Aug. 9, 1938. C. D. LAKE 2,126,644

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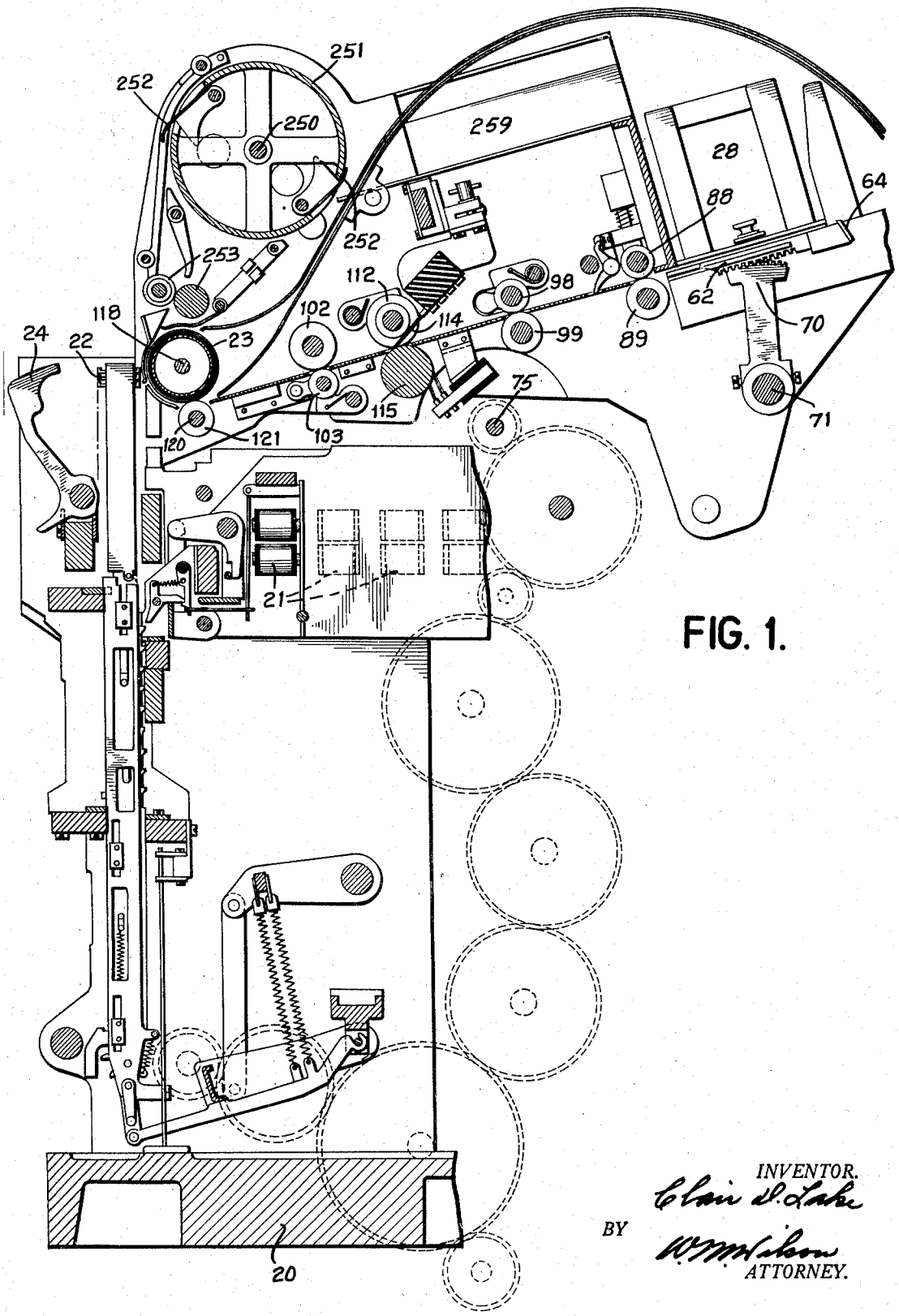


FIG. 1.

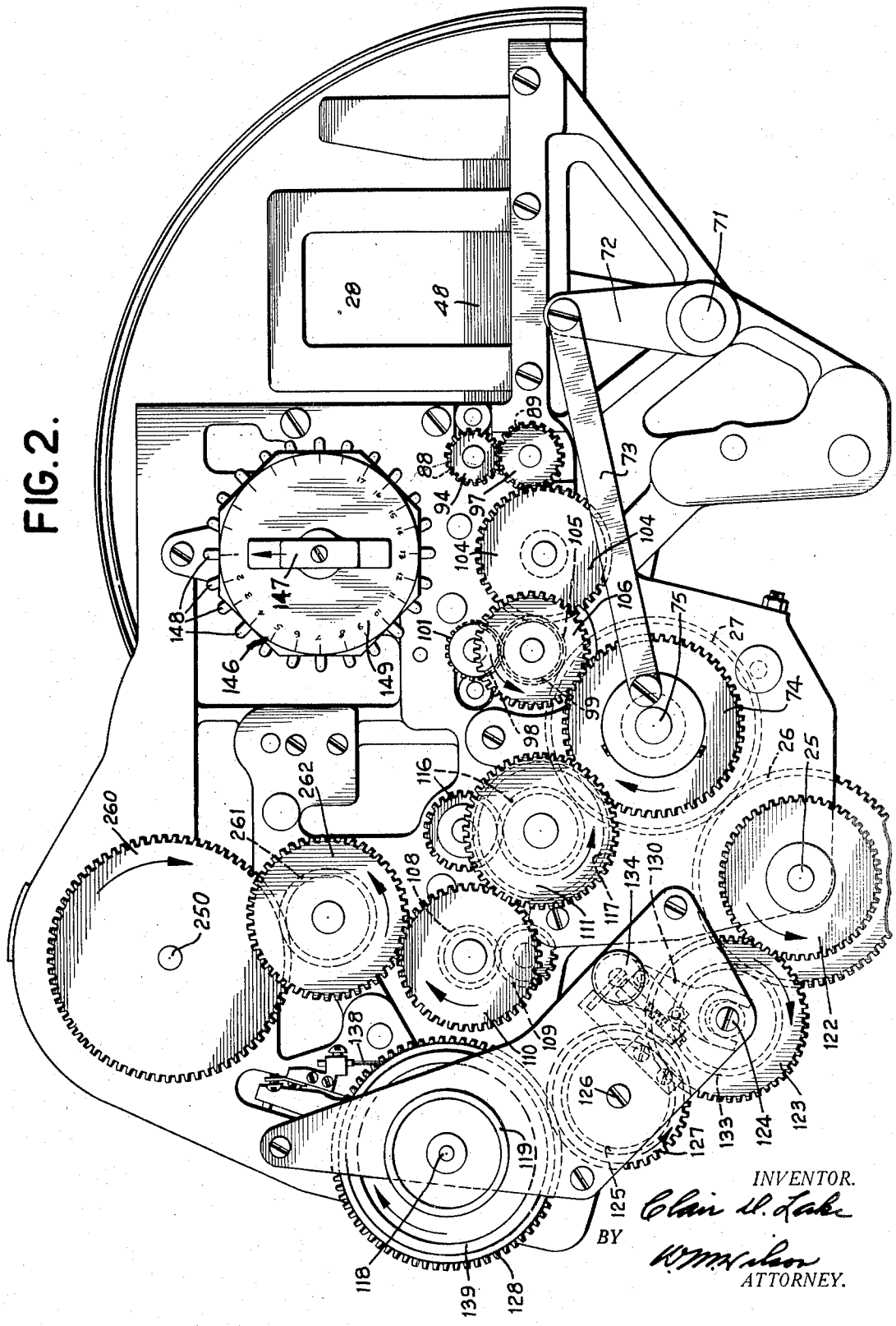
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FIG. 2.



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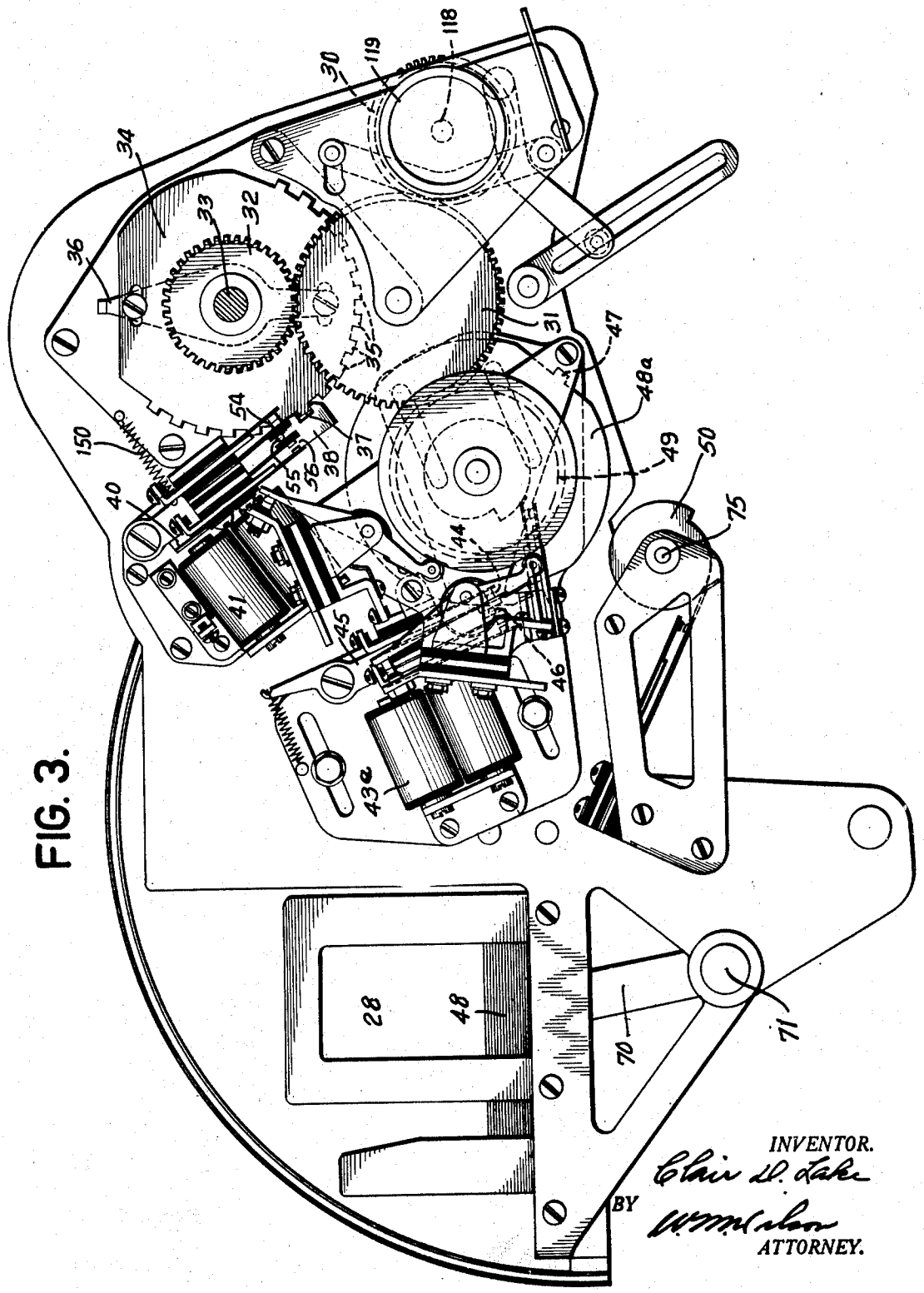


FIG. 3.

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FIG. 4.

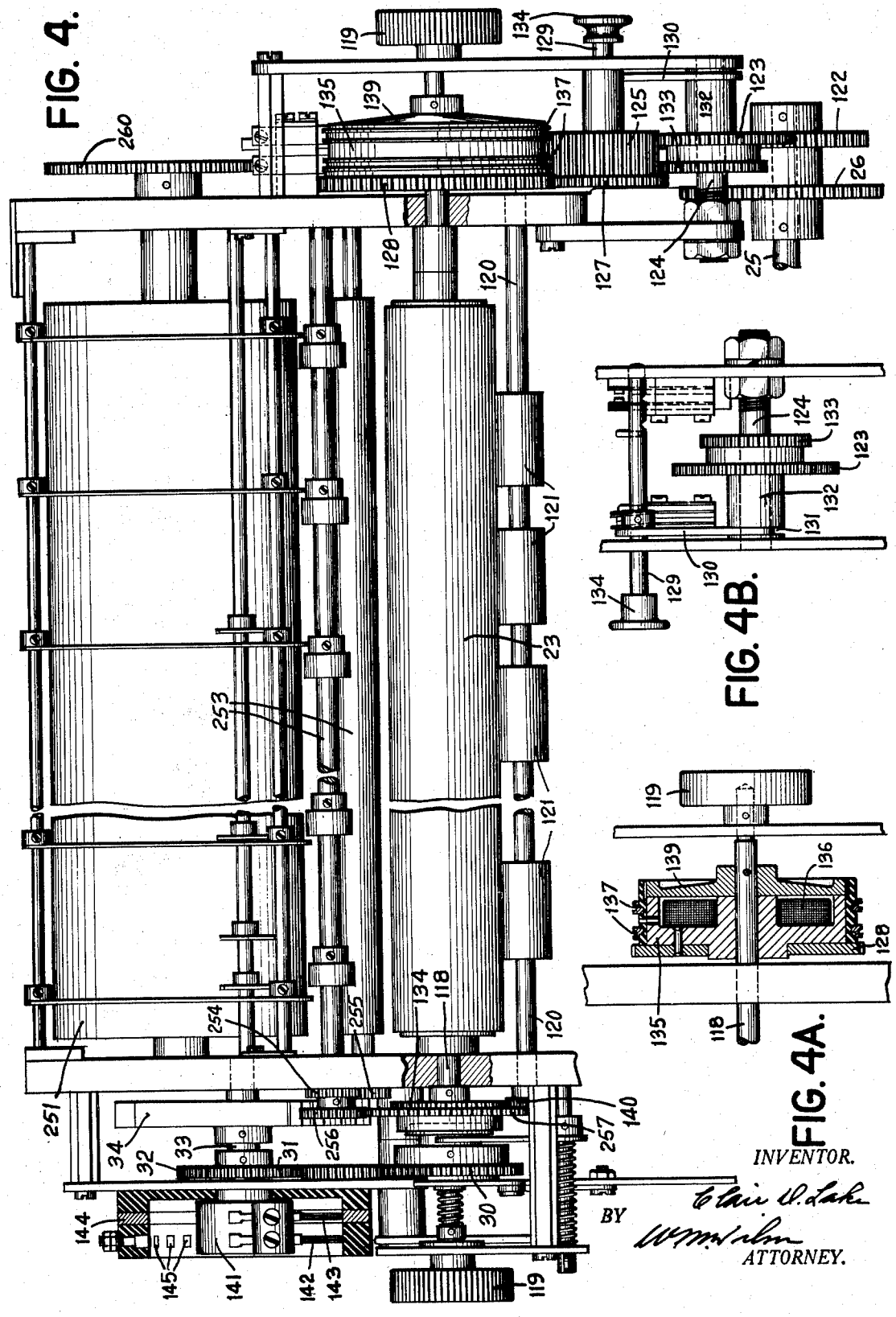


FIG. 4B.

FIG. 4A.

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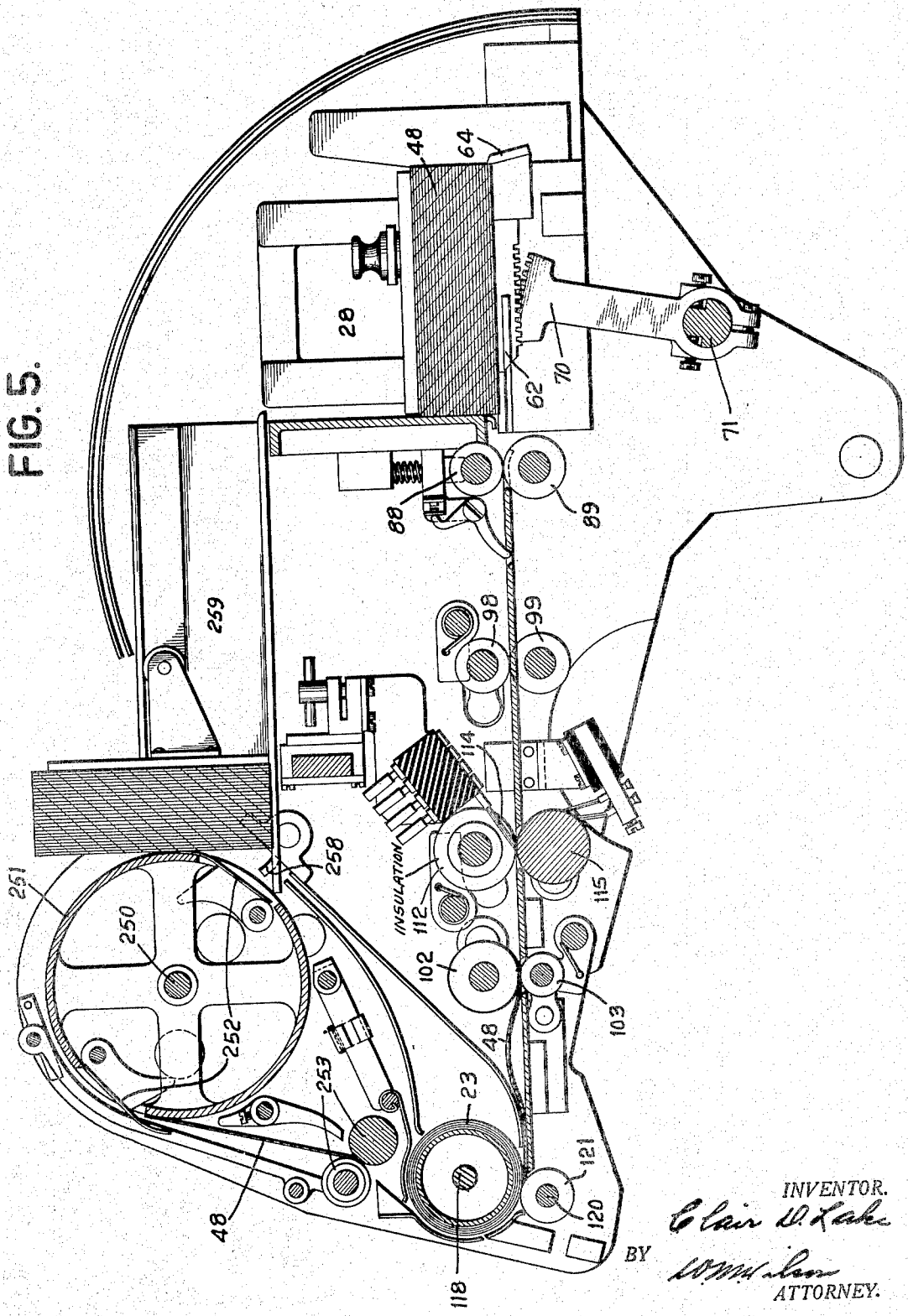
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FIG. 5.



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FIG. 6.

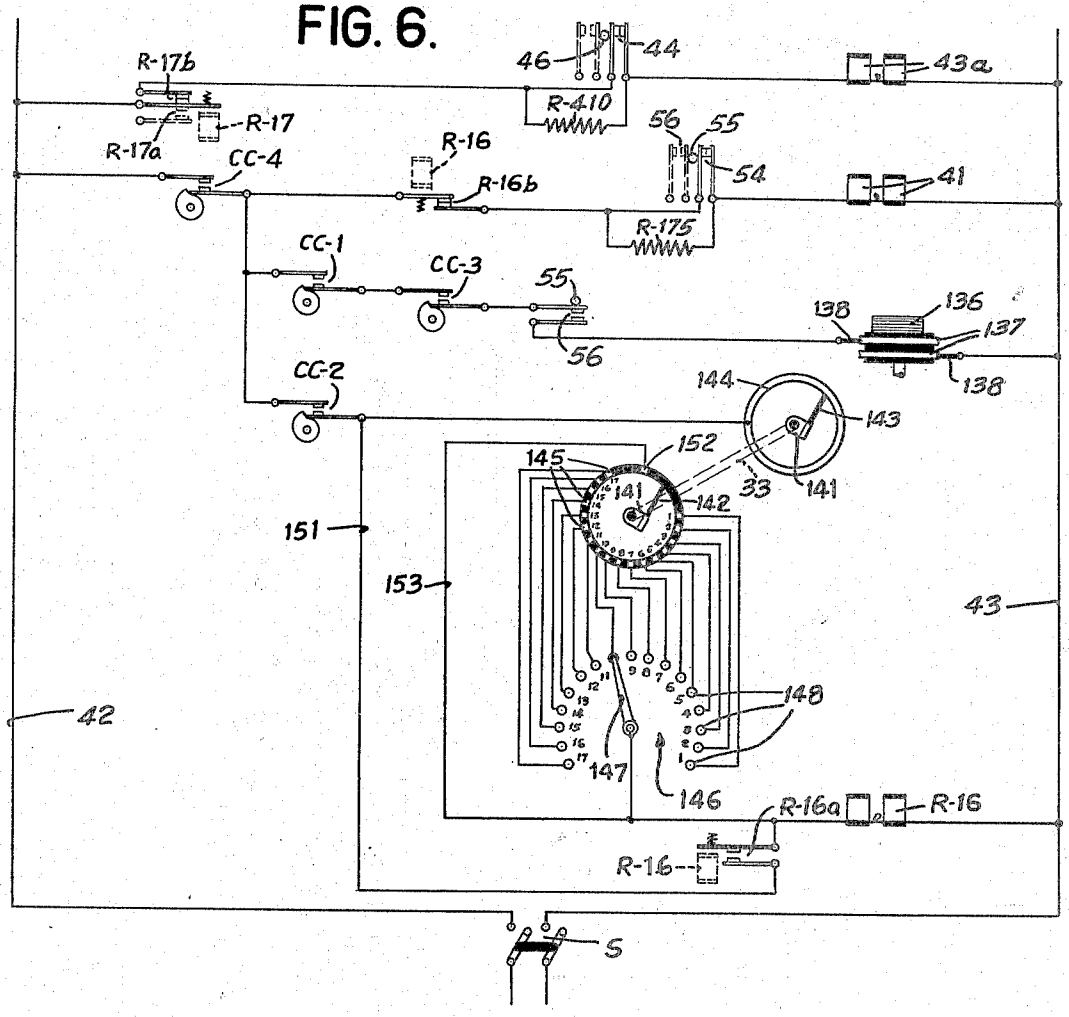
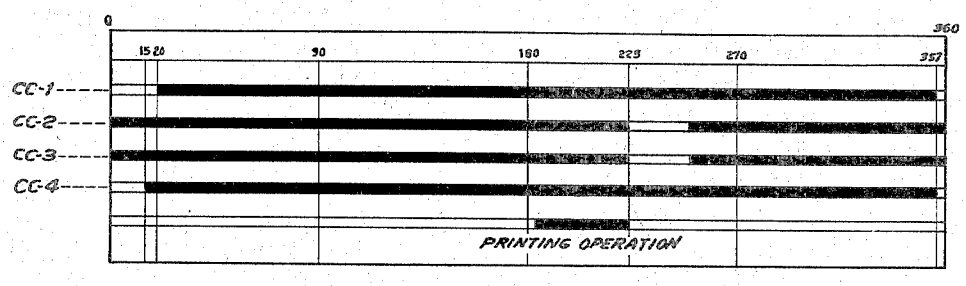


FIG. 7.



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Patented Aug. 9, 1938 2,126,644

UNITED STATES PATENT OFFICE

2,126,644

PAPER SPACING DEVICE

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Application October 26, 1937, Serial No. 171,013

8 Claims. (Cl. 101—297)

The invention relates to bill feeding mechanisms for printing machines and more particularly to the type provided with a selective control whereby the bill may be fed to a predetermined extent to a selected printing line.

The invention is preferably adapted for use in machines wherein separate bills or ledger cards are successively fed from a supply stack to the printing mechanism to thereby cause the printing of an item on a single line of the bill. Thereafter the bill may be ejected from the platen and stacked in a storage hopper.

The main object of the invention is to provide an improved electrical control device for manually selecting the printing line of the ledger card.

Another object of the invention is to provide a stacking mechanism for the improved bill printing machine which is continuously operable so that by its continuous operation it will receive the printed bills and stack them by successive operations. In this manner the machine operates smoothly and without jerks or shocks.

In more detail, bills or ledger cards are successively fed to a platen by successive cycles of operation. At a predetermined point in the cycle of operation of the machine an electrical circuit is closed by cam-operated contacts to cause the energization of a magnet which unlocks the platen and closes contacts which close a circuit to a coil of a magnetic clutch. The magnetically controlled clutch is now engaged to cause platen rotation. By means of a commutator arrangement rotatable with the platen a selected live commutator segment will stop the rotation of the platen by energizing a relay magnet which opens its relay contacts and which latter causes the opening of the circuit of the magnetic clutch coil. The latter is now deenergized and platen rotation terminates during which time the printing operation takes place and the platen is locked.

After the printing operation, cam controlled contacts again close to resume the rotation of the platen by closing the circuit to the magnetic clutch coil and the platen which is again unlocked automatically rotates a supplemental extent to feed the printed bill to the stacker mechanism.

The initial feed of the ledger card to the selected printing line and the supplemental feed combines the same extent irrespective of the printing line selected. The stacker mechanism continuously rotates and since its extent of rotation is always the same and corresponds to the combined feed given to the bill the feeding operations given to the platen permit the continuous operation of the stacker, and thus the machine runs smoothly and without shocks.

Further objects of the instant invention reside in any novel feature of construction or operation or novel combination of parts present in the embodiment of the invention described and shown in the accompanying drawings whether within or without the scope of the appended claims and irrespective of other specific statements as to the scope of the invention contained herein.

In the drawings:

Fig. 1 is a vertical sectional view of the tabulating machine to which the present invention is preferably applied and shows the printing mechanism thereof, and the associated bill or ledger card feeding mechanism.

Fig. 2 is a right side elevation of the bill feed mechanism.

Fig. 3 is a left side elevation of the bill feed mechanism.

Fig. 4 is a top plan view of the bill feed mechanism.

Fig. 4A is a detail view of the magnetic clutch for effecting platen rotation.

Fig. 4B is a detail view of a selective gear clutch device.

Fig. 5 is a central sectional view of the bill feed mechanism.

Fig. 6 is an electrical wiring diagram of the machine.

Fig. 7 is a timing diagram of certain cams adapted to effect closure of electrical contacts.

Purely as a matter of convenience in description, the bill feeding and printing mechanism has been shown in the drawings as applied to an electrical accounting and statistical machine now well known in the art as the "International electric accounting machine." The basic principles of operation of this machine are described in numerous patents to Herman Hollerith and others, and the machine shown in general outline in Fig. 1 may be the same one as described in the Letters Patent Nos. 1,822,594, 1,762,145 and 1,379,268 which are merely representations of many patents disclosing this type of machine. As the mechanism of the machine forms no part of the bill feeding attachment, except as particularly pointed out hereinafter, only a few details of such type of machine will be given herein to enable those skilled in the art to understand how the bill feeding attachment may be applied to a conventional accounting machine.

The present bill feeding and printing mechanism is an improvement over that shown in the patent to W. P. Scharr, No. 2,046,001 and is par-

ticularly relied upon for showing certain details of the mechanism not involved in this invention.

Numeral 20 (Fig. 1) indicates the base of the accounting machine which is provided with the usual Hollerith printer control magnets 21. The magnets 21 control the elevation of the type bars 22 in the manner described in the cited patents; the selected type being impelled to printing position by the usual hammers 24 against a ledger card or bill surrounding a platen 23.

Shaft 25 (Fig. 2) may be considered as the main driving or listing shaft of the bill printing unit and drives a gear 26 attached thereto. The gear 26 drives a gear 27 which is attached to a shaft 75 corresponding to the similarly designated shaft in Patent No. 2,046,001.

The means for removing the bills from the supply hopper is precisely the same as that shown in Patent No. 2,046,001 to which reference should be had for further details of construction and operation but this mechanism is generally described herein.

The bills or ledger cards 40 (Fig. 5) are removed from a supply hopper 28 (Fig. 5) by a picker 64 carried by picker slides 62, the movement of the slides 62 to the left removing the lowermost card to feeding rollers to be later referred to. The slides 62 carrying pickers 64 are operated by means of gear sectors 70 mounted on a shaft 71. An arm 72 (Fig. 2) is secured to shaft 71 and to said arm 72 there is secured a link 73 which is pivoted to a gear 74, which is attached to shaft 75, by a screw stud which is threaded into the hub of the gear 74. As fully described in Patent No. 2,046,001 the slides 62 move forward to the left during the first half revolution of shaft 25 to push the bill at the bottom of the hopper to the left, to feeding rollers now to be described in detail.

The first set of rollers receiving the ejected bill or ledger card comprises rollers 88 and 89 (Fig. 5). These rollers are intergeared by pinions 94 and 97 (Fig. 2) and the latter meshes with an idler gear 104. This arrangement is the same as Patent No. 2,046,001 and the same parts are designated by the same reference numerals.

However, in the present arrangement gear 104 meshes with a pinion 105 attached to a gear 106 meshing with the driving gear 74, and by such gearing drive the feed rollers 88—89 to convey the ledger card or bill to the second set of rollers 98, 99 (Fig. 5) correspondingly designated in the Patent No. 2,046,001. The rollers 98, 99 are intergeared by pinions 101 and 105 (Fig. 2) and the lower pinion 105 as stated meshes with the gear 104, thus constituting the driving means for rollers 98, 99, and 88, 89.

Differing from the Patent No. 2,046,001 the next set of rollers constitute a feeding roller 112 (Fig. 5) composed of insulating material and lower cooperating metallic contact and feeding roller 115. The roller 112 is grooved or slotted circumferentially so that each slot receives an analyzing brush 114 which bears upon the contact roller 115. Pinions 116 (Fig. 2) intergear the rollers 112, 115 and the lower gear 116 is attached to a gear 117 (dotted in Fig. 2) which meshes with the gear 74. Both the upper and lower roller 112, 115 serve a dual purpose, one for feeding the ledger card and the other for the purpose of analyzing the card being fed. The gear 74 drives the pairs of feeding rollers 88, 89; 98, 99; 112, 115; in synchronous relationship with the feeding of the tabulating card, that is, corresponding index points of the tabulating card and ledger card are analyzed so as to effect by means not involved in this invention a comparing operation to compare the perforations on the tabulating card with the perforations on the ledger card.

A fourth set of feeding rollers 102, 103 (Fig. 5) is provided and they correspond to rollers designated 106, 107 of Patent No. 2,046,001. The shafts of the rollers 102, 103 are intergeared as in the patent by pinions 108, 109 (Fig. 2) and to the gear 108 there is secured a gear 110 meshing with a gear 111 attached to the gear 117. It is also evident that since rollers 102, 103 are driven by gear 74 they will also feed the ledger card in synchronous relationship with the feeding of the tabulating card.

The platen 23 is attached to a shaft 118 and is provided with the usual knobs 119 (Fig. 4) secured to the shaft 118 to turn the platen manually. Extending parallel with the platen and beneath it is a shaft 120 provided with a number of rollers 121 and between the platen 23 and rollers 121 the ledger card is fed so that a subsequent rotation of the platen will cause the feeding of the ledger card to the printing line. The magnetic clutch for causing the rotation of the platen will now be described.

To the shaft 25 there is secured a gear 122 (Figs. 2 and 4) meshing with a gear 123 loosely mounted on a rod 124. The gear 123 meshes with a wide pinion 125 loosely mounted on a rod 126 (Fig. 2) and said pinion has attached thereto a gear 127 meshing with a gear 128 which rotates one element of a magnet clutch to be later described. The gear ratio between gears 122, 123 drives through gears 125, 127 and 128 the clutch element at a low speed which is desirable for certain types of accounting work. For feeding bills or ledger cards by the rotation of the platen 23 a higher speed is required and this is selected by a selective gear drive now to be described.

Referring to Figs 2, 4 and 4B a slidably mounted rod 129 has attached thereto a shifter fork 130 engaging a groove 131 of a sleeve 132 to which is secured a gear 133 and the aforementioned gear 123. When a button 134 attached to rod 129 is depressed inwardly the shifter fork 130 will slide gear 123 out of cooperation with gear 122 and cause gear 133 to mesh with the gear 26, the pinion 125 being sufficiently wide to retain the meshing relationship with gear 123. Gear 26 will drive the gear 133 at a much higher speed than is effected by the gear ratio of gears 122, 123, thus causing the gear 128 to be driven at a speed twice as fast as would be effected by gears 122, 123.

The magnetic clutch for clutching the selective gear drive to the platen 23 will now be described with particular reference to Figs. 2, 4 and 4A.

To the gear 128 there is secured a casting 135 which is recessed to receive a magnetic coil 136. The ends of the winding of the coil 136 are electrically connected to insulated collector rings 137 carried by the casting 135 and against these rings 137 brushes 138 (see Fig. 2) continually bear. By these brushes 138 and collector rings 137 current is supplied to the coil 136 so that when the coil is energized the casting 136 will be magnetised and magnetically attracted to a disk 139 attached to the platen supporting shaft 118. The gear 128 and casting 136 will slide on the shaft 118 to effect the desired magnetic clutch connection.

To the shaft 120 at its left end (Fig. 4) there is secured a pinion 140 meshing with a gear 134 attached to the drive shaft 118 to cause the rotation of rollers 121 at the time the platen 23 is rotated.

As explained in Patent No. 2,046,001 three cycles of operation of the shaft 25 are required before the first bill in the supply hopper reaches the platen. After leaving the rollers 106—107 of said patent the card is fed between the platen 23 and rollers 121 and the ledger card 48 buckles as shown in Fig. 5, prior to the rotation of the platen. This buckling is effected because the feed rollers and platen run at different speeds and is a preferable mode of operation as it corrects any inaccuracies in the location of the ledger card due to slipping or other conditions which may occur while the card is passing through the feed rollers.

Attached to the shaft 118 is a gear 30 which through an idler gear 31 drives a gear 32 (Figs. 3 and 4) which is attached to a stub shaft 33. Attached to the shaft 33 is a line spacing control disk 34 having seventeen integral teeth 35 and a tooth 36 adjustably mounted on the disk 34. In the home position of the disk 34 the adjustable tooth 36 is engaged by a recess 37 of a latch arm 38. An armature 40 is part of the latch arm 38 so that when a magnet 41 is energized it will attract the armature 40 and rock the latch arm 38 to remove the recess 37 from engagement with the adjustable clutch tooth 36. The platen is now unlocked so that it can be rotated by the magnetic clutch to feed the card a predetermined amount by the rotation of the platen to bring a selected line of the card to printing position.

The card has preferably seventeen printing lines and to conform to the selection of one of these lines the disk 34 is provided with seventeen teeth 35. The tooth 36 is adjustable so that by adjustment of this tooth the location of the first printing line of the ledger card in relation to its top edge can be changed.

When current is applied to lines 42 and 43 by the closure of switch S (Fig. 6) a circuit is closed from line 42 through relay contacts 17b of relay magnet R—17, (not involved in the present invention) through contacts 44 which are closed when the magnets 43a are deenergized, magnets 43a, to the line side 43. The energization of magnet 43a will attract its armature and rock a latch arm 45 whereby a pin 46 carried thereby will permit the opening of contacts 44. However, a resistance R—410 will provide a shunt for contacts 44 to retain magnets 43a energized. The latch arm 45 is similar to latch arm 38 and as long as magnets 43a are energized the latch arm 45 is in shifted position to permit a tooth 47 of a constantly turning disk 48a to pass by the latch arm 45 without being caught. The gear 31 drives a gear 49 (Fig. 3) to which the disk 48a is secured and since the latter turns with the disk 34, since both are driven by gear 31, the tooth 47 will not interfere with latch arm 45 as long as magnet 43a is retained energized, and therefore disk 34 will be the controlling instrumentality in connection with latch arm 38. The disk 48a is used for other control purposes not involved in the present invention and the means just described renders it inoperative.

Referring to Fig. 3 it will be seen that shaft 75 rotates certain cams, such as a cam 50 for closing contacts at predetermined times. When cam contacts CC—4 (Fig. 6) close early in the cycle a circuit is closed from line 42 through contacts CC—4, through normally closed relay contacts R—16b, contacts 54 which are now closed because magnet 41 is deenergized, magnet 41 to the line side 43. By the energization of magnet 41 latch arm 38 will now be rocked to cause the opening of contacts 54, but these contacts will be shunted by a resistance R—175 to keep the magnet 41 energized and keep contacts 54 open, and by means of a pin 55 carried by the latch arm 38 close contacts 56. The platen is now unlocked for rotation and which rotation is effected by the energization of coil 136 by a circuit control means now to be described.

Cam contacts CC—1 close shortly after cam contacts CC—4 close to close a circuit described as follows: line side 42, cam contacts CC—4, CC—1, CC—3 which are already closed when cam contacts CC—1 close, contacts 56 now closed, magnetic clutch coil 136, to the line side 43. The magnetic clutch now being engaged the platen will rotate to the selected line position, the line being selected by means now to be described.

Attached to the shaft 33 is an arm 141 (Fig. 4) carrying a brush 142 and a brush 143, the latter being in continuous contact with a ring 144 and the former adapted to contact with a series of seventeen electrical contact points or segments 145, corresponding to the number of teeth 35 of disk 34.

A dial switch 146 (Fig. 2) is provided with a switch arm 147 settable to contact a selected one of a series of contact points 148 which are wired as shown in Fig. 6 to the segments 145. An indicating disk 149 (Fig. 2) has the numerals 1–17 to conform to the number of printing lines of the ledger card and by setting the switch arm 147 to the numeral corresponding to the printing line selected the extent of the necessary rotation of the platen will be controlled and determined.

The circuit to energize the clutch coil 136 was previously described and since cam contacts CC—4 and CC—2 are now closed the circuit extends from line side 42 to the ring 144, brush 143, brush 142, the latter rotating with the rotation of the platen until brush 142 strikes a segment 145 conforming to the setting of arm 147. In Fig. 6 the arm 147 is shown at the "10" position so that when the 10th segment 145 is engaged by brush 142 the circuit will extend from arm 147 to relay magnet R—16 to the other line side 43. Relay magnet R—16 will open its relay contacts R—16b so that the magnets 41 will be deenergized thus permitting latch arm 38 to be rocked by its spring 150 (Fig. 3) to engage the tooth 35 corresponding to the selected printing line. Of course, since contacts 56 now open the circuit to the magnet clutch coil 136 will be opened, thus stopping the rotation of the platen.

Attention is directed to the fact that the coil 136 is deenergized just prior to the time that the selected tooth 35 is aligned with the recess 36 so that the disk 34 and parts connected thereto will coast to the latching position by their own momentum.

This is effected by timing the commutator 141—142—143—144—145 so that the end of the latch arm 38 strikes the top of a tooth 35 preceding the selected tooth and as the drop is not sufficient to open contacts 56 the magnetic clutch remains energized until the recess 37 of latch arm 38 drops to engage the adjacent tooth. The disk 34 then coasts to latching position.

Cam contacts CC—4 and CC—2 remain closed during the printing operation which is effected by the printing bars 22 of the tabulating machine

thereby printing the information printed under control of the tabulating card on the ledger card or bill. It will be noted that the holding circuit to effect this is from the line side 42, cam contacts CC—4, cam contacts CC—2, wire 151, relay contacts R—16a now closed, relay magnet R—16 to the line side 43.

After the printing operation at 223° cam contacts CC—3 and cam contacts CC—2 open the latter breaking the holding circuit for relay R—16 thus causing the closure of the relay contacts R—16b, and opening of relay contacts R—16a. The closing of relay contacts 16b cause magnets 41 to be energized rocking latch arm 38 to unlock the platen, and to close contacts 56. The closure of these contacts 56 will when cam contacts CC—3 again close after they have opened cause the energization of the magnetic clutch coil 136 and the platen will now rotate after the printing operation.

Brush 142 will eventually contact with the last or "home" segment 152 and by a wire 153 cause the energization of relay magnet R—16. The circuit for relay magnet R—16 is held by the relay contacts R—16a and cam contacts CC—1 and CC—4 until cam contacts CC—1 and CC—4 break about 357°. When relay magnet R—16 energizes it causes relay contacts R—16b to open to deenergize magnets 41 and cause the latch arm 38 to be rocked by spring 150 to open contacts 56 thus deenergizing the magnetic clutch coil 136. The latch arm 38 rocks just prior to the time the adjustable tooth comes to home position, and as the disk 34 coasts to home position the recess 37 of the latch arm 38 engages the tooth 36. The parts are now at normal position ready for the next ledger card or bill to be fed to the platen.

The ledger card or bill stacking mechanism is the same in general construction as in the aforementioned Patent No. 2,046,001 differing in the driving mechanism therefor. In the patent the stacker is driven through a Geneva drive by the main drive shaft and is operated in a step-by-step fashion, whereas in the present arrangement the stacker drum rotates continually. This is provided for by having the sum of the feeding and ejecting movements of the platen during each cycle of operation to be the same regardless of the selected printing line of the ledger card or bill. In this manner the stacker drum can rotate continually and objectionable shocks due to starting its rotation from rest is avoided, thus providing a smoother operating machine than has been possible heretofore.

The stacker drum 251 is secured to a shaft 250 and the drum is provided with two sets of resiliently urged stacker fingers 252 corresponding to those designated 227 in the Patent No. 2,046,001. These fingers 252 are adapted to engage a bill 48 (see Fig. 5) when the latter has been ejected by the platen 23. Rollers 253 as best shown in Fig. 4 are intergeared by gears 254, 255 attached to the shafts carrying the rollers 253. The shaft carrying the forward rollers 253 has secured thereto a gear 256 meshing with a gear 257 secured to the platen shaft 118. Thus it is evident that the rotation of the platen 23 will cause this simultaneous rotation of rollers 253 to eject a bill beneath one of the sets of fingers 252, as shown in Fig. 5.

The means for operating the fingers 252 so as to press the bill against the stacker drum 251 comprises the same mechanism shown in the Patent No. 2,046,001 and for this reason is not described herein. If so desired, the fingers 252 may be resiliently held against the drum.

As the drum rotates it carries the bill with it and eventually the top edge of the bill will be brought into contact with lugs 258 (Fig. 5) thus stripping the bill from the drum and stacking it in a supply hopper 259.

Attached to the shaft 250 is a gear 260 (Fig. 2) meshing with a pinion 261 to which is secured a gear 262 meshing with the aforementioned gear 109, thus communicating to the stacker drum a continuous rotation to successively stack the ejected printed bills in the storage hopper 259.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification 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. In a machine of the class described, in combination, a platen, a normally idle driving means for said platen, means initiated in operation by means in said machine for causing said driving means to be effective to rotate said platen, means for determining the extent of rotation of said platen comprising a movable contact means movable with said platen and commutator contacts contacted by said contact means, means for selectively connecting a contact in an electrical circuit, a relay magnet in said circuit and energized when the selected contact and said contact means closes said circuit, and means controlled by said magnet for rendering the driving means ineffective to rotate said platen.

2. In a machine of the class described, having printing means, the combination of a platen, a driving means therefor, a magnetic clutch interposed between said platen and said driving means, means to energize said clutch to cause said driving means to rotate said platen, a commutator comprising a series of contacts and a contact device rotatable with said platen to successively engage said contacts, means to selectively place one of the contacts in a circuit, means in said circuit for deenergizing said magnetic clutch when said contact device contacts with a selected contact to interrupt the rotation of said platen, and means for retaining the deenergization of said magnetic clutch during the printing operation of the aforesaid printing means.

3. In a machine of the class described the combination with a platen, locking means therefor, magnetic means for releasing said locking means, a driving means for said platen, a magnetic clutch for causing said platen to be driven by said driving means, electrical contact closing means for closing a circuit to said magnetic means to release said locking means, circuit closing means operable by said magnetic means for closing a supplemental circuit to energize said magnetic clutch to thereby initiate the rotation of said platen by said driving means, a commutator having a plurality of contacts, means to selectively place one of the contacts in an electrical circuit, a relay magnet in said circuit, means operable with the rotation of said platen to successively engage with said contacts to close the last-named circuit through the selected contact to energize said relay magnet, and means controlled by said relay magnet to

deenergize said magnetic clutch to interrupt the rotation of said platen by said driving means.

4. In a machine of the class described, a platen, a driving means therefor, a notched disk movable with said platen and provided with locking teeth, an arm normally engaging a tooth of said disk, circuit closing means operated by said machine for causing the operation of magnetic means to actuate said arm to release said disk whereby said driving means rotates said platen, a control means for determining the extent of rotation of said platen comprising a contact device rotatable with said platen and said disk and successively contacting with contacts insertible in an electric circuit, means for selectively inserting a contact in said circuit, and means in said circuit for causing said magnetic means to be ineffective to thereby release said arm for engagement with a tooth of said disk to lock said platen against further rotation.

5. In a machine of the class described, in combination, a platen, a driving means therefor, a control means for determining the extent of rotation of said platen comprising a contact making device rotatable with said platen and contacting with a series of contacts, means for selectively placing one of said contacts in an electrical circuit, magnetic means in said circuit for causing the operation of devices for interrupting the rotation of said platen by said driving means, means for automatically causing said driving means to supplementally rotate said platen, and a supplemental contact in said circuit and engageable by said contact making device when said platen has been rotated a supplemental extent for causing said magnetic means to cause the operation of said devices to interrupt the rotation of said platen by said driving means.

6. In a machine of the class described, a platen, a driving means therefor, a clutch interposed between said platen and said driving means, a commutator comprising a contact making device and a series of contacts selectively placed in an electrical circuit, means for selectively placing a contact in said circuit to close said circuit when said contact making device engages therewith by the rotation of said platen, means in said circuit and energized by the closure thereof for disabling said clutch for interrupting the rotation of said platen, means for thereafter automatically causing said clutch to rotate said platen a supplemental extent and to an extent dependent upon the contact selected, and means comprising a contact of said commutator engageable by said contact making device for closing a circuit to cause the operation of magnetic means for disabling said clutch to interrupt the rotation of said platen after its supplemental extent of rotation.

7. In a machine of the class described, in combination, a platen, a normally idle driving means for said platen, means initiated in operation by means in said machine for causing said driving means to be effective to rotate said platen, means for determining the extent of rotation of said platen comprising a movable contact means movable with said platen and contacting commutator segments, means for selectively placing a segment in an electrical circuit, a relay magnet in said circuit and energized when the selected segment and said movable contact means closes said circuit, means controlled by said magnet for rendering the driving means ineffective to rotate said platen, means for retaining said relay magnet energized during a printing operation, means for automatically rendering said driving means effective at the completion of the printing operation to supplementally rotate said platen, and means for subsequently terminating the rotation of said platen comprising a segment in said circuit and contacted by said movable contact during the supplemental rotation of said platen for energizing said relay magnet to cause the operation of the means controlled thereby for rendering the driving means ineffective.

8. In a machine of the class described, a driving means therefor, a rotatable stacker drum for bills and continually rotated by said driving means, a platen carrying said bills, means for causing said driving means to rotate said platen, means to control the last-named means to determine the extent of rotation of said platen for selecting the printing line, means for thereafter causing said driving means to supplementally rotate said platen to an extent dependent upon the printing line selected, both of said rotations of said platen feeding said bills a constant extent irrespective of the printing line selected to feed the bill to said stacker drum.

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