June 6, 1944. C. D. LAKE ET AL 2,350,511

SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 1

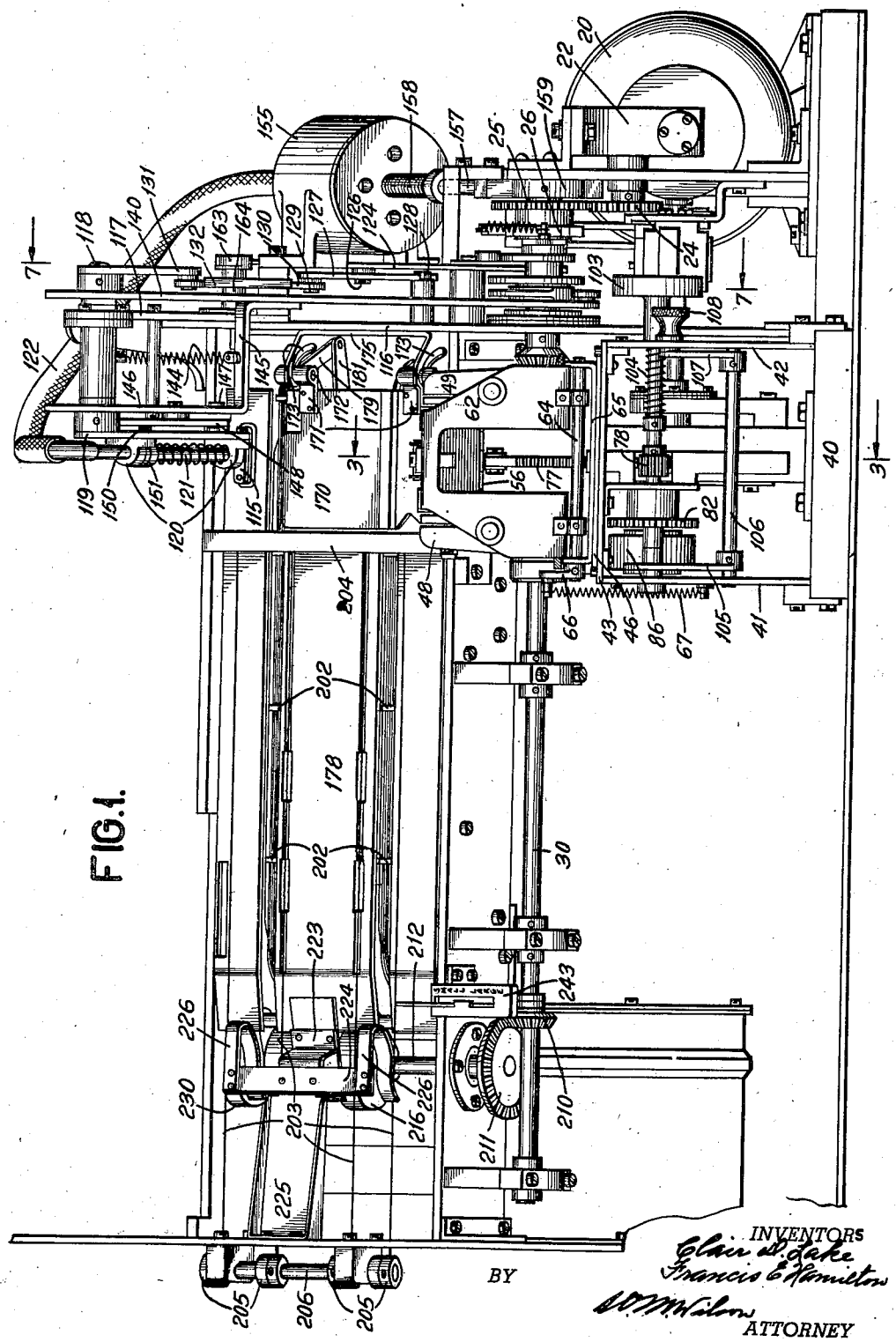


FIG. 1.

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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 2

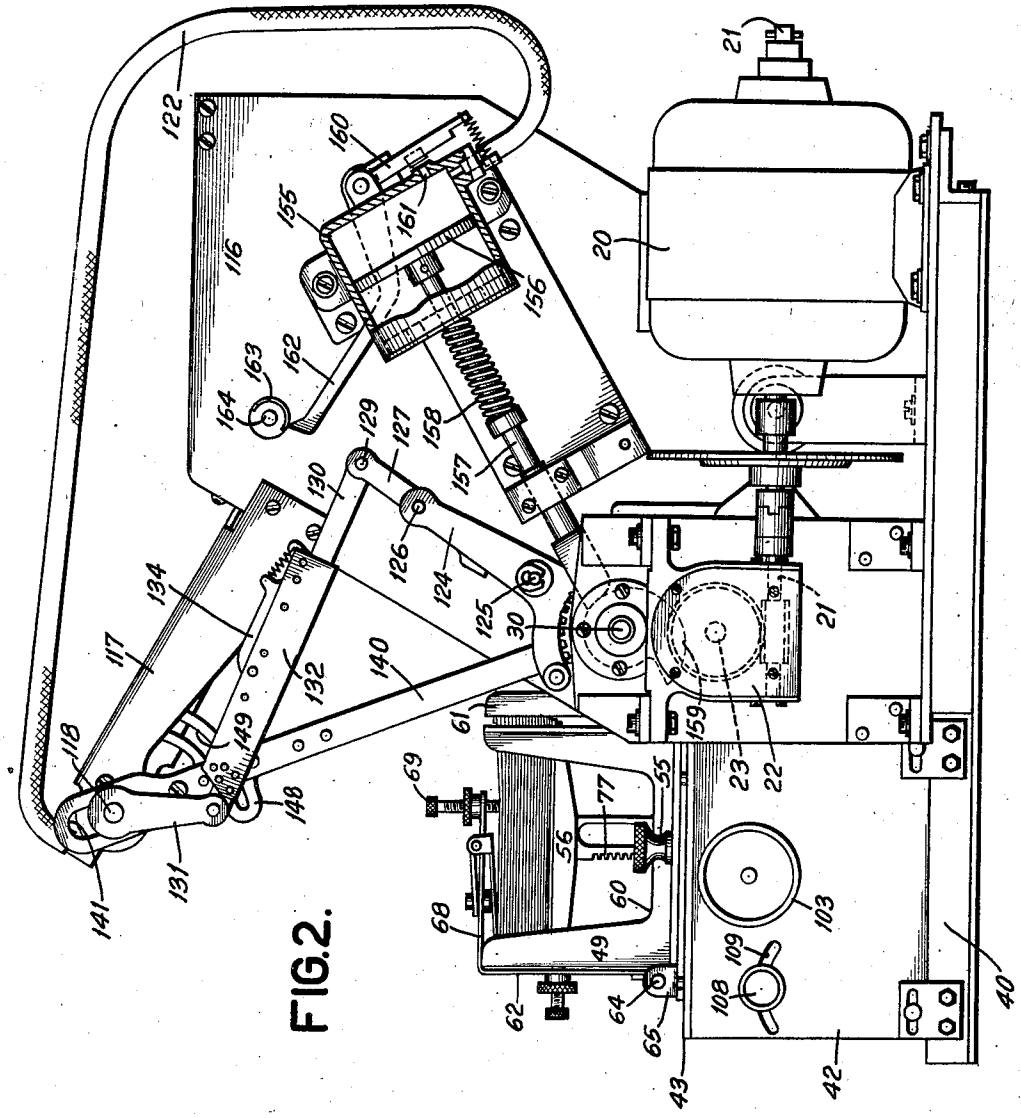


FIG. 2.

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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 3

FIG.3.

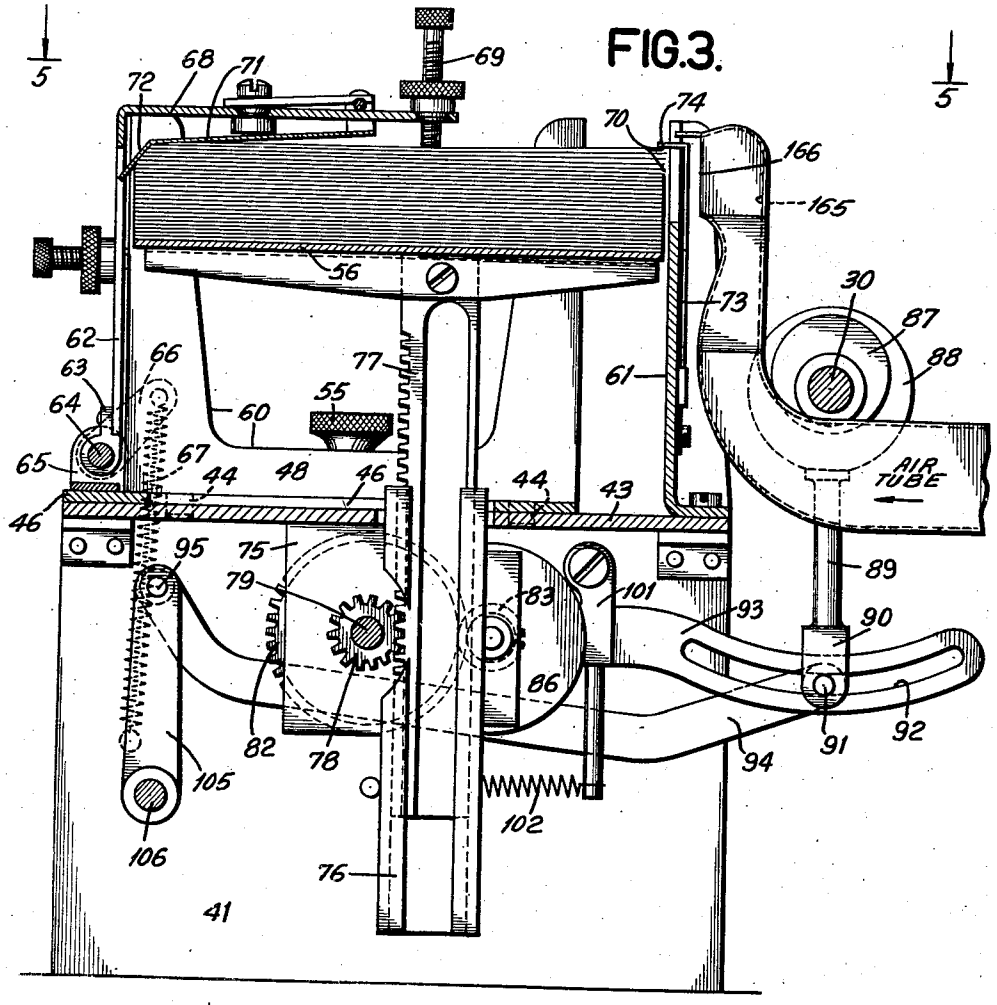
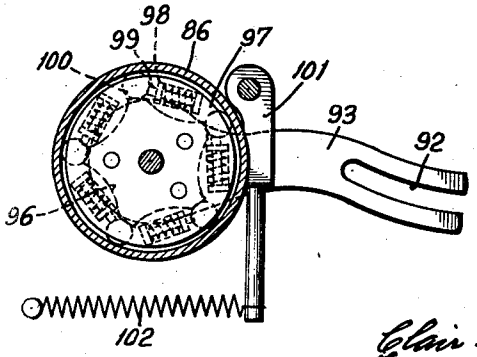


FIG.4.



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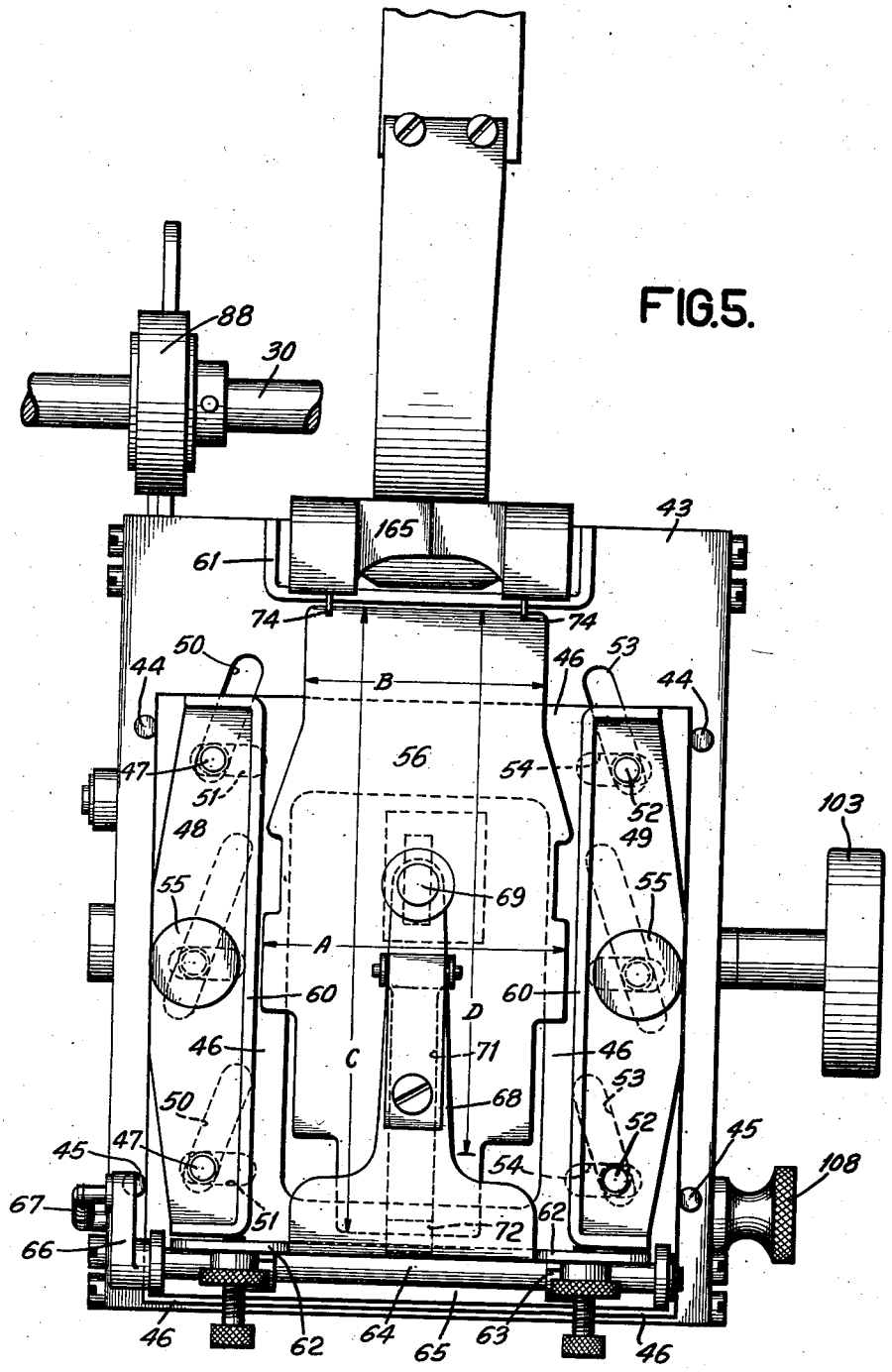
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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 4

FIG.5.



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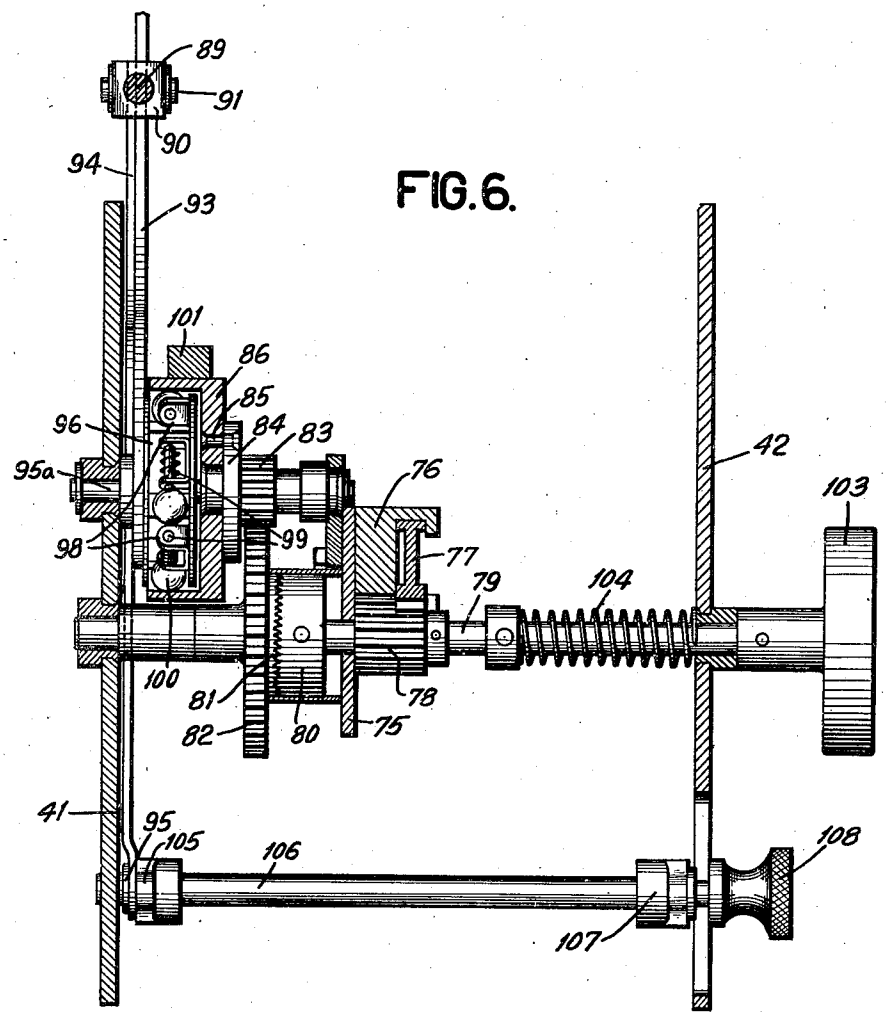
BY W. M. Wilson ATTORNEY.

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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 5

FIG. 6.



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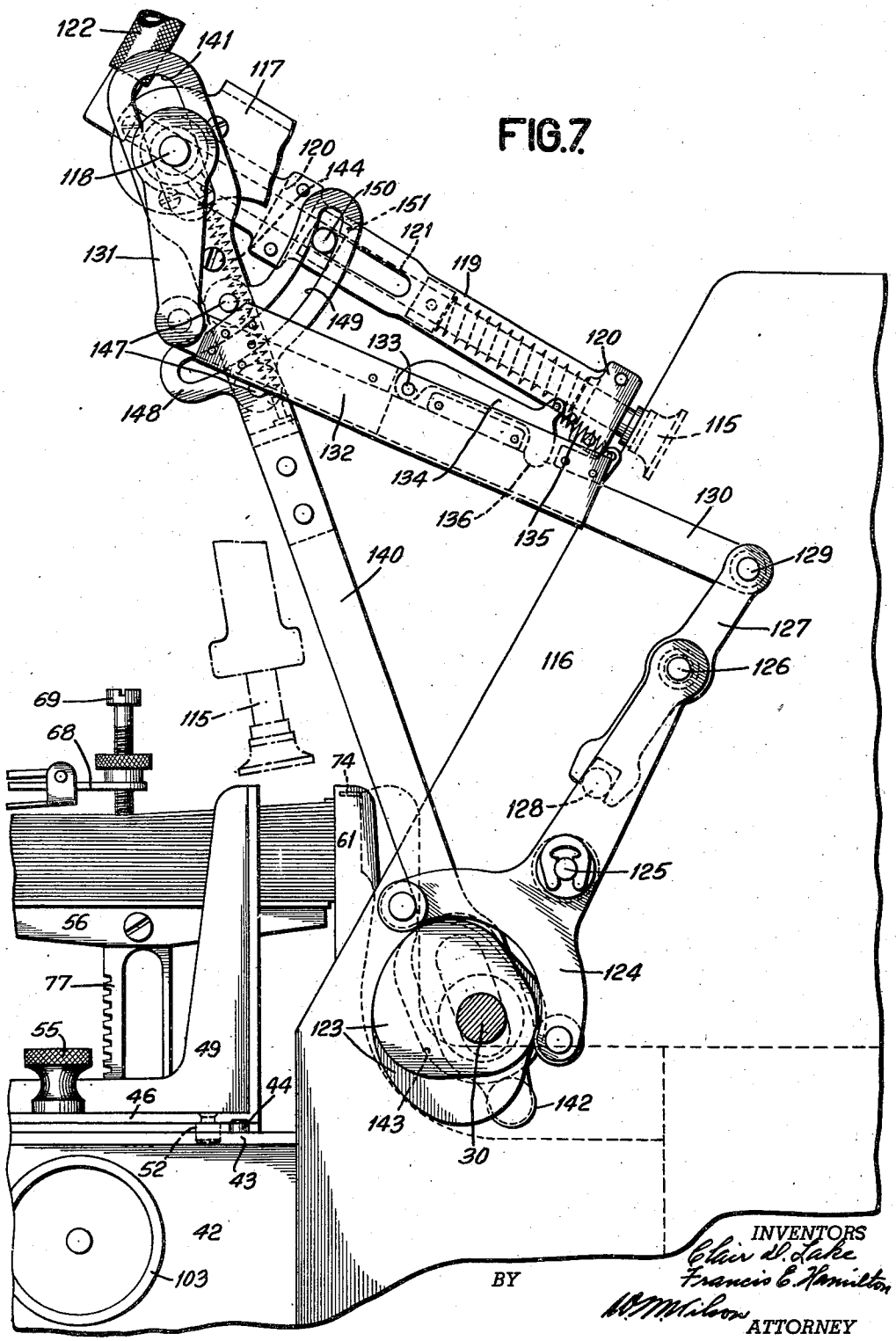
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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 6

FIG.7.



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SHEET FEEDING MACHINE

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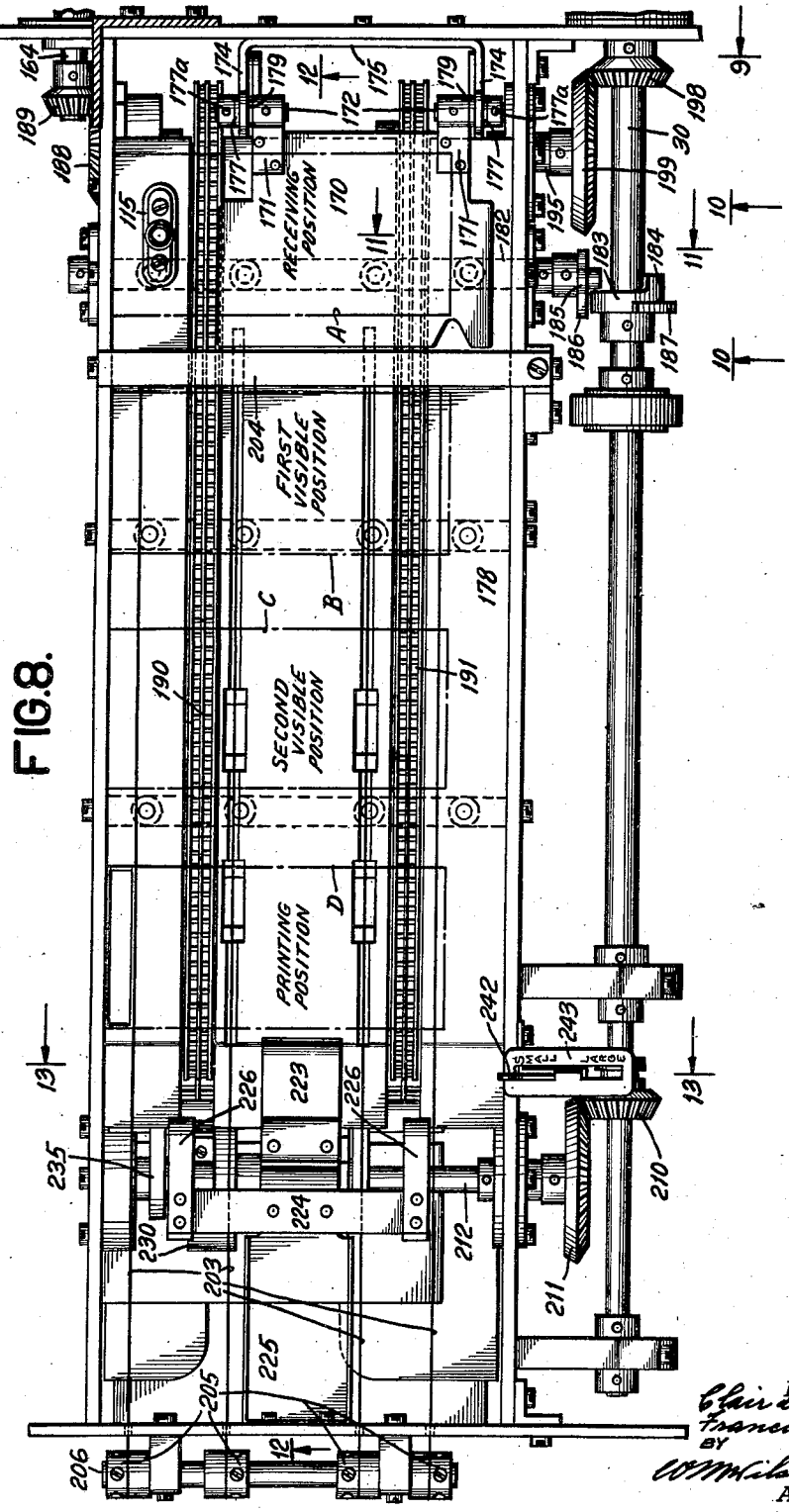


FIG.8.

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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 8

FIG.9.

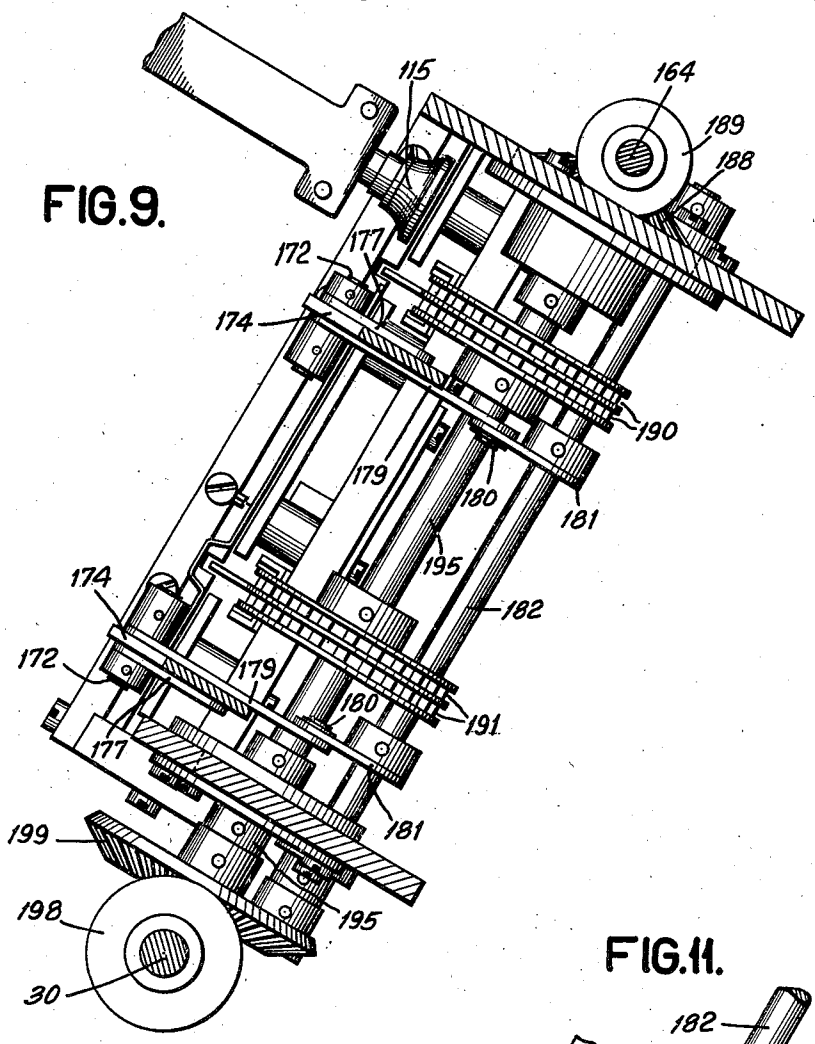


FIG.11.

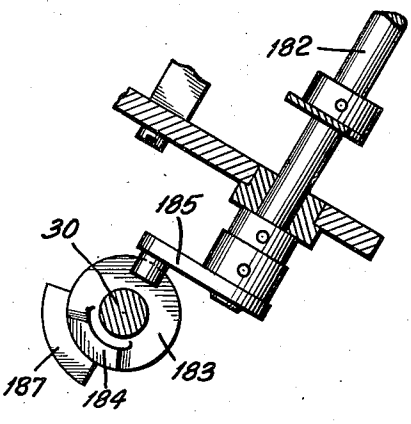
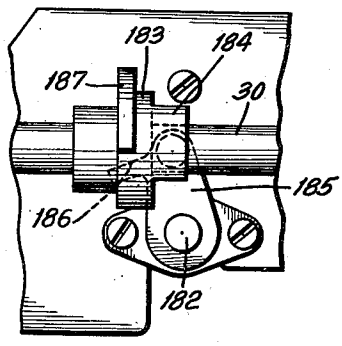


FIG.10.



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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 9

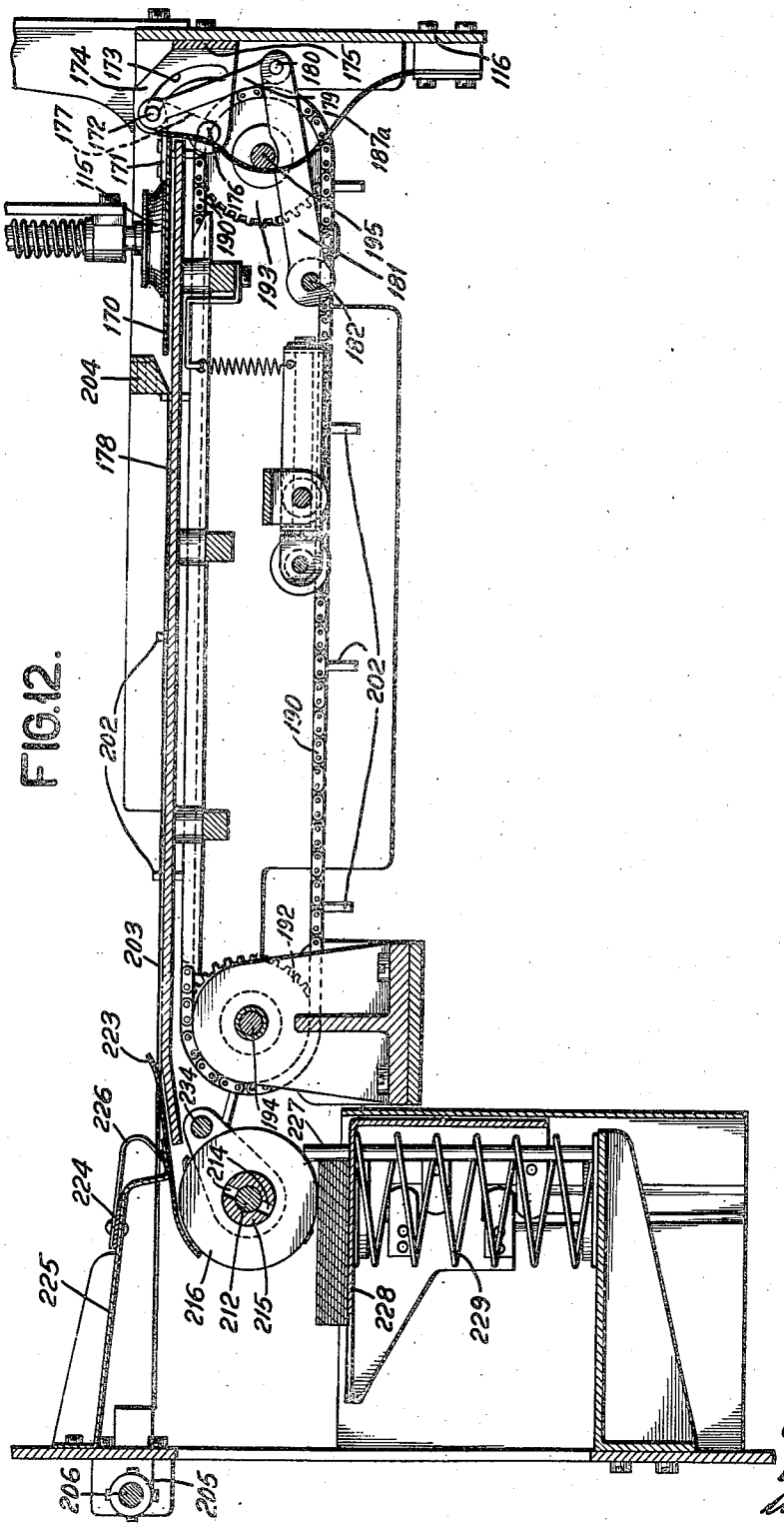


FIG. 12.

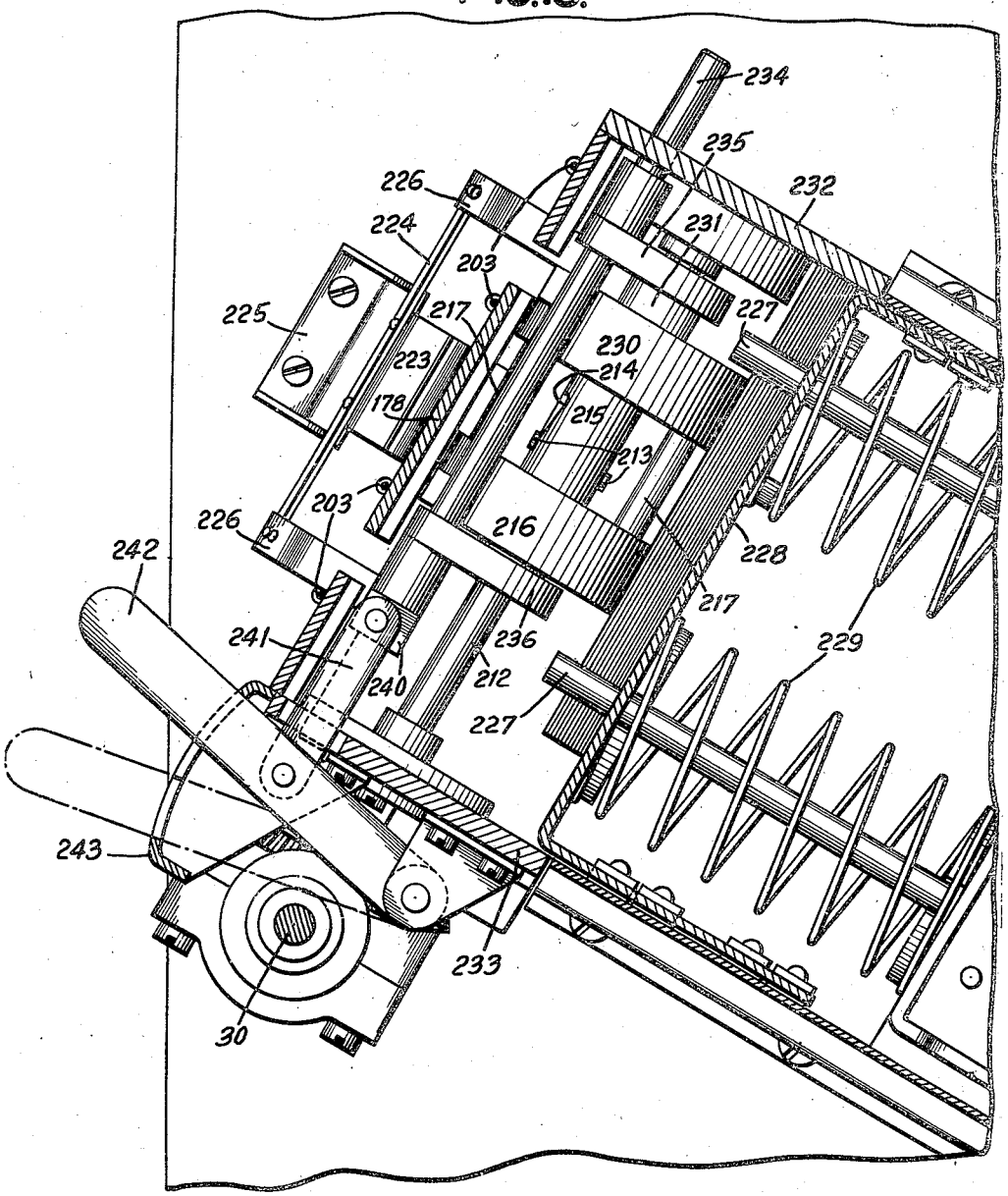
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SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 10

FIG.13.



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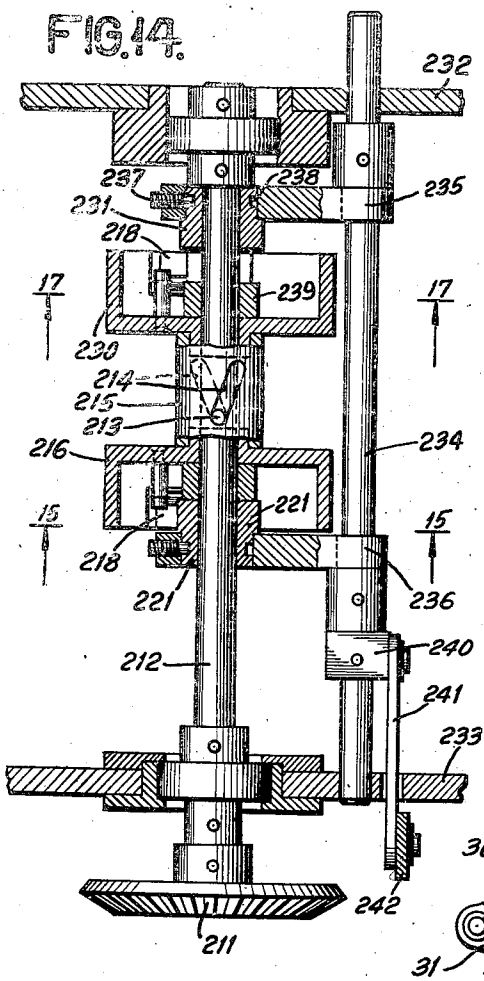
ATTORNEY.

June 6, 1944. C. D. LAKE ET AL. 2,350,511

SHEET FEEDING MACHINE

Filed Aug. 15, 1942 11 Sheets-Sheet 11

FIG.14.



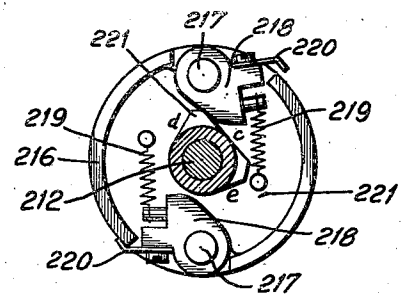


FIG.15.

FIG.16.

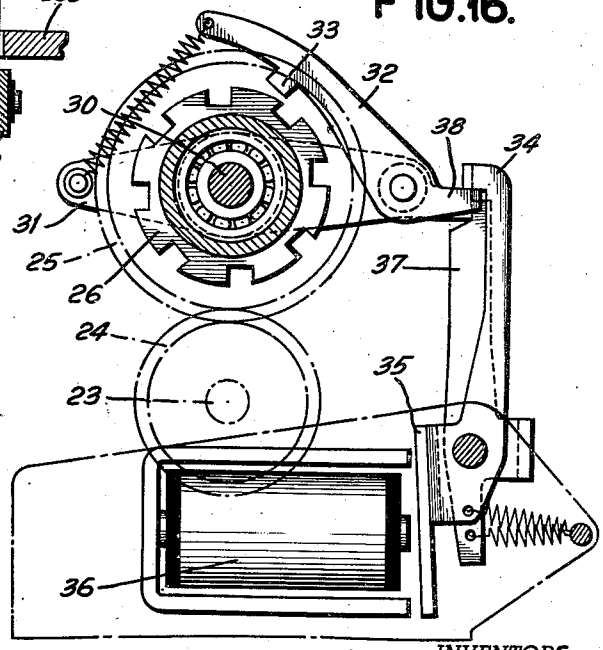
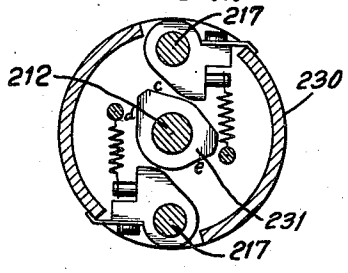


FIG.17.



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Patented June 6, 1944

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UNITED STATES PATENT OFFICE

2,350,511

SHEET FEEDING MACHINE

Clair D. Lake, Binghamton, and Francis E. Hamilton, Endicott, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application August 15, 1942, Serial No. 454,912

10 Claims. (Cl. 271—11)

This invention relates to sheet feeding mechanisms and more particularly to the type which is adapted to individually pick off sheets from a supply hopper and by successive cyclic operations of the machine 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 hopper.

The broad object of the present invention is to provide for an improved suction means for individually seizing tickets and disposing them into operative relationship with a conveying mechanism which thereafter feeds them to viewing and printing positions.

Another object of the invention related to the sheet seizing mechanism is the provision of an adjustable hopper which enables the hopper to accommodate two sizes of tickets so that they may be individually seized in an efficient manner and disposed to the aforesaid conveying mechanism.

Associated with the sheet seizing mechanism is a conveying mechanism which conveys the sheets as they are fed to successive positions, one of which may be a position for facilitating the transcription of data, and an associated position whereby data may be printed on the sheets which are fed. It is to be understood that the uses just mentioned are merely exemplary and it is immaterial to what use the sheets which are fed are put to since this will depend upon the particular use of the apparatus.

Another object of the invention is to provide an improved stacking mechanism which will stack the two different sizes of sheets with the same degree of efficiency. This object is carried out by providing an adjustment of the timing of the operation of the stacker mechanism which adjustment is preferable, due to the different widths of the sheets which are fed.

Other objects of the invention will be pointed out in the following description of the invention which is 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 view in front elevation of the assembled sheet feeding machine constructed according to the present invention.

Fig. 2 is a side elevation view taken at the right side of the assembled machine.

Fig. 3 is a section view taken on the line 3—3 of Fig. 1, and on an enlarged scale showing in detail the parts for maintaining the supply of sheets to be fed in the elevated position during successive sheet feeding operations.

Fig. 4 is a detail view of the one-way driving clutch utilized in the driving train for the sheet elevating mechanism.

Fig. 5 is a plan view taken on the line 5—5 of Fig. 3 of the sheet supply hopper, showing in particular the adjusting mechanism for changing the sheet receiving dimensions so that two different size sheets may be received thereby.

Fig. 6 is a plan view, partially in section, showing the driving train for the sheet adjusting and elevating mechanism.

Fig. 7 is a side elevation view taken at the right end of the machine, showing particularly the operating mechanism for the suction tube sheet pickup device for picking up the sheets to be fed one at a time from the supply hopper.

Fig. 8 is a plan view of the left end of the machine, showing particularly the sheet conveying mechanism for feeding the sheets in successive position during successive cyclic operations of the machine.

Fig. 9 is a section view taken on the line 9—9 of Fig. 8.

Fig. 10 is a detail view taken on the line 10—10 of Fig. 8, showing particularly one of the operating cams of the machine and associated driving train.

Fig. 11 is another view of the same mechanism but taken on the line 11—11 of Fig. 8.

Fig. 12 is a longitudinal section view of the machine taken on the line 12—12 of Fig. 8.

Fig. 13 is a cross section view taken on the line 13—13 of Fig. 8 but on an enlarged scale to show details of the sheet stacking mechanism.

Fig. 14 is a section view showing in more detail the construction and assembly of the parts associated with the sheet stacking mechanism.

Fig. 15 is a detail view taken on the line 15—15 of Fig. 14.

Fig. 16 is a section view showing in detail the one-revolution clutch mechanism for the machine for effecting successive cyclic operations of the machine.

Fig. 17 is a detail view taken on the line 17—17 of Fig. 14.

General description

One function of the sheet feeding attachment shown herein is to facilitate transcription and reading of written data on the sheets to be fed so that when moved to viewing position the oper-

ator can read this data, eliminating the necessity for the operator to handle the sheets beyond the necessity of placing or removing a supply of sheets from the supply hopper and storage hoppers, respectively. The sheet feeding mechanism is preferably adjustable so as to be adaptable in the main for two sizes of sheets. In addition to the adjustment of the size of the supply hopper there is an adjustment in the sheet stacking mechanism to compensate for the change in sheet width. An adjustment of the hopper follower plate, or the base plate on which the supply of sheets is laid, is adjustable so that upon each sheet feeding operation the supply stack will be fed upwardly a sufficient amount to maintain it in an elevated position which is maintained constant for all sheet feeding operations.

Sheets are fed singly from the supply hopper by means of a suction cup mounted on an oscillating arm. A stream of air is blown continuously against one edge of the sheets to prevent the sheets from adhering so that the suction cup will not pick up two sheets at a time. When a cyclic operation of the machine is initiated the suction arm is moved to a lower position over the stack of sheets. The suction cup then slides closer to the sheets and a suction pump is released which creates a vacuum or suction in the suction cup to a tube leading to it. Because of this vacuum the suction cup holds the sheet which it has picked up while the oscillating arm is restored to swing the suction cup and sheet to the upper limit of travel where the sheet is in the receiving position of the conveying mechanism of the machine. At this point a pivoted door swings down to hold the sheet flat in the position on the bed and a cam actuated valve opens which admits air to the suction cup and releases the vacuum holding the sheet. At the termination of the first cyclic operation of the machine the sheet is now in the initial position of the sheet conveying mechanism.

On the following cyclic operation of the machine the series of events just described are repeated and the first sheet fed is pushed along the bed of the conveying mechanism by means of projecting lugs on two endless chains to the first visible station. During this travel of the sheet it moves out from under the door where it enters beneath four stretched guide wires. These guide wires guide the sheet on the bed to maintain it in position. A third cyclic operation of the machine causes a new sheet to be fed and the two previously fed sheets move along the bed and the first sheet is now brought into what is known as a second visible station and the preceding sheet fed is now brought to the first visible station. The second visible station just precedes the printing station. When the sheet is in the second visible station the data may be conveniently read and after this a cyclic operation of the machine then ensues and the first sheet fed then moves into the printing station. It is obvious, of course, that all of the sheets which are fed subsequently after the first sheet move along from station to station in the same manner so that when the first sheet is moved to the printing station successive sheets automatically follow.

After printing has taken place on each sheet the sheet is fed to a sheet stacking mechanism so that these sheets are all placed in the storage hopper, properly stacked and in the same serial order in which they are fed.

The motive power for effecting the cyclic operation of the machine is derived from a motor 20 (Fig. 2) which continually rotates an armature shaft 21. Reference character 22 indicates a speed reduction mechanism so that the driven shaft 23 thereof rotates at a speed reduced with respect to the armature shaft 21. The shaft 23 is shown in Fig. 16 and attached to this shaft is a gear 24 which drives a gear 25 to which is secured a toothed clutch disk 26.

In order to cyclically drive the main drive shaft 30 for the machine a one-revolution clutch of a conventional form is provided, which is fully illustrated in Fig. 16. Secured to the drive shaft 30 is a clutch arm 31 upon which is pivoted a spring urged clutch dog 32 provided with a clutch tooth 33 which is normally kept out of engagement with the teeth of the clutch disk 26 by a clutch release arm 34. The clutch release arm is provided with a depending portion 35 providing an armature for a clutch control magnet 36. Obviously, when the clutch control magnet 36 is energized the clutch release arm 34 is disengaged from the pawl 32 so that the clutch tooth 33 thereof engages one of the teeth of the clutch disk 26, thereby effecting the rotation of the shaft 30 in a counterclockwise direction. At the termination of the one-revolution of the shaft 30 the extension 38 of the clutch pawl 32 is now engaged by the clutch release arm 34 which, in the meantime, has been restored to its normal position, shown in Fig. 16. This will effect a disengagement between the clutch tooth 33 and the clutch disk 26, thereby stopping the rotation of the shaft 30 when a full revolution thereof has been effected. The usual retrograde preventing stop arm 37 is provided to prevent rebound of the clutch release arm 31 and hold the latter in the normal position, shown in Fig. 16. From the shaft 30 the various parts of the machine are operated and the cyclic operation is effected by an impulse transmitted to the clutch control magnet 36 each time that the cyclic operation is to be effected. No control circuits are shown herein for energizing the magnet 36 since this may be varied in many ways and any suitable control may be provided for controlling cyclic operations, depending upon the use to which the present machine is put.

Supply hopper

The hopper is adjustable so as to accommodate two different sizes of sheets and incorporates a construction which enables the thin sheets inserted in the hopper to be picked off from the top in an efficient manner so that upon each cyclic operation of the machine a sheet will be removed from the top of the hopper. The assembled hopper is mounted upon a base plate 40 (Fig. 2) and mounted upon this plate are two side frame plates 41 (Fig. 3) and 42 (Fig. 2) and resting upon these supporting plates is a base plate 43 (Figs. 3 and 5). To the plate 43 there are secured two pairs of guide pins 44 and 45 which guide a plate 46 in its adjustment for adjusting the plate 46 either towards the operator or away therefrom.

The hopper comprises a pair of laterally adjustable vertical hopper guide plates 48 and 49 mounted on the plate 46, the plate 48 carrying a pair of guide studs 47 working in inclined slots 50 formed in the plate 43 and also in slots 51 of the plate 46. In the same manner the hopper guide plate 49 is provided with studs 52 cooperating with inclined slots 53 formed in the support plate 43 and also with slots 54 in the plate 46. Obviously, when both hopper side plates 48

and 49 are moved rearwardly from the position shown in Fig. 5 the action of cam slots 50, 53 on the cooperating studs 47, 52 will cause the guide plates to come closer together so as to decrease the width of the sheet receiving space between the hopper side plates. At the same time the cooperation of studs 47 and 52 with the slots 51, 54 in the plate 46 will move the plate 46 rearwardly on the plate 43 guided by the pairs of studs 44, 45. The adjustment of the hopper side plates 48 and 49 is facilitated and secured by knobs 55 passing through the related plates 48 and 49 and preferably having a screw extension screwed in a nut prevented from turning by slots similarly to those just described.

The sheets which are to be fed rest upon a floating base plate 56 and the manner in which it is guided to function as a floating base plate will be subsequently explained, it being noted that as shown in Fig. 5 when the hopper guide plates 48 and 49 are in the position shown these guide plates provide a sheet receiving width designated A in Fig. 5. When the hopper guide plates 48 and 49 are adjusted to be closer together, in such position the sheet receiving width is the narrowest, as designated by B. The greatest length of sheets that can be fed, with width A is designated by C, and when the width is narrowed to B, the available length is decreased to D. To prevent interference with the base plate 56 when adjusted to this narrowed width and length the hopper guide plates 48 and 49 are each provided with a cutout portion 60. (See also Figs. 2 and 3.)

The rear wall of the hopper is provided by an upstanding plate 61 (Figs. 3 and 5) which is fixed to the base plate 43 and this rearward wall of the hopper is, of course, not adjustable.

The front wall of the hopper is provided by a plate 62 (Fig. 3) and at its lower end are attached hinges 63 which are fixed to a rod 64 which functions as a pivot for the plate 62. The rod 64 is pivoted in a U-shaped bracket 65 carried by the adjustable plate 46. In order to maintain the front wall plate 62 in the position shown in Fig. 3, attached to the rod 64 is an arm 66 (Figs. 3 and 5) to which a tensioned spring 67 is connected. Hence, the front wall plate 62 is maintained in the position shown in Fig. 3 but it may be rocked by the operator so as to provide easy access to the positioning of a new supply of sheets to be placed on the floating base plate 56.

It is preferable to hold down the top portion of the supply stack of sheets to prevent more than one sheet being fed at a time. To this end the plate 62 has an overhanging portion 68 which carries a threaded pressure screw 69 (Fig. 3) and the latter is so adjusted that as the floating base plate 56 is urged upwardly the bottom part of the pressure screw 69 will press upon the stack of paper at one point. It is also preferable to push ahead some of the top sheets and which sheets are indicated by reference character 70 in Fig. 3. This is provided by a plate 71 which has an inclined depending cam portion 72 which engages the front edges of the top sheets to be fed and as the base plate 56 is moved upwardly the cam portion 72 will cam some of the top sheets to the front ahead of the others.

Since the front wall plate 62 is pivoted on rod 64 which is carried by bracket 65 mounted on plate 46, the adjustment of the plate 46 to the rear will cause the inclined cam portion 72 to functionally cooperate with the front edges of the smaller sized sheets in the same way and, of course, the pressure screw 69 will also press down upon the smaller sized sheets at the same relative position with respect to the larger sized sheets. Hence, the desirability of moving the plate 46 is evident.

To hold down the top sheets the rear wall plate has secured to it a pair of spring wires 73 having bent ends 74 overhanging the displaced top sheets. Air is directed to the edges of these sheets as will be subsequently described, and such stop wires thereby prevent such sheets from being displaced too far.

Means for maintaining the stack of sheets in elevated position

As the sheets are withdrawn from the supply stack one after the other it is necessary to elevate the base plate 56 to compensate for each withdrawal, whereby the top sheet of the supply stack will always be in the desired position to facilitate and insure its removal upon the next cyclic operation of the machine. Means is preferably provided to effect a slight movement of the base plate 56 for each removal of the sheet and is preferably effected by the following described means: Depending from the support plate 43 is a bracket 75 (Figs. 3 and 6) which bracket provides a journal for some of the shafts to be presently mentioned and also carries a guide bar 76 for guiding a rack bar 77 secured at its upper end to the base plate 56 as shown in Fig. 3. Hence, the plate 56 is guided for upward or downward movement as is necessary. Meshing with the rack bar 77 is a pinion 78 fixed to a shaft 79 journalled in the bracket plate 75 and the side plate 41. Secured to the shaft 79 is a ratchet wheel 80 (Fig. 6) meshing with a correspondingly formed ratchet wheel 81 (Fig. 6) which latter is secured to a gear 82 meshing with a pinion 83. The pinion 83 has fast to it a disk 84 which is riveted by a rivet 85 to a cup-shaped clutch housing member 86.

Referring now to Fig. 3 it will be observed that the main drive shaft 30 has secured to it an eccentrically mounted plate 87 cooperating with an eccentric ring 88 to which ring there is fixed a connecting rod 89. The action of the eccentric 87 on the ring 88 is to effect a reciprocating movement of the connecting rod 89 and during the downward movement of the rod 89 motion is communicated to the plate 56 through a one-way clutch mechanism now to be described. The lower end of the rod 89 is provided with bifurcated projections 90 which support a stud 91 fitting in a slot 92 of a rock lever 93. The pin also passes through the extremity of a lever 94 which is pivoted at 95 and for the present description it will be assumed that the pivot 95 is in the position shown in Fig. 3 so that when the connecting rod 89 is depressed it will rock the lever 93 clockwise as viewed in Fig. 3. Interposed between the clutch housing 86 and the lever 93 is a one-way ball clutch of a conventional form, this clutch also being shown in Fig. 4. Lever 93 is pivoted in the side plate 41 by means of a stud 95a and to the lever 93 at its pivotal point there is connected a cam plate 96 having the configuration shown in Fig. 4. Mounted upon a plate 97 is a plurality of mountings 98 for spring-urged plungers 99 which wedge the clutch balls 100 between the cam plate 96 and the interior of the housing 86. During the clockwise rocking of the lever 93 a wedging action is effected between the cam disk 96 and the housing 86 so that the clockwise rotation of the housing 86 will be con-

veyed to the gear 83, rocking the latter as viewed in Fig. 3 in the same direction. The clockwise movement of pinion 83 will rotate gear 82 counterclockwise and through the clutch elements 80—81 pinion 78 will also be rotated in a counterclockwise direction, thereby communicating an upward movement to the rack bar 77. During the restoration of the rocking lever 93 the wedging action between the clutch disk 96 and the interior of the housing 86 will be released so that by this well known form of clutch the return of the lever 93 to normal will not disturb the previous movement given to the rack 77 and the latter will be retained in its slightly upwardly moved position, preferably by means of a brake arm 101 (Fig. 4) urged by a spring 102 against the periphery of the housing 86, thereby retaining the latter in its moved position.

It is sometimes desirable to be able to move the plate 56 to a position by manual means, particularly when a new supply of sheets to be fed is placed in the hopper. A convenient means for providing for this comprises a handle wheel 103 (Fig. 6) which is fast to the shaft 79. It will be observed that by first moving the wheel 103 to the right as viewed in Fig. 6 against the action of a spring 104 the clutch element 80 is disengaged from the companion clutch element 81 so that shaft 79 may now be manually rotated by rotating wheel 103 to elevate or lower the rack bar 77 as desired. As is shown in Fig. 2 the wheel 103 is positioned outside of the frame plate 42 for convenient manual manipulation.

In order to provide means to vary the extent of rocking movement given to the lever 93, the following means is preferably provided: The pin 91 is positionable at any place of the slot 92 and by positioning the pin 91 at the left end of the slot as shown in Fig. 3 the maximum amount of rocking movement is given to the lever 93 whereas if the pin 91 is positioned at the right end of the slot the minimum rocking movement is given to the lever 93. Obviously, any mid-position of the pin 91 will provide other extents of rocking movement given to the lever 93. The position of the pin 91 in the slot 92 is effected by positioning the arm 94 and as shown in Fig. 3 the pivot connection 95 previously described articulates the arm 94 with an upstanding arm 105. The arm 105 is attached to a rod 106 and at the other end of the rod 106 as viewed in Fig. 1 there is attached an upstanding arm 107 and the latter is provided with an adjusting knob 108 positionable in a concentric slot 109 (Fig. 2). By unscrewing the knob 108 from the arm 107 the knob may be adjusted in any portion of the slot 109 (Fig. 2) and by screwing the knob 108 tightly against the plate 42 the position of adjustment is maintained. Hence, by rocking the arm 107 the shaft 106 will be commensurately rocked and therefore the arm 105 (Fig. 3) will also be rocked to position the arm 94 so that the pin 91 is in the desired position of the slot 92, enabling the desired amount of upward movement given to the sheet supply base plate 56.

Suction tube for picking off sheets

The sheets are removed from the supply stack by a suction cup 115 (Figs. 1 and 7) and movement is given to the suction cup from the full line position shown in Fig. 7 to the dotted line position, thence downwardly from such dotted line position to seize the top sheet and then backwardly to the full line position shown in Fig. 7. Means for effecting this movement will now be described: To the side frame plate 116 there is attached an upstanding bracket plate 117 (Figs. 1 and 2) in which is journalled a rod or rock shaft 118. To the rock shaft 118 there is secured a downwardly extending arm 119 to which is secured a pair of guide brackets 120 in which is slidably mounted the suction tube 121 which terminates at the suction cup 115. The upper end of the suction tube 121 has attached thereto a hose 122 which communicates suction to the suction cup 115 from a suction pump to be described hereinafter.

For moving the suction cup 115 from the full line position to the dotted line position, an operating train consisting of the following is provided. Mounted upon the drive shaft 30 is a pair of complementary profile cams 123 cooperating with rollers of a follower arm 124 pivoted at 125. The upper end of the arm 124 has a pivot connection 126 to a double arm 127, the lower end of which is bifurcated to receive a pin 128 secured to the frame plate 116 and the upper arm of the double arm 127 has a pivot connection 129 to a link 130. Secured to the rock shaft or rod 118 is an arm 131 and the link connection between the arm 131 and the upper arm of the double arm 127 comprises a link connection of which the member 130 is one portion of the link and the other portion is a member 132 consisting of two spaced plates which provide a pivotal connection 133 for a latch lever 134. The latch lever 134 is urged by a spring 135 so that the downward portion thereof engages a scalloped depression 136 of the member 130. Hence, by the above construction it is obvious that the link connection between the double arm 127 and the arm 131 comprises an impositive link connection which enables the shortening of the link resulting possibly from an overthrow movement of the arm 127 without damaging the connecting apparatus.

At the beginning of the cyclic movement of the drive shaft 30 the complementary cams 123 act upon the follower arm 124, rocking the same in a counterclockwise direction to rock the double arm 127 by a compound movement in a counterclockwise direction to shift the link connection 130—132 to the left as viewed in Fig. 7, thereby rocking the arm 119 to move the suction cup 115 from its upper position to the lower position shown in Fig. 7. After the suction tube is in the dotted line position shown in Fig. 7, downward movement is given to the suction tube by means now to be described and when the suction tube is in the dotted position, further movement is given to it so as to engage the top sheet of the supply stack. A pitman 140 (see Figs. 1 and 7) is provided with a closed guide slot 141 receiving the rock shaft 118 and the lower end of the pitman 140 is provided with a follower roller 142 cooperating with a profile cam 143 secured to the drive shaft 30. By the action of the cam 143 on the follower roller 142 the pitman 140 is moved downwardly against the action of a spring 144 and by continued rotation of the cam 143 the pitman 140 is restored under the action of the tensioned spring 144.

From Fig. 1 it will be seen that the pitman 140 is provided with a laterally extending yoke 145 (Fig. 1) and the upper portion 146 of this yoke is also provided with a closed slot like the closed slot 141 (Fig. 7) which also receives the shaft 118. By means of rivets 147 a cam plate 148 is secured to the part 146 and the cam plate 148 is provided with a cam slot 149 receiving a pin

150 carried by bracket 151 fixed to the suction tube 121.

During the initial oscillating movement of the suction cup 115 about the center of the rock shaft 118, the action of the cam slot 149 on the pin 150 will cause the suction cup to be moved slightly downward and this downward movement is completed when the suction cup 115 is in the dotted line position. After this position has been reached the cam 143 acting on the roller 142 will depress the pitman 140 and with the stud 150 in the left end of the slot 149 the cam plate 148 will also be moved away from the shaft 118 to cause the suction cup 115 to come in contact with the top sheet of the supply stack. In this position of the suction cup 115 suction is applied thereto so that this will cause the suction cup to seize the top sheet, after which the cam 143 then effects the return movement of the pitman 140 and the suction cup 115 to its dotted line position. After the suction cup is elevated by the action of the cam 143 the suction cup carrying arm 119 is rocked back to its normal position by cams 123 and by the reverse action of the cam slot 149 on the stud 150 the latter is brought to the full line position shown in Fig. 7 with the top sheet which has been removed from the supply stack carried thereby.

Suction pump

The suction pump is provided for the purpose of producing a suction at the suction cup 115 at the time the suction cup has been lowered to contact the uppermost sheet of the supply stack.

Referring to Fig. 2 it will be seen that the suction pump comprises a cylinder 155 in which is disposed a piston 156 and to the piston there is connected a piston rod 157 and the latter is urged by spring 158 to contact with a profile cam 159 secured to the main drive shaft 30. The suction pump is provided with a bleeder valve 160 which registers with an orifice 161 of the cylinder. For rocking the bleeder valve 160 closed or open, the latter is provided with a connecting arm 162 cooperating with a cam 163 attached to a shaft 164 rotated in a manner to be subsequently described.

During the time that the suction cup 115 is being moved to its dotted line position the bleeder valve 160 is rocked by the cam 163 to open the valve and during this time the high portion of the profile cam 159 will shift the piston rod 157 and piston 156 to the upper part of the piston cylinder 155. After the suction cup 115 has been lowered to contact with the top sheet the cam 163 rocks the arm 162 to close the bleeder valve 160 closely against the orifice 161, thus sealing the cylinder. After this, the piston rod drops off the high part of the cam 159 and under the action of the spring 158 the piston is quickly drawn to the lower part of the cylinder, producing a suction in the cylinder which is conveyed to the hose 122 which has a communication to the cylinder and also to the suction tube 121 as previously described and as is evident from Fig. 1. The suction action at the suction cup 115 will cause it to seize the top sheet and during the time that the suction cup is being restored to its normal position the suction action is continued to cause the suction cup to retain hold of the seized sheet. At a time in the operation of the machine for a purpose to be referred to more in detail hereinafter the bleeder valve 160 is opened, destroying the suction in the suction cup 115 so as to release the seized sheet.

Separation of sheets by air pressure

In order to prevent the sheets from adhering to each other so as to facilitate the removal of only one sheet at a time, it is preferable to provide means for directing a blast of air at the edges of the sheets to effect their physical separation. In the present machine this is effected by a means of an air supply tube 165 (Fig. 3) which has an open nozzle 166 disposed at the rear of the stack of sheets. The fan for directing air to the tube 165 is not shown herein since any conventional form will be satisfactory, it being noted that in the operation of the machine this fan continuously directs the air blast to the sheets in the manner just described.

Card gate

The card gate is for the purpose of pushing down the sheet which was fed on the bed of the conveying mechanism; forcibly detaching it from the suction cup 115 and holding the sheet flat on the bed. The associated mechanism is best shown in Figs. 1, 8, 9, 10, 11 and 12.

The gate consists of a plate 170 which is disposed just to the front of the suction cup 115 when the latter is in the position shown in Figs. 1 and 8 so that when the gate is rocked down after having been rocked upwardly to a position for free placing of the sheet on the bed, the gate may rock back to its lowered position without interference with the suction cup 115. From Fig. 8 it will be seen that gate plate 170 overlies only the lower part of the bed plate 178 and does not extend completely to the rear of the bed plate so that the area of the bed plate 178 at the rear and uncovered by gate plate 170 comprises a suction gripper receiving position. By means of hinge plates 171 attached to gate plate 170 a pair of hinge pins 172 are carried thereby and the pins 172 project in arcuate slots 173 formed in the side members 174 of a yoke 175 secured to the side frame member 116. Loosely pivoted at 176 to the side members 174 are arms 177 and said arms are pinned by pins 177*a* (Fig. 8) to the related hinge pins 172. The gate 170 is normally disposed as shown in Fig. 12 and obviously as the arms 177 are rocked in a clockwise direction about their pivots 176 the pins 172 will follow the curvature of the slots 173 and the action on pins 172 by arms 177 is to rock the pins clockwise to cause the gate 170 to be rocked clockwise and when the hinge pins 172 are at the lower positions of the slots 173 the gate 170 is in such rocked and elevated position that there will be no interference by it when the suction cup deposits a sheet on the part of the bed plate 178 which was previously covered by the gate plate 170. For the purpose of rocking the gate in such position a link 179 is loosely pivoted to the hinge pin 172 and to a pivot stud 180 of an arm 181 secured to a rock shaft 182. A pair of such link and arm connections is provided so that each side of the gate may be rocked the same extent and by rocking the shaft 182 the gate may be rocked upwardly, or lowered to the position shown in Fig. 12 over the sheet which has been placed by the suction cup.

The means for rocking the shaft 182 is best shown in Figs. 10 and 11 where it will be seen that to the shaft 30 there is secured a disk 183 which has a projecting cam portion 184 cooperating with a follower arm 185 secured to the rock shaft 182. Substantially at the time in the

operation of the machine that the suction cup has been lowered to the dotted line position shown in Fig. 7, the cam disk 183 has been rotated sufficiently so that the cam portion 184 engaging the follower arm 185 will rock the rock shaft 182 to thereby elevate the gate plate 176 and the cam portion 184 will retain the gate in such elevated position and it will be held in such position, during the time that the suction cup 115 is restored to the position shown in Fig. 1 with the paper sheet just seized over the bed plate 178. The gate is held in such position by cooperation of a projection 186 of the follower arm 185 with an extension 187 of the disk 183. Ultimately, projection 186 drops off the extension 187, quickly rocking the gate plate 176 back to its normal position on top of the sheet just fed and thereby forcibly detaching it from the suction cup in the event that it should stick thereto. The reverse rocking of gate plate 176 is assisted by the tendency of a flat spring 187*a* (Fig. 12) to come to normal, the upper part of which above shaft 195 is bent by gate plate 176 as the latter is rocked clockwise. The bleeder valve 169 is rocked to destroy the vacuum at the suction cup while the gate plate is being shut so that the sheet will be freely detached from the suction cup.

After this operation the suction cup 115 remains in the position shown in Fig. 7 for a short time at the termination of the cycle of operation but before the cycle of operation is terminated the suction cup 115 begins to move slightly downward from the full line position shown in Fig. 7 so that when the next cycle of operation is initiated the suction cup begins to move downwardly from the slightly moved position.

Conveying mechanism

A conveying mechanism is adapted to position the sheet in successive positions designated in Fig. 8 as A or the initial "Receiving position," thence to the B position or the "First visible position," thence to position C or "Second visible position," and thence to position D which may be the "Printing position" for the sheet. The conveying mechanism by successive cyclic operations of the machine brings the sheets to these positions in succession.

The conveying mechanism consists of a pair of endless chains 190 and 191 (Figs. 8, 9 and 12), the chain 190 passing around sprocket wheels 192 and 193 (Fig. 12) which are secured to respective shafts 194 and 195. The chain 191 passes over similar sprocket wheels also secured to the aforementioned shafts 194 and 195. For driving the shaft 195 it will be observed that secured to the shaft 30 is a beveled gear 198 meshing with a beveled gear 199 secured to the drive shaft 195. Also secured to drive shaft 195 is a beveled gear 188 meshing with a beveled gear 189 (Figs. 8 and 9) attached to shaft 164 for rotating cam 163 (Fig. 2) previously referred to.

The chains 190 and 191 carry a plurality of lugs 202 which engage the sides of the wider sheets because the separation of adjacent lugs correspond to the width of the wider sheets. It is obvious for each cyclic operation of the machine that the narrow or wide sheet is moved from one position to the successive position, it being shifted along by the lugs 202 that the trailing edge of the sheet coacts with. In order to insure that the sheet will be fed over the plate 178 in this manner, disposed over the plate 178 are four guide wires 203 (Figs. 1, 8, 12, 13). These guide wires are extended from a block 204 and are attached to respective hubs 205 which are adjustable upon a rod 206 so that each hub may be independently adjusted and the wire made taut. When the sheet is fed from the "Receiving position" to the "First visible position" the sheet passes underneath the wire 203, retaining the sheet down on the bed plate 178 and such sheet is maintained in this position during the successive feeding of the sheets until the "Printing position" is reached at which time a stacking mechanism seizes the sheet and stacks it in a storage hopper in a manner now to be explained.

Sheet stacking mechanism

While the narrow or wide sheets which are successively fed may be fed off the bed plate 178 to any convenient supply receptacle, it is preferable to stack the sheets in an orderly manner so that they are in the same order as they are fed. To this end a sheet stacking mechanism shown particularly in Figs. 12, 13, 14, 15 and 17 is provided and forms the subject matter of applicants' application, Serial No. 460,128, filed September 29, 1942.

Secured to the drive shaft 30 is a beveled gear 210 (Fig. 8) meshing with a beveled gear 211 secured to a drive shaft 212. The shaft 212 as best shown in Fig. 14 carries a pin 213 which projects through and to the outside of the shaft and engages at the outside of the shaft the diagonally formed cam slots 214 formed in a tube 215 loosely mounted on the shaft 212. Two slots of the diagonal formation shown in Fig. 14 are formed in the tube 215 so that the extremities of pin 213 cooperate with the respective diagonal slot. With the pin 213 in the ends of the slots as shown and with the tube 215 adjusted to the position shown in Fig. 14 by means to be later described, rotation of the shaft 212 will cause the concomitant rotation of tube 215 and parts secured thereto in a manner now to be described.

To the tube 215 there is secured in any desirable manner a pair of sheet stacking drums 216 and 230, provided to stack the sheets of both narrow and wider widths. Within each stacking drum there is secured to one end of a rod 217 a plate 218 which is urged by a spring 219 so that a sheet gripper plate 220 carried by the plate 218, if not restrained, rests upon the outside periphery of the drum 216, or 230, as the case may be. As shown in Fig. 13, the rod 217 interconnects the related pair of gripper plates 218 of the stacking drums 216 and 230.

From Fig. 15 it will be noted that the sheet gripper parts for the stacking drum 216 are duplicated, this also being true of the gripper parts for the stacker drum 230 as shown in Fig. 17. By means of the gear ratio between the beveled gears 210 and 211 the shaft 212 is given a half revolution for each cyclic operation of the machine. The members 218 and their gripper plates 220 carried thereby are sheet gripping devices, one of which is operable for each stacking drum during each cyclic operation of the machine to seize the sheet, or in other words, for each stacking drum the sheet grippers are alternately effective. For the purpose of rocking the inter-connected members 218 for the sorting drums 216 and 230 to effect a separation between the effective gripper plates 220 and the periphery of the

respective stacking drums 216 and 230 and for the closure of this space there is provided for stacking narrow sheets a double lobed cam member 221 having the contour shown in Fig. 15 and the cam member 221 should be considered as stationary during the rotation of the sheet stacking drums 216 and 230.

The stacking drum 216 is shown in Fig. 15 in normal position so that the gripper plate 220 has been moved away from the periphery of the drum 216. With cam member 221 in effective position, it is to be understood that the gripper plates 220 of the stacking drum 230 are also in the position shown in Fig. 15, due to the interconnection of the gripper devices by the connecting rods 217. As the stacking drums 216 and 230 rotate further counterclockwise, the cooperation of cam portion c will cause plates 218 to be rocked counterclockwise, causing the gripper plates 220 to be moved further away from the periphery of the stacking drums 216 and 230 and as the wider gap is being formed the leading edge of the sheet is being fed over bed plate 178 until, at some point in the operation, the leading edge is now under the gripper plates 220. After this, cam portion *d* enables the gripper plates 220 to close to contact the periphery of the drums, holding the leading edge of the sheet against the drums as the sheet is still fed by the conveyor so that as the drums further rotate they will carry the sheet around.

From Fig. 1 it will be seen that a bracket support plate 225 extends over the stacking drums and carries a transverse plate 224 which carries a central guide plate 223 and at the ends curved guide fingers 226 guide the sheet to insure that the grippers carry the paper sheet away and off the bed plate. As the stacking drums 216 and 230 further rotate the sheet is carried across the top of a storage hopper until it engages stop rods 227. The base plate of the storage hopper is indicated by reference numeral 228 and receives the stop rods 227 to guide the base plate as it moves downwardly against the action of the springs 229. As the leading edge of the sheet strikes rods 227 cam portion *e* rocks the effective gripper plates 220 of the stacking drums 216 and 230 to separate it from the periphery of the drums to release the hold on the now stacked sheets and at the end of the cycle operation the gripper plates then go to a closed position and then open position for the beginning of the next cycle. The above sequence of events takes place during two cycles of machine operation and by the sequential operation of the grippers associated with the stacking drums 216 and 230 one pair of grippers of the stacking drums may be effective to turn the sheet around to be deposited in the storage hopper while the other grippers may be in position to receive a following sheet.

Means for adjusting timing of stacker drums to stack wider sheets

The stacker drums 216 and 230 are not only utilized for stacking small sized or narrow sheets but also for stacking wider sheets but a change in timing of the operation of the effective grippers for the stacking drums 216 and 230 is effected to accommodate the reception of the larger sized or wider sheets.

The change in timing is effected by the utilization of a cam 231 and the latter effects the concurrent operation of the effective grippers of the stacking drums 216 and 230 and in the same manner as described for cam 221 but the desired timing of the actuation of the grippers is somewhat different, due to the difference in the angular position of the cam portion *c—d* from the same cam portions of cam 221.

As shown in Fig. 14, cam 231 is out of cooperative relationship with the stacker drum 230 when the cam 221 is in cooperative relationship with the grippers of the stacker drum 216 which relationship is necessary for stacking narrow sheets.

In order to selectively bring the aforementioned cam plates 221 and 231 into cooperative relationship with the respective stacking drum, means is provided to render one effective when the other is ineffective. Slidably mounted between two frame plates 232 and 233 is a rod 234 and secured to the rod 234 are arms 235 and 236. The arm 235 has a hole which receives the collar of the cam 231 and cam 231 is fixed to the arm 235 by means of a set screw 237 passing through the arm 235 and engaging a part of an annular groove 238 formed in the collar of the cam 231. This set screw and groove construction is preferably provided in order to enable close angular adjustment of the cam 231 to provide for the desired timing in operations. A similar connection is made between the arm 236 and the cam 221 for the same purposes.

When the rod 234 is in the position shown in Fig. 14. cam 221 is effective and therefore control the grippers of the stacker drums 216 and 230 but when the rod 234 is moved towards the operator the cam 221 is moved out of cooperative relationship and the cam 231 is moved to such position that it will be effective to control the grippers of the stacker drums 216 and 230. After the cam 231 is moved within the stacker drum 230 and after it engages a bushing 239 carried by the stacker drum 230, further movement of the rod 234 towards the operator will cause the movement of the assembly which comprises the tube 215 and the stacker drums 216 and 230 and parts carried thereby. Further movement of the rod 234 after this engagement is effected will move this assembly towards the operator and by means of the diagonal slots 214 in cooperation with the pin 213 the tube 215 will be rotated slightly counterclockwise, thereby giving the proper relationship of the effective grippers associated with the stacker drums 216 and 230 with respect to its operating cam 231 to provide for the desired timing in operations. This movement of the stacking drums 216 and 230 also positions the latter so that they are located somewhat centrally with respect to the sheet to be seized and fed.

To provide a convenient means of adjusting the rod 234 for stacking either narrow or wide sheets a block 240 is pinned to the rod 234 and a link 241 provides a connection between the block 240 and adjusting lever 242 (see Fig. 13). The latter works in a slot of an index plate 243 (see also Fig. 8) and the adjusting lever 242 is adjustable to positions on the index plate marked "Small" and "Large" to select the desired cam for stacking narrow or wide sheets. respectively. From Fig. 8 it is obvious that when a sheet is in the "printing position" designated by D a wide sheet will, at the termination of a machine operation, be somewhat closer to the stacking mechanism than a narrow sheet, and in general, the change in timing is provided so that when stacking narrow sheets the machine provides for gripping the narrow sized sheets somewhat earlier in the cyclic operation of the machine

than for feeding wide sheets. For securing the gripping of the wider sheets later in the cycle of operation the effective cam portion *c—d* of the cam 231 is disposed as shown in Fig. 17. In general, the operations are the same, that is, the pair of gripper plates of the stacking drums 216 and 230 which are effective open up as the wide sheet is being fed by the conveyor mechanism and during a certain point in the operation of the machine the leading edge of the sheet is completely under the gripper plates and over the periphery of the stacking drums 216 and 230. The effective gripper plates now ride down the cam portion *d*, causing the effective gripper plates to hold the leading edge of the sheet firmly against the periphery of the stacking drums 216 and 230. The seized sheet is carried around in the same manner and is also stacked in the storage hopper in the manner previously described in detail so that a repetition of the description is believed to be unnecessary.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a single embodiment, 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 machine for separating sheets from the top of a stack and feeding them comprising a suction operated gripper oscillatable about a pivot over a stack of sheets to seize the uppermost sheet, a sheet conveyor mechanism for longitudinally feeding the sheets in successive positions during successive cyclic machine operations, a pivoted gate at the entrance of the conveyor mechanism and overlying the flat bed thereof, means for rocking the gate to provide a free entrance position on the conveyor for the sheet fed, means for oscillating the suction gripper from a position adjacent the entrance position to a position over the stack and then back to said entrance position, and means for then rocking the gate to dislodge the sheet from the suction gripper to place the sheet on the conveyor at the entrance position thereof.

2. A machine for separating sheets from the top of a stack and feeding them comprising a suction operated gripper oscillatable about a pivot over a stack of sheets to seize the uppermost sheet, a sheet conveyor mechanism comprising endless chains with lugs spaced to receive the sheets for longitudinally feeding the sheets in successive positions during successive cyclic machine operations, a pivoted gate at the entrance of the conveyor mechanism and overlying the flat bed thereof, means for rocking the gate to provide a free entrance position on the conveyor for the sheet fed, means for oscillating the suction gripper from a position adjacent the entrance position to a position over the stack and then back to said entrance position, means for then rocking the gate to dislodge the sheet from the suction gripper to place the sheet on the conveyor at the entrance position thereof between a pair of said lugs, and power operated means for driving said endless chains and for operating said gate rocking means and said oscillating means in timed operation to cause the successive positioning of the sheets previously fed on the bed of the conveyor, and for each feeding operation cause said oscillating means to feed a sheet from the stack to the conveyor and cause said rocking means to operate the gate to dislodge the sheets from the suction gripper.

3. A machine for separating sheets from the top of a stack and feeding them comprising a suction operated gripper oscillatable about a pivot over a stack of sheets to seize the uppermost sheet and radially movable to contact the uppermost sheet, a sheet conveyor mechanism for longitudinally feeding the sheets in successive positions during successive cyclic machine operations, a pivoted gate at the entrance of the conveyor mechanism and overlying the flat bed thereof, means for rocking the gate to provide a free entrance position on the conveyor for the sheet fed, means for oscillating the suction gripper from a position adjacent the entrance position to a position over the stack and then to said entrance position, cam means operable during the oscillating movement to radially move said gripper to seize the uppermost sheet, and means for rocking the gate when the sheet seized is at the entrance position to dislodge the sheet from the suction gripper to place the sheet on the conveyor at the entrance position thereof.

4. A machine for separating sheets from the top of a stack and feeding them comprising a suction operated gripper oscillatable about a pivot over a stack of sheets to seize the uppermost sheet, a sheet conveyor mechanism for longitudinally feeding the sheets in successive positions during successive cyclic machine operations, a pivoted gate at the entrance of the conveyor mechanism and having a width overlying only part of the flat bed thereof to leave a suction gripper receiving position, means for rocking the gate to provide a free entrance on the conveyor for the sheet fed, means for oscillating the suction gripper from a position adjacent the entrance position to a position over the stack and then to said suction gripper receiving position at the entrance position of said conveyor, and means for then rocking the gate to dislodge the sheet from the suction gripper to place the sheet on the conveyor at the entrance position thereof.

5. In a sheet feeding device for a stack of sheets, the combination of a gripper for feeding from the stack a single sheet to be fed, a movable base plate, a stationary base plate with means for adjustably carrying said movable base plate, adjustable hopper side plates forming with said movable base plate a sheet supply hopper, means for adjustably mounting said hopper side plates on said movable base plate to provide for both longitudinal and transverse movements of said hopper side plates to provide a sheet receiving space of variable widths and lengths, said mounting means having connections to said movable base plate for concurrent longitudinal adjustment of the movable base plate on the stationary base plate as the hopper side plates are adjusted transversely and longitudinally on the movable base plate.

6. In a sheet feeding device of the class described, the combination of a support plate for a stack of sheets to be fed, a movable suction gripper for picking off the top of the stack a single sheet to be fed, a movable base plate parallel to said support plate and beneath said support plate, adjustable hopper side plates forming with said support plate a sheet supply hopper, means for adjustably mounting said hopper side plates on said movable base plate to provide a

sheet receiving space of two different widths, a stationary base plate with means for adjustably carrying said movable base plate for concurrent adjustment of the movable base plate on the stationary base plate as the hopper side plates are adjusted on the movable base plate, and a rear wall plate carried by said stationary base plate forming the rear wall of said hopper.

7. In a sheet feeding device of the class described, the combination of a support plate for a stack of sheets to be fed, a movable suction gripper for picking off the top of the stack a single sheet to be fed, a movable base plate parallel to said support plate and beneath said support plate, adjustable hopper side plates forming with said support plate a sheet supply hopper, means for adjustably mounting said hopper side plates on said movable base plate to provide a sheet receiving space of two different widths, a stationary base plate with means for adjustably carrying said movable base plate for concurrent adjustment of the movable base plate on the stationary base plate as the hopper side plates are adjusted on the movable base plate, a rear wall plate carried by said stationary base plate forming the rear wall of said hopper, and a presser member carried by said movable base pressing upon the top of the stack to press the sheets against the support plate at a place variably dependent upon the adjustment of the base plate.

8. In a sheet feeding device of the class described, the combination of a support plate for a stack of sheets to be fed, a movable suction gripper for picking off the top of a stack a single sheet to be fed, a stationary base plate, a movable base plate parallel to the support plate and beneath said support plate, adjustable hopper side plates forming with said support plate a sheet supply hopper, and pins carried by each of said side plates working in diagonal slots in said stationary base plate to converge said side plates to diminish the sheet receiving space, said pins operating in slots in said movable base plate at right angles to the movement of the pins to cause the positioning of the movable base plate relative to said stationary base plate.

9. In a sheet feeding device of the class described, the combination of a support plate for a stack of sheets to be fed, a movable suction gripper for picking off the top of a stack a single sheet to be fed, a stationary base plate, a movable base plate parallel to the support plate and beneath said support plate, adjustable hopper side plates forming with said support plate a sheet supply hopper, pins carried by each side plates working in diagonal slots in said stationary base plate to converge said side plates to diminish the sheet receiving space, said pins operating in slots in said movable base plate at right angles to the movement of the pins to cause the movement of the movable base plate relative to said stationary base plate, a front wall plate carried by said movable base plate, and a presser member carried by the front wall plate pressing on the top sheet of the stack at a place variably dependent upon the adjustment of the movable base plate.

10. In a sheet feeding device of the class described, the combination of a support plate for a stack of sheets to be fed, a movable suction gripper for picking off the top of a stack a single sheet to be fed, a stationary base plate, a movable base plate parallel to the support plate and beneath said support plate, adjustable hopper side plates forming with said support plate a sheet supply hopper, pins carried by each side plates working in diagonal slots in said stationary base plate to converge said side plates to diminish the sheet receiving space, said pins operating in slots in said movable base plate to cause the movement of the movable base plate relative to said stationary base plate, a front wall plate carried by said movable base plate, and cam means carried by said front wall plate for preliminarily moving some of the top sheets relative to the lower sheets, said cam means cooperating with the edges of the sheets of different sizes as a result of the adjustment of the front wall plate by the adjustment of the movable plate.

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