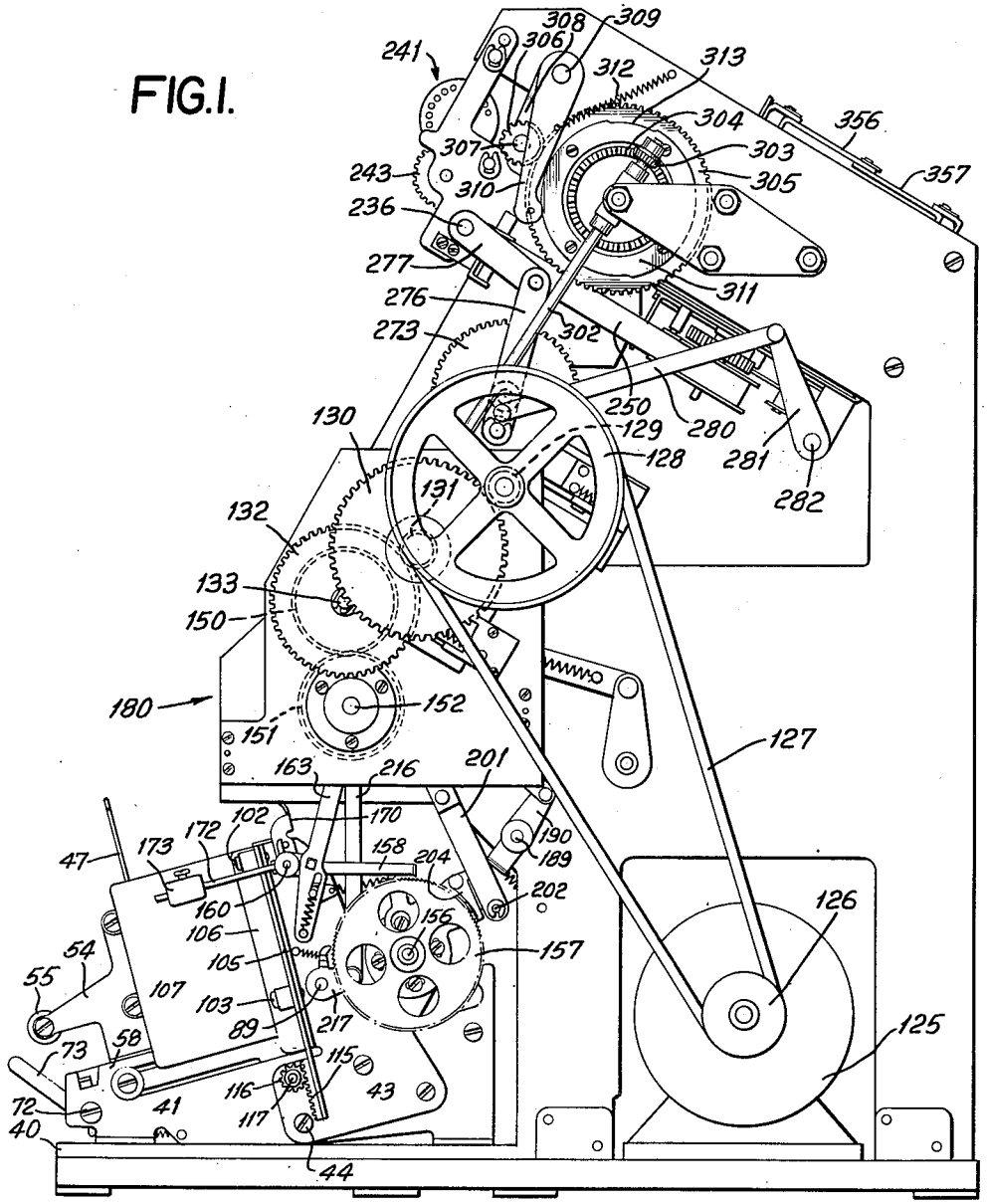
March 10, 1953 C. D. LAKE ET AL 2,631,037

SHEET FEEDING MACHINE

Filed Dec. 5, 1947 14 Sheets-Sheet 1

FIG. 1.



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SHEET FEEDING MACHINE

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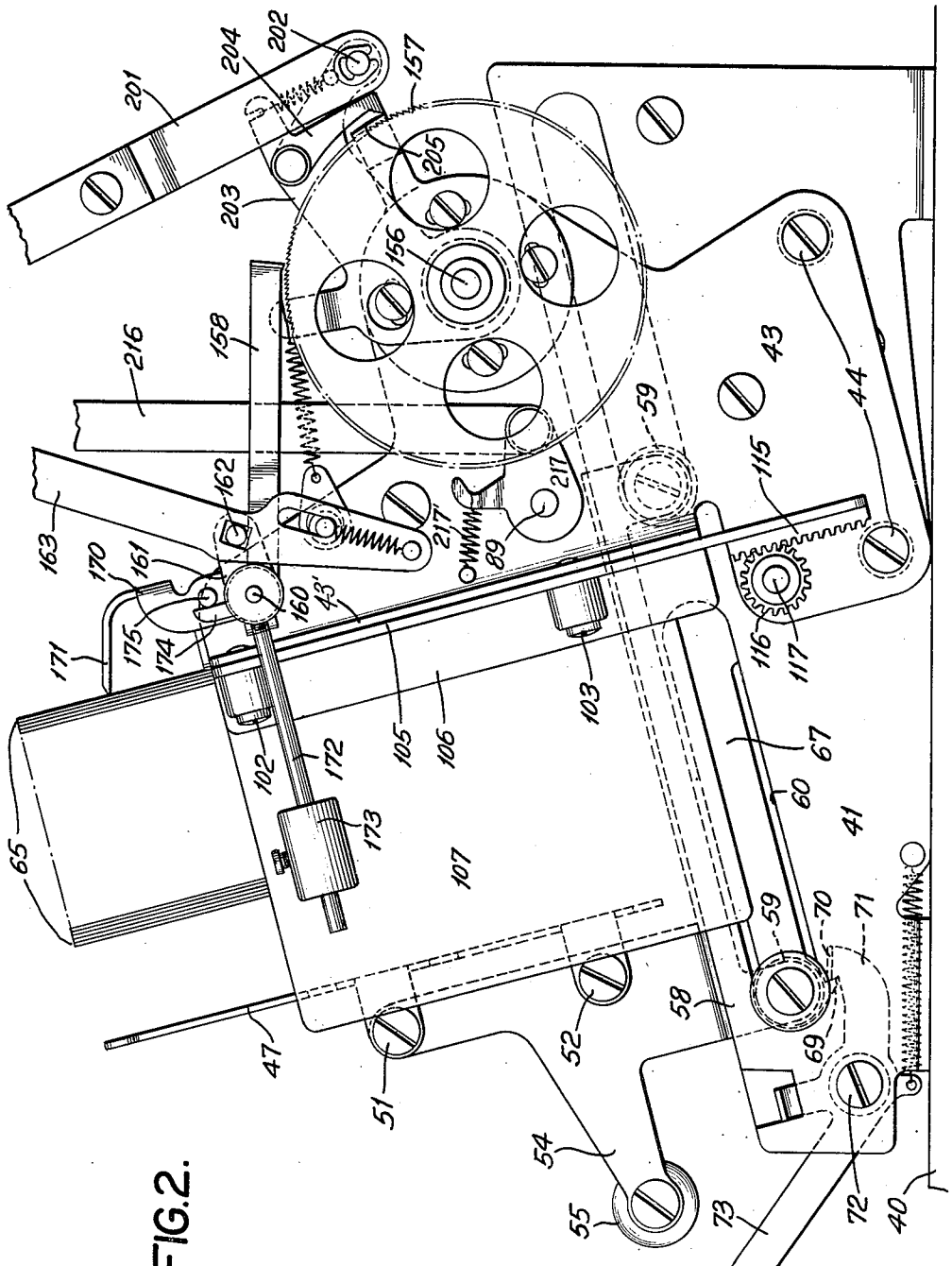


FIG. 2.

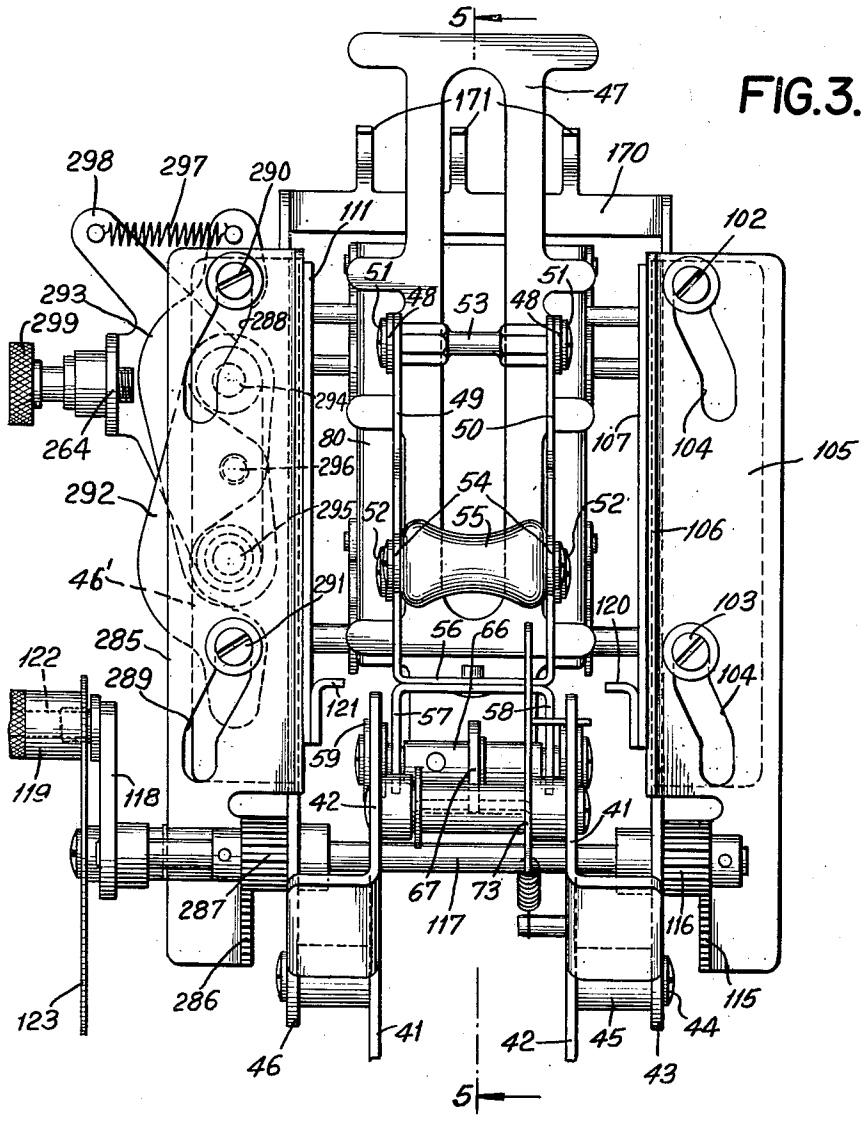
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SHEET FEEDING MACHINE

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FIG.3.



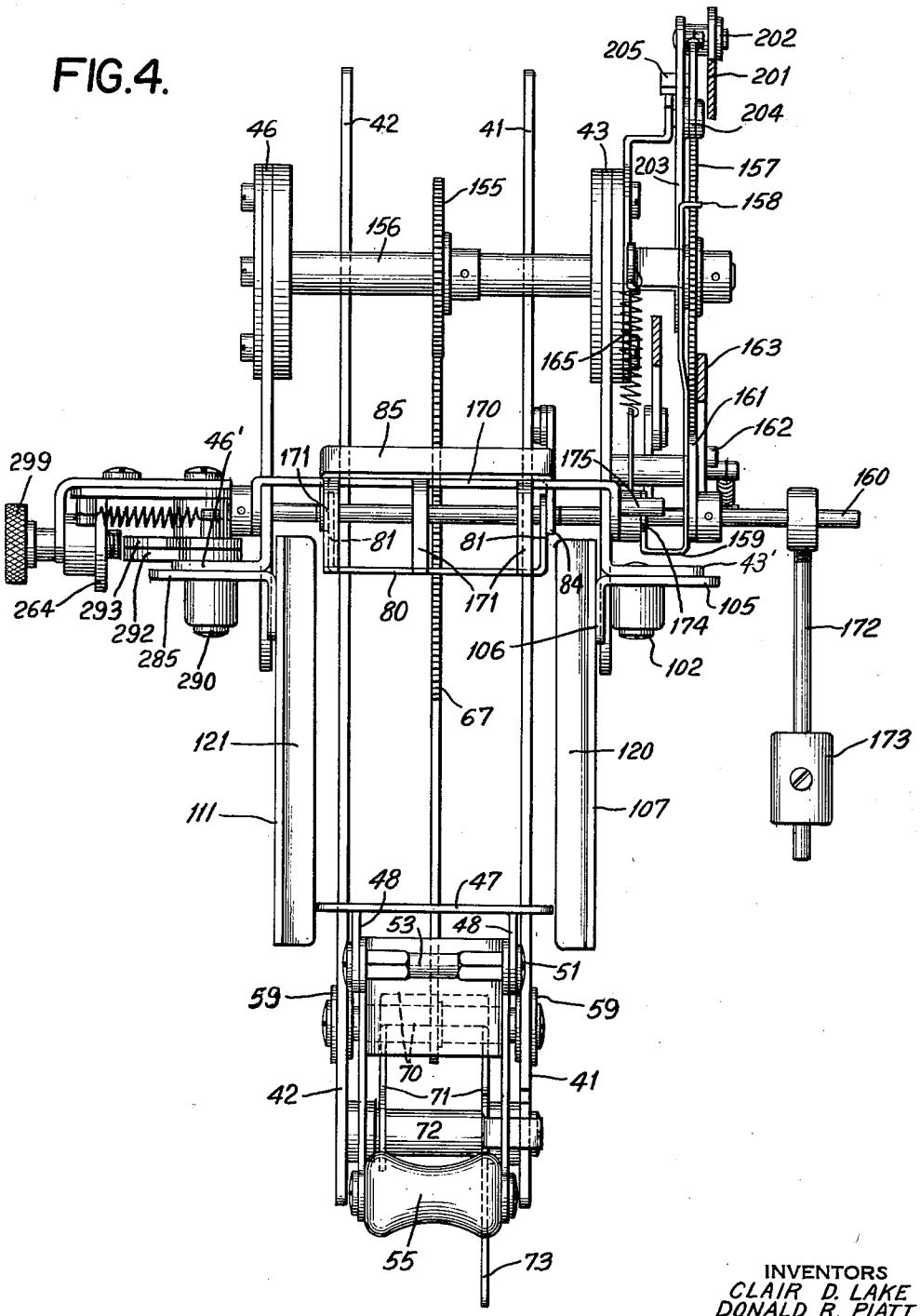
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SHEET FEEDING MACHINE

Filed Dec. 5, 1947 14 Sheets-Sheet 4

FIG.4.



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SHEET FEEDING MACHINE

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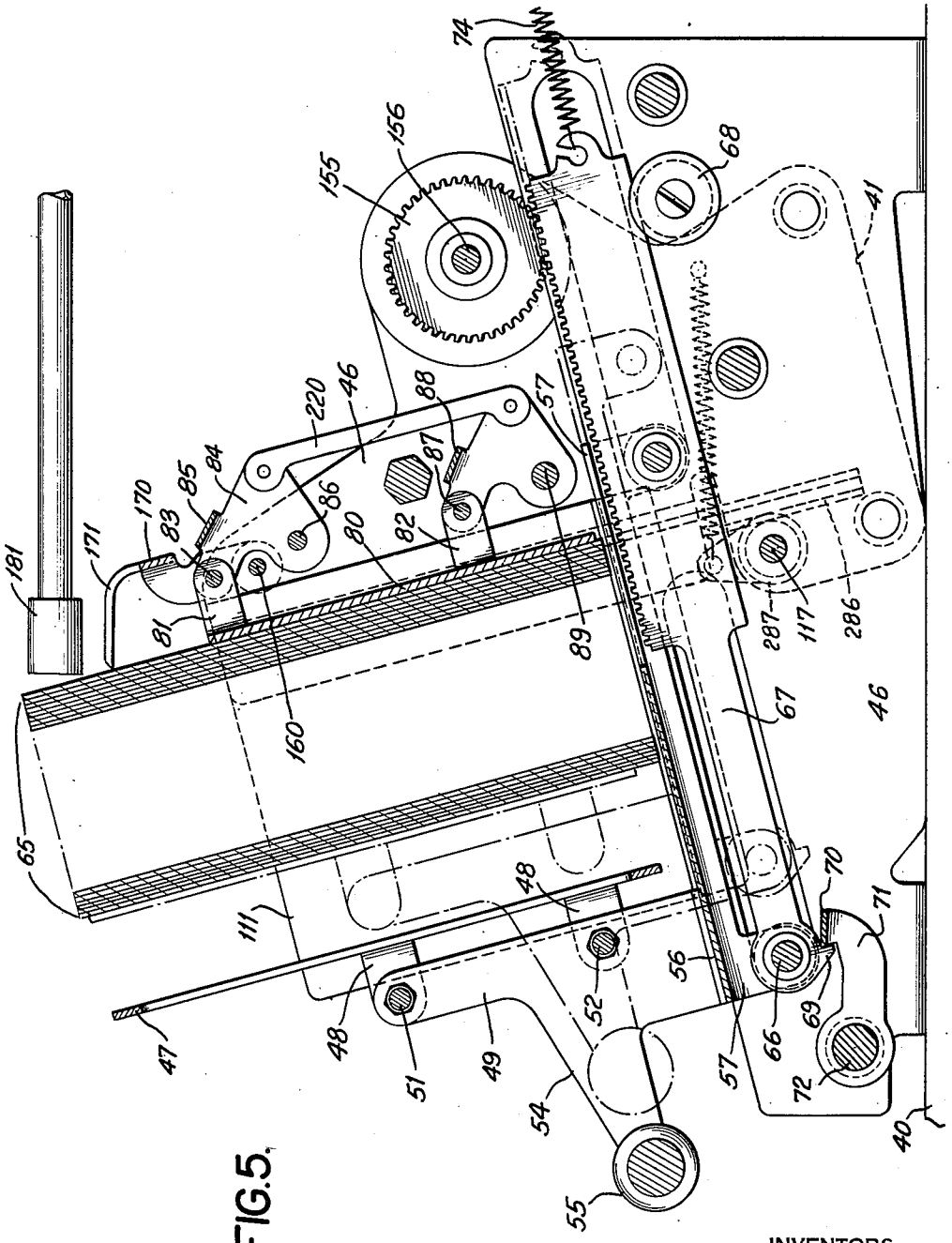


FIG. 5.

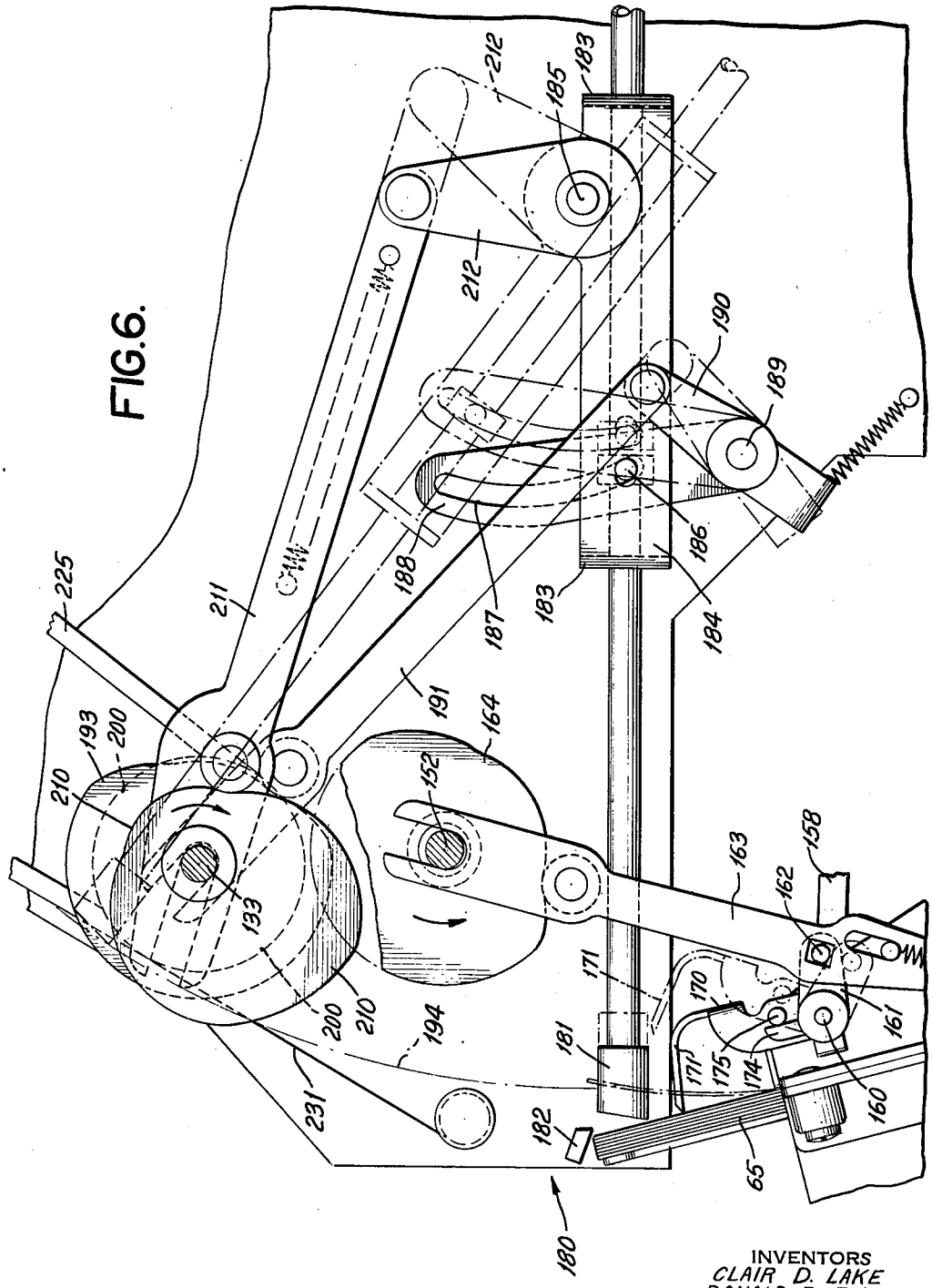
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SHEET FEEDING MACHINE

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FIG.6.



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SHEET FEEDING MACHINE

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FIG. 7.

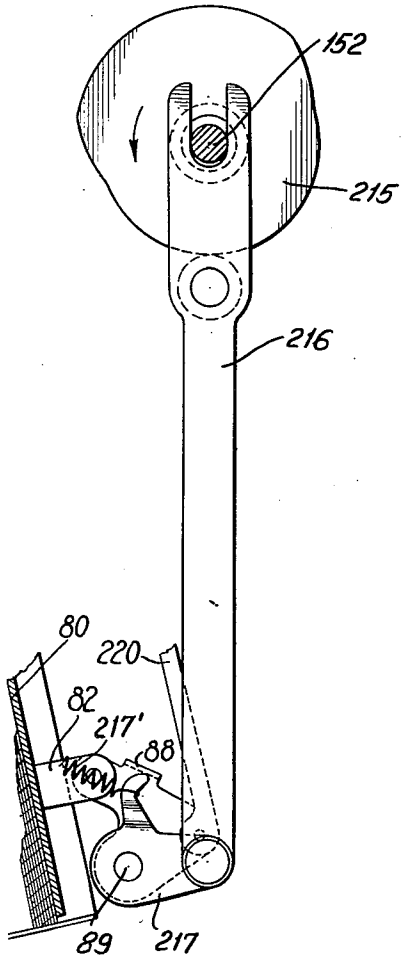
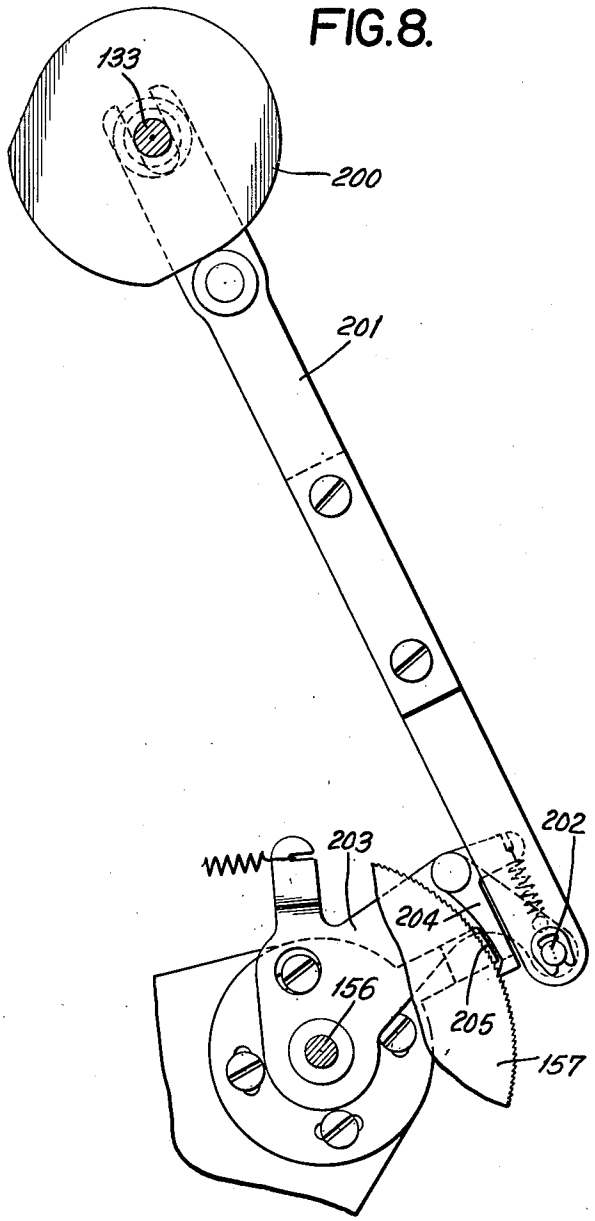


FIG. 8.



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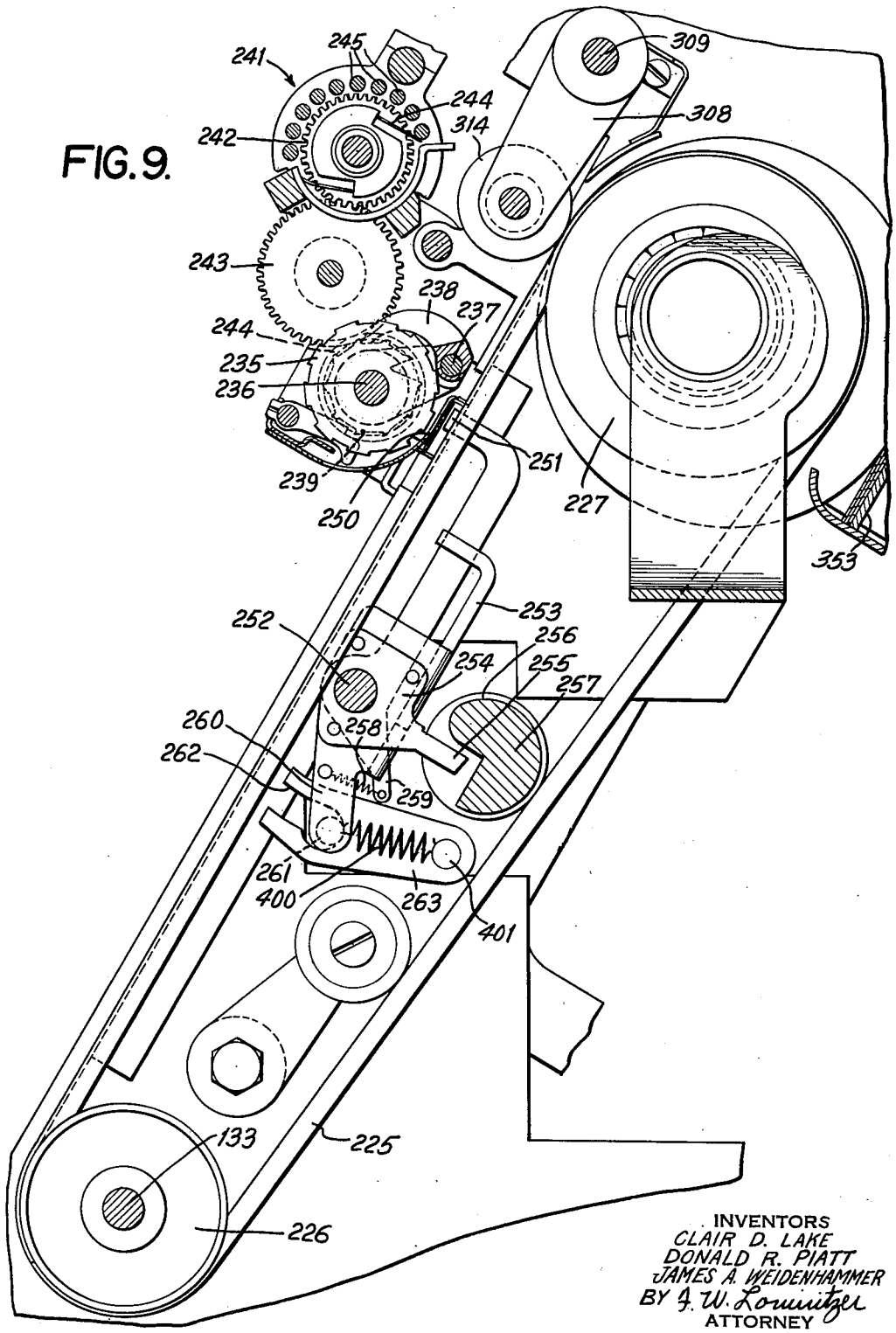
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SHEET FEEDING MACHINE

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14 Sheets-Sheet 8

FIG. 9.



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SHEET FEEDING MACHINE

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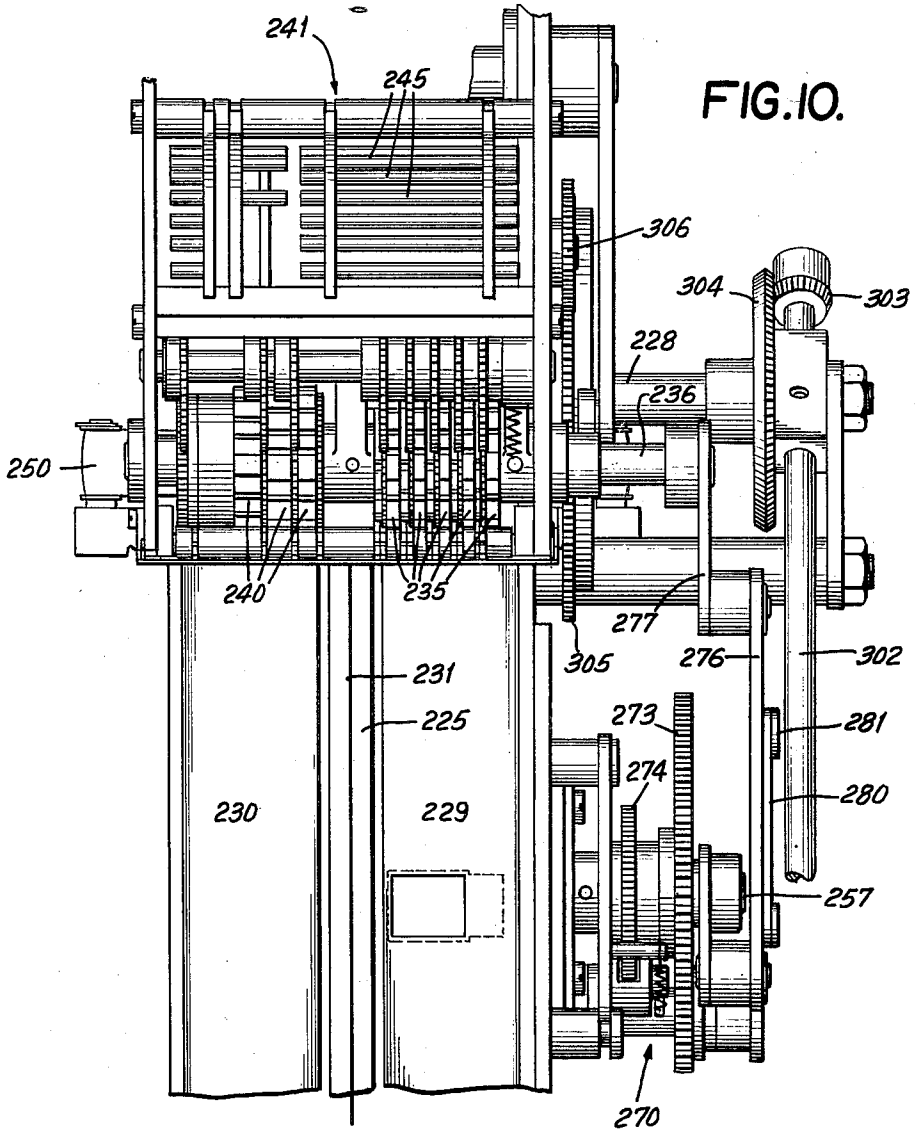


FIG. 10.

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SHEET FEEDING MACHINE

Filed Dec. 5, 1947 14 Sheets-Sheet 10

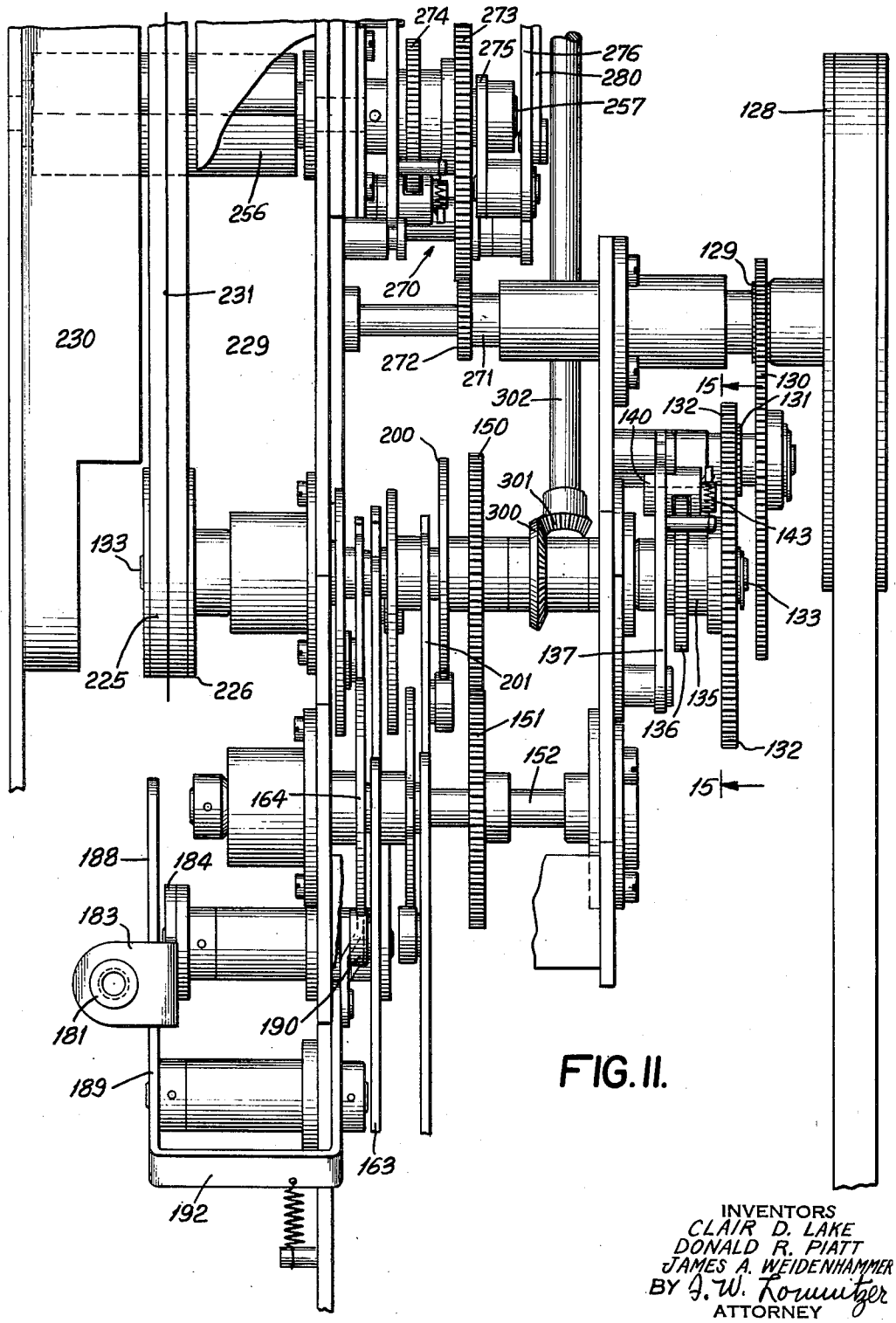


FIG. II.

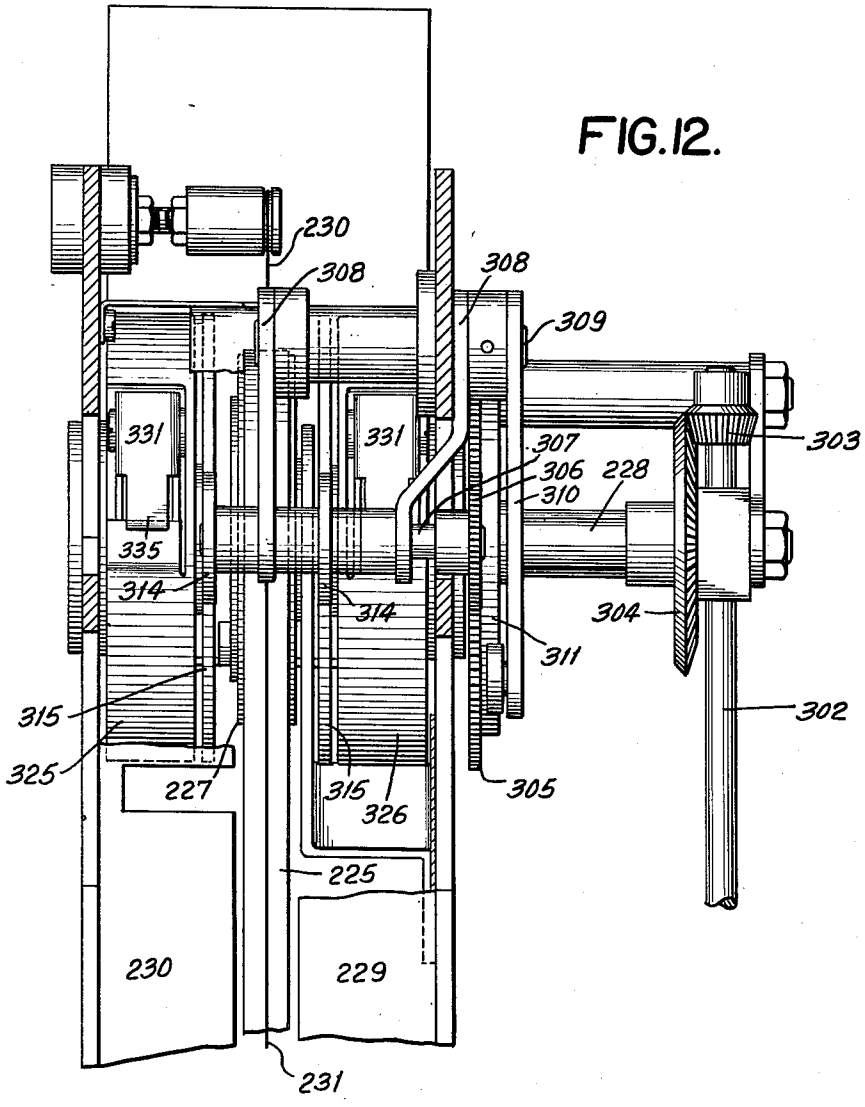
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SHEET FEEDING MACHINE

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FIG. 12.



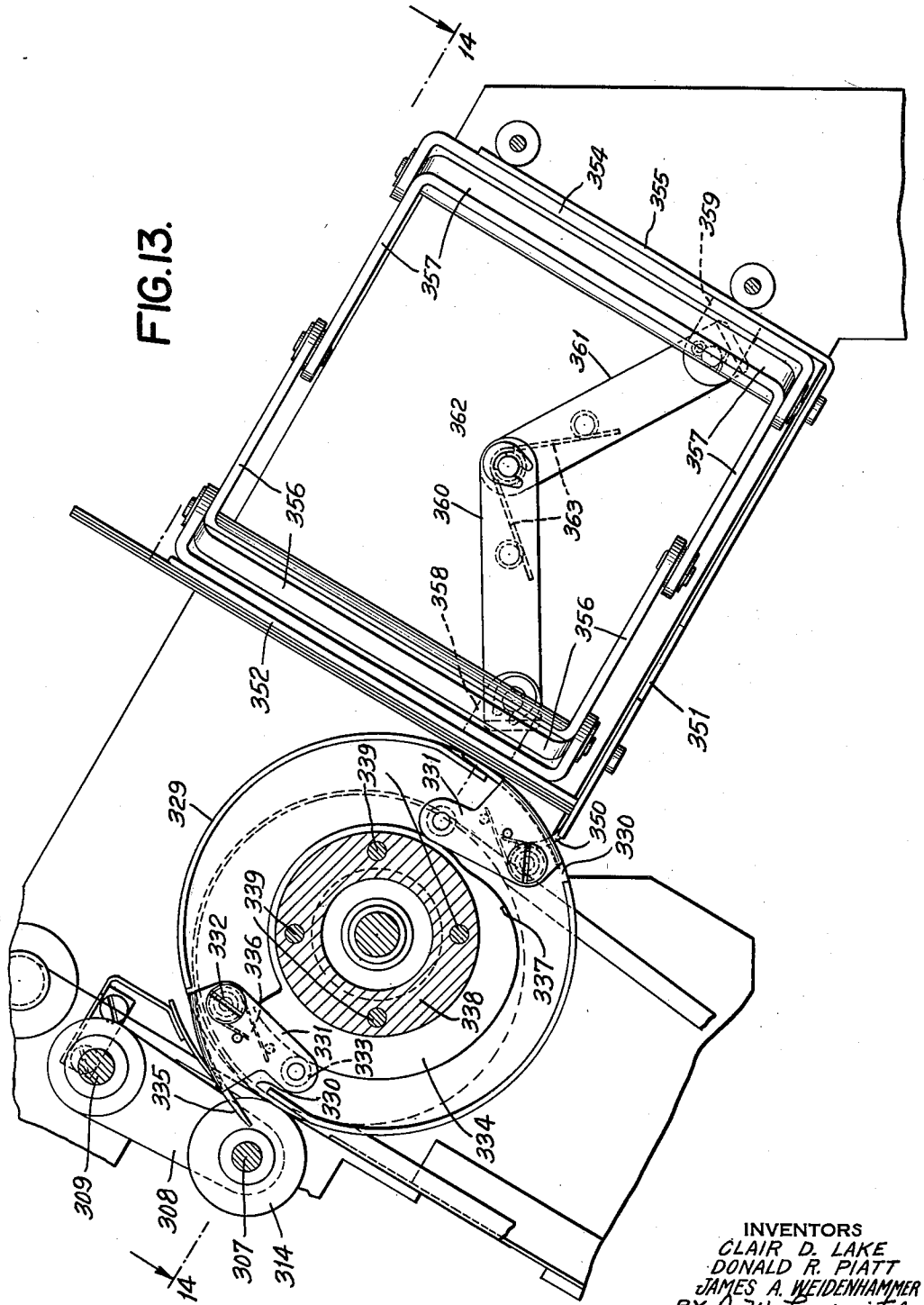
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SHEET FEEDING MACHINE

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FIG. 13.



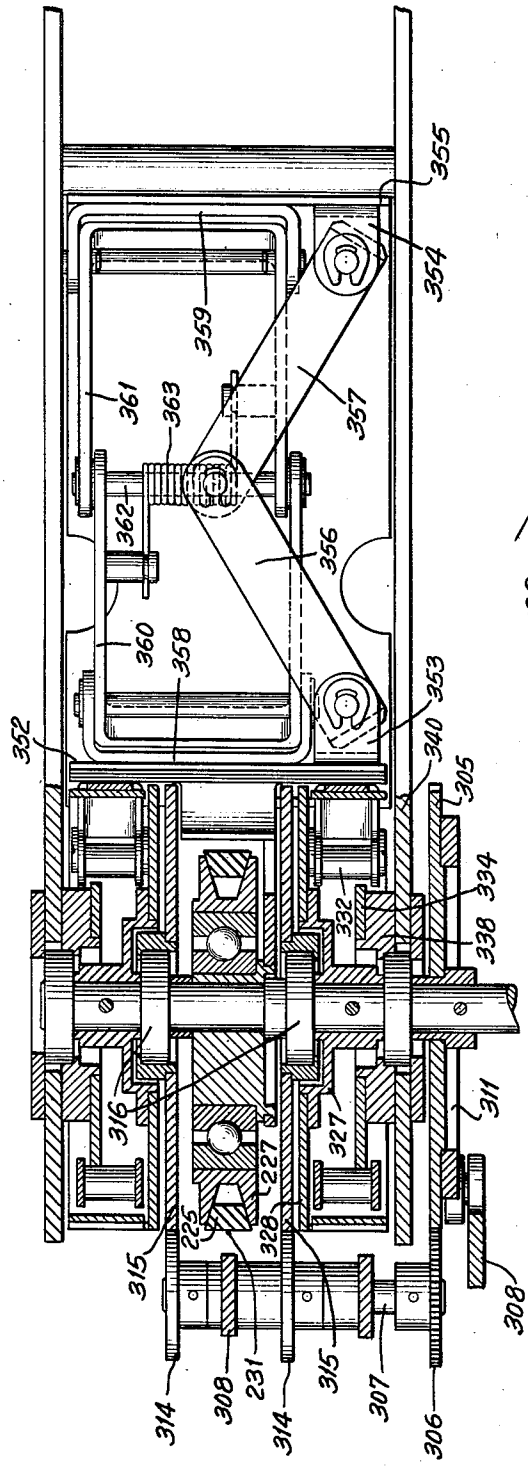
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SHEET FEEDING MACHINE

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FIG. 14.



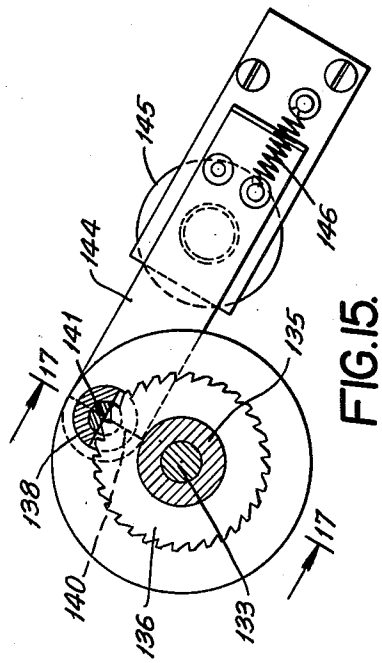


FIG. 15.

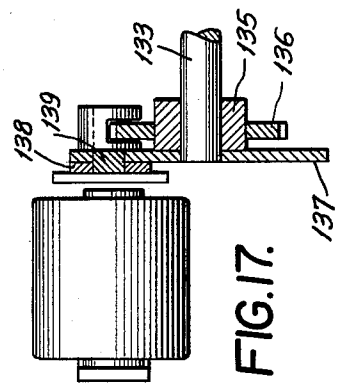


FIG. 17.

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SHEET FEEDING MACHINE

Filed Dec. 5, 1947 14 Sheets-Sheet 14

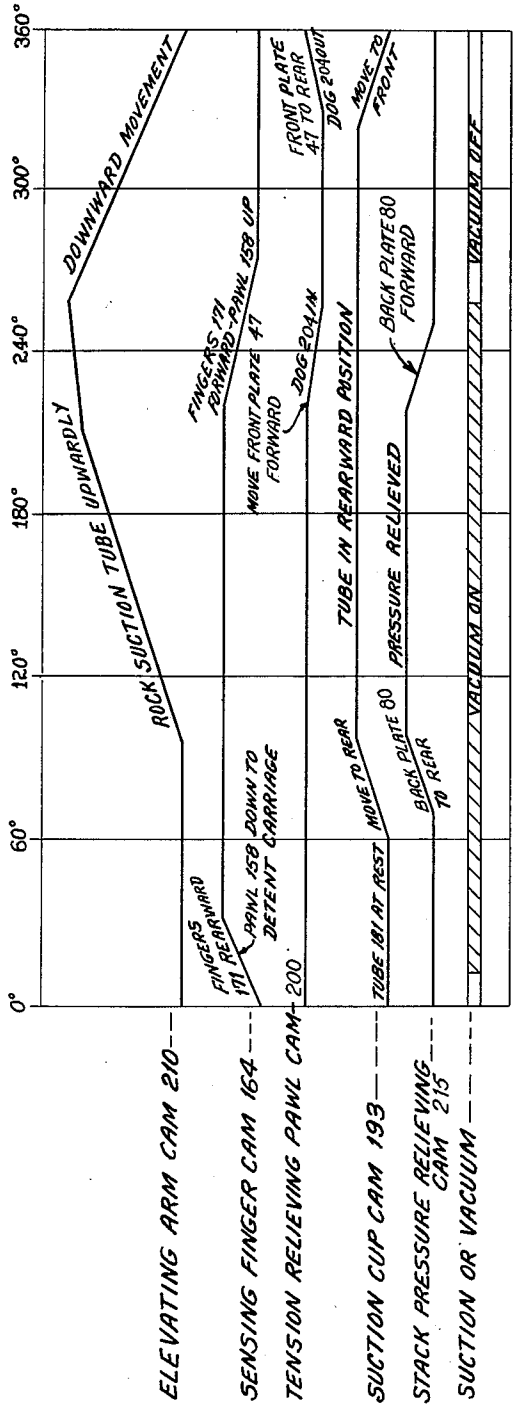


FIG. 16.

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Patented Mar. 10, 1953

2,631,037

UNITED STATES PATENT OFFICE

2,631,037

SHEET FEEDING MACHINE

Clair D. Lake, Binghamton, and Donald R. Piatt and James A. Weidenhammer, Endicott, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application December 5, 1947, Serial No. 789,790

14 Claims. (Cl. 271—62)

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This invention relates to sheet feeding machines and more particularly to the type which is adapted to advance the pack of sheets to a common sheet picking-off position, individually pick off sheets at such position by a pneumatic separator, and by successive cyclic operations of conveying means feed them to predetermined positions for operations thereon and then automatically stacking them so that they are in the same order in which they are fed from the supply magazine.

A broad object of the invention is to devise efficient means for advancing the pack, improved pneumatic separator means for picking off sheets from the supply magazine, provide conveying means for conveying them to a position which will facilitate the transcription or reading of data written or printed on the sheets, then to a further position whereby additional data may be printed on the sheets and then to a stacking mechanism for placing them in an orderly manner in a storage hopper.

It is to be understood that the feeding to printing and reading positions just mentioned are merely examples of use and it is immaterial what operations are made in connection with the sheets since this will depend upon the particular apparatus in which the invention is incorporated.

The invention also comprehends a structural arrangement of a supply magazine which includes a back plate and front plate between which the stack of sheets are stacked on edge so as to be individually picked off. The structural arrangement also contemplates the provision of movably mounting the back plate so that at a predetermined point in the operation of the machine the pressure on the rearmost sheets may be relieved to allow air to pass in between and separate them to facilitate the individual sheet pickoff. An associated feature also comprehends the provision of mounting the front plate in a movable carriage so that by a manual separation from the back plate the insertion of a stack of sheets therebetween may be facilitated. Further, during the operation of the machine the carriage carrying the front plate is moved under spring pressure so as to place the stack of sheets in a compressed relationship.

The invention also comprises a vacuum cup means or pneumatic separator which individually picks off the rearmost sheets and the inclusion of means to shift one of the plates of the magazine so as to disable the aforementioned spring pressure on the stack. Thus, removal of the spring pressure so opens the stack so as to

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enable the vacuum cup to seize and withdraw a single sheet with facility without requiring extraordinary suctional force.

Associated with the vacuum cup means which picks off the sheets individually is a conveying means comprising a rotatable endless belt which takes the sheets fed thereto by the vacuum cup and feeds them upwardly to the transcribing and printing position.

Another feature of the invention is to provide a sheet stacking mechanism which will grip the sheets after the printing operation and stack them in a storage hopper. The present sheet feeding apparatus is devised to take care of the requirements of handling sheets or tickets of different sizes, and the invention comprehends the provision of having the supply magazine adjustable to accommodate the different sizes of tickets or sheets. The stacking mechanism hereinbefore mentioned is capable of handling the sheets of different sizes without changing the timing of the operation of the stacking mechanism as is required in the stacking mechanism shown in the patent to C. D. Lake et al., No. 2,350,511, patented June 6, 1944.

In the machine of the patent, due to the fact that the sheets were fed to the grippers in a direction in which the width of the sheet varied, a change in the timing of operation of the grippers of the sheet gripping mechanism was required to grip sheets of different widths. In the present machine the direction of feed of the sheets is in a direction of their lengths. Feeding the sheets so that, irrespective of the slight variation in length, the top edges are always at a fixed registered position does not require any change in timing of the operation of the grippers according to the varying widths of the sheets and the present arrangement is deemed to be a simplification over the patented arrangement.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a side elevational view of the right side of the machine as assembled, and shows the structural relationship between the ticket or sheet magazine, pneumatic separating mechanism, the conveyer, the printing device, and the sheet or ticket stacker, as well as the power drive.

Fig. 2 is a side elevational view of the sheet or ticket supply magazine, on a larger scale than Fig. 1.

Fig. 3 is a front elevational view of the sheet or ticket supply magazine.

Fig. 4 is a plan view of the sheet or ticket supply magazine.

Fig. 5 is a longitudinal sectional view taken on the line 5—5 of Fig. 3.

Fig. 6 is a side elevational view showing the vacuum or pneumatic sheet separator mechanism for withdrawing tickets from the supply magazine and elevating them to a conveyer.

Fig. 7 is a detail view of a cam operated mechanism.

Fig. 8 is a detail view of another cam operated mechanism.

Fig. 9 is a side elevational view of part of the machine above the supply magazine and shows particularly the ticket conveyer, the ticket printing wheels, and the platen operating mechanism.

Fig. 10 is a plan view of the printing mechanism and shows part of an associated drive.

Fig. 11 is a plan view showing principally the gear and cam driving mechanism of the machine.

Fig. 12 is a plan view of the ticket or sheet stacking mechanism.

Fig. 13 is a sectional view showing the sheet or ticket stacking mechanism and associated storage hopper.

Fig. 14 is a view taken on the line 14—14 of Fig. 13.

Fig. 15 is a sectional view showing the main clutch and is taken on line 15—15 of Fig. 11.

Fig. 16 is a timing diagram.

Fig. 17 is a sectional view taken on the line 17—17 of Fig. 15.

Supply magazine

The constructional details of the supply magazine is best shown in Figs. 2, 3, 4, and 5 to which recourse should be had for understanding the following description:

The assembled magazine and other units of the machine are supported by a base plate 40 and attached to said base plate are uprising main side frame plates 41, 42. The side plate 41 has attached thereto a side frame plate 43 by means of screws 44 and spacing sleeves 45 over said screws space the frame plate 43 away from the frame plate 41. In a similar manner side frame plate 42 carries a side frame plate 46. As best shown in Fig. 3 the side frame plates 43, 46 are outer frame plates, and side frame plates 41, 42 are the inner side frame plates.

The front plate 47 of the magazine has two pairs of integral ears 48 (Fig. 3) and are attached to the side plates 49, 50 of a U-shaped member by attaching screws 51, 52 which are screwed into related threaded spacing members 53. The side plates 49, 50 have integral front extensions 54 which carry a handle 55. To the cross plate 56 of the U-shaped member 49, 50, there is secured another U-shaped member, but in an upside-down relationship (see Fig. 3) and said member comprises side plates 57, 58. Each of said plates 57, 58 carries a pair of flanged rollers 59 (Fig. 2) which roll in a slot 60 formed in the associated side frame plate 41, 42. Thus, it is evident that the front plate 47 of the magazine is carried by a carriage which is movable forwardly by the handle 55 to allow the insertion of a stack of papers 65 (see Fig. 5).

Between the side plates 57, 58 and mounted on a roller shaft 66 of the front set of rollers 59 is a rack-toothed member 67 (Figs. 4 and 5) which is guided by a roller 68 at its rear, said member

having a lug 69 which can be engaged by a latching bail 70 when the carriage is in a most forward position. When released from the latch a spring 74 secured to member 67 urges the carriage rearwardly and thus the front frame plate 47 is spring-pressed against the stack of papers 65. The latching bail 70 is carried by side arms 71 pivoted on a spacing stud 72 carried by side frame plate 41, 42, and one of said arms 71 has a hand operating lever 73 (Fig. 1) to manipulate the latch bail to latch the carriage when a stack of papers are to be inserted in the magazine.

The back plate 80 of the magazine has two pairs of integral ears 81, 82 (Fig. 5). Ears 81 are pivoted by a rod 83 to side arms 84 of a bail member having a cross plate 85, which bail member is pivoted on a rod 86. Ears 82, in a similar manner, are supported by a rod 87 carried by a bail 88 secured to a rod 89.

Since the tickets to be fed from the magazine or supply hopper vary in width the side frame plates of the magazine are arranged to be adjusted to the desired separation to conform to the width of the tickets. In the present arrangement large and small tickets are accommodated by suitable adjustments. When the hopper is adjusted for small tickets there is a supplementary width adjustment. This adjustment is necessary to insure that the right-hand edges of the tickets abut the right-hand side wall of this hopper, within a relatively narrow tolerance, to insure proper registration of the right-hand edge of the small tickets with the printing wheels, to avoid the possibility of not printing one of the numbers on the small tickets from the printing wheels.

The hopper comprises two side walls 107 and 111 near the lower edges of which are welded flanges 120 and 121 to support the bottom edge of the pack of tickets. The mechanism by which the right-hand side wall is mounted on the frame member 43 is relatively simple. The frame member 43 has a flange 43' bent out at right angles, on which are mounted two posts 102, 103. The side wall 107 has welded to it an upright flange 105 with slots 104 to guide it upon the posts 102, 103. The lower end of the flange 105 has a toothed part 115 meshing with a spur gear 116 on a shaft 117. This shaft is revolvably mounted in the frame member 43 and a similar frame member 41 and is provided with a crank 118 by which it can be rocked through an arc of about 180°. A handle 119 threaded on a screw 122 fixed to the crank 118 is used to rock the crank and can also be used to clamp the crank in any position in an arcuate slot of a stationary plate 123.

The mounting of the left-hand side wall 111 is somewhat more complex. This side wall 111 also has welded to it a flange 285 provided with a toothed portion 286 meshing with a spur gear 287 on the shaft 117. The flange 285 has slots 288 and 289 to guide it upon posts 290 and 291. These posts are not fixed to the flange 41' of the frame member 41, but are mounted on respective levers 292 and 293. The lever 292 is pivoted at 294 to the flange 41' and the lever 293 is pivoted at 295 to the flange 41'. The levers 292 and 293 are interconnected in scissors fashion by a pivot 296. The top end of the lever 293 is pulled to the left by a spring 297 anchored to a stationary member 298. A knurled headed screw 299 is threaded into a lug 264 of the stationary member 298 and the end of the screw is aligned with the edge of the lever 293, so that it can be used

at times, to limit the movement of the lever to the left.

The mechanism is shown in the position it assumes for holding large tickets. The flanges 105 and 285 are in their lowest position and the side walls are held at their widest spacing by grooves 104, 288, and 289. In this position a strip (not shown) welded to the side wall 111 abuts against the stationary frame member 41 and prevents the side wall 111 from moving to the left as far as would be permitted by the levers 292 and 293. This position is the widest spacing required for the side walls and there is no reason to provide the auxiliary adjustment to be described presently for this wide spacing.

When the crank 118 is turned downward in the slot the flanges 105 and 285 are moved upward by the gears 116 and 287. The slots 104 throw the side wall 107 toward the left. The slots 288 and 289 first permit the levers 293 and 292 to move to the left, under the influence of spring 297, until the lever 293 strikes the end of screw 299. Further upward movement of the flange 285 throws the side wall 111 to the right, due to the action of the slots 289 and 288 against the now stationary posts 290 and 291. When the flange 285 has moved to the top of its travel, an auxiliary adjustment of the position of the side wall 111 can be obtained by turning the screw 299. The end of this screw, in coaction with the spring 298, will cause the lever 293 to rock about its pivot 295. The lever 292 will follow this movement, due to the scissors connection at 296 and its pivot at 294.

Motive power and cyclic control

Since the operations to be subsequently described are performed by the main operating mechanism the motive power and clutch control therefor will now be described.

As best shown in Fig. 1, the motive power is derived by a motor 125 which drives a pulley 128 through a belt 127 on the pulley 126 of the motor. The pulley 128 has attached to it a pinion 129 driving a gear 130 to which a pinion 131 is secured, and which is in mesh with a gear 132 loose on a cam drive shaft 133.

The gear 132 has a sleeve connection 135 to a ratchet wheel 136 loose on shaft 133, and said ratchet wheel constantly rotates (see Figs. 11, 15 and 17). Pinned to shaft 133 and aside of the ratchet wheel 136 is a disk 137 which has riveted to it at its outer periphery a bushing 138 which supports a small shaft 139 which has a half round detent head 140 and a half round clutch tooth 141 (see Fig. 15) which is in alignment with the teeth of the ratchet wheel 136. The clutch tooth 141 is normally out of engagement with the ratchet wheel 136 and to effect the engagement the shaft 139 has an extension to which a spring 143 (Fig. 11) is attached, said spring attempting to engage the clutch tooth 141 with the ratchet wheel 136. However, such engagement is normally restrained by the armature 144 of a clutch control magnet 145. The end of the armature 144 is so positioned that it normally cooperates with the flat edge of the half round detent head 140 so that when a disengagement is effected as a result of the energization of the magnet 145, the clutch engagement will be made. Before a complete revolution of shaft 133 the magnet is deenergized and a spring 146 will now rock the armature into a position to engage the half round detent head 140 and thereby disengage the clutch.

Secured to shaft 133 is a gear 150 (Fig. 11) which meshes with a gear 151 secured to a supplemental cam drive shaft 152. For each cyclic operation of the machine, effected by energization of clutch control magnet 145 by any desired and suitable means, shafts 133 and 152 are driven to perform operations now to be described.

Sensing fingers

At the initial part of a cycle of machine operation between 0°–30° (see Fig. 16), sensing fingers 171 are moved to the dotted line position of Fig. 6 by means now to be described.

The three sensing fingers 171 are formed as an integral part of a bail 170 secured to a rock shaft 160. To shaft 160 there is secured an arm 161 having a loose pin and slot connection 162 to a follower pitman 163 operated by a cam 164 (Fig. 6) secured to the cam shaft 152. At the initial rotation of cam 164 the follower pitman will be depressed and shaft 160 rocked clockwise to rock bail 170 similarly to move fingers 171 out of cooperation with the sheets in the stack 65. The fingers are kept in such position until 220° of the machine cycle (see Fig. 16).

To cause sensing fingers 171 to act against the paper stack by the desired pressure there is secured to shaft 160 a rod 172 (Fig. 2) on which is adjustably mounted a weight 173, the desired position of the weight causing fingers 171 to act with the desired pressure against the papers. The pin and slot connection 162 is loose enough to permit this adjustment.

Means for detenting carriage

At the initial part of cyclic operation of the machine the carriage which supports the front plate 47 of the magazine is detented.

Referring to Figs. 2 and 4 the rack slide 67 meshes with a gear 155 secured to a shaft 156 supported by the side frame plates 43 and 46, and said shaft 156 has fixed thereto a ratchet wheel 157. Coacting with the ratchet wheel 157 is a holding pawl 158 formed at its forward end as a bail 159 (see Fig. 4) loose on the rock shaft 160. The bail 159 has an upstanding finger 174 projecting against a stud 175 carried by the bail 170. As stud 175 moves forward its cooperation with the finger 174 allows bail 159 to rock clockwise and permit the free end of pawl 159 to be lowered by the action of gravity, or a spring, to engage the ratchet wheel 158 to detent the carriage. This condition also remains until 220° of the machine cycle (see Fig. 16).

The sensing fingers 171 sense the tickets in the hopper to determine, as will be described, whether the hopper plate 47 should be permitted to move rearwardly as the tickets are removed. If fingers 171 move to the left sufficiently, lock pawl 158 will be moved from ratchet 157 to permit plate 47 to apply pressure to the stack of tickets. Adjustable weight 173 provides power to disengage lock pawl 158. The adjustment is desirable in view of handling papers of different thicknesses and weights, and changes in other conditions.

Means to relieve pressure on stack of sheets

With ratchet wheel 157 detented by lock pawl 158, back plate 80 is moved to the rear during 70–100° of the cycle and remains so, in order to free the rear ticket, until the latter has been removed from the stack.

Secured to the cam shaft 152 is a cam 215 (Fig. 7) having an associated follower pitman 216 connected to an arm 217 fixed to rod 89. This is

the support rod for the rock bail 88 which supports the back plate 80 by ears 82 (see also Fig. 5). By means of a link connection 220, the lower bail 88 and the upper bail 85 are connected together for simultaneous movement and both move the rear plate 80 rearwardly for the purpose just mentioned. When the cam follower 216 rides onto the low part of the cam 215 the back plate is moved forward against the pack by a spring 217'.

Sheet withdrawing means

The sheet withdrawing means and appurtenant mechanism are carried by a framework 180 (Fig. 1) above the supply magazine. The sheets are withdrawn singly from the stack 55 by a suction tube 181 normally positioned as shown in Figs. 5 and 6.

The suction pump and its time-controlled valve for producing a suction or vacuum in the suction tube 181 is not shown herein, since it is conventional and may comprise the arrangement shown in Fig. 2 of the patent to C. D. Lake et al., No. 2,348,073. The time that the valve should admit suction to the tube 189 and cut off is shown herein in Fig. 16.

The face of the terminal end of the suction tube 181 is beveled as shown in Fig. 6. With the suction tube in the Fig. 6 position the applied suction will attract the upper portion of the rearmost sheet to separate it from the adjacent sheet and tilts it back at a considerable angle to provide a wide separation from the next sheet. This tilting, which takes place during 60–100° of the machine cycle, causes the upper edge of the withdrawn sheet to pass under and by a fixed retaining plate 182 which also acts to stop the adjacent sheet from following.

The suction tube 181 is slidably mounted in a pair of ears 183 of an arm 184 pivoted on a rock shaft 185 and a pin 186 carried by the tube engages a slot 187 in a plate 188 which is part of a bail 192 secured to a rock shaft 189. An extension 190 of said bail 192 has a connection to a follower arm 191 operated by a cam 193 secured to drive shaft 133. Through this operating train the suction tube 181 is retracted to the right or rear of the machine between 60–100° of the cycle and when in such position its arcuate movement commences to rock the suction tube 181 upwardly, following the dotted line path designated 194 in Fig. 6, known herein as the "ticket line."

During the time that the suction tube moves to the right, mechanism previously described comes into play to relieve the pressure on the stack of sheets normally created by the spring 217' (Fig. 2) which, as stated, is effected by moving the rear plate 80 to the rear. This operation is performed during 70–100° of the cycle and before the arcuate path of the suction tube commences so that the sheet can be freely withdrawn from the stack.

Arcuate movement of suction tube

The upward arcuate movement of the suction tube 181 commences at about 100° and terminates at about 260°, after which it is returned downwardly, as seen in Fig. 16. This movement is effected by a cam 210 (Fig. 6) acting on a follower pitman 211 which is connected to an extension 212 of the suction tube support arm 184. The arcuate movement moves the suction tube in the path designated 194, moving the ticket carried by the tube to a position where it is engaged by a conveyer to be presently described. The back plate 80 remains in its rear position until the ticket is fully withdrawn from the stack and is restored to its forward position from 220° to 250°.

Before the downward movement commences the control valve of the suction tube 181 opens and the vacuum or suction is destroyed, freeing the ticket from seizure by the tube. However, at this time it is held by the conveyer to be presently described. As the tube 181 approaches its lowest downward position cam 193 will move the suction tube 181 forwardly to its normal position shown in Fig. 6.

Means to relieve tension on pawl 158

Secured to the drive shaft 133 is an operating cam 200 having an associated follower pitman 201 (Fig. 8) connected at 202 with a pawl carrying plate 203 loose on the shaft 156.

The plate 203 carries a spring-pressed pawl 204 which is in the plane of the ratchet wheel 157. In the normal position of the parts, as in Fig. 2, the pawl 204 is held out of engagement with the ratchet wheel 157 by an adjustable plate 205. This is adjustable to vary the extent of rotation of the ratchet wheel 157 by the pawl 204, which should be less than one tooth length in all cases. The purpose of the pawl 204 is to impart just enough clockwise movement to the ratchet wheel 157 to free the pawl 158, so that the weight 173 can rock the latter out of engagement with the ratchet wheel, as will now be explained.

Sensing finger operation

It was previously described how the sensing fingers 171 were rocked away from the stack of papers at the initial part of the cycle under control of cam 164. Cam 164 is again effective at 220° to rock sensing fingers 171 forwardly towards the stack of papers, this occurring during the time that pawl 158 is freed by the slight clockwise movement of ratchet wheel 157, as will be seen in Fig. 16. The pin 162 (Fig. 2) has enough freedom of movement in the rectangular hole in pitman 163 to allow the sensing fingers 171 to assume a position, under the influence of the weight 173, determined by the thickness of the stack, referred to the position of the front plate 47. At the time of the test, the position of the front plate 47 is determined by the pawl 204 at its forward limit and the particular tooth of the ratchet wheel 157 in which it is engaged. If the sensing fingers 171 rock far enough the pawl 158 will be lifted above the teeth of the ratchet wheel.

From 330° to 360° the pawl 204 is retracted and the front plate 47 moves the stack rearward. The stack rocks the sensing fingers clockwise and the pawl 158 either engages the same tooth of ratchet wheel 157 as before, or, if the stack is sufficiently reduced, the next following tooth.

At the end of the cycle the detent pawl 158 is held in engagement with the ratchet wheel 157 by the force of spring 74 acting through the pack on the sensing fingers 171. The front plate 47 can be pulled back by means of the handle 55 to insert more sheets and when the handle is released the carriage will be restored by the spring 74 until the detent pawl 158 is rocked into engagement with the ratchet wheel 157 by the action of the pack on the sensing fingers 171.

The purpose of the arrangement for operating the pawls 158 and 204 and back plate 80 is

to provide a systematic uniform pressure relieving action on the stack 65 during each cycle, irrespective of the diminishing thickness of the stack. If the pawl 158 engages a particular tooth of the ratchet wheel 157 on one cycle, a few cycles later when a few sheets have been withdrawn from the stack the wheel will rotate one tooth farther before it is engaged by pawl 158. This means that when pawl 204 rides off the cam 205 on the next stroke it will engage one tooth further clockwise on ratchet wheel 157 than during the previous cycle. The carriage and front plate 47 will move to the forward left position slightly to the right of the position where it was stopped in the previous cycle, and its movement to the right will terminate slightly to the right of the position where it was stopped on the previous cycle.

Conveyer

The conveyer receives the tickets which are elevated by the suction tube and moves them successively, in tandem, with each ticket first in view of the operator, and then moved in the next cyclic operation of the machine to a printing position. When a ticket is in view of the operator written or printed data may be read by the operator for setting up such information on an adding machine, card punching machine, etc.

As the ticket approaches its most elevated position the suction tube deposits it under a conveyer belt 225 which surrounds a pulley 226 secured to shaft 133 and a pulley 227 on another shaft 228 (Fig. 12). The belt 225, as shown in Fig. 11, is disposed between table portions 229, 230, and each ticket is fed by the belt beneath a taut wire 231, which holds each ticket against the table, and conveyer belt. During the last 48° of the rise of the suction tube the elevation of the latter is decreased in speed (see Fig. 16) to conform to the linear speed of the conveyer belt, so that the latter can take the ticket from the suction tube. When the ticket is well engaged by the conveyer belt the vacuum in the suction tube is destroyed, and the latter drops to its lower position. The speed of the conveyer belt is sufficiently low so that written data thereon can be read by an operator. At the end of each second ticket feed cycle for each ticket, the latter arrives at a printing position. Since the present invention is concerned mostly with the ticket feed mechanism, it will only be generally described.

Printing mechanism

Correlated with the conveyer mechanism is a printing mechanism which prints upon the top of each ticket the serial number and a date which is set up in the machine.

Referring to Figs. 9 and 10, serial number printing is effected by five printing wheels 235 loosely mounted on a rock shaft 236. These printing wheels have printing type thereon so that the serial number may be printed upon each ticket. For advancing the serial number representing wheels to represent consecutive numbers, the customary bail 237 which carries pawls 238 of different lengths is provided. These pawls cooperate with ratchet teeth 239 carried by each print wheel 235. For each reciprocation of bail 237 the lowest order of printing wheel is advanced to represent the next digit and by means of the pawls 238 of different lengths and cooperating deep notches in the ratchet wheels 239, transfers may be effected from each lower order print wheel to the next order print wheel in the customary manner. Bail 237 is fixed to the rock shaft 236 which is reciprocated in a manner to be subsequently described.

For printing the month and the day tens and day units of the month there are provided three printing wheels 240 which are settable in the machine.

In Fig. 9 and Fig. 10 reference numeral 241 represents what is known as an "electrical readout device." Such readout device is settable by each of the print wheels 235 and 240 so as to give a representation of the print wheel settings. For each order of the readout device a gear 242 is driven by a gear 244 attached to each print wheel and through an intermediate gear 243. A brush 244 carried by said gear 242 cooperates with commutator rods 245, the brush 244 engaging a particular rod 245, depending upon the setting of the print wheel. The electrical arrangement just described provides an electrical readout so that the data represented by the print wheels may control a suitable card punching mechanism.

For taking impressions from the print wheels there is provided the customary inking ribbon 250 which extends across and underneath the series of printing wheels 235 and 240.

A platen hammer 251 is provided underneath each of the printing wheels except the printing wheels 240 for printing the day tens and day units, for which combination one platen hammer is provided. Each hammer is loosely pivoted on a rod 252 and said hammers are reciprocated to impress the ticket against the ribbon and the printing wheels 235 and 240. Pivoted on the rod 252 is a complete hammer operating unit 253 which has riveted thereto a member 254 having a tail portion 255 cooperating with a cam 256 secured to a drive shaft 257. A spring 258 is connected between a tail 259 of the print hammer 251 and a tail 260 of the hammer operating unit 253. The tail 260 has a pin 261 which operates in a limited movement in a slot 262 of a guide member 263. The profile of the cam 256 is such that in a counterclockwise rotation of shaft 257 the complete hammer operating unit 253 and hammers 251 will be rocked in the same direction but the guide member 263 will limit the movement of the tail 260 so that spring 400 will be tensioned from a stationary shaft 401 and when the tail portion 255 drops off the high part of the cam 257 the complete hammer operating unit will be urged by spring 400 (Fig. 9) to travel as permitted by guide 263, the hammers 251 continuing to move and print from the wheels 235 and 240 by percussive action due to the momentum transmitted from the complete unit 253.

The operation of the hammer 251, the units advance of the consecutive number wheels, and the shift of the inking ribbon is effected by an independently operated clutch designated 270 in Fig. 10 and Fig. 11. This clutch is the same as the main clutch previously described and shown in Figs. 15 and 17.

Referring to Fig. 11 the constantly rotating gear 129 has a sleeve connection 271 to a gear 272, meshing with a gear 273 which constantly rotates a ratchet wheel 274 similar to the ratchet wheel 136. By means of an electro-magnetically controlled clutch 270 the shaft 257 is driven a complete revolution for each operation of the printing mechanism and timed so that the platen

hammer 251 will be reciprocated when the ticket is in printing position.

Referring to Fig. 11, connected to the shaft 257 is a crank arm 275 which has a link connection 276 (Fig. 1) to an arm 277 secured to the rock shaft 236, thereby reciprocating the bail 237 to advance the consecutive number wheels unit. Connected to the link 276 is a link 280 connected to an arm 281 secured to a shaft 282, which shaft is the ribbon operating shaft of the machine. The inking ribbon is provided with the customary ink reversing mechanism and rocking of shaft 282 actuates this mechanism to advance the inking ribbon an increment for each printing operation.

Stacking mechanism

It is preferable to stack the tickets after they have been printed in an orderly manner so that they are stacked in a receiving hopper in the same order that they are initially stacked in the magazine. To this end a sheet stacking mechanism shown particularly in Figs. 12, 13 and 14 is provided.

Referring now to Fig. 11 it will be seen that the shaft 133 which is given a complete revolution for each engagement of the ticket feed clutch has secured thereto a beveled gear 300 meshing with a beveled pinion secured to an upwardly extending shaft 302 (see Fig. 1) which carries at its extremity a beveled pinion 303 meshing with a beveled gear 304 secured to the shaft 228 on which, it will be recalled, the pulley 227 is freely rotatable. The gear ratio between the drive shaft 133 and 228 is such that a complete revolution of the former will effect a half revolution of the latter shaft 228. To shaft 228 there is secured a gear 305 (see Figs. 1, 12 and 14) which meshes with a pinion 306 fixed to a shaft 307. Shaft 307 is carried by a pair of arms 308 attached to a rock shaft 309 and said rock shaft has fixed thereto a follower arm 310 cooperating with a cam 311 attached to the gear 305. A spring 312 (see Fig. 1) urges the follower arm 310 constantly against the profile of the cam 311. At each half revolution of the cam 311 the follower arm 310 under the action of spring 312 moves to a lower cam portion 313, thereby allowing shaft 309 to be rocked counterclockwise as viewed in Fig. 1 so that a pair of wheels 314 rotatable with the shaft 307 move downwardly to coact with the respective one of a pair of wheels 315 which are freely rotatable on the shaft 228 being mounted thereon by ball bearings 316 (see Fig. 14). During this engagement a ticket has been fed by the conveyer belt 225 between two pairs of cooperating wheels 314, 315 and at the contact of such wheels the wheels 314 are being rotated through the pinion 306 and gear 305. The peripheral speed of the wheels 314 is slightly greater than the linear speed of the conveyer belt 225 and the ticket therefore travels slightly faster at this time than it did previously, so that its leading edge will be urged into cooperation with a sheet gripping mechanism now to be described. Pinned to the shaft 228 is a pair of gripper carrying drums 325 and 326. Since the construction of each is identical the detail description of the construction and operation will be confined to the gripper carrying drum 326 shown in Fig. 13. The drum 326 comprises a hub portion 327 (see Fig. 14) carrying a side plate 328 and a concentric ring 329 having a pair of openings 330 through which each of a pair of sheet grippers 331 projects. Each gripper is pivotally mounted on a stud 332 carried by the side plate 328 and comprises a bail-shaped member having a follower roller 333 cooperating with a fixed cam 334 and also a projecting sheet engaging portion 335. A coil spring 336 wound around the pivot 332 urges the follower roller 333 to cooperate with the cam 334.

In the position shown in Fig. 13 it is evident that the leading edge of the ticket is fed by the two pairs of wheels 314, 315 underneath the portion 335 of the gripper and over the ring 329 and as the gripper carrying drum 326 rotates clockwise the sheet will be fed so that it will be maintained beneath the gripper portion 335. After a slight clockwise rotation of the gripper carrying drum 326 the follower roller 333 will drop off the highest portion of the cam 334 and by the action of the spring 336 the sheet gripping portion 335 of the gripper 331 will now clamp the sheet against the ring 329. This action is simultaneous with respect to the two gripper carrying drums and the leading edge of the ticket is now positively gripped and will be carried off the conveyer belt 225 and turned around with the now rotating gripper carrying drums 325 and 326. Towards the end of the cycle the follower roller 333 of the gripper which has gripped a ticket will cooperate with a rising portion 337 of the cam 334 which will rock said gripper 331 so as to unclamp it from the ring 329 of the stacker carrying drum. This release enables the positioning of the ticket in a storage hopper in the manner to be subsequently described.

It will be observed that due to the half revolution given to each of the stacker drums 325 and 326, the pair of grippers carried by each will be alternately operable so that while one gripper is placing a sheet in the storage hopper the other gripper is in a position to receive the following ticket fed by the conveyer belt 225.

Reference was made to the fixed position of the cam 334 and by referring to Fig. 14 it will be seen that the cam 334 is attached to a plate 338 which in turn is secured by fastening means 339 to the side plate 340. There is, of course, one fixed cam 334 for each gripper carrying drum and the manner of assembly is the same for each drum.

Storage hopper

As each ticket or sheet is carried around by a gripper drum the edge seized will strike against the terminal edge 350 of a fixed plate 351 which is slotted to allow the grippers 331 to pass through. At this time the grippers are opened, and in successive operations a stack of tickets is built up to rest upon the fixed plate 351, and against a plate 352 which moves back as the stack is built up, by the following means:

Pivotally carried by a bracket 353 attached to plate 352 and a bracket 354 attached to an integral upstanding portion 355 of the plate 351 are bails 356 and 357. Thus, it is obvious from Fig. 14 that the angular position of bails 356, 357 diminishes as plate 352 moves back.

Also pivoted on a bracket 358 attached to plate 352 and a bracket 359 attached to plate 355 are bails 360 and 361 which are at right angles to the bails 356, 357. Thus, it is obvious from Fig. 13 that the angular position of bails 360, 361 diminishes as plate 352 moves back.

This means of support for plate 352 at right angles enables the positioning of plate 352 in parallel positions, and without requiring a great deal of force to do so, as the stack is built up.

In this manner much friction usually encountered in previous arrangements of follower-up plates in storage hoppers is avoided.

Encircling the pivot connection 362 of bails 360, 361 is a spring 363 so connected as to place a force of compression against plate 352, and thus the stack of papers against the gripper drums.

While there have been shown and described and pointed out the fundamental novel features of the invention, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. A sheet feeding mechanism wherein a stack of sheets are removed from a magazine in serial order, comprising a magazine having two movable end plates, one being a pressure relieving end plate and the other a follow up end plate, means to withdraw single sheets from the end of the stack adjacent said pressure relieving end plate, means to move said pressure relieving end plate away from the stack during the operation of said withdrawing means and then restoring the same, spring means for moving said follow up end plate progressively between said withdrawing operations as the stack is reduced, a ratchet toothed member movable with said follow up end plate, a detent pawl engaging said ratchet toothed member during the movement of said pressure relieving plate to detent said follow up end plate during a sheet withdrawing operation, and means for moving said follow up end plate in a direction away from the stack which causes said pawl to be free to be disengaged from said ratchet toothed member and moved to a non-detenting position to enable said spring means to move said follow up end plate to compress the stack between withdrawing operations as the stack is reduced.

2. A sheet feeding mechanism described in claim 1 including in combination therewith a sensing device bearing against the stack to determine its compressed condition, and means controlled by said sensing device for holding said pawl in disengaged position when it is determined that said stack is not firmly compressed to enable the movement of said follow up end plate by said spring means to an extent determined by the compressed condition of said stack.

3. A sheet feeding mechanism wherein a stack of sheets are removed from a magazine in serial order, comprising a magazine having two movable end plates, one being a pressure relieving end plate and the other a follow up end plate, means to withdraw single sheets from the end of the stack adjacent said pressure relieving end plate, means to move said pressure relieving end plate away from the stack during the operation of said withdrawing means and then restoring the same, and means for moving said follow up end plate progressively between said withdrawing operations as the stack is reduced, comprising a spring urging said follow up end plate in the advancing direction, detenting means held in detenting position by the tension of said spring to hold said follow up end plate stationary while said pressure relieving end plate is moved away from the pack, said detenting means movable in a non-detenting position when the tension of said spring is relieved by the retraction of said follow up end plate and means for retracting said follow up end plate in a direction away from the stack which relieves the tension of said spring to enable said detenting means to move to a non-detenting position and cause said spring to then move said follow up end plate in said advancing direction.

4. A sheet feeding mechanism wherein a stack of sheets are removed from a magazine in serial order, comprising a magazine having two movable end plates, one being a pressure relieving end plate and the other a follow up end plate, means to withdraw single sheets from the end of the stack adjacent said pressure relieving end plate, means to move said pressure relieving end plate away from the stack during the operation of said withdrawing means and then restoring the same, means for moving said follow up end plate progressively between said withdrawing operations as the stack is reduced, comprising a spring urging said follow up end plate in the advancing direction, detenting means to hold said follow up end plate stationary while said pressure relieving end plate is moved away from the stack and again at the termination of the advancement of said follow up end plate, a sensing device for sensing the compressed condition of the stack, and means connecting said sensing device to said detenting means, said sensing means causing by its connection to said detenting means the latter to be withheld in a non-detenting position upon detection of a certain compressed condition of said stack until said follow up end plate advances by the action of said spring to effect the desired compression of said stack.

5. A sheet feeding mechanism wherein a stack of sheets are removed from a magazine in serial order, comprising a magazine having two movable end plates, one being a pressure relieving end plate and the other a follow up end plate, means to withdraw single sheets from the end of the stack adjacent said pressure relieving end plate, means to move said pressure relieving end plate away from the stack during the operation of said withdrawing means and then restoring the same, a carriage upon which said follow up end plate is mounted, a ratchet wheel geared to said carriage, a spring moving said carriage for causing said follow up end plate to compress the stack, a detent pawl coacting with said ratchet wheel to detent said follow up end plate, sensing means for sensing the compressed condition of said stack and connected to said detent pawl to move said pawl to engage a tooth of said ratchet wheel when said sensing means determines said stack has a certain compressed condition, and to move said detent pawl to be disengaged from said ratchet wheel to enable the movement of said follow up end plate by said spring when said sensing means determines a loose condition of the stack.

6. A sheet feeding mechanism as described in claim 5, wherein the force of said spring holds a tooth of the ratchet wheel against said detent pawl to detent said follow up end plate and means are provided to retract said carriage against the force of said spring, in order to release said detent pawl for a disengagement.

7. A sheet feeding mechanism as described in claim 5, wherein said retracting means comprises a pressure relieving pawl adapted to coact with said ratchet wheel and means to reciprocate said pressure relieving pawl to first retract said carriage and release said detent pawl for a disengagement.

8. A sheet feeding mechanism wherein a stack of sheets are removed from a magazine in serial

order, comprising a magazine having two movable end plates, one being a pressure relieving end plate and the other a follow up end plate, individual spring means urging said two end plates toward each other to compress the pack, the spring means acting on said follow up end plate being stronger than the other spring means, detent means for said follow up end plate and held in detenting position by the force of the spring associated with said follow up end plate cyclically operating means to retract said pressure relieving end plate intermittently against the force of its spring means, and sheet withdrawing means operable during the retraction of said pressure relieving end plate to remove a sheet from the stack.

9. A sheet feeding mechanism as described in claim 8, wherein cyclically operating means are provided to retract said follow up end plate to disable the force of the spring associated with the follow up end plate which holds said detent means in detenting position, to release said detent means and allow said follow up plate to assume new positions progressively closer to said pressure relieving end plate as the pack is reduced.

10. A sheet feeding mechanism wherein a stack of sheets are successively removed comprising a magazine having a movable follow up plate, a second relatively movable pressure relieving end plate in proximity to the sheet removal end of the magazine, support means for supporting a stack of sheets in substantially vertical position between said end plates, a movable carriage carrying said follow up plate, means for mounting said carriage to enable the movement of the follow up plate relative to said pressure relieving plate, spring means for moving said carriage towards said pressure relieving plate to place the stack of sheets in compressed relationship between both of said plates, a ratchet wheel, means operated by said carriage to rotate said ratchet wheel in one direction as said carriage is moved by the successive removal of the sheets, a detent pawl cooperating with said ratchet wheel, sensing means for sensing the compressed condition of the pack, means operated by said sensing means for moving said detent pawl to engage said ratchet wheel to detent the latter and hold said follow up plate in a fixed position after said follow up plate has been moved by said spring means to an extent determined by the compressed condition of the pack, and means for moving said pressure relieving plate away from the stack during the time that the follow up plate is detented and held in said fixed position.

11. A sheet feeding mechanism comprising a magazine having a movable pressure relieving end plate, a movable follow up plate, spring means to move said follow up plate in one direction to compress a stack of sheets in the magazine, a ratchet wheel, a detent pawl adapted to cooperate with said ratchet wheel, means to connect said ratchet wheel and follow up plate for effecting a rotation in said ratchet wheel in one direction as said follow up plate is moved by said spring means to progressive stack compressing conditions, means to move said pressure relieving plate to a stack pressure relieving condition, means controlled by the pack and effective prior to the movement of the pressure relieving plate to stack pressure relieving position to move said detent pawl to engage and detent said ratchet wheel to hold said follow up end plate, a feeding pawl to move said ratchet wheel in a reverse direction and retract said follow up end plate by movement in another direction, means to operate said feeding pawl to rotate said ratchet wheel in said reverse direction, and means connected to said detent pawl to move the latter out of engagement with said ratchet wheel when said ratchet wheel is rotated in said reverse direction.

12. A sheet feeding mechanism according to claim 11 wherein when said detent pawl is moved out of engagement with said ratchet wheel said spring means is effective to move said follow up plate to a progressive position.

13. A sheet feeding mechanism comprising a magazine having a movable stack pressure relieving plate, a movable follow up plate, between which plates a stack of sheets is interposed, spring means to move said follow up plate to compress said sheets in the magazine, a plurality of fingers which normally press against the stack, a ratchet wheel, means to connect said ratchet wheel and said follow up plate for movement in one direction or the other as said follow up plate is moved in corresponding directions, a detent pawl cooperating with said ratchet wheel, means to connect said fingers and said detent pawl for simultaneous movement, means to move said fingers into and out of engagement with the stack and when out of engagement move said detent pawl to engage said ratchet wheel and detent the latter to hold said follow up plate, means for thereafter moving said pressure relieving plate to pressure relieving position, a feeding pawl cooperating with said ratchet wheel, means for actuating said feeding pawl after each sheet removal operation to move said ratchet wheel in such direction that said feeding pawl is cammed by the ratchet teeth of said wheel to enable a movement of said detent pawl to a non-detenting position, said feeding pawl being thereafter restored to enable the follow up plate to be moved by said spring means to progressive positions as the sheets are removed from said pack.

14. A sheet feeding mechanism according to claim 13 wherein means is provided to move said detent pawl independently of said fingers to a non-detent position and said fingers are moved by said finger moving means to engage said stack to subsequently enable said detent pawl to engage a successive ratchet tooth upon each progressive position of the follow up plate.

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