the contracting action of the spring 109, thus releasing the pawl 89 to again engage the ratchet 90.

The sheet separating mechanisms 39 are arranged for operation at opposite sides and near the front edge of the pile of sheets 20, and act to preliminarily separate the front opposite corner portions of the top sheet from said pile and then to simultaneously stretch and lift the entire front edge portion of said sheet to a predetermined position above the pile for accurate transfer to and engagement by the gripping devices on the chain gripper units 45 and 46. The sheet separating mechanisms 39 are constructed one right-hand and the other left-hand, the right-hand mechanism being diagrammatically shown in Fig. 1 and disposed outwardly of the chain gripper unit 45, and the left-hand mechanism being shown in detail in Figs. 6 to 9 and occupying a corresponding position outwardly of the chain gripper unit 46, and since the construction of said mechanisms are otherwise identical, a description of one will suffice for both.

Each sheet separating mechanism 39 comprises a casing 110 slidably mounted on the crossbars 37, 38 of the separator carriage and provided with a guiding member 111 engaged with the crossbar 37, and with clamping members 112 engaged with the crossbar 38 for securing said casing in various positions of adjustment along said crossbars. Each casing 110 is suitably constructed to provide suitable clearance openings for the shafts 66 and 71 to extend therethrough. Disposed within each casing 110 is a bevel gear 115 which is keyed to the single revolution shaft 66 for rotation thereby and for sliding movement along said shaft with said casing. This bevel gear 115 meshes with and drives a bevel gear 114 which is fixed on a short horizontal cam shaft 113 journalled in suitable bearings in the casing 110. The bevel gears 114 and 115 are of the same diameter and, hence, the cam shaft 113 of each separator mechanism will be driven to make one complete revolution for each cycle of operation of the feeder. The cam shafts 113 of the separator mechanisms are driven by the gears 114, 115 so that they rotate in opposite directions, i. e., toward each other and the pile of sheets 20 as indicated by the arrow in Fig. 7.

Keyed to the shaft 113 of each separator mechanism 39 within the casing 110 is a cam 118 which engages a roller 129 journalled on one arm 128 of a bell crank having another arm 125 projecting transversely of said casing toward the pile of sheets 20. The bell crank 125, 128 is pivotally mounted on a rock shaft 126 extending longitudinally of the feeder and parallel to the shaft 113 and the adjacent side of the pile 20 and journalled in bearings in the casing 110. Journalled as at 121 on the inner free end of the bell crank arm 125 is a combing wheel 127 having secured thereto a sprocket 124 around which passes a chain 123 which also passes around a sprocket 122 secured to one end of a sleeve 116. This sleeve 116 is journalled on the shaft 126 and has secured to the other end thereof a spur pinion 120 which meshes with a spur gear 117 that is secured to the cam 118. The combing wheels 127 are rotated in the direction of the arrows indicated in Figs. 1 and 7 through the described driving connections for said wheels with the cam shafts 113.

Each bell crank arm 125 has pivotally connected therewith at 143 (Fig. 7) the upper end of a vertically disposed spring-pressed rod 144 the lower end of which extends through a suitable clearance opening in an arm 145 which is pivotally mounted at 146 on the casing 110. The arm 145 rests on an adjusting nut 147 which is threaded on the lower end of a stem 148 that projects through a suitable elongated opening in said arm and is secured at the upper end thereof in the casing 110. The coil compression spring for rod 144 is indicated at 149 and mounted thereon between the head of said rod and the arm 145. Each bell crank arm 125 has also connected therewith at 143 one end of a coil extension spring 149' the opposite end of which is connected at 149'' to the casing 110. This spring 149' operates to counterbalance the weight of the bell crank 125, 128 and parts carried thereby so that downward movement of the combing wheel 127 is effected solely by the spring-pressed rod 144, and the degree of pressure of said combing wheel on the pile 20 is solely under the control of the spring 149.

The combing wheels 127 are thus spring operated toward and into frictional engagement with the top of the pile of sheets 20, and cam operated away from and out of engagement with said pile, and the pressure of the springs 149 and resulting pressure of the combing wheels on the pile may be adjusted by rotating the nuts 147 and thereby vertically adjusting the arms 145. Once during each cycle of operation of the feeder, and at the proper time, the combing wheels 127 are lowered on to the top of the pile of sheets 20 and effect a preliminary separation of the top sheet by moving the front opposite corner portions of said sheet inwardly towards each other whereby small buckles or humps are formed in the sheet adjacent said corners. In order to confine this preliminary separation of the top sheet by the combing wheels 127 to the opposite corner portions of said sheet, two presser fingers 142 (Fig. 1) are lowered into engagement with the top of the pile a short distance inwardly from said combing wheels. These presser fingers 142 are rocked by the feeler shaft 71 into and out of engagement with the top of the pile of sheets 20 in unison with the feeler 70, and are yieldingly mounted on said shaft so as not to affect the pile height sensing operation of said feeler.

After preliminary separation of the top sheet has been effected at its front opposite corners by the combing

wheels 127, the sheet is engaged at its buckled corner portions by two suction devices which operate to lift said sheet from the pile and stretch the same in a direction transversely to the feeding direction. This stretching of each sheet straightens and raises its entire front edge portion for accurate engagement at spaced points along said edge by the gripping devices on the chain gripper units 45 and 46. The suction sheet lifting and stretching devices form a part of the sheet separating mechanisms 39 and are identical, and each of said devices is constructed, mounted and operated as follows.

Each cam shaft 113 has fixed thereon a cam 119 which engages a roller 131 journalled on an arm 130 which is secured to the rock shaft 126. Fixed on the projecting rear end of the rock shaft 126 is a lever 133 which projects from said shaft inwardly towards the pile of sheets 20. Fitted in the lever 133 for sliding movement lengthwise thereof is a rod 134 which is held against rotation relative to said lever by a square block 135 secured to said rod and disposed between spaced inner and outer portions of the lever and relatively close to a guiding surface 136 of said lever. The rod 134 projects beyond the inner end of the lever 133 and has secured to its inner end a clamp 132. Secured in the clamp 132 is a tubular fitting 139 which forms a part of a suction sheet gripping device which is preferably, but not necessarily of a well-known type comprising a cylinder 141 communicating with said fitting, a hollow piston stem 141' in and communicating with said cylinder and projecting downwardly beyond the lower end of the cylinder, and a rubber suction cup 140 fixed on the lower end of said stem and communicating with the latter and said cylinder. Stem 141' and cup 140 are actuated downwardly by a spring (not shown), and are actuated upwardly by vacuum when said cup has gripped and is sealed by a sheet. The rod 134 and the suction sheet gripping device carried thereby are yieldingly urged inwardly towards the pile of sheets 20 by a coil compression spring 134' surrounding said rod and having one end thereof engaging against the clamp 132 and the opposite end engaging against the inner end of the lever 133, said inward movement being limited through engagement of the block 135 with the inner portion of the lever 133. Engagement of the blocks 135 with the inner portions of the levers 133 serves to properly locate the suction sheet gripping devices for operation on the separated corner portions of the top sheet of the pile 20.

Each suction sheet gripping device is yieldingly urged downwardly into engagement with the top of the pile of sheets 20 by a coil extension spring 133' having one end thereof connected to the lever 133 outwardly of the pivotal axis 126, and the opposite end connected to a block or shelf 110' secured to or formed integrally with the casing 110, said spring also serving to yieldingly urge the roller 131 toward the cam 119. The levers 133 are thus raised by the cams 119 and lowered by the springs 133', thereby raising and lowering the suction sheet gripping devices at intervals such that following preliminary separation of the opposite front corner portions of the top sheet by the combing wheels 127, the suction cups 140 will, upon creation of vacuum in the cylinders 141, grip the inwardly combed humped portions of said sheet and further separate them through retraction of the stems 141' into said cylinders. Thereupon the suction devices are swung upwardly and outwardly away from each other toward the sides of the pile of sheets 20 to lift the sheet at its front edge, and at the same time transversely stretch the entire front edge portion of said sheet in a manner to be presently described. The cams 118 and 119 are so chosen that when the respective rollers 129 and 131 are engaged with the high parts of said cams, the combing wheels 127 and the suction sheet gripping devices are swung upwardly and outwardly beyond the vertical projection of the sides of the pile of sheets 20, as shown in broken lines in Figs. 7 and 8, so as to clear the separated sheet and not interfere with the removal thereof in an upward direction from said pile. The timing relationship of the combing wheels 127 and the suction sheet gripping devices is such that the lowering and raising operations of said combing wheels precedes the lowering and raising operations of said suction devices and that the combing wheels are raised substantially the instant the sheet is gripped by the suction devices.

Stretching of the entire front edge portion of the separated top sheet by the suction devices is effected through outward movements of said suction devices away from each other which occurs as the suction devices move upwardly and while said sheet is being lifted thereby a short distance away from the top of the pile 20. For this purpose, each block 135 has journalled thereon a roller 137 (Figs. 6 and 8) adapted to engage an inclined cam arm 138 which is pivotally mounted at 138' on the casing 110. The cam arm 138 has threaded therein outwardly of the pivot 138' an adustable abutment screw 137' adapted to engage the upper surface of the shelf or block 110' and thereby prevent upward swinging movement of said arm about its pivot 138'. The cam arm 138 may be adusted on its pivot 138' to various operating positions with respect to the roller 137 by rotating the abutment screw 137' in opposite directions.

The cam arms 138 continuously engage the rollers 137 and are so formed and located that the lower edges thereof engaged by said rollers are disposed inside the arc of swinging movement of the rollers about the axes 126. Accordingly, when the suction devices are moved downwardly as hereinbefore described, the rollers 137 will move downwardly along the cam arms 138 and permit the rods 134 to be axially extended by the expanding action of the springs 134' until the blocks 135 on said rods engage the inner portions of the levers 133 and the suction devices are thereby properly positioned for gripping of the inwardly combed humped corner portions of the top sheet by the suction cups 140. When the sheet is gripped by the cups 140 and the suction devices are thereafter raised to lift the front edge portion of said sheet, the rods 134 and therewith said suction devices, through upward movement thereof and engagement of the rollers 137 with the cam arms 138, will be forced by said cam arms outwardly away from each other relative to the levers 133, thereby stretching the entire front edge portion of the sheet substantially through equal outward movements of the suction devices to an extent depending on the slack or sag in the sheet, the cam arms 138 being so adjusted to effect this stretching operation during lifting of the sheet a short distance from the top of the pile 20 and without causing the suction devices to tear or slip on the sheet.

Immediately after the sheet is gripped, lifted and stretched by the suction devices as described, said sheet is transferred to and taken by mechanical grippers on the chain gripper units 45, 46 of the upright conveyor hereinafter described, at which time the suction devices are released from the sheet and continues to move farther upwardly and outwardly to positions clear of the side edges of said sheet. It is to be noted that by virtue of the cam arm 138 and the relative outward or retracting movement of the rod 134 and suction device effected by said cam arm, the overall length of the lever 133 from the axis 126 to the extreme end of the suction device is in effect shortened as said suction device moves farther upwardly and outwardly after release of the separated sheet, thus requiring less upward stroke of each suction device to bring it to a position clear of the side edge of the sheet. After the separated sheet is taken by the mechanical grippers on the chain gripper units 45, 46 and before said sheet is completely removed from the top of the pile of sheets 20, the combing wheels 127 and the suction devices are returned beneath the separated sheet for action thereof on the next sheet in the next cycle of operation of the feeder. In this manner, each succeeding sheet is separated,

lifted and stretched while still partly covered by a previously separated sheet and is taken by the upright conveyor and removed from the pile **20** in underlapped relation with the receding sheet, with the result that the sheets are advanced by the upright conveyor in underlapped relation and in the form of a continuous stream thereof, as shown diagrammatically in Fig. 19.

In order to control the extent of downward movement of each suction device so that the suction cup **140** thereof will engage the humped corner portion of the sheet at its separated level and not depress said portion back onto the pile **20**, each rock shaft **126** has adjustably secured thereto for rocking movement therewith a finger **195** which is located adjacent to and rearwardly of the lever **133** (Figs. 6, 8 and 9). This finger **195** extends inwardly from the shaft **126** and is adapted to engage the top of the pile of sheets **20** when the suction cup **140** contacts the separated humped corner portion of the sheet, thus holding the shaft **126** against further rotation and the suction device against further downward movement by the spring **133'**.

Vacuum is created in the suction devices at predetermined intervals through flexible conduits **196** (Figs. 1 and 6) having corresponding ends connected to the fittings **139** and opposite ends connected to the vacuum side of a rotary valve mechanism **197** which is suitably secured to the crossbar **38** for movement with the vertically movable separator carriage. This valve mechanism **197** is of the general type disclosed in the United States Patent No. 2,333,934, granted March 4, 1941, to Headley Townsend Backhouse, and needs no detail description herein, except to say that said mechanism is suitably connected to a vacuum pump (not shown), and the rotor thereof is engaged over and suitably connected to the single revolution shaft **66** for rotation thereby to control the making and breaking of vacuum in the cylinders **141** of the suction devices.

The chain gripper units **45** and **46** of the upright conveyor for receiving the sheets successively separated from the top of the stationary pile of sheets **20** and for advancing said sheets from said pile in an upward direction are constructed one right hand and the other left hand, and since the constructions of said units are otherwise identical, a description of one will suffice for both. As herein shown, each chain gripper unit **45** and **46** is preferably constructed, mounted and operated as follows. Slidably mounted on the single revolution shaft **60** and drivably connected, as by a key and keyway connection, to said shaft for continuous rotation thereby is a sprocket **171** around which passes an endless roller chain **150** (Figs. 1, 10 and 19). The chain **150** is arranged and guided to travel in a fixed closed path defined by a straight upwardly travelling rear run located adjacent the front side of the stationary pile of sheets **20** and extending from the bottom of the feeder to the top thereof and terminating in a forwardly curved, forwardly travelling, downwardly and forwardly inclined run extending to the sprocket **171**, a downwardly and rearwardly travelling run extending from the sprocket **171** and terminating in a straight downwardly travelling front run extending to the bottom of the feeder, and a semi-circular run at the bottom of the feeder connecting said straight front and rear runs and leading from one to the other.

For this purpose, each chain gripper unit **45**, **46** includes an upper bracket **152** which is slidably mounted on the crossbar **29** and is provided with a suitable bearing to receive the shaft **60**. This bracket **152** carries the bearing for the upper end of the unit adjusting shaft **44** hereinbefore described. The bracket **152** encloses the sprocket **171** and is provided with an outer guide track **170** which is engaged by the rollers of the chain **150** and which, as shown in Fig. 10, is formed of several curved and straight elements secured to said bracket in abutting relation for guiding said chain and causing it to travel in the above described path. The bracket **152** has also secured thereto inner track elements **162**, **164** and **166** which are engaged by the rollers of the chain **150** and cooperate with the guide track **170** to constrain said chain and assure movement of the latter in the above described path. Secured to the bracket **152** and extending downwardly therefrom is an upright bar **176** (Figs. 10, 11, 12 and 14) having secured thereto two upright track bars **177** which are engaged by the rollers of the chain **150** and serve to guide the front run of said chain for straight-line downward movement, said bars forming continuations of the guide track **170** and the track element **164**. The bar **176** is undercut to provide sufficient clearance for the connecting-link-plates of the chain **150** at one side thereof. Secured to the bracket **152** and extending downwardly therefrom is an upright bar **178** having secured thereto two upright track bars **179** which are engaged by the rollers of the chain **150** and serve to guide the rear run of said chain for straight-line upward movement, said bars forming continuations of the guide track **170** and the track element **166**. The bar **178** is undercut to provide sufficient clearance for the connecting-link-plates of the chains **150** at one side thereof, and said bar has also secured thereto a relatively wide upright pile positioning bar **193** which extends the full length of the bar **178** and against the wide face of which the pile of sheets **20** is loaded in position for accurate feeding of the sheets from the top thereof. The rear face of the bracket **152** is suitably formed to provide an upward extension of the pile positioning bar **193**.

The support bars **176** and **178** of each unit **45**, **46** are secured at their lower ends to a bracket **194** which is slidably engaged over the crossbar **31**. This bracket **194** carries the bearing for the lower end of the unit adjusting shaft **44** hereinbefore described. Secured to the bracket **194** is another bracket **198** which has secured thereto two concentric semi-circular track elements **199** which are engaged by the rollers of the chain **150** and serve to guide said chain and cause it to travel in a semi-circular path from the front trackway defined by the bars **177**, **177** to the rear trackway defined by the bars **179**, **179**. The bracket **198** is undercut to provide sufficient clearance for the connecting-link-plates of the chain **150** at one side thereof, and said bracket is mounted on the bracket **194** for vertical adjustment so that any slack in the chain may be taken up and the desired degree of tightness of said chain may be obtained. To enable vertical adjustment of the bracket **198** the latter is provided with a suitable elongated clearance opening through which the crossbar **31** extends.

The chain **150** of each unit **45**, **46** is provided at intervals therealong with a plurality of mechanical grippers indicated generally at **151** (Figs. 1, 10, 15, 16, 17, and 19). These grippers **151** are equally spaced apart along the chain **150** and such that the distance between the same is equal to the distance desired between the leading or front edge of a preceding sheet and the leading or front edge of a succeeding sheet on the upright conveyor, said distance being less than the length of the shortest sheet which the feeder is designed to handle, whereby the sheets as they are carried upwardly from the pile **20** hang in underlapped relationship as diagrammaticaly indicated in Fig. 19. The sprockets **171** are so chosen that for each complete revolution thereof, i. e., for each cycle of operation of the feeder, the chains **150** will be advanced a distance equal to the distance between successive grippers **151**, whereby successive sets of said grippers will pass in position to receive successive sheets separated from the top of the pile **20** during successive cycles of operation of the feeder.

As shown particularly in Figs. 10, 15 and 16 of the drawings, each mechanical gripper **151** comprises a plate **153** which is provided at one side thereof with two pins located thereon as at **154** and **155** and which are of the same pitch as the chain **150** and pass through corresponding links of said chain in place of the standard chain pins. Pivotally mounted at **154** on the other side of the

plate 153 is a gripper jaw 156 having pivotally mounted thereon at 157 a companion gripper jaw 158. Pivotally connected as at 158' to the jaw 158 is one end of a short rod 159 the opposite end of which extends loosely through a suitable opening in the jaw 156. Surrounding the rod 159 is a coil compression spring 159' having one end thereof engaging against the head of said rod and the opposite end engaging against a surface of the jaw 156. The gripper jaw 158 is thus normally urged by the spring-pressed rod 159 into close contact with the gripper jaw 156. Eccentrically pivoted to the gripper jaw 156 as at 156' is one end of a short rod 165 the opposite end of which extends loosely through a suitable opening in a block 153' which is rotatably carried by the plate 153. Surrounding the rod 165 is a coil compression spring 165' having one end thereof engaging against the head of said rod and the opposite end engaging against the block 153'.

It will thus appear that by the described arrangement of the parts, the gripper jaws 156 and 158 are capable of rocking movement as a unit in opposite directions about the pivotal axis 154 relative to the chain 150, and the gripper jaw 158 is capable of rocking movement in opposite directions about the pivotal axis 157 relative to the gripper jaw 156 to opened and closed positions. It will also appear that the gripper jaw 156 and the spring-pressed rod 165 form in effect a toggle joint, and when said jaw is rocked by means to be presently described in one direction about the pivotal axis 154 thereof and the pivotal axis 156' of said rod passes the axis 154, the spring-pressed rod 165 operates to move the gripper jaws 156, 158 farther in said direction by a snap action to bring said jaws from the positions thereon shown in Fig. 16 to the positions shown in Fig. 15. Similarly, when the gripper jaw 156 is rocked in the opposite direction from the position thereof shown in Fig. 15, and the pivotal axis 156' of the spring-pressed rod 165 passes the axis of the block 153', said rod operates to move the gripper jaws 156, 158 farther in said direction by a snap action. Rocking movement of the gripper jaw 156 and therewith the gripper jaw 158 is limited in one direction through engagement of a surface 167 on the jaw 156 with a stop pin 168, and in the opposite direction through engagement of a surface 169 on said jaw with said pin, the latter being secured in the carrier plate 153. The gripper jaw 156 has journalled thereon at 156' a roller 169, and the gripper jaw 158 has journalled thereon at 161' a roller 161. The gripper jaw 156 has also journalled thereon at 154 a roller 163.

As previously stated, the cam units 40 and 41 are carried by and movable vertically with the separator carriage, and said units have fixed thereon for vertical movement therewith gripper introducing and opening cam blocks 174 (Figs. 1 and 17) which are disposed in the paths of upward movement of the grippers 151 on the chains 150. Each of the cam blocks 174 is constructed to provide a lower inclined cam surface 181 and an upper reversely inclined cam surface 182. Disposed at the tops of the chain gripper units 45, 46 and in the paths of forward movement of the grippers 151 on the chains 150 are gripper opening cam bars 172. Secured to the brackets 193 on and at the bottoms of the chain gripper units 45, 46 are gripper tumbling or turnover cam bars 173 which are disposed in the paths of downward movement of the grippers 151 on the chains 150, each of said cam bars being constructed to provide an upper inclined cam surface 173'.

Referring now to Fig. 17 of the drawings, which diagrammatically illustrates the gripper circuit and shows one gripper or one set of grippers 151 in the various positions it occupies as it travels around said circuit, let it be assumed that said gripper or set of grippers is travelling upwardly from the bottom of the feeder towards the top of the stationary pile of sheets 20 adjacent to but clear of the front side of said pile. At this time the gripper 151 is closed and the surface 167 of the jaw 156 is engaged with the pin 168, thus positioning the jaws 156, 158 that the bite thereof is substantially horizontal. As the gripper 151 reaches the top of the pile of sheets 20 at whatever level it may be, the roller 161 on the jaw 158 rides upwardly past, and out of contact with, the lower cam surface 181 of the cam block 174, and as the gripper 151 continues to move upwardly, the roller 160 on the jaw 156 engages and rides upwardly along the lower cam surface 181 of the cam block 174 and the roller 161 on the jaw 158 simultaneously engages and rides upwardly along the upper cam surface 182 of said cam block. Under these conditions the jaws 156, 158 are rocked as a unit rearwardly about the axis 154 towards the separated, lifted and stretched sheet 185 by the combined actions of the cam block 174 and the spring-pressed toggle rod 165, and the jaw 158, through such rocking movement thereof with the jaw 156 and engagement of the roller 161 with the cam surface 182, is caused to rock about its axis 157 farther away from the jaw 156, thus fully opening the grippers 151 and introducing the jaw 156 beneath the lifted and stretched front edge portion of the sheet and protecting the jaw 158 over said sheet portion. Thereafter, as the gripper 151 continues to move upwardly, the roller 161 on the jaw 158 rides off the cam surface 182 of the cam block 174, whereupon said jaw is rocked about its axis 157 toward the jaw 156 by the spring-pressed rod 159 to firmly grip the sheet 185 between the same and the jaw 156. During the described gripper opening and introducing operations the gripper 151 is steadied through engagement of the rollers of the chain 150 with the track bars 179 and engagement of the roller 163 with a surface 175 on the respective cam unit.

After the front edge portion of the separated, lifted and stretched sheet 185 is gripped by the transversely aligned set of grippers 151, said sheet, through continued upward movement of said grippers, is withdrawn from the top of the stationary pile 20 and advanced upwardly to the top of the gripper circuit. During this upward movement of the grippers 151 and the sheet 185 gripped thereby, said grippers are caused to gradually rock about the axes 154 downwardly towards the pile of sheets 20, whereby each gripper will assume a position such that the bite thereof more nearly approaches vertical position and thus conforms to the vertical attitude of the hanging sheet 185 gripped thereby. For this purpose, each chain gripper unit 45 and 46 includes a bar 190 which is secured at its lower end to a bracket 190' which, in turn, is pivotally mounted as at 191 on the bracket 194. The bars 190 extend upwardly to substantially the top of the crossbar 29 and are normally tilted forwardly at a slight angle with respect to the straight-line vertical upward movement of the chains 150 and the grippers 151 thereon. The bars 190 pass through and are guided in suitable bifurcated portions of the cam units 40, 41 and they engage adjustable balls 192 loosely carried in suitable sockets in said units.

It will thus appear that when the grippers 151 are rocked by the combined actions of the cam blocks 174 and the spring-pressed toggle rods 165 rearwardly into positions to grip the sheet 185 as above described, the rollers 160 on the gripper jaws 156 engage the bars 190 and are held in engagement with said bars under the influence of the toggle rods 165. Accordingly, as the grippers 151 travel upwardly with the gripped sheet 185 to the top of the gripper circuit, the rollers 160 being under the influence of the spring-pressed toggle rods 165 are caused to follow the inclined bars 190 and in so doing permit said grippers to progressively rock in a downward direction under the influence of said toggle rods an extent permitted by said bars. The degree of rocking movement of the grippers 151 which is required in conformity with the inclination of the bars 190 varies in accordance with the distance between the top of the pile of sheets and the top of the gripper circuit, i. e., ac-

cording to the height of the pile. In order to achieve this variation the inclination of the bars **190** is adjusted in accordance with the elevated position of the cam units **40** and **41**.

The sheet **185** taken by the grippers **151** is advanced upwardly to the top of the gripper circuit and then forwardly and delivered to the tape conveyor **21** between the latter and cooperating pressure rollers **203**, at which time the grippers are opened to release said sheet for further movement by said conveyor toward the printing press or other machine with which the feeder is associated. As the grippers **151** enter the path of forward movement thereof they assume a natural position in which the bites of the jaws **156**, **158** are trailing and are substantially tangential to said movement. Opening of the grippers **151** after the sheet **185** is delivered to and between the tape conveyor **21** and pressure rollers **203** is effected by the cam bars **172** which are so positioned in the path of forward movement of said grippers that the rollers **160** on the jaws **156** pass beneath said bars, and the rollers **161** on the jaws **158** pass above said cam bars. As the grippers **151** reach the end of their forward travel and begin their return travel around the sprockets **171** which occurs after the sheet **185** is delivered between the tape conveyor **21** and the pressure rollers **203**, the gripper jaws **158**, through downward movement of said grippers and engagement of the rollers **161** with the fixed cam bars **172**, are forced away from the gripper jaws **156**, thus opening the grippers **151** to release the sheet **185**. As the grippers **151** continue to move downwardly around the sprockets **171**, the rollers **161** on the gripper jaws **158** move out of engagement with the cam bars **172**, whereupon said grippers are again closed by the action of the spring-pressed rods **159** on said jaws. The grippers **151** then continue to move downwardly to the bottom of the feeder in a natural position in which the bites of the jaws **156**, **158** are trailing and are substantially vertical.

As the grippers **151** approach the bottom of the feeder and before they enter their semi-circular path and begin their upward movements to act on another sheet separated from the top of the pile **20**, the rollers **160** on the jaws **156** engage and ride downwardly along the cam surfaces **173'** of cam bars **173**, whereupon said grippers are, through the combined actions of said cam bars and the spring-pressed toggle rods **165**, tumbled or turned-over approximately 90° about their axes **154** from the positions thereof in which the bites of the jaws **156**, **158** are vertical to positions in which said bites are horizontal and the jaws **158** are leading, as shown in Fig. 17, thus resetting the grippers for action on another sheet as the same again travel upwardly past the top of the pile of sheets **20**. The described gripper operations are repeated for each set of grippers as the same travels along the described gripper circuit, whereby sheets separated successively from the top of the pile **20** are taken by successive sets of grippers, removed from said pile, and advanced upwardly in lapped relation, as shown diagrammatically in Fig. 19. It is to be noted that by virtue of the described upward removal of the sheets from the top of the pile **20**, a relatively wide space is immediately created between the topmost sheet being removed and the next sheet on said pile, which space advantageously enables immediate return of the combing wheels **127** and the suction devices beneath said topmost sheet, and performance of the separating, lifting and stretching operations on said next sheet while the latter is still partly covered by the outgoing topmost sheet.

To facilitate the movement of the sheets in the forward direction guide brackets **200** (Figs. 1 and 18) are slidably mounted on the crossbar **29** inwardly of the chain gripper units **45**, **46**. These guide brackets **200** are laterally spaced from the chain gripper units and are secured to the upper brackets **152** of said units by means of bolts **204** and **205**, the bolts **204** passing through suitable clearance openings in the brackets **152** and being threaded into spacer brackets **206**, and the bolts **205** passing through suitable clearance openings in the brackets **152** and **206** and being threaded into the brackets **200**. The guide brackets **200** carry the gripper opening cams **172** and the outline of said brackets is similar to the outline of the brackets **152** in conformity with the path of forward travel of the sheets. To further support and guide the sheets in the forward movement thereof onto the tape conveyor **21**, other curved guide brackets **207** are adjustably secured to the cross bar **29** between the guide brackets **200**.

The tape conveyor **21** comprises a plurality of transversely spaced endless tapes **202**, two only being shown, which travel over and along a feedboard **201** suitably supported on the feeder frame. The rear portions of the tapes **202** pass around and are driven by flanged pulleys **208** (Fig. 18) which are disposed between the brackets **152** and **200** and are keyed to the shaft **60** for rotation thereby and for sliding movement along said shaft. The tapes **202** are driven at the same surface speed as that of the grippers **151** so that the lapped relation of the sheets is maintained as said sheets are further advanced by the conveyor **21** to the printing press or other machine. The rear portions of the tapes **202** also pass over and around idler rollers **209** journalled at **210** on the guide brackets **200**, and over and around tape tightening rollers **211** which are journalled as at **212** on the upper ends of arms **213** which are pivotally mounted at **205** on the spacer brackets **206**. The arms **213** have connected therewith corresponding ends of coil extension springs **214** the opposite ends of which are connected as at **215** to the guide brackets **200**. The pressure rollers **203** are journalled on arms **216** which are adjustably secured on a shaft **217** that extends transversely of the feeder and is rotatably carried by the upper side frame brackets **26**. The pressure rollers **203** rest by gravity on the tapes **202**, augmented by a coil extension spring **218** having one end thereof connected to a rod **219** which extends through and is secured in one end of the shaft **217**, said rod being utilized to manually lift said pressure rollers out of engagement with said tapes and the sheets carried thereby. The opposite end of the spring **218** is connected to the adjacent upper side frame bracket **26**.

The operation of the feeder will be clearly understood from the foregoing description and may be briefly summarized as follows. The continuously rotating combing wheels **127** are lowered onto the top of the stationary pile of sheets **20** and comb the front corner portions of the top sheet inwardly towards each other whereby small buckles or humps are formed in said sheet adjacent said corners and the sheet is separated from the next or underlying sheet at opposite front corners thereof. During this combing operation, the feeler **70** and presser fingers **142** are resting on the top of the pile, and the suction devices are being lowered towards said pile. When the combed top sheet is engaged and gripped at the humped corner portions thereof by the suction cups **140**, the combing wheels **127** are raised to the broken line positions thereof shown in Fig. 7 clear of the side edges of said sheet, and the feeler **70** and presser fingers **142** are raised to positions clear of the front edge of the sheet. The suction devices are then raised to lift and stretch the entire front edge portion of the sheet which is then gripped by a set of upwardly travelling grippers **151** at spaced points along said edge and removed from the pile in an upward direction. When the lifted and stretched front edge portion of the top sheet is gripped by the grippers **151**, said sheet is released by the suction cups **140** through the breaking of vacuum therein, and the suction devices are further raised to the broken line positions thereof shown in Fig. 8 clear of the side edges of the upwardly moving sheet. While the top sheet is being removed from the pile **20** by the grippers **151**, the feeler **70**, the presser fingers **142**, the combing wheels **127** and the suction devices

return beneath said sheet and the next sheet is separated, lifted and stretched at the front edge thereof and is taken by the next set of upwardly travelling grippers **151** before the preceding sheet has been completely removed from the pile so that there is formed on the upright conveyor a stream of lapped sheets which is delivered to the tape conveyor **21** and is advanced by said tape conveyor to the printing press or other machine which takes the forward uppermost sheets successively from said stream for performance of printing or other operations thereon.

As the height of the stationary pile of sheets **20** decreases through feeding of sheets from the top thereof, the sheet separating mechanisms **39** are automatically lowered, the cyclic timing of the operations of said mechanisms is automatically advanced in relation to the movement of the sets of grippers **151** and the advanced arrival thereof at the changing level of the gradually diminishing pile, and the sheet taking operations of said grippers are automatically controlled to occur as the grippers travel past said changing pile level, whereby separation of the sheets successively from the top of the pile and removal of said sheets from said pile is maintained and assured throughout the entire run of the pile of sheets and until said pile is exhausted.

Although only a single embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be expressly understood that the invention is not limited to said embodiment. Various changes may be made, particularly in the design, arrangement and mode of operation of the parts illustrated, without departing from the spirit and scope of the invention, as will now be apparent to those skilled in the art. For example, one of the gripper carrying chains **150** may be employed to drive the separator driving shaft **66** one revolution for each cycle of operation of the feeder since the cyclic surface speed of said chain is equal to the spacing between the sheet grippers **151**. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, sheet conveying means arranged adjacent said pile for removing the separated sheets successively from said pile, means for lowering said separating means as the sheets are removed from said pile, and means for operating said separating means at timed intervals and for timing the operation thereof as it descends, said last-named means comprising a rotatable annular member, a vertically positioned driving element continuously engaged with said annular member for continuously rotating the latter, said annular member being movable vertically with said separating means and along said driving element, and driving connections from said annular member to said separating means, said annular member being caused to turn relative to said driving element in the direction of its normal rotation upon downward movement thereof along said driving element with said separating means, whereby the timing of said separating means is advanced as the latter descends and in accordance with the change in vertical position thereof with respect to the top of said pile.

2. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, sheet conveying means arranged adjacent said pile and extending from substantially the lowermost sheet of said pile to a level above the top of said pile for removing the separated sheets successively from said pile, means for lowering said separating means relative to said conveyor means as the sheets are removed from said pile, and means for operating said separating means at timed intervals and in timed relation with the cycle of movement of the successive sheets by said conveyor means, said last-named means comprising a rotatable annular member, a vertically positioned driving element continuously engaged with said annular member for continuously rotating the latter one revolution for each cycle of operation of the feeder, said annular member being movable vertically with said separating means and along said driving element, and driving connections from said annular member to said separating means, said annular member being caused to turn relative to said driving element upon downward movement thereof along said driving element with said separating means, whereby the timing of the separating means is varied as the latter descends and in accordance with the change in vertical position thereof with respect to the top of said pile and said conveying means.

3. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, sheet conveying means arranged adjacent said pile for removing the separated sheets successively from said pile, means for lowering said separating means as the sheets are removed from said pile, means for raising said separating means, and means for operating said separating means at timed intervals and for timing the operation thereof as it is lowered and raised, said last-named means comprising a rotatable annular member, a vertically positioned driving element continuously engaged with said annular member for continuously rotating the latter, said annular member being movable vertically with said separating means and along said driving element, and driving connections from said annular member to said separating means, said annular member being caused to turn relative to said driving element in one direction upon movement thereof along said driving element in one vertical direction with said separating means, and in the opposite direction upon movement thereof along said driving element in the opposite vertical direction with said separating means, whereby the timing of said separating means is advanced when the latter is moved in one of said vertical directions and is retarded when said separating means is moved in the other of said vertical directions.

4. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, an endless sheet conveyor arranged with a reach thereof adjacent said pile and extending from substantially the lowermost sheet of said pile to a level above the top of said pile for removing the separated sheets successively from said pile, said conveyor advancing the sheets a predetermined distance for each cycle of operation of the feeder, means for lowering said separating means relative to said conveyor as the sheets are removed from said pile, and means for operating said separating means at timed intervals and in timed relation with the cycle of movement of said conveyor, said last-named means comprising a rotatable annular member movable vertically with said separating means, driving connections from said annular member to said separating means, and an endless flexible element driven in timed relation with the cycle of movement of said conveyor and having a reach thereof travelling in the same direction as said conveyor reach and continuously engaged with said annular member to rotate the latter one revolution for each cycle of operation of the feeder, said annular member rolling downwardly along said endless element when said separating means is lowered, thereby effecting an angular movement of said annular member relative to said endless element and retiming said separating means relative to the cycle of movement of said conveyor in accordance with the change in vertical position of said sepa-

rating means with respect to the top of said pile and said conveyor.

5. Sheet feeding apparatus as defined in claim 4, wherein the sheets are advanced from said pile in an upward direction by said conveyor, and said annular member through said angular movement thereof advances the timing of said separating means as the latter descends.

6. Sheet feeding apparatus as defined in claim 4, wherein the cyclic surface speed of said conveyor is less than the length of the sheets.

7. Sheet feeding apparatus as defined in claim 4, wherein said endless flexible element is driven at the same surface speed as that of said conveyor, and said annular member has a circumferential length equal to the extent of movement of said conveyor for each cycle of operation of the feeder.

8. Sheet feeding apparatus as defined in claim 7, wherein said endless flexible element is a chain, and said annular member is a sprocket having continuous meshing engagement with said chain.

9. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, a vertically positioned endless conveyor arranged adjacent said pile and extending from substantially the lowermost sheet of said pile to a level above the top of said pile, said conveyor carrying sheet grippers at spaced intervals therealong for gripping successive separated sheets and removing said sheets from said pile in an upward direction, means for lowering said separating mechanism as the sheets are removed from said pile, said separating means including an actuating shaft movable vertically therewith, a sprocket fixed on said shaft and having a circumferential length on the pitch line equal to the spacing between said sheet grippers, and a vertically positioned endless chain driven in the same direction and at the same surface speed as that of said conveyor and having the upwardly travelling reach thereof continuously meshing with said sprocket for rotating the latter and said shaft one revolution for each cycle of operation of the feeder, said sprocket rolling downwardly along said chain when said separating means is lowered, thereby effecting an angular movement of said sprocket relative to said chain whereby the timing of said separating means is advanced relative to the cycle of movement of said conveyor a degree commensurate with the extent of downward movement of said separating means.

10. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising a vertically movable carriage, sheet separating means on said carriage and operable to separate the sheets successively from the top of said pile, a series of sheet gripping means spaced equal distances apart and travelling successively in a closed path including an upgoing run, said sheet gripping means acting to grip the successive separated sheets at an edge thereof and remove said sheets from said pile in an upward direction, a shaft journalled in said carriage, driving means between said shaft and said sheet separating means for actuating the latter, a sprocket on said shaft having a circumferential length on the pitch line equal to the spacing between said sheet gripping means, endless chain means drivably connected with said sheet gripping means and having a reach thereof continuously meshing with said sprocket for rotating said sprocket one revolution for each cycle of operation of the feeder and for advancing said sheet gripping means for each feeder cycle a distance equal to the spacing between said sheet gripping means, and means on said carriage for lowering the latter relative to said sheet gripping means and said chain means as the sheets are removed from said pile, said sprocket rolling downwardly along said chain means when said carriage is lowered, thereby effecting an angular movement of said sprocket relative to said chain means whereby the timing of said sheet separating means is advanced in accordance with the change in vertical position of the latter with respect to the top of said pile and said sheet gripping means and a degree commensurate with the extent of downward movement of said carriage.

11. In a sheet feeder, a feed board at a fixed elevated level, a low level support for a stationary pile of sheets, an upstanding endless conveyor disposed between the pile and feed board, a carriage movable up and down parallel to said conveyor, cam shaft means journalled in said carriage, a vertically disposed endless chain driven in timed relation with the machine to which sheets are being fed, a sprocket on said cam shaft means meshing directly with said chain for turning said cam shaft means continuously one revolution for each machine cycle, sheet separating means on said carriage, sheet gripping means spaced at regular intervals along the length of said conveyor, the grippers on the upgoing run of said conveyor being adapted to take separated sheets from said pile, move them up to and place them upon said feed board, means on said cam shaft means functioning to actuate said separating means, means on said carriage functioning to operate each of said sheet gripping means as the latter on their upward travel pass said carriage, means actuated by said cam shaft means for lowering said carriage an increment at a time, and means for disabling said lowering means when the difference between the height of the carriage and that of the pile becomes less than a predetermined amount.

12. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, an endless sheet conveyor arranged with a reach thereof adjacent said pile and extending and traveling from substantially the lowermost sheet of said pile to a level above the top of said pile for removing the separated sheets successively in an upward direction from said pile, said conveyor advancing the sheets a predetermined distance for each cycle of operation of the feeder, means for lowering said separating means relative to said conveyor as the sheets are removed from said pile, and means for operating said separating means at timed intervals and in timed relation with the cycle of movement of said conveyor, said last-named means comprising a rotatable member mounted in and movable vertically with said separating means, driving connections from said rotatable member to said separating means, and an endless flexible element driven in timed relation with the cycle of movement of said conveyor at the same surface speed as that of said conveyor and having a reach thereof traveling in the same direction as said conveyor reach and continuously engaged with said rotatable member to rotate the latter one revolution for each cycle of operation of the feeder, said rotatable member rolling downwardly along said endless element when said separating means is lowered, thereby effecting an angular movement of said rotatable member relative to said endless element and retiming said separating means relative to the cycle of movement of said conveyor in accordance with the change in vertical position of said separating means with respect to the top of said pile and said conveyor.

13. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, an endless sheet conveyor arranged with a reach thereof adjacent said pile and extending and traveling from substantially the lowermost sheet of said pile to a level above the top of said pile for removing the separated sheets successively in an upward direction from said pile, said conveyor advancing the sheets a predetermined distance for each cycle of operation of the feeder, means for lowering said separating means relative to said conveyor as the sheets are removed

from said pile, and means for operating said separating means at timed intervals and in timed relation with the cycle of movement of said conveyor, said last-named means comprising a rotatable member mounted in and movable vertically with said separating means, driving connections from said rotatable member to said separating means, and an endless flexible element driven in timed relation with the cycle of movement of said conveyor at the same surface speed as that of said conveyor and having a reach thereof traveling in the same direction as said conveyor reach and continuously engaged with said rotatable member to rotate the latter continuously one revolution for each cycle of operation of the feeder, said rotatable member rolling downwardly along said endless element when said separating means is lowered, thereby effecting an angular movement of said rotatable member relative to said endless element and retiming said separating means relative to the cycle of movement of said conveyor in accordance with the change in vertical position of said separating means with respect to the top of said pile and said conveyor.

14. Sheet feeding apparatus for feeding sheets successively from a stationary upright pile thereof, comprising sheet separating means arranged for vertical movement and operable to separate the sheets successively from the top of said pile, an endless sheet conveyor arranged with a reach thereof adjacent said pile and extending and traveling from substantially the lowermost sheet of said pile to a level above the top of said pile for removing the separated sheets successively in an upward direction from said pile, said conveyor advancing the sheets a predetermined distance for each cycle of operation of the feeder, means for lowering said separating means relative to said conveyor as the sheets are removed from said pile, and means for operating said separating means at timed intervals and in timed relation with the cycle of movement of said conveyor, said last-named means comprising a rotatable member mounted in and movable vertically with said separating means, a sprocket wheel fixed to said rotatable member, driving connections from said rotatable member to said separating means, an endless chain driven in timed relation with the cycle of movement of said conveyor at the same surface speed as that of said conveyor and having a reach thereof traveling in the same direction as said conveyor reach and continuously engaged with said sprocket wheel to rotate the latter and said rotatable member continuously one revolution for each cycle of operation of the feeder, said sprocket wheel rolling downwardly along said chain when said separating means is lowered, thereby effecting an angular movement of said rotatable member relative to said chain and retiming said separating means relative to the cycle of movement of said conveyor in accordance with the change in vertical position of said separating means with respect to the top of said pile and said conveyor.

15. In a sheet feeder, a feed board at a fixed elevated level, a low level support for a stationary pile of sheets, an upstanding endless conveyor disposed between said pile and said feed board for advancing one sheet at a time from the top of the pile to said feed board, a carriage movable up and down parallel to said conveyor, cam shaft means journaled in said carriage, a vertically disposed operating member driven in timed relation with the machine to which sheets are being fed, means on said cam shaft means operatively connected to said member for turning said cam shaft means continuously one revolution for each machine cycle, sheet separating means on said carriage, means on said cam shaft means functioning to actuate said separating means once for each revolution of said cam shaft means, a feeler mounted on said carriage, means actuated by said cam shaft means for lowering said feeler into engagement with the top of said pile once for each cycle, and means actuated by said cam shaft means and controlled by said feeler for lowering said carriage an increment at a time, said operative connection traveling downward along said vertically disposed operating member when the carriage is lowered, thereby advancing the angular position of said cam shaft means with respect to said vertical member whereby the height of the carriage as controlled by said feeler determines the timing of said sheet separating means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,248,786	Bachwitz	Dec. 4, 1917
2,536,356	Dager	Jan. 2, 1951