

Nov. 19, 1957

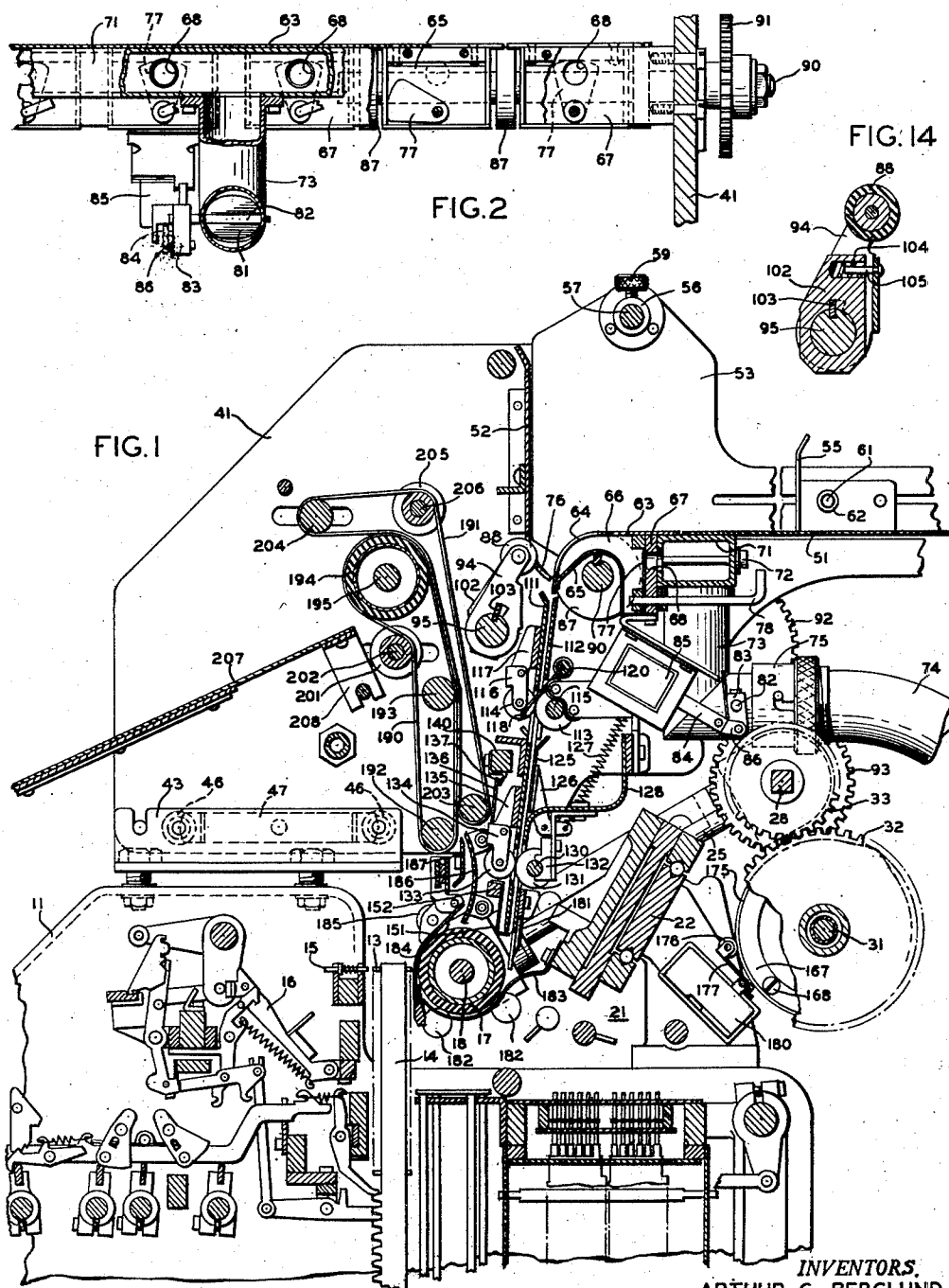
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2,813,612

SINGLE SHEET FEED MECHANISM

Filed July 24, 1953

6 Sheets-Sheet 1



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SINGLE SHEET FEED MECHANISM

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6 Sheets-Sheet 2

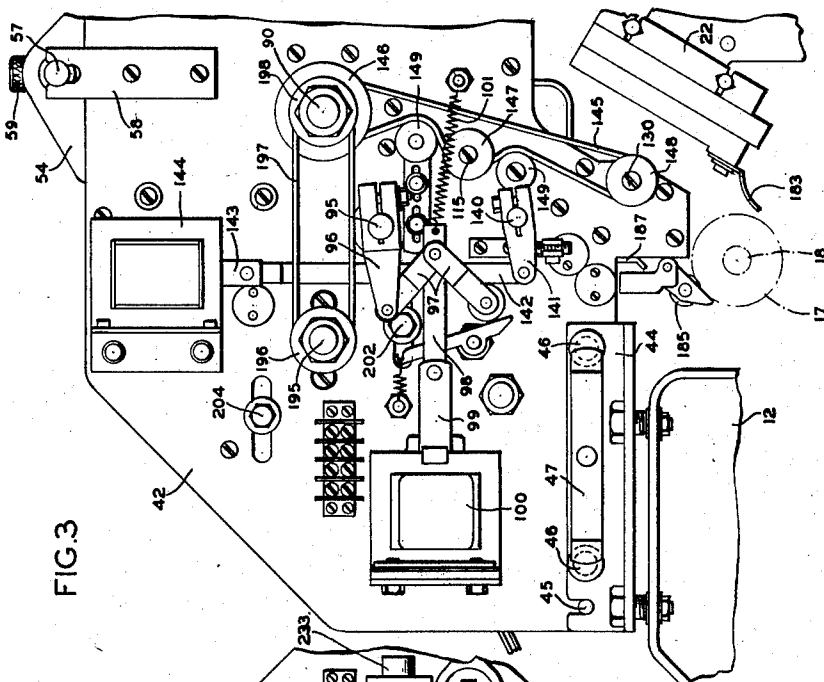


FIG. 3

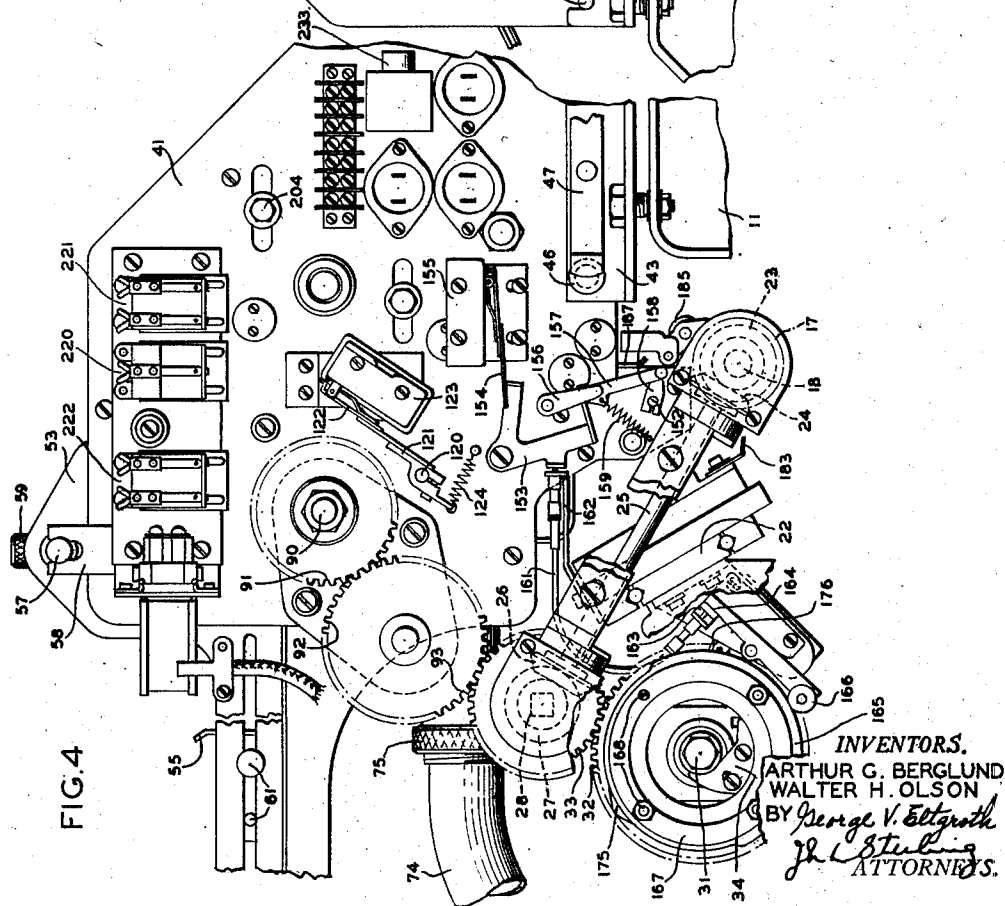


FIG. 4

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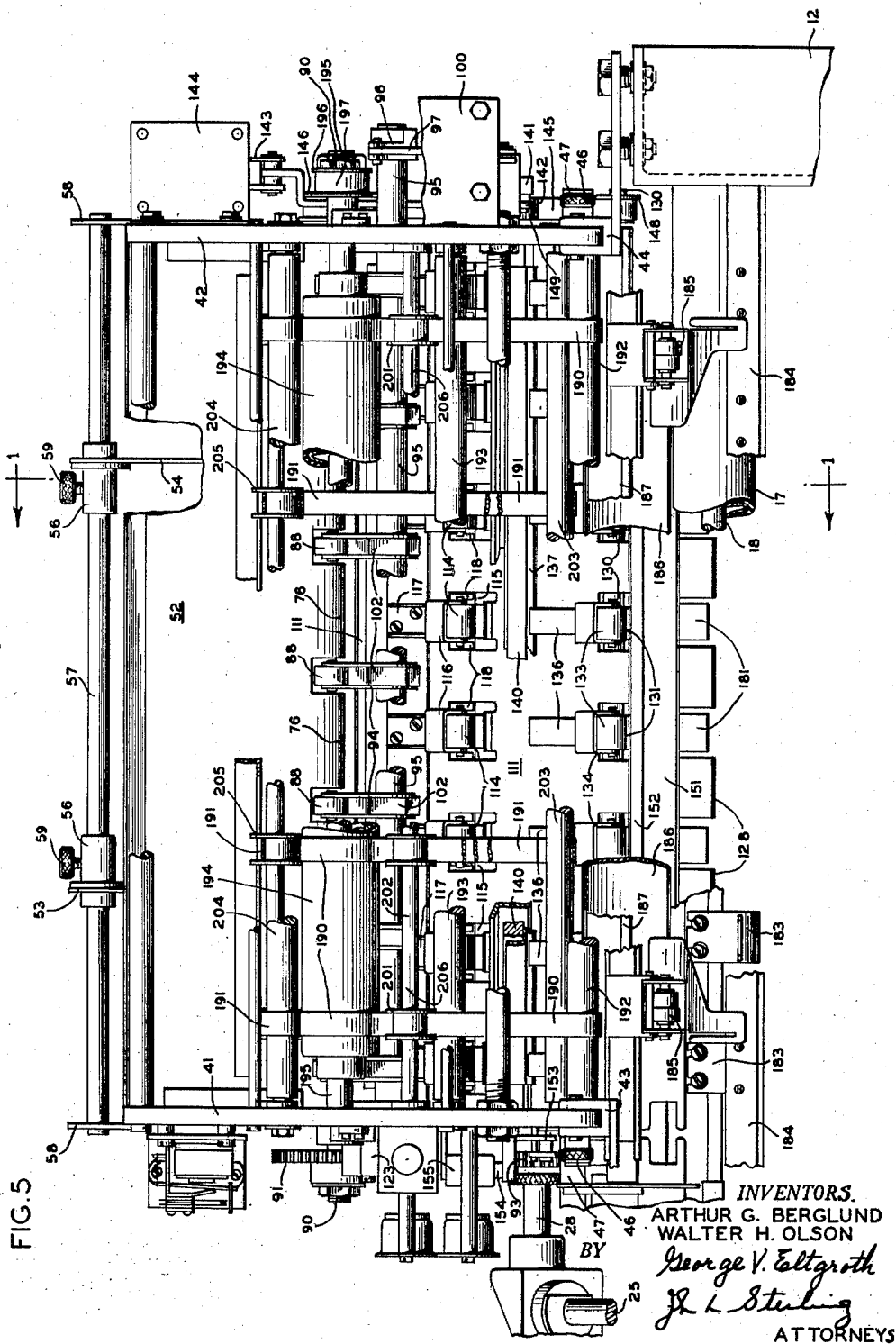
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SINGLE SHEET FEED MECHANISM

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6 Sheets-Sheet 3



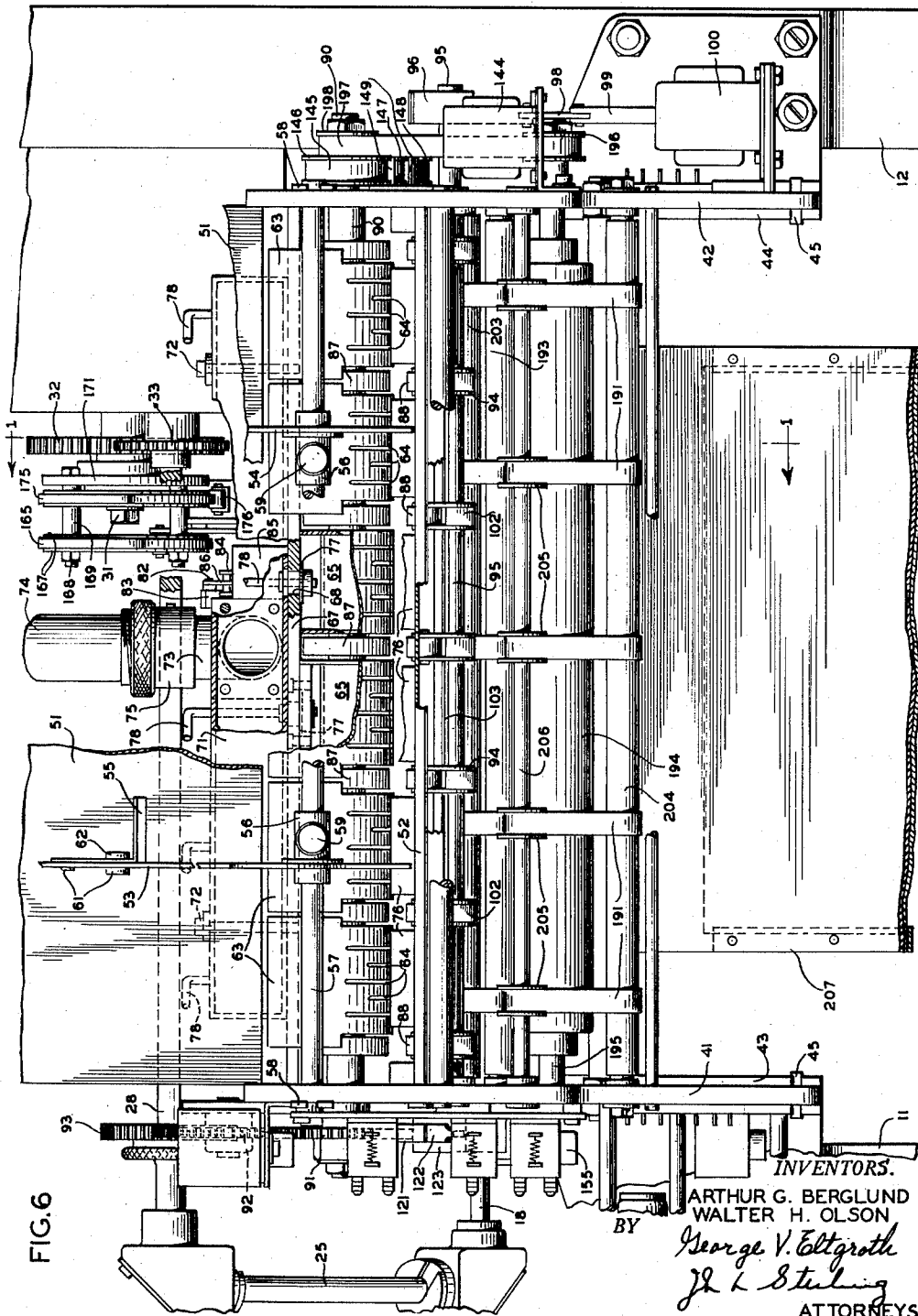
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SINGLE SHEET FEED MECHANISM

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6 Sheets-Sheet 4



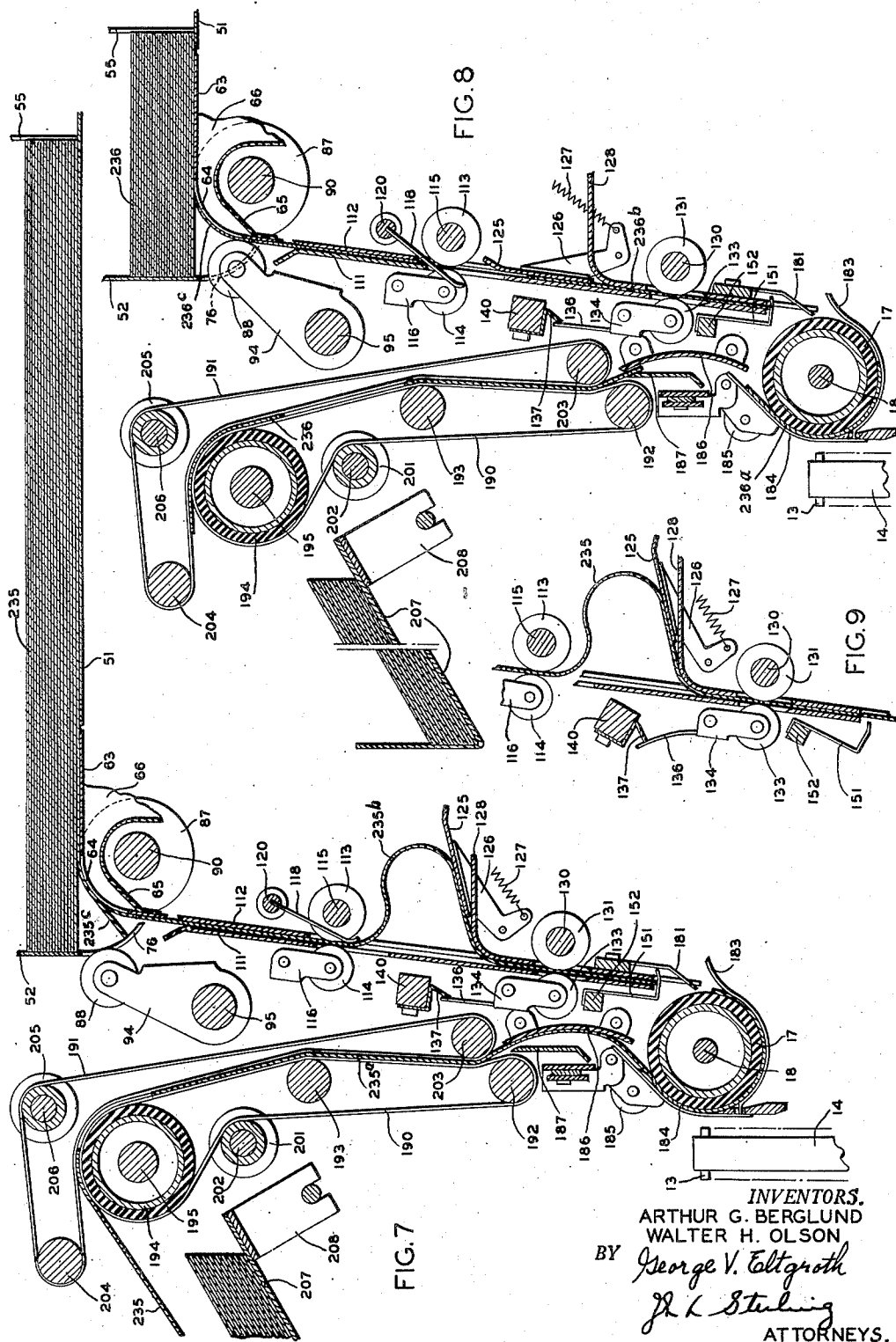
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SINGLE SHEET FEED MECHANISM

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6 Sheets-Sheet 5



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SINGLE SHEET FEED MECHANISM

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6 Sheets-Sheet 6

FIG. 10

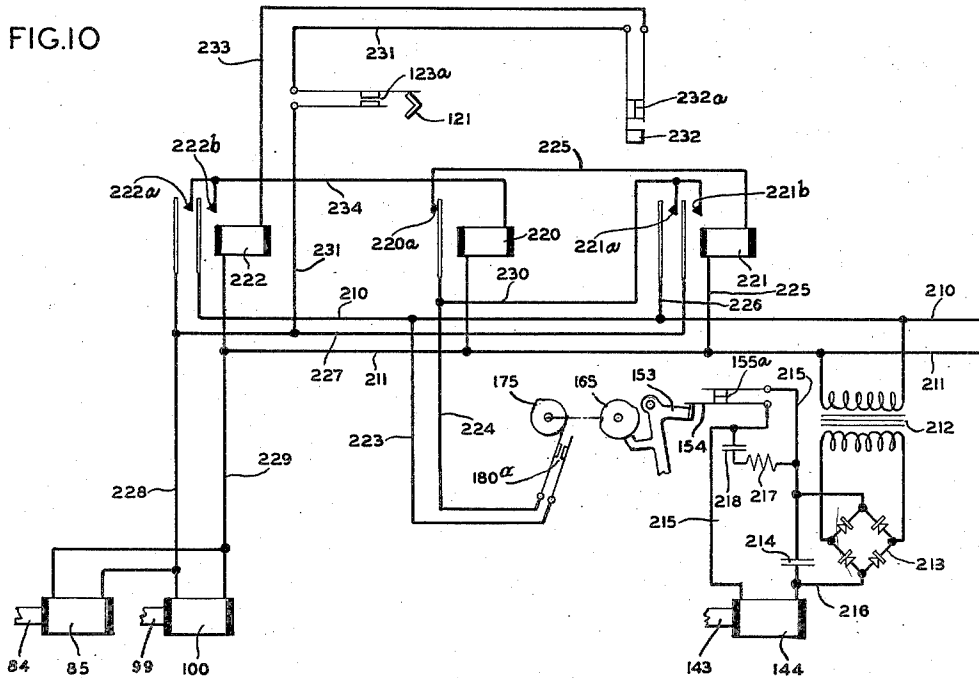


FIG. 11

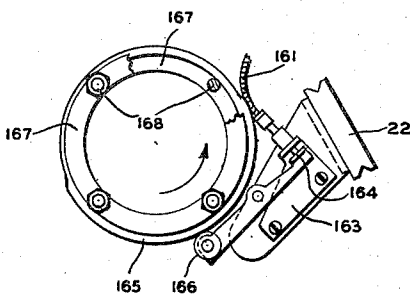


FIG. 12

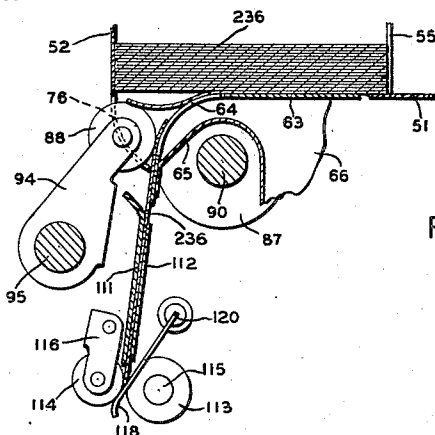
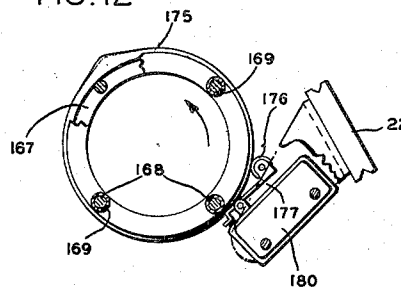


FIG. 13

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2,813,612

SINGLE SHEET FEED MECHANISM

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Application July 24, 1953, Serial No. 370,066

21 Claims. (Cl. 197—130)

This invention relates in general to automatic feeding means including the control thereof, and has more particular relation to mechanism for feeding singly and in succession individual unconnected sheets of flexible material from a plurality of said sheets prearranged in stack formation to and through a series of precisely registered spaced positions with respect to other means operable thereupon.

The invention is disclosed in an embodiment adapted for feeding sheets of paper, card stock or the like to the printing platen of a business machine such as a record controlled tabulator, although it will be understood that the invention may be readily adapted for feeding materials other than paper or card stock to operating stations other than the printing platen of a business machine.

Business machines of the class herein disclosed are ordinarily equipped with paper feed drive mechanism of the automatic compensating type which may be controlled in accordance with any one of a variety of operating conditions occurring in the machine to impart an occasional long or compensating feed stroke to the paper in place of the usual line spacing feed stroke. When the paper being fed comprises prepared business forms, a long or compensating feed stroke may be employed to advance the paper from any printing position on a preceding form to the desired first printing position on a succeeding form.

It will of course be appreciated that in long compensating feed operations the paper is driven at considerably higher velocity than during the normal line space feeding thereof, which velocity is directly proportional to the length of form employed, and also that when employing business forms, the accurate registration of the paper in printing position about the platen is an important result to be achieved. When the forms to be printed are on a continuous roll or otherwise connected together, the problem of obtaining accurate registration thereof in conjunction with long or compensating feed strokes is more easily overcome since under these conditions the feeding mechanism may be in constant positive engagement with the paper in such a manner that each successive form will be drawn into correct registration about the platen by the form which preceded it. When the forms to be fed constitute individual unconnected sheets, as is often desired, the correct registration thereof in printing position at the high feeding speeds encountered in long compensating feed strokes, presents additional problems since under these circumstances registration must be made for each individual sheet fed and without the assistance of the form preceding it in the line of feed.

It is therefore an object of the present invention to provide improved means for feeding individual and unconnected sheets of flexible material at high speeds to a succession of accurately registered spaced positions with respect to other machine members operable thereon.

It is a further object of the invention to enable the accurate registration of individual sheets feeding at high speeds through a single sheet feeding mechanism.

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It is a further object of the invention to provide in a single sheet feeding mechanism a registration station for momentarily delaying the advance of each sheet being fed and then releasing the sheet at the precise moment required for bringing it into accurate registration with other machine members operable thereupon.

It is still a further object of the invention to provide a single sheet feeding mechanism which may be readily adjusted for accommodating sheets of various sizes and also for varying the area of the sheet on which the work thereon may be performed.

The mechanism of the invention, in the embodiment herein disclosed, is mounted in an independent framework which may be detachably mounted on the head of a tabulating machine. It includes a magazine having adjustable wall portions for maintaining cards or sheets of various sizes in stack formation; vacuum applying means for separating a single sheet from the remainder of the stack; feed rollers releasable at a predetermined point of the feeding cycle for withdrawing the separated sheet from the magazine; a sensing means, controlled by the movement of the sheet a predetermined distance, for restoring said feeding rollers; and a registration station comprising a sheet stop member disposed adjacent the printing platen to delay the advance of the sheet into printing position about the platen until a precisely predetermined point in the feeding cycle.

Other objects and features of the invention, together with the structural details by which they are carried out, will be apparent from the following description when read in conjunction with the drawings wherein:

Fig. 1 is a right hand view in elevation taken along the section lines 1—1 of Figs. 5 and 6 and showing the feeding mechanism mounted on the head of a tabulating machine with which it cooperates;

Fig. 2 is a detail rear view illustrating the construction of the vacuum manifold and related parts;

Fig. 3 is an elevation of the feeding mechanism taken from the right hand side;

Fig. 4 is an elevation of the feeding mechanism taken from the left hand side;

Fig. 5 is a front elevation of the mechanism;

Fig. 6 is a plan view of the mechanism with a portion of the feed table broken away to more clearly show the related parts of the tabulator long feed drive mechanism;

Fig. 7 is a fragmentary view of the parts as shown in Fig. 1 and illustrating the passage of relatively long sheets through the mechanism;

Fig. 8 is a fragmentary view similar to Fig. 7 illustrating the passage of relatively short sheets or cards through the mechanism;

Fig. 9 is a detail view of a portion of the mechanism shown in Figs. 7 and 8 and illustrating the manner in which sheets are released from the registration station;

Fig. 10 is a wiring diagram of the device;

Figs. 11 and 12 are detail views respectively of the separate cams mounted on the tabulator long feed drive mechanism for controlling the timing of the feeding mechanism;

Fig. 13 is a view of a portion of the mechanism shown in Fig. 8 but at a different stage of the feeding cycle; and

Fig. 14 is a detail view in section of a portion of the sheet withdrawing mechanism which is shown in side elevation in Fig. 1.

The invention is shown herein as adapted for a record control tabulator having a universal compensating paper feed drive mechanism of the type fully disclosed in patent to J. H. McDonnell, No. 2,476,449, issued July 19, 1949, the tabulator being more fully disclosed in patent to J. Mueller, No. 2,381,361, issued August 7, 1945. As disclosed therein, the tabulator is housed in a framework

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including a left and right hand side frame casting 11, 12 respectively. Printing is effected by type elements 13 carried by each of a series of differentially settable type bars 14, said type bars rising each operating cycle to bring a desired type element into horizontal alignment with a firing pin 15. At the proper time of each machine cycle, type hammers 16 are released to strike the related firing pin 15 and thereby drive the selected type element 13 against the printing platen 17. The machine herein disclosed is equipped with one hundred type bars 14, thereby enabling the machine to print in one operating cycle and in one line the entire capacity of the well-known "Powers" 90-column tabulating card. The printing platen is carried by a platen shaft 18 which is journaled in the usual way in the side frame portions of a paper carriage 21 which is adjustably supported by a carriage mounting bar or rail 22 suitably supported on legs 23 which are secured to the top rear portion of the side frame castings 11, 12, respectively of the machine. This construction enables the paper carriage to be adjustably positioned laterally relative to the type bars 14.

The platen is driven through a train of gearing enclosed in a suitable housing secured to the left hand wall of the paper carriage, said gear train, as seen best in Fig. 4, including a bevelled gear 23 mounted on the left hand end of the platen shaft 18 meshing with a bevelled gear 24 mounted on the front end of an inclined shaft 25. The rear end of shaft 25 carries a bevelled gear 26 in mesh with a bevel gear 27 carried by a squared shaft 28 which is suitably journaled in the framework of the paper carriage 21.

As fully disclosed in the aforementioned patent to McDonnell, 2,476,449, line spacing of the platen is effected through ratchet means, including a ratchet wheel, not shown herein, carried by the squared shaft 28 near the right hand end thereof. Said ratchet means operates each cycle when line spacing is desired to step the shaft 28 in a counterclockwise direction as viewed in Fig. 1, which stepping movement operates through the gearing just described to rotate the platen 17 in a clockwise direction a sufficient distance to effect either single, double or triple line spacing as desired. The disclosed machine is designed to print six lines to an inch when set for single line spacing, and the platen is of such a diameter as to feed paper thirty line spaces through each complete rotation thereof.

A long or compensating feed stroke is effected through the compensating drive mechanism, partially shown herein, having a compensating drive shaft 31 carrying a detachable drum unit to which is secured a compensating drive gear 32. Said gear 32 meshes with a gear 33 carried by the squared shaft 28, and, during line spacing rotation of said shaft 28, is driven by said gear 33 in a clockwise direction about the shaft 31. As is fully described in said patent to McDonnell, 2,476,449, the compensating drum on which gear 32 is mounted carries a plurality of notched discs settable to drive the drum to different predetermined points in its rotation one of which points may be regarded as a home position. Said home position in the present application represents the first print line on which a new form is to be printed. Whenever the operating conditions of the machine call for a compensating or long feed stroke, means are provided to engage the shaft 31 of the drive mechanism with said drum at whatever point it may have been advanced by line spacing action and thereby drive the drum and gear 32 to the desired point which, when a new form is to be started, would be for the balance of one complete rotation back to the home position. This compensating stroke is effective within one machine cycle and operates through the shaft 28 in the aforementioned gearing to drive the platen 17 a sufficient distance to bring a new form into first line print position. It will of course be understood that the size of the gear 32 must

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correspond to the length of the form being fed. In the event it were desired to feed for example forms eleven inches long, a gear 32 of sufficient size to drive, in one rotation thereof, the platen sixty-six line spaces, would be provided. In order to facilitate the interchanging of the gears 32, 33, to obtain various driving ratios, the drum upon which gear 32 is mounted is detachably mounted as aforesaid on the shaft 31 and for this purpose, as best seen in Fig. 4, there is a spring urged clip pivoted on the drum and cooperating with an annular groove in the shaft 31 for locking the desired drum unit on the shaft 31. A plurality of gears 33 may be provided on shaft 28 and of various sizes so as to fit any one gear 32 which may be selected.

The mechanism according to the instant invention for conveying single detached sheets of paper to and from the printing platen is supported in an independent framework comprising left and right side frame plates 41, 42 respectively. Said mechanism is detachably mounted on the tabulator by means of angular supporting bars 43, 44 respectively, each supported by and secured to the top front portion of each of the tabulator side frame castings 11, 12 respectively. The upright portion of each of the supporting bars is in the form of a channel (Fig. 5) for receiving the bottom edge of the respective one of the side frame plates 41, 42, said frame plates having pins 45 fitting in slots cut into the walls of said channel for properly locating the paper feed unit on the machine. Manually operable plungers 46 mounted in said channel portion cooperate with openings in the side frame plates to lock the unit in its proper location. A pivoted retainer strip 47 disposed to overlie the heads of the plungers 46, holds the plungers in effective locking position. The supporting means just described enables the unit to be readily mounted on the tabulator, in place of the conventional continuous sheet feeding mechanism of the type disclosed in said aforementioned patent.

The individual sheets to be fed are supported on a feed table consisting in part of a plate 51 extending between and suitably secured to the side wall frame plates 41, 42. An upright plate 52 also extending between and secured to the side frame plates 41, 42, constitutes the front wall of the loading magazine and is disposed to abut the leading edges of the sheets stacked on the feed table 51. The sheets are maintained in stack formation by adjustably positioned plates 53, 54 constituting the side walls of the loading magazine and upright plates 55 constituting the rear wall of the magazine. The side wall plates on the magazine are each provided with collars 56 slide fitted on a supporting rod 57 carried in slotted brackets 58 secured to each of the side frame plates 41, 42 respectively of the unit. Set screws 59 threaded into each of the collars 56 enable each of the side wall plates 53, 54 of the magazine to be adjustably positioned laterally with respect to the feed table 51 so as to accommodate sheets of various widths and also to vary laterally the relative location of a sheet of given width with respect to the feed table 51. The rear wall members 55 of the magazine comprise one face of an angular plate the other face of which carries a pair of studs 61 disposed to ride in a slot formed in the rearwardly extending arm of each of the side frame plates 53, 54. One of each pair of studs 61 is threaded to receive a locking nut 62 so as to enable front to rear adjustment of each rear wall member 55 relative to the feed table 51. From the foregoing it will be apparent that by lateral adjustment of the side wall members 53, 54 and rearward adjustment of the rear wall members 55, all of which wall members rest on the feed table 51, sheets of any width or of any length will be positively maintained in stack formation with the leading edges thereof abutting against the front wall member 62.

Disposed forwardly of the plate 51 is a laterally extending row of individual vacuum chambers, each of said individual chambers comprising a top plate 63, the forward

portion of which is bent downwardly in an arc and provided with slotted ports 64, a curved bottom plate 65 and side wall enclosures 66, see also Fig. 2. Said individual vacuum chambers are suitably secured to a transversely extending frame rib 67 with the flat portion of the top plate 63 lying flush with the plate 51 so as to constitute a forward extension of the feed table. The plates 63, 65, 66 together with the rib 67 provide a sealed in enclosure by means of which the vacuum may be drawn through the ports 64. The rib 67 is provided with openings 68 entering into each individual vacuum chamber and communicating with a rectangular manifold 71 which is suitably secured to the rear of the rib 67 by bolts 72. Secured to the manifold is a vacuum exhaust tube 73 detachably connected to an exhaust hose 74 by a suitable coupling 75. The other end of the hose 74 is connected to the intake of a vacuum pump, not shown herein, which is preferably located in the base of the machine and driven by the driving motor of the tabulator so as to provide a source of constant vacuum for the manifold 68 and each individual vacuum chamber which may be set in operative condition. It will be seen (Figs. 7 and 8) that a vacuum applied in the above mentioned manner through the individual vacuum chambers will be effective for drawing the leading edge of the lowermost sheet in the magazine, which leading edge projects forwardly of the flat horizontal portion of the feed table, downwardly around the arcuate portion of the vacuum chamber and over the ports 64 and thereby sealing off the vacuum from the remaining sheets in the stack. The sheet thus separated from the stack is subsequently fed out of the magazine in a manner hereinafter to be described, whereupon the trailing edge of such sheet (Fig. 7) when traversing the arcuate portion of the vacuum chamber gradually opens up the ports 64 so as to apply the vacuum to the next lower sheet in the stack. It will be noted that the front wall member 52, at the bottom portion thereof, is in the form of laterally spaced extensions which curve rearwardly in an arc which is substantially concentric to the forward edge of the horizontal feed table. In this manner the leading edge of the lowermost sheet when being drawn down about the ports 64 maintains abutting relation with the front wall of the magazine thereby preventing the vacuum from drawing upon other sheets in the stack. It will also be noted Fig. 1 that the bottom edge of the side wall members 53, 54 of the magazine are shaped to conform to the outline of the vacuum chambers so as to substantially seal the vacuum within the magazine.

When feeding sheets having a width less than that of the feed table, one or more of the individual vacuum chambers will be disposed in the area outside of that defined by the loading magazine. In order to prevent leakage of the vacuum through such externally disposed vacuum chambers means are provided to cut off each individual vacuum chamber from the manifold 71, which means comprises a shutter valve 77 (Figs. 1 and 2) disposed within each individual vacuum chamber and carried on the end of a manually rotatable valve stem 78. Said valve stem is journaled in the frame rib 67 and may be rotated to swing the valve 77 to a position closing off the port 68 when it is desired to disable the individual vacuum chamber. In order to control the amount of vacuum applied to the vacuum chambers, as required for different stages of the feeding operation, a butterfly valve 81 is provided in the exhaust tube 73, the stem 82 carrying a rock arm 83 pivotally connected to the armature 84 of a vacuum control solenoid 85 by a link 86. Energization of the solenoid in a manner hereinafter more fully described occurs at the time the separated sheet starts to feed out of the magazine and is effective for rotating the valve 81 to decrease the amount of vacuum at this time so as to lessen the drag on the sheet as it is feeding out of the magazine.

The lowermost sheet separated from the stack in the manner above described is started out of the magazine

at a predetermined time in the feeding cycle by means of feed rolls 87, each operatively associated with an opposed roller 88. As can be seen also in Figs. 5 and 6, the rolls 87 are secured fast at spaced intervals intermediate the individual vacuum chambers on a feed roll shaft 90. As best seen in Fig. 4, the left hand end of shaft 90 carries a gear 91 meshing with an idler 92 suitably journaled in the left hand frame plate 41, which idler is driven by a gear 93 mounted on the squared shaft 28. As heretofore mentioned, the shaft 28 is the means by which the platen 17 is driven. The gearing just described is of such ratio as to drive the feed rolls 87 at substantially the same rate as the platen. The cooperating feed rollers 88 are pivotally carried between the double bent over wall portions of individual rock arms 94 mounted on a rock shaft 95. Said rock shaft is suitably journaled in the left and right hand frame plates 41, 42, the right hand end of said shaft 95 extending beyond the frame plate 42, as best seen in Fig. 3, having a rock lever 96 clamped thereto. Said rock lever 96 is pivoted to one of a pair of toggle links 97, the other link of the pair being pivoted to the frame plate 42. The knuckle joint of said toggle is pivotally connected by a link 98 with the armature 99 of a solenoid 100 which is suitably secured to the right hand frame plate 42 of the unit. Energization of the solenoid at the proper predetermined time in the feeding cycle operates through said linkage to rock the shaft 95 in a clockwise direction as viewed in Fig. 3, said shaft being restored upon deenergization of the solenoid by a restoring spring 101 connected to the link 97. As can be best seen in Fig. 14, a thrust arm 102 is fitted between the wall portions of each rock arm 94, said thrust arm being notched to closely fit the key 103 of the shaft 95 while the rock arm 94 has an oversize notch fitted to said key. A spring 104 supported by a pin 105 projecting from the bridging portion of the double walled rock arm 94 receives the thrust on the arm 102 so as to provide a yielding effect for the rollers 88 as the shaft 95 is rocked clockwise by energization of the solenoid 100. The rollers 88 are disposed between the projecting portion 76 of the front magazine wall plate 52 so that upon energization of the solenoid 100 they contact the sheet wrapped around the arcuate portion of the vacuum chamber and press against the associated roller 87 so as to thereby withdraw said sheets from the magazine in accordance with the amount of drive imparted to the rolls 87, which withdrawal it will be understood is in step with the rotation of the platen 17. The radius of the feed rolls 87 is slightly less than that of the arcuate portion of the vacuum chamber plate 63 so that rotation of the rolls 87 is ineffective for withdrawing the sheet when the roller 88 is in its restored position as shown in Fig. 1, but is effective only when the roller 88 is rocked to actuated position in contact therewith by rocking of the shaft 95.

From the magazine the leading edge of the sheet is fed into a passageway defined by a front guide plate 111 and a rear guide plate 112. Said guide plates are suitably secured to the side wall frame plates 41, 42, the front plate extending substantially from the feed roll 87 to the platen 17, the rear plate 112 terminating at a point about midway between said roll and said platen. The bottom portion of the plate 112 is cut away at spaced intervals to accommodate feed rolls 113 cooperating with rollers 114, said feed rolls 113 being disposed in vertical alignment with the feed rolls 87 and mounted on a feed roll shaft 115 journaled in the side wall frame plates 41, 42. The rollers 114 lie in openings cut out of the front guide plate 111 and are pivotally carried in arms 116 pivoted to brackets 117 secured to the front guide 111, said arms being spring urged to hold each roller 114 in constant engagement with the corresponding roll 113.

Disposed for engagement by the leading edge of the sheet at a point just in advance of the feed roll 113 are a plurality of sheet sensing fingers 118 carried by a rock shaft 120. Said shaft is journaled in side frame plates 41, 42,

the left hand end of the shaft, as best seen in Fig. 4, projecting beyond the plate 41 carrying a rock arm 121 clamped thereto. Said rock arm is disposed to engage one of the pair of arms 122 of a micro-switch 123 suitably secured to the left hand frame plate 41. The arrangement is such that the sheet bearing on the sensing fingers 118 operates to rock the shaft 120 clockwise against tension of a spring 124, which clockwise movement opens the contacts of the switch 123. Said switch, as hereinafter more fully described, is connected in the circuit for the solenoid 100 so that the opening of the switch contacts operate to deenergize the solenoid 100 to restore the feed rollers 88 to their non-actuated position as shown in Fig. 1 whereupon the feed rolls 113 and spring rollers 114 become the sole feeding means for continuing the advance of the sheet through said passageway and out of the loading magazine.

The lower portion of the sheet passageway is defined in part, at the rear thereof, by a flapper 125 extending across the unit and supported at each end in the arms of bell cranks 126 which are pivoted to the left and right hand frame plates 41, 42, respectively. Springs 127 stretch between each of said bell cranks and the frame plates yieldably maintain the flapper in normal spaced relation to the front guide plate 111 but permit said flapper to yieldably open to allow for a loop to be formed in the sheet being fed according to the manner of operation as will hereinafter be more fully described. The extreme bottom portion of the passageway is defined at the rear thereof by a plate 128 formed with double reverse bends and suitably secured to the side frames 41, 42. The forwardmost face of said plate lies in suitably spaced relation to the front guide plate 111 thereby constituting the lower portion of the passageway.

Disposed near the lower end of the feed passageway is an additional feed roll shaft 130 suitably journaled in the side frame plates 41, 42 and carrying a series of feed rolls 131 lying in cutaway portions of the rear guide plate 128. An additional bearing 132 (Fig. 1) is provided for the shaft near its midpoint to prevent any possible whipping action, said bearing being secured to the guide plate 128. Cooperating with each feed roll 131 is a pressure roller 133 lying in cutaway portions of the front guide plate 111 and carried by a bent over double wall rock arm 134, pivotally mounted on brackets 135 secured to the front guide plate 111. Secured to the bridging portion of each rock arm 134 is a leaf spring 136 disposed for engagement by the bent under flange 137 secured to a squared rock shaft 140. The left hand end of said shaft 140, as best seen in Fig. 3, has secured thereon a rock arm 141 pivotally connected by link 142 with the armature 143 of a pressure roll control solenoid 144, suitably secured to the upper portion of the right hand frame plate 42. As hereinafter more fully explained, said solenoid is energized at predetermined times in the feeding cycle to rock the shaft 140 in a clockwise direction so as to increase, through spring 136, the pressure of the rollers 133 against the rolls 131.

The feed roll shafts 115 and 130 are driven by a belt 145 from the shaft 90, as best seen in Fig. 3. The right hand end of shaft 90 carries a pulley 146, and the right hand end of feed roll shafts 115 and 130 carry pulleys 147, 148 respectively, in which pulleys said belt rides. Rollers 149 carried in brackets adjustably secured to the frame plate 42 enable tension on the belt 145 to be properly maintained. It will be understood that the driving ratio between the pulleys is such as to give the feed rolls 113 and 131 a surface velocity which is substantially equal to that of the feed rolls 87 and also of the platen 17.

The feed rolls 131 and rollers 133 cooperate to advance the sheet to a registration station which station is that point in sheet travel wherein the leading edge of the sheet abuts against a rockable stop 151 which is disposed to block off the lower end of the passageway defined by the plates 111, 128. Said stop 151 is carried by a rectangular rock shaft

152 suitably journaled in the side frame plates 41 and 42, and operates to block the feeding of the sheet until a predetermined time in the feeding cycle when the shaft 152 is rocked to open the passageway thereby enabling the sheet to reach the printing platen 17 at the precise point in the feeding cycle required to bring the desired first print line of said sheet into printing alignment with the type firing pins 15 at the completion of the feeding cycle. The stop 151 is opened substantially simultaneous with the energization of the solenoid 144 so that the increased pressure on the pressure rolls 133 will be provided by the time the stop 151 has fully opened. The pressure on the rolls 133 is adjusted so that when the solenoid 144 is not energized, there is sufficient spring tension to feed the sheet to the stop but insufficient tension to prevent slipping or skidding of the rolls 133 when the sheet is held in its position of registration by the closed stop 151. In this manner, buckling or damage to the leading edge of the sheet is avoided. Energization of the solenoid 144 as the stop 151 opens prevents continued skidding by the rollers 133 thereby enabling release of the sheet from the registration station without slippage and at the precise moment that the stop 151 is opened. Said solenoid 144 and said stop 151 are controlled through means which includes a cam actuated bell crank 153, as best seen in Fig. 4, pivotally carried by the left hand frame plate 41. One arm of said bell crank carries a bent over ear disposed for engaging the switch arm 154 of a microswitch 155 which switch, as hereinafter more fully described, is in the circuit for said solenoid 144 and is effective for closing said circuit upon the counterclockwise rocking of said bell crank 153. The other arm of said bell crank 153 is formed with a projecting shoulder disposed in the bearing engagement with a rock arm 156 pivoted to the left hand frame plate 41. An additional rock arm 157 is formed with an ear overlying the front edge of the arm 156 and is pivotally joined to a rock arm 158 which is clamped fast to the left hand end of the rectangular stop shaft 152. Upon the counterclockwise rocking of the bell crank 153 the arms 156, 157 operate as a toggle to rock the arm 158 and shaft 152 counterclockwise, as viewed in Fig. 4, or clockwise, as viewed in Fig. 1, so as to swing the stop 151 to its open position at the same time that the increased pressure is applied to the roller 133 by the simultaneous energization of the solenoid 144. The bell crank 153 is actuated by means of a Bowden wire 161 one end of which is supported in bearing engagement with a shoulder of the bell crank by means of a bracket 162 secured to the side frame plate 41. The other end of said Bowden wire is supported in a bracket 163 secured to the paper carriage mounting rail 22, said other end of the Bowden wire being disposed in bearing relation to one end of a follower lever 164 pivotally carried by said bracket 163. A cam 165 formed as shown in Fig. 11 carried by the compensating drum of the sheet feed drive mechanism, heretofore described, is disposed in cooperative relation with a roller 166 mounted on the other end of said follower lever 164. Said cam, as seen also in Fig. 6, for adjustment purposes is in the form of a ring and is held firm between two clamping discs 167 on bolts 168 which carry a spacing collar 169 and are suitably mounted on a supporting disc 171 which is secured fast on said compensating drum of the drive mechanism. As heretofore mentioned, said drum makes one complete revolution for each sheet fed, each complete revolution of said drum starting from the home position thereof constituting one feed cycle. Accordingly, at a predetermined point of each feeding cycle the cam 165 will be effective for causing the actuation of the solenoid 144 and opening the stop 151 for releasing a sheet from its registration station to the platen 17.

An additional cam 175, see also Figs. 1 and 12, is also adjustably carried between clamping discs 167 supported on the bolts 168 of the compensating drum of the paper feed drive mechanism. Said cam 175 cooperates with a

roller 176 carried by the contact arm 177 of a micro-switch 180, said switch being suitably secured to the paper carriage mounting rail 22. The short rise of the cam 175 is effective at a predetermined point in the feeding cycle to momentarily close the contacts of the switch 180 thereby establishing a circuit for the solenoid 100 which, as heretofore described, when energized operates to rock the feed rollers 88 into active feeding position against the feed rolls 87.

The cam 165, 175 may be adjusted in a number of different ways depending upon the length of the forms being fed, the position on the form at which the first printing line is desired and the size of the compensating gear 32 which is employed. The setting of cam 165 which controls the opening of the card stop 151 determines the position on the form or sheet at which first printing line will occur. For example, if it were desired to start printing on each form at the first printing line thereof, the cam 165 would be adjusted to open the card stop 151 at that point in the feeding cycle whereat the remainder of the feeding cycle, which includes the compensating feed stroke, would advance the sheet just to the position where the first print line thereof would align with the type firing pins 15. If it were desired to have the printing of each sheet start below the first print line then the cam 165 would be adjusted to open the card stop 151 earlier in the feeding cycle so that the sheet would be further advanced by the completion of the feeding cycle. The cam 175 is adjusted so as to start the withdrawal of a sheet from the loading magazine at such time in the feeding cycle as to cause the sheet so withdrawn to reach the card stop 151 when in closed position. The adjustment thereof depends in part upon the relation between the length of the forms being fed and the size of the compensating gear 32. For example, when feeding forms eleven inches long a compensating gear 32, sufficient in size to cause a slightly longer travel than eleven inches, i. e., a thirteen inch compensating gear, would be employed. Under such circumstances a two inch gap would result between successive forms feeding to the platen 17. However, the holding of the preceding sheet in the registration station against the stop 151 results in the succeeding sheet closing down said two inch gap during the period that the preceding sheet is being thus held. It will of course be understood that one reason for holding the sheet at the registration station is to effect accurate registration thereof by enabling correction of any skewing or skipping of the sheet during its travel to said registration station. Accordingly, cam 175 is adjusted to rock the feed rollers 88 to active position at such time as to hold a sheet at the registration station a sufficient period for effecting accurate registration but not of such a duration as will result in overrunning of the sheet at the registration station by the sheet which succeeds it.

The leading edge of each sheet released from the registration station is guided to the platen by a light leaf spring 181 secured to the bottom of the rear passage guide 128 and which directs the sheet between the platen 17 and the rear most one of a pair of pressure rolls 182. The sheets are held firmly against the platen by action of said pressure rolls 182 in cooperation with a lower paper guide 183, the forward end of which is overlapped by an upper paper guide 184. An additional pressure roller 185 maintains the sheet in firm engagement with the platen after passing printing position. It will, of course, be understood that there are a plurality of pressure rollers 182 and guides 183 arranged in spaced intervals in a row extending longitudinally of the platen so as to properly engage sheets of various widths, and that the upper guides 184 and pressure rolls 185 are arranged in pairs which may be slidably adjusted longitudinally of the platen so as to cooperate with the side edges of a sheet regardless of its lateral disposition relative to the platen.

The sheets are fed from the platen through a passage defined by an arcuate shield 186 and guide strip 187,

which shield and strip extend between and are suitably secured to the side frame plates 41, 42 of the unit.

The sheets are withdrawn from the platen and ejected by means of a plurality of paired belts 190, 191 which are disposed at spaced intervals between the side frame plates 41, 42, see also Figs. 5 and 6, and which frictionally engage each sheet as delivered from between the shield 186 and strip 187. The belt 190 is the driving belt and is reached about rows 192, 193, and a driving roll 194 mounted on a belt drive shaft 195. The rolls 192, 193 and shaft 195 are suitably journaled in the side frame plates 41, 42, the shaft 195 at its right hand end, see Fig. 3, having mounted thereon a drive pulley 196. A drive belt 197 reached about the pulley 196 and a pulley 198 on the feed roll shaft 90 drives the shaft 195 in step with the feed roll shaft. For adjusting the tension of the belt 190, idler pulleys 201 freely mounted on a cross rod 202 are provided for each belt, said cross rod being adjustably secured in slotted portions of the side frame plates 41, 42. Each belt 191 is reached about rolls 203, 204 and pulleys 205 freely mounted on a cross rod 206. Said rolls 203, 204 and rod 206 are suitably carried by the side frame plates 41, 42, the roll 204 being adjustably supported in a slotted portion of the frame plates to enable proper adjustment of the tension of the belt 191. Said belts, which are driven in step with rotation of the platen, eject the sheets onto a sheet receiver member which may be of any desired form depending upon the size of the sheets being fed and which in the present instance is shown as a tray 207 disposed with a slight forward incline and being supported at its rear end on brackets 208 slidably mounted on a cross rod 209. It will, of course, be understood that a receiver in the form of a magazine could readily be substituted in place of the tray 207 in the event it were desired to have the sheets or cards fed by the mechanism arranged in accurately stacked relation.

The wiring diagram, see Fig. 10, illustrates the manner in which the various control solenoids heretofore mentioned are timed to operate under control of the cams 165, 175. A suitable source of alternating current is supplied to the leads 210, 211. A power pack which may be disposed at any convenient location in the machine and comprising a transformer 212, full wave rectifier 213 and filter capacitor 214 provides a constant source of direct current on leads 215, 216. Said leads 215, 216 run to the solenoid 144 which, as heretofore described, when energized is effective for increasing the pressure on the pressure rollers 133, the lead 215 containing the contacts 155a of the micro-switch 155 which are closed at the proper time in the feeding cycle by bell crank 153 under control of the cam 165. Arc suppression means comprising a resistor 217 in series with a capacitor 218 and connected across the contacts 155a is provided to eliminate arcing at said contacts. By these means it will be seen that at a predetermined time in each feeding cycle and simultaneously with the opening of the stops 151 which are also under control of the cam 165, which time depends upon the desired line space whereat the first print line is to occur, the solenoid 144 will be energized to increase the pressure on the rolls 133. Direct current is employed for the solenoid 144 in order to provide uniformity in the time interval at which said solenoid reaches peak efficiency after the closure of the contacts 155a.

The circuits for the solenoid 100, which are under control of the cam 175, include three relays 220, 221, and 222, mounted as seen in Fig. 4 on the left hand frame plate 41, the relay 220 having single normally closed contact 220a, the relays 221, 222 being holding relays for solenoid 100 each having normally open double contacts 221a, 221b, 222a, and 222b, respectively. At the proper predetermined time in the feeding cycle, somewhat in advance of the closure of contacts 155a by cam 165, the cam 175 operates to momentarily close contacts 180a of the micro-switch 180 to establish a circuit from A. C.

conductor 210 through lead 223, contacts 180a, lead 224, contacts 220a of relay 220, lead 225, through the coil of relay 221 and the A. C. conductor 211. The closure of contacts 221a, 221b completes a holding circuit for solenoid 100 from conductor 210 over leads 226, 227, to lead 228 through the coil at the solenoid 100, and lead 229 to the conductor 211. At the same time a locking circuit is completed for relay 221 running from conductor 210, lead 226, contact 221a, leads 230, 224, contact 220a, lead 225 through the coil of relay 221 to conductor 211. The closure of said contacts 221a, 221b, also sets up a parallel circuit which runs from the lead 227 through lead 231, contacts 123a, when closed, of microswitch 123, which as heretofore described are controlled by the sensing fingers 118 and opened by passage of the sheet over said sensing fingers, to the contacts 232a of a reset button 232 which, as seen in Fig. 4, is mounted on the left frame plate 41. From the contacts 232a said parallel circuit is completed through leads 233, the coil of relay 222, to the conductor 211.

The closure of contacts 222a, 222b upon energization of the relay 222, completes an independent holding circuit for the solenoid 100 which runs from conductor 210, contacts 222b, 222a, lead 228, the solenoid 100 and lead 229 to the conductor 211. The closure of contacts 222a, 222b also completes a parallel circuit for energizing relay 220, which parallel circuit runs from the conductor 210, contacts 222b, lead 234, through the coil of relay 220 and to the conductor 211 thus energizing relay 220 to open the locking circuit for relay 221. It will be seen that the circuit to the coil of relay 222 establishes a separate holding circuit for the solenoid 100 and is effective for breaking the first mentioned holding circuit to solenoid 100 established through the contacts of relay 221 while maintaining the independent holding circuit to the solenoid as long as the contacts 123a and 232a remain closed. The reset button 232 is provided to permit manual opening of the circuit to solenoid 100 which is normally necessary when starting the first sheet through the feed mechanism. This function of opening said circuit to solenoid 100 is normally, during the operation of the machine, accomplished by the contacts 123a under the control of the sensing fingers 118, but since, when starting the feed of the first sheet, there is no sheet in position for engaging said sensing fingers, the manually operable reset button 232 is thereby provided. The provision of separate holding circuits for solenoid 100, through the contacts of relays 221 and 222 respectively, permits wide flexibility in adjusting the timing of the mechanism for sheets of various sizes and for various first print line positions thereon since the holding circuit for solenoid 100 through contacts of relay 221 gives assurance that sheet withdrawal will always be started at the proper time of a feeding cycle regardless of whether or not the preceding sheet at that time of the cycle has cleared the sensing fingers so as to close contacts 123a as is required for establishing the other holding circuit for solenoid 100.

The solenoid 85 which, as heretofore mentioned, regulates the amount of vacuum applied to the individual vacuum chambers, is in a circuit parallel to that for solenoid 100, said vacuum regulating solenoid being connected to the leads 228, 229. In this manner it will be seen that whenever the solenoid 100 is energized to throw the rollers 88 into active feeding position, the solenoid 85 will be effective for reducing the vacuum in the vacuum chambers thereby lessening the drag on the sheet being fed. When the solenoid 100 is de-energized, the concurrent de-energization of solenoid 85 enables the opening up of the vacuum supply control valve 81 so as to create the maximum vacuum at that time for separating the lowermost sheet from the remainder of the stack in the manner hereinbefore described.

Figs. 7 and 8 illustrate diagrammatically the location of sheets in the feeding mechanism for two typical applications of the invention.

Fig. 7 illustrates the manner in which relatively long sheets such as standard letter size sheets having the length of eleven inches are fed through the mechanism, while Fig. 8 illustrates how relatively shorter sheets such as the standard tabulating card having the length of three and one quarter inches is fed through the mechanism. In each case the parts are shown in the position they assume when a sheet is in the registration station and at that point in the feeding cycle which is immediately prior to the time that the stops 151 open to release the sheet from the registration station to the platen 17. In the case of the eleven inch sheets, as shown in Fig. 7, it will be understood that a compensating gear 32, see Fig. 1, is employed which has a circumference equivalent to a feed of slightly more than eleven inches and in the present instance it is assumed that the compensating gear employed will result during one rotation thereof, in a feed of thirteen inches or in other words, seventy-eight line spaces. This relationship between the length of the sheet and the size of the compensating gear result in a two inch gap between succeeding sheets as they feed about the platen 17 and as they are withdrawn from the loading magazine.

It should also be understood that in each case the cams 165, 175 are so adjusted that the cam 175 will operate to energize solenoid 100 to start the withdrawal of a sheet from the magazine approximately 36° of the feeding cycle in advance of the time that cam 165 operates to open the stops 151 and release a sheet from the registration station. This adjustment results in each sheet being held by the stop for approximately one-tenth of the feeding cycle which period in the case of the eleven inch sheet 235 and thirteen inch compensating gear is equivalent to one and three-tenths inches of feed by the sheets preceding and succeeding the sheet in the registration station. In the case of the three and one-quarter inch sheet or card 236, as shown in Fig. 8, employing a five inch compensating gear, the one-tenth feeding cycle adjustment for registration purposes is the equivalent of one-half inch of feed by the cards 236 which precede and succeed the card at the registration station.

As shown in Fig. 7 the sheet 235a in printing position about platen 17 is approaching the last printing line thereof while the succeeding sheet 235b is held in the registration station against the stop 151. When the trailing edge of the sheet 235a about the platen 17 has reached a distance exactly two inches from the card stop 151, said stop will be opened by operation of cam 165 which will result in bringing said succeeding sheet into the desired first line printing position upon the completion of the feeding cycle. It will be noted that it makes no difference whether the stop 151 is opened during the course of a line space feed stroke or of a long compensating feed stroke, and whether it occurs during one or the other depends upon the length of the particular compensating feed stroke and also upon the relative line on each sheet on which it is desired to have the first printing occur. It will be noted that the eleven inch sheet is longer than the distance from the stop 151 to the feed rolls 113. Since rolls 113 and rollers 114 are under constant tension or pressure they continue to feed the trailing edge of the sheet while the leading edge is held by the stops 151 thus producing a loop in the sheet which is accommodated for by the yieldable flapper 125. When a sheet is in the registration station the rolls 131 and rollers 133 act only as skid rolls to properly register the sheet against the stops 151 since at this stage of the feeding cycle the solenoid 144 which operates the rock shaft 140 is de-energized to remove the maximum pressure on the rollers 133. Immediately upon opening of the stop 151, solenoid 144 is energized to rock the shaft 140 to the position as shown in Fig. 9 thereby applying maximum pressure to the rollers 133 so as to prevent any slippage on the sheet from the moment that the stops are open. As the trailing edge of the sheet 235b at the registration station is withdrawn from the loading magazine, the ports 64 of the

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vacuum chambers are gradually opened causing the now bottom sheet 235c of the stack to be gradually drawn about the arcuate portion of the vacuum chambers and over said ports 64. When the trailing edge of sheet 235b has reached a point two inches from the throat of the loading magazine, cam 175 will be effective for energizing the solenoid 100 causing the rollers 88 to swing to active position and thereby start the feeding of the lowermost sheet 235c then in the magazine. It will be noted that as the solenoid 100 is energized at a time when the preceding sheet in the registration station is still in position to rock the sensing fingers 118 to the position wherein the contacts 123a of the micro-switch 123 are open, although, as described previously in connection with the wiring diagram, the opening of the contacts 123a by action of the leading edge of the sheet being withdrawn from the magazine, operated to break the circuit to solenoid 100 so as to restore the rollers 88 to their inactive position. The establishment of a separate holding circuit for the solenoid 100 to be effective when contacts 123a are open is made possible by the locking circuit for relay 221 which runs from conductor 210 through contacts 221a, 221b leads 230, 224, contact 220a, lead 225 through the coil of relay 221 and to conductor 211. However, the moment the trailing edge of the sheet in the registration station passes the sensing fingers 118, contacts 123a close to complete the circuit heretofore described through relay 222 which operates to break the aforesaid locking circuit to relay 221 whereupon the second mentioned holding circuit is maintained to solenoid 100 only until the contacts 123a are again opened by action of the leading edge of the succeeding sheet striking the sensing fingers 118 to thereby restore the rollers 88 to their inactive position. By this arrangement, which requires that the contacts 123a be closed momentarily before the solenoid 100 can be de-energized to restore the rollers 88, assurance is provided that the necessary gap between succeeding sheets passing the sensing fingers 118 is present, otherwise, in the absence of such a gap resulting from any possible misfeed condition in the loading magazine, the continued withdrawal of succeeding sheets would be impossible thus indicating to an operator a misfeed condition and at the same time preventing jamming of a plurality of sheets within the feeding mechanism.

In setting up the mechanism for feeding the relatively shorter sheets or cards 236, as seen in Fig. 8, a smaller or five inch compensating gear 32 is preferably employed, although it should be understood that a compensating gear of larger size could be employed if desired. The larger the compensating gear is with relation to the length of the forms being fed merely results in a longer gap between succeeding sheets with consequent higher velocity in the speed of feed during the compensating feed stroke. The use of a five inch compensating gear with the sheets or card 236, shown in Fig. 8, will result in a gap of one and three-quarter inches between the cards as they feed about the platen 17 and as they are withdrawn from the throat of the loading magazine. The principle of operation for feeding cards 236 is substantially identical with that described in connection with the longer form shown in Fig. 7. In the case of the shorter forms 236 it will be seen that when the card is about to leave the registration station, the preceding card reached about the platen 17 is substantially closer to the first or top printing line thereof than in the case of the longer sheets. The card 236 at the registration station is not as long as the distance from the stop 151 to the feed rollers 113 and therefore no loop is formed therein and the flapper 125 remains normal. The relatively shorter length of the cards 236 results in the card succeeding the card at the registration station being substantially withdrawn from the loading magazine. It will be noted that said succeeding card 236c is still in the grip of the rollers 88 and rolls 87 since the leading edge thereof has not yet actuated the sensing fingers 118. As soon as the leading edge of said succeed-

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ing card actuates the sensing fingers 118 the continued advance thereof will be effected by the rolls 113 and rollers 114 since the rollers 88 will be restored to their inactive position to enable the bottom most sheet or card 236 then in the magazine to be separated from the stack and drawn about the arcuate surface of the vacuum chambers. It will be noted that at this stage of the feeding operation which is just prior to the opening of the stop 151, the gap between the card and registration position and the succeeding card is somewhat less than the gap between said card in registration position and the card about the platen. This lessened gap is the result of the holding of each card by the stops 151 for approximately one-tenth of the feeding cycle to enable the proper registration thereof in the manner and for the reasons hereinbefore described.

From the foregoing it will be apparent that the mechanism operates to feed, at the relatively high operating speed of business machines, individual disconnected sheets which may be of a variety of sizes and which may be disposed laterally at any desired location with respect to the longitudinal axis of the platen of the machine; that each sheet so fed by the mechanism will be accurately registered within the feeding mechanism immediately prior to its delivery or release to the platen; that each sheet will be released from said registration position at the precise moment of the feeding cycle required to bring the desired first print line thereof into exact alignment with the type firing mechanism upon the completion of the feeding cycle; and that in the event a misfeed situation should develop in the course of operation as a result of abnormal conditions of the sheets, the means for withdrawing the sheets from the magazine will become inoperative to prevent jamming of the sheets and erroneous operation of the mechanism.

While there has herein been described what is believed to be a preferred embodiment of the invention, it will of course be recognized that the invention may readily be embodied in other forms without departing from the scope thereof, and it is therefore desired that the invention be not limited to the exact form herein shown and described and to nothing less than the whole of the invention as set forth in the following claims.

What we claim as new, and desire to secure by Letters Patent is:

1. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means operable each feeding cycle for withdrawing single sheets from a plurality thereof prearranged in stack formation, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, said withdrawing means advancing each sheet towards said operating station, means disposed adjacent said operating station for registering each sheet advanced thereto, said registering means being operable each feeding cycle for delivering each sheet when registered to said operating station, and means for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

2. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means for separating single sheets from a plurality thereof prearranged in stack formation, means operable each feeding cycle for advancing each

separated sheet toward said operating station, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, means disposed adjacent said operating station for registering each sheet advanced thereto, said registering means being operable each feeding cycle for delivering each sheet when registered to said operating station, and means for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

3. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means operable each feeding cycle for withdrawing single sheets from a plurality thereof prearranged in stack formation, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, said withdrawing means advancing each sheet toward said operating station, registering means disposed adjacent said operating station including a member operable for momentarily engaging and subsequently releasing the leading edge of a sheet advancing toward said operating station said registering means including feeding elements operable to feed and hold said leading edge in register against said member when said member is in sheet engaging position and to deliver each sheet from said registering means when said member is not in sheet engaging position, and means for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

4. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means for separating single sheets from a plurality thereof prearranged in stack formation, withdrawing means operable each feeding cycle for advancing each separated sheet toward said operating station, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, registering means disposed adjacent said operating station and including a member operable for momentarily engaging and subsequently releasing the leading edge of each sheet advancing to said operating station, said registering means including feeding elements operable to advance and maintain the leading edge of a sheet in engagement with said member when said member is in sheet engaging position and for delivering said sheet from said registering means when said member is in non-engaging position, and means for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

5. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding

sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means operable each feeding cycle for withdrawing single sheets from a plurality thereof prearranged in stack formation, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, said withdrawing means advancing each sheet toward said operating station, means disposed adjacent said operating station for registering each sheet advanced thereto, said registering means being operable each feeding cycle for delivering each sheet when registered to said operating station, means for timing the operation of said registering means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, and timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means, said last mentioned timing means including a sheet sensing member disposed for engagement by each sheet when advanced a predetermined extent by said withdrawing means, said sensing member when engaged controlling said withdrawing means to prevent the continued operation of said withdrawing means on each sheet when advanced to said predetermined extent and until said withdrawing means are again rendered operable for withdrawing a succeeding sheet in the succeeding feeding cycle under control of said last mentioned timing means.

6. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means for separating single sheets from a plurality thereof prearranged in stack formation, means operable each feeding cycle for advancing each separated sheet toward said operating station, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, means disposed adjacent said operating station for registering each sheet advanced thereto, said registering means being operable each feeding cycle for delivering each sheet when registered to said operating station, means for timing the operation of said registering means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, and timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means, said last mentioned timing means including a sheet sensing member disposed for engagement by each sheet when advanced by said withdrawing means a predetermined extent, said sensing member controlling said withdrawing means to prevent the continued operation of said withdrawing means on each sheet when advanced said predetermined extent and until said withdrawing means are rendered operable for withdrawing a succeeding sheet in the next feeding cycle under control of said last mentioned timing means.

7. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means operable each feeding cycle for withdrawing single sheets from a plurality thereof prearranged in stack formation, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, said withdrawing means advancing each sheet toward said operating station, registering means disposed adjacent said operating station including a member

operable for momentarily engaging and subsequently releasing the leading edge of the sheet advancing toward said operating station, said registering means including feeding elements operable to feed and hold said leading edge in register against said member when said member is in sheet engaging position and to deliver each sheet from said registration station when said member is not in sheet engaging position, means for timing the operation of said registering means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, and timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means, said last mentioned timing means including a sensing member disposed for engagement by each sheet when withdrawn a predetermined extent, said sensing member when engaged controlling said withdrawing means to render said withdrawing means inoperable for advancing each sheet after reaching said predetermined extent of advance and until said withdrawing means are again rendered operable for withdrawing a succeeding sheet in the succeeding feeding cycle under control of said last mentioned timing means.

8. In a machine of the class described operable through a succession of machine cycles, mechanism for feeding sheets of flexible material into accurately spaced relationship with respect to an operating station therefor and comprising in combination, means for separating single sheets from a plurality thereof prearranged in stack formation, withdrawing means operable each feeding cycle for advancing each separated sheet toward said operating station, each feeding cycle comprising one or more machine cycles during each of which may be imparted to said mechanism a short intra-sheet spacing feed stroke or a long inter-sheet compensating feed stroke, registering means disposed adjacent said operating station and including a member operable for momentarily engaging and subsequently releasing the leading edge of each sheet advancing to said operating station, said registering means including feeding elements operable to advance and maintain the leading edge of a sheet in engagement with said member when said member is in sheet engaging position and for delivering said sheet from said registering means when said member is in non-engaging position, means for timing the operation of said registering means to render said registering means effective for releasing each sheet at such time as will cause a desired portion thereof to reach said operating station at a predetermined point of the feeding cycle, and timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means, said last mentioned timing means including a sensing member disposed for engagement by each sheet when advanced by said withdrawing means a predetermined extent, said sensing member when engaged controlling said withdrawing means to render said withdrawing means inoperable for continuing the withdrawal of each sheet after advanced said predetermined extent and until said withdrawing means are rendered operable for withdrawing a succeeding sheet in the succeeding feeding cycle under control of said last mentioned timing means.

9. In a machine of the class described having a rotatable platen for supporting individual sheets of flexible material of various sizes in a plurality of line space positions, and platen driving means for rotating said platen in each feeding cycle an extent bearing a predetermined ratio to the length of said sheets, a magazine for supporting a plurality of said sheets in stack formation, sheet guide means for directing said sheets from said magazine toward said platen and including feeding members driven by said driving means in step with said platen for advancing each sheet through said guide means, means driven by said platen driving means in step with said platen and operable each feeding cycle for withdrawing single sheets

from said magazine, said withdrawing means advancing each single sheet into said guide means, means associated with said guide means and disposed adjacent said platen for registering each sheet fed thereto, said registering means being operable each feeding cycle for delivering each sheet when registered to said platen, and means adjustable in accordance with the length of said sheets for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired line space thereof to reach said platen at a predetermined point of the feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

10. In a machine of the class described having a rotatable platen for supporting individual sheets of flexible material of various sizes in a plurality of line space positions, and platen driving means for rotating said platen in each feeding cycle an extent bearing a predetermined ratio to the length of said sheets, a magazine for supporting a plurality of said sheets in stack formation, sheet guide means for directing said sheets from said magazine toward said platen and including feeding members driven by said driving means in step with said platen for advancing each sheet through said guide means, vacuum applying means within said magazine for separating one edge of a single sheet from said plurality of sheets in stack formation, means driven by said platen driving means in step with said platen and operable each feeding cycle for engaging said separated edge and advancing said edge into said guide means, means associated with said guide means and disposed adjacent said platen for registering each sheet fed thereto, said registering means being operable each feeding cycle for delivering each sheet when registered to said platen, and means adjustable in accordance with the length of said sheet for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired line space thereof to reach said platen at a predetermined point of the feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

11. In a machine of the class described having a rotatable platen for supporting individual sheets of flexible material of various sizes in a plurality of line space positions, and platen driving means for rotating said platen in each feeding cycle an extent bearing a predetermined ratio to the length of said sheets, a magazine for supporting a plurality of said sheets in stack formation, sheet guide means for directing said sheets from said magazine toward said platen and including feeding members driven by said driving means in step with said platen for advancing each sheet through said guide means, means driven by said platen driving means in step with said platen and operable each feeding cycle for withdrawing single sheets from said magazine, said withdrawing means advancing each single sheet into said guide means, sheet registering means cooperating with said guide means and disposed adjacent said platen including a member operable for momentarily engaging and subsequently releasing the leading edge of each sheet advancing toward said platen, said registering means including feeding elements operable to feed and hold said leading edge in register against said member when said member is in sheet engaging position and to deliver each sheet from said registering means when said member is not in sheet engaging position, and means adjustable in accordance with the length of said sheets for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired line space thereof to reach said platen at a predetermined point of a feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

12. In a machine of the class described having a rotat-

able platen for supporting individual sheets of flexible material of various sizes in a plurality of line space positions, and platen driving means for rotating said platen each feeding cycle an extent bearing a predetermined ratio to the length of said sheets, a magazine for supporting the plurality of said sheets in stack formation, sheet guiding means for directing said sheets from said magazine toward said platen and including feeding members driven by said driving means in step with said platen for advancing each sheet through said guiding means, vacuum applying means in said magazine for separating one edge of a single sheet from said plurality of said sheets in stack formation, means driven by said platen driving means in step with said platen and operable each feeding cycle for engaging said separated edge and advancing said single sheet into said guide means, sheet registering means cooperating with said guide means and disposed adjacent said platen including a member operable for momentarily engaging and subsequently releasing the leading edge of a sheet advancing toward said platen, said registering means including feeding elements operable to feed and hold said leading edge in register against said member when said member is in sheet engaging position and to deliver each sheet from said registering means when said member is not in sheet engaging position, and means adjustably settable in accordance with the length of said sheets for timing the operation of said registering means and said withdrawing means to render said registering means effective for releasing each sheet at such time as will cause a desired line space thereof to reach said platen at a predetermined point of the feeding cycle, said timing means controlling said withdrawing means to operate the latter for advancing each sheet to said registering means.

13. In a machine of the class described having a platen for supporting individual sheets of flexible material in a plurality of line space positions, means for driving said platen in each feeding cycle an extent bearing a predetermined ratio to the length of said sheet, and means for advancing said sheets individually and successively at spaced intervals toward said platen, said last mentioned means including guide means for directing each sheet into engaging relation with said platen, sheet registering means disposed adjacent to said platen and comprising means movable into and out of engaging position with respect to the leading edge of a sheet advancing through said guide means, said movable means being operated to engage with and subsequently release each sheet advanced thereto at a predetermined point of a feeding cycle, and sheet feeding members mounted for differentially gripping each sheet when in said registering means, said feeding members being operated to impositively advance each gripped sheet when said movable means is in sheet engaging position and to positively advance said gripped sheet when said movable means are not in sheet engaging position.

14. In a machine of the class described having a platen for supporting individual sheets of flexible material in a plurality of line space positions, means for driving said platen in each feeding cycle an extent bearing a predetermined ratio to the length of said sheets, and means for advancing said sheets individually and successively at spaced intervals toward said platen, said last mentioned means including guide means for directing each sheet into engageable relation with said platen, sheet registering means disposed adjacent to said platen and comprising a stop member movable into and out of engaging position with respect to the leading edge of a sheet advancing through said guide means, sheet feeding members driven by said driving means in step with said platen and disposed for gripping opposed faces of each sheet in said guiding means, yieldable means urging said feeding members into gripping engagement with said sheet, said yieldable means normally supplying sufficient tension on said feeding members for advancing the leading edge of a

gripped sheet against said stop member, said normal tension being insufficient for continuing the advancement of a gripped sheet while the leading edge engages said stop member, means operable through said yieldable means for increasing the tension on said feeding members, and means associated with said driving means for timing the operation of said stop member and said tension increasing means, said timing means rendering said stop member effective for engaging the leading edge of each sheet feeding through said guide means and subsequently moving to non-engaging position to release said sheet at a predetermined point of each feeding cycle, said timing means rendering said tension increasing means effective simultaneously with the movement of said stop member to non-engaging position and ineffective when said stop member is in sheet engaging position.

15. In a feeding mechanism of the class described for advancing sheets of flexible material singly and successively at spaced intervals from a plurality thereof prearranged in stack formation, sheet withdrawing means comprising a magazine for maintaining said plurality of sheets in stack formation, said magazine including a feed table having an arcuate portion aligning with the leading edge of said sheets, means for applying a vacuum through said arcuate portion of said feed table to said magazine, said vacuum applying means being effective for separating the leading edge of a single sheet from the adjacent sheet in said stack, rotatable feeding members for gripping the leading edge of a single sheet separated by said vacuum applying means one of said feeding members being disposed concentric with said arcuate portion of said feed table to engage with one face of said separated edge, the other one of said feeding members being disposed for engagement with the opposite face of said leading edge, means for moving said other feeding member into and out of operative relation with said one feeding member at predetermined points of a feeding cycle, said feeding members when in gripping relation advancing the gripped sheet out of said magazine, and means for regulating said vacuum applying means in accordance with the movement of said other feeding member, said regulating means decreasing the supply of vacuum to said magazine when said other feeding member is moved to gripping relation with said one feeding member.

16. In a feeding mechanism of the class described for advancing sheets of flexible material singly at successively spaced intervals from a plurality thereof prearranged in stack formation, sheet withdrawing means comprising a magazine for maintaining said plurality of sheets in stack formation, said magazine including a feed table having an arcuate portion aligning with the leading edge of said sheets, rotatable feeding members for gripping the leading edge of a single sheet, one of said feeding members being disposed concentric with said arcuate portion of said feed table to engage with one face of a single sheet, the other end of said feed members being disposed for engagement with the opposite face of said single sheet, means for moving said other feeding member into and out of operative relation with said one feeding member at predetermined points of a feeding cycle, a sheet sensing member disposed for engagement by each sheet when withdrawn by said feeding members a predetermined distance, and means controlled by said sensing member when engaged by a sheet for moving said other feeding member out of operative relation with said one feeding member.

17. In a feeding mechanism of the class described for advancing sheets of flexible material singly and successively at spaced intervals from a plurality thereof prearranged in stack formation, sheet withdrawing means comprising a magazine for maintaining said plurality of sheets in stack formation, said magazine including a feed table having an arcuate portion aligning with the leading edge of said sheets, means for applying a vacuum through said arcuate portion of said feed table to said magazine, said

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vacuum applying means being effective for separating the leading edge of a single sheet from the adjacent sheet in said stack, rotatable feeding members for gripping the edge of the single sheet separated by said vacuum applying means, one of said feeding members being disposed concentric with said arcuate portion of said feed table to engage with one face of separated edge, the other one of said feeding members being disposed for engagement with the opposite face of said leading edge, means for moving said other feeding member into operative relation with said one feeding member at a predetermined point of each feeding cycle, said feeding members when in gripping relation advancing the gripped sheet out of said magazine, a sheet sensing member disposed for engagement by each sheet when withdrawn by said feeding members a predetermined distance, and means controlled by said sheet sensing member when engaged by a sheet for moving said other feeding member out of operative relation with said one feeding member.

18. In a feeding mechanism of the class described for advancing variable size sheets of flexible material singly and successively at spaced intervals to an operating station therefore, sheet registering means disposed adjacent said operating station including a member operable for momentarily engaging and subsequently releasing the leading edge of each sheet advancing to said operating station, sheet feeding members disposed for gripping each sheet on opposite faces thereof and operable for advancing the leading edge of each sheet to said registering means, said feeding members being disposed a predetermined distance from said sheet engaging member, and means for guiding each sheet from said feeding members to said registering means and including guide members arranged in spaced apart relationship to define a passageway to said registering means, one of said members being yieldably maintained in normal guiding relation to the other said member, said one guiding member yieldably opening said passageway under the stress imparted thereto through each sheet by said feeding members when the leading edge of said sheet engages said stop member and when the length of said sheet is greater than said predetermined distance between said stop member and said feeding members.

19. In a feeding mechanism of the class described for advancing single sheets of flexible material successively at spaced intervals from a plurality thereof prearranged in stack formation, said mechanism including feeding members rendered active at a predetermined time of each feeding cycle for withdrawing a single sheet from said stack formation, and a sheet sensing member disposed for actuation by each sheet when withdrawn by said feeding members a predetermined distance, circuit means for controlling said feeding members comprising circuit breaking means operated by said sensing member when engaged by a sheet, a feed control member effective when energized for rendering said feeding members active, means including a first and second holding relay for maintaining said control member energized, said first holding relay also establishing through said circuit breaking means a circuit for said second holding relay, said second holding relay when energized also establishing a circuit effective for deenergizing said first holding relay, and means operable at a predetermined point of each feeding cycle for momentarily completing a circuit to said first holding relay.

20. In a feeding mechanism of the class described for advancing single sheets of flexible material successively at spaced intervals from a plurality thereof prearranged in stack formation, said mechanism including feeding mem-

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bers rendered active each feeding cycle for withdrawing a single sheet from said stack formation, a sheet sensing member disposed for actuation by each sheet when withdrawn by said feeding members a predetermined distance, and sheet registering means momentarily arresting and subsequently releasing a sheet each feeding cycle, said registering means including additional normally inoperative feeding members rendered positive upon the release of each sheet by said registering means, circuit means for controlling said feeding members comprising circuit breaking means operated by said sensing member when engaged by a sheet, a first control member effective when energized for rendering said first mentioned feeding members active, a second control member effective when energized for rendering said additional feeding members positive, means including a first and second holding relay operable for maintaining a circuit to said first mentioned control member, said first relay also establishing a circuit through said circuit breaking means to said second holding relay, said second holding relay establishing a circuit effective for opening the circuit for said first holding relay, means operable at a predetermined point of each feeding cycle for completing the circuit to said second control member, and means operable at a predetermined point of each feeding cycle for momentarily completing a circuit to said first holding relay.

21. In a feeding mechanism of the class described for advancing single sheets of flexible material at successively spaced intervals from a plurality thereof prearranged in stack formation, said mechanism including feeding members rendered active each feeding cycle for withdrawing a single sheet from said stack formation, and a sheet sensing member disposed for actuation by each sheet when withdrawn by said feeding members a predetermined distance, circuit means for controlling said feeding members comprising contacts opened by said sensing member when engaged by a sheet, a solenoid effective when energized for rendering said feeding members active, a relay having normally closed contacts, a first holding relay in a circuit including said normally closed contacts and having normally open contacts, a second holding relay in a circuit established through the contacts operated by said sheet sensing member and having normally open contacts, a current source, individual holding circuits established through the contacts of each of said holding relays through said solenoid, parallel circuits established through the contacts of said first holding relay including a locking circuit for said first holding relay and a circuit to said second holding relay, said parallel circuit to said second holding relay including the contacts operated by said sensing member, a parallel circuit established by the contacts of said second holding relay to said first mentioned relay, and means operated at a predetermined point of each feeding cycle for completing the circuit from said source through the contacts of said first mentioned relay to said first holding relay, said locking circuit through said first mentioned holding relay being broken upon the energization of said second holding relay, the circuit for said second holding relay being broken by opening of the contacts operated by said sensing member whereby said solenoid is deenergized to render said feeding members inactive upon the advance of a sheet said predetermined distance.

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