May 2, 1944. G. F. DALY 2,348,059

PAPER FEEDING MECHANISM

Filed Feb. 19, 1943 11 Sheets-Sheet 1

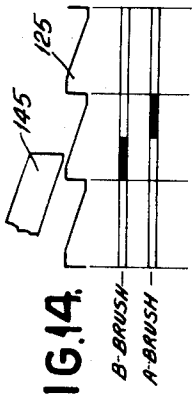


FIG. 14.

FIG. 1.

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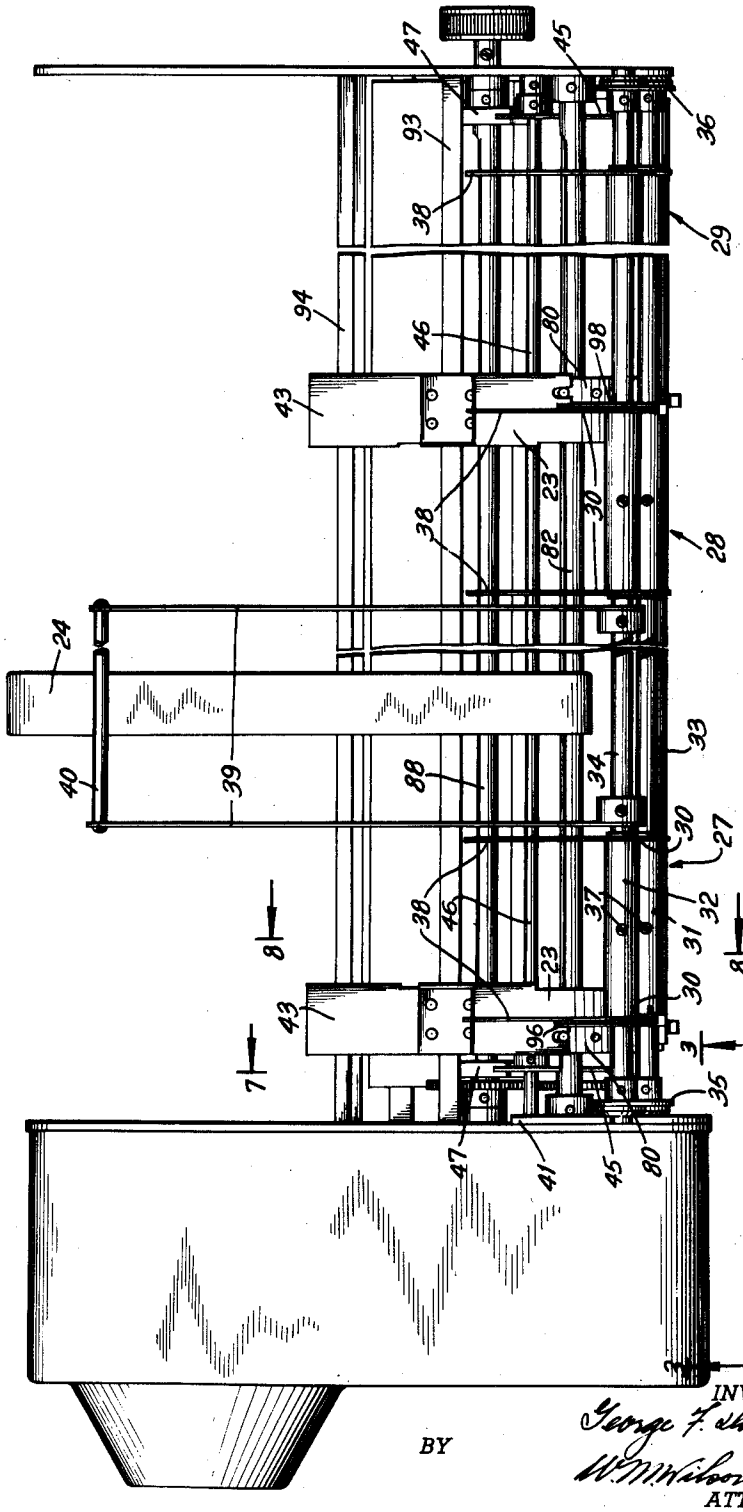
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Filed Feb. 19, 1943 11 Sheets-Sheet 2

FIG. 2.



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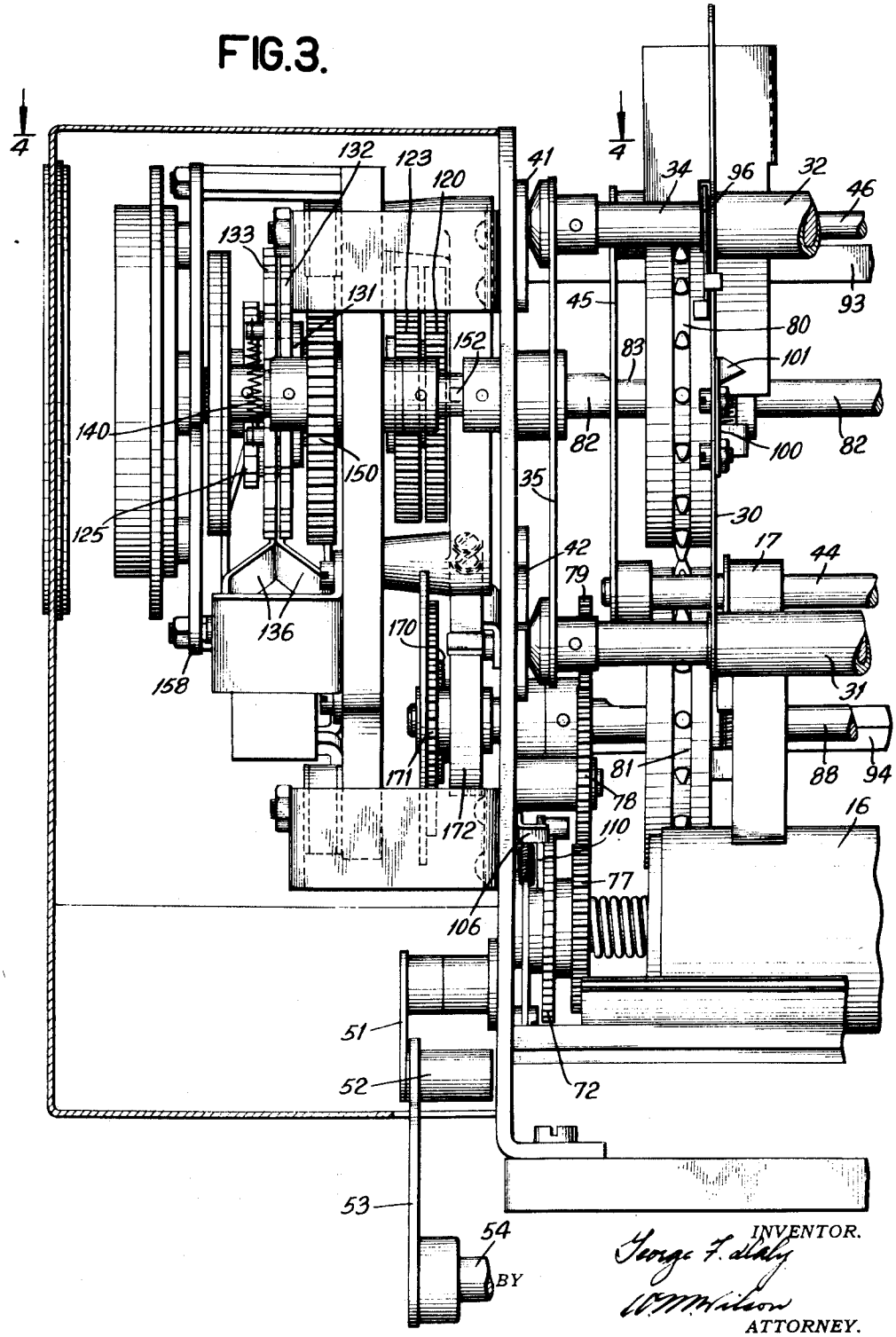
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PAPER FEEDING MECHANISM

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FIG.3.



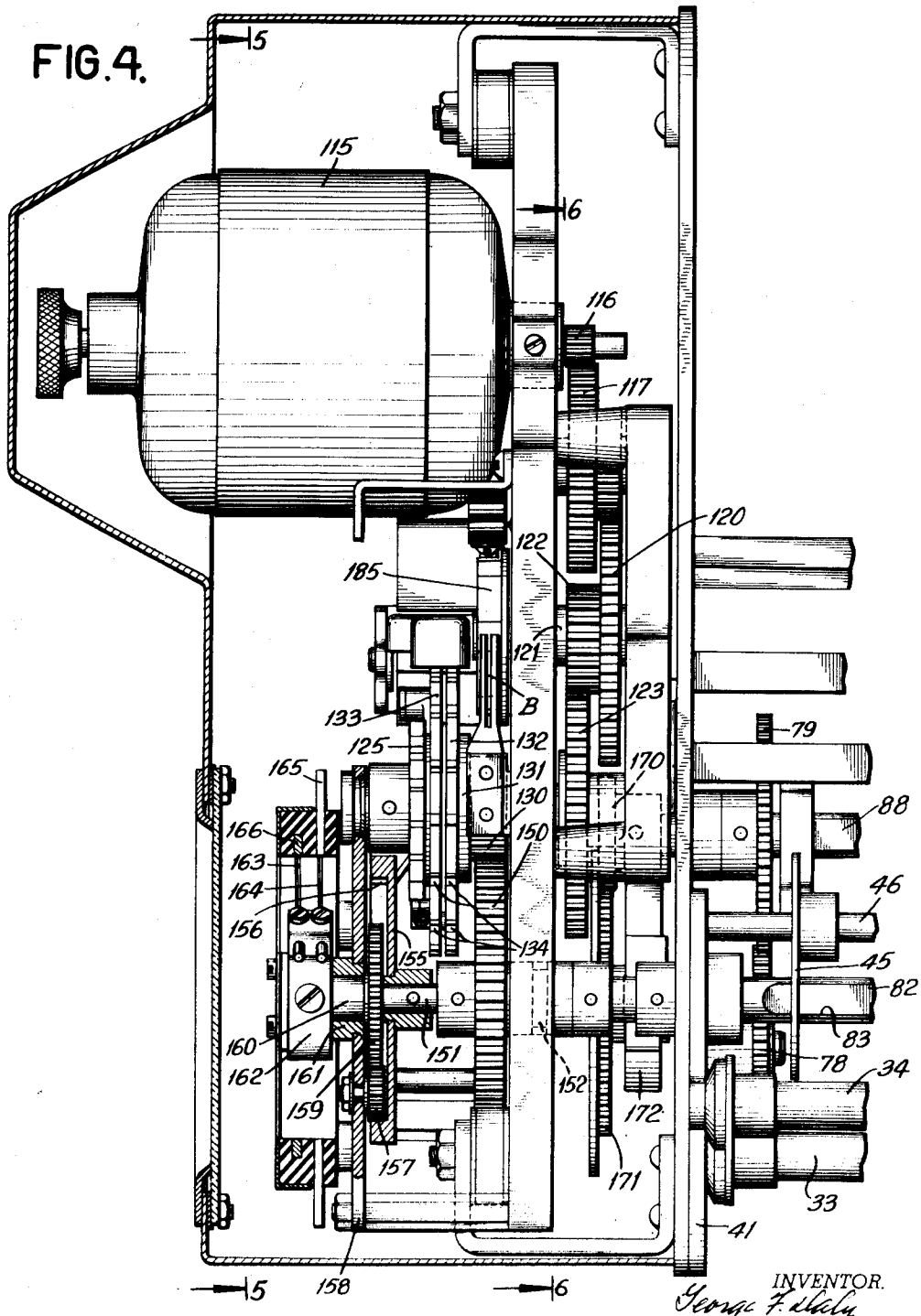
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Filed Feb. 19, 1943 11 Sheets-Sheet 4

FIG. 4.



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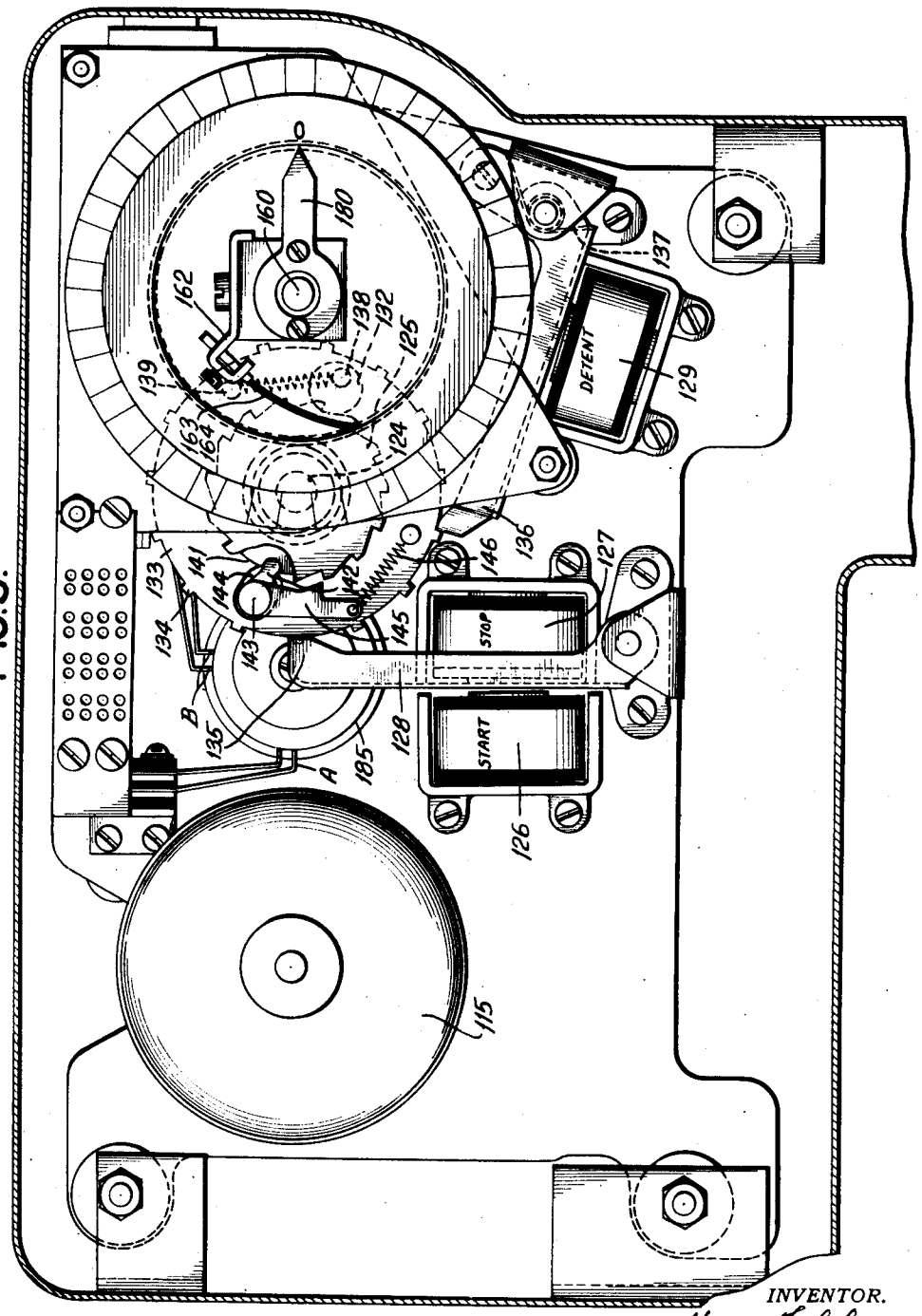
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FIG.5.



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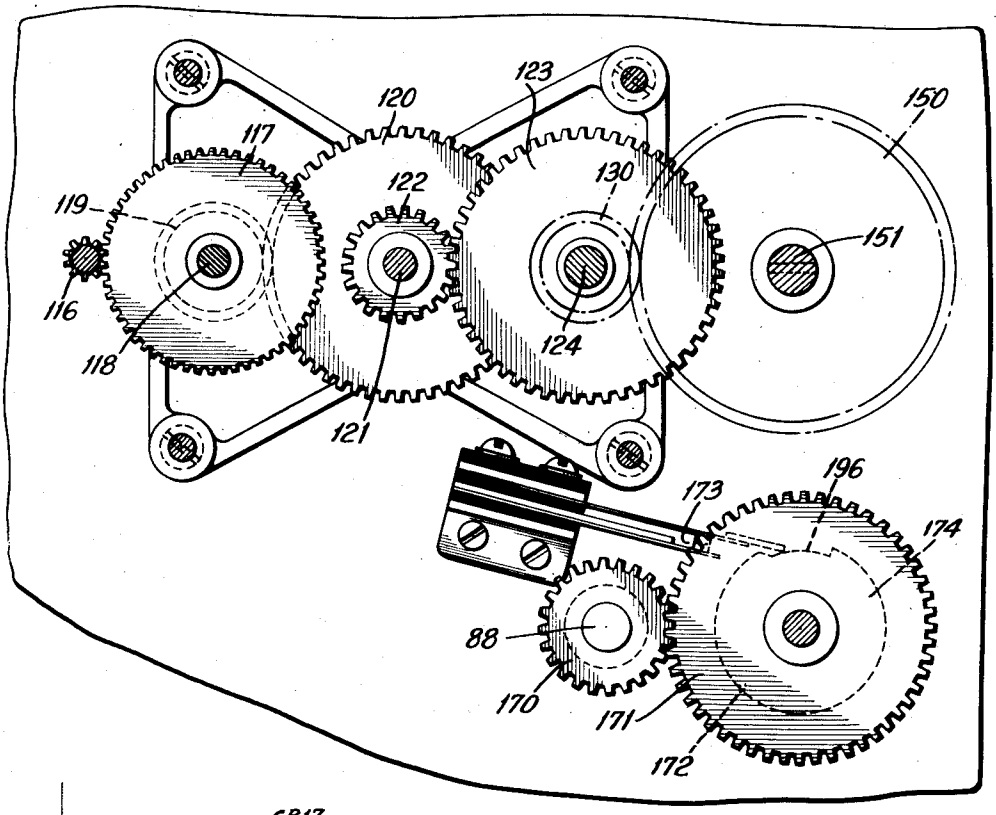
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Filed Feb. 19, 1943 11 Sheets-Sheet 6

FIG.6.



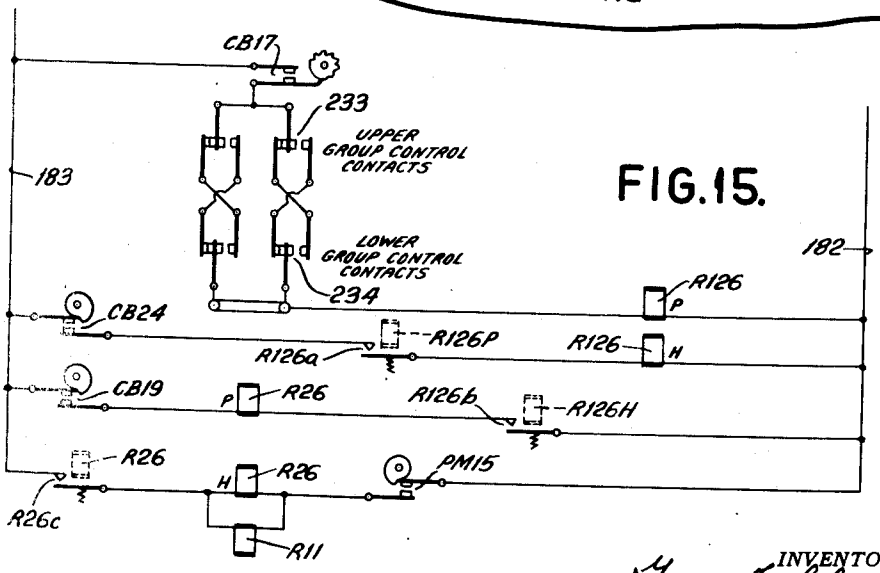


FIG.15.

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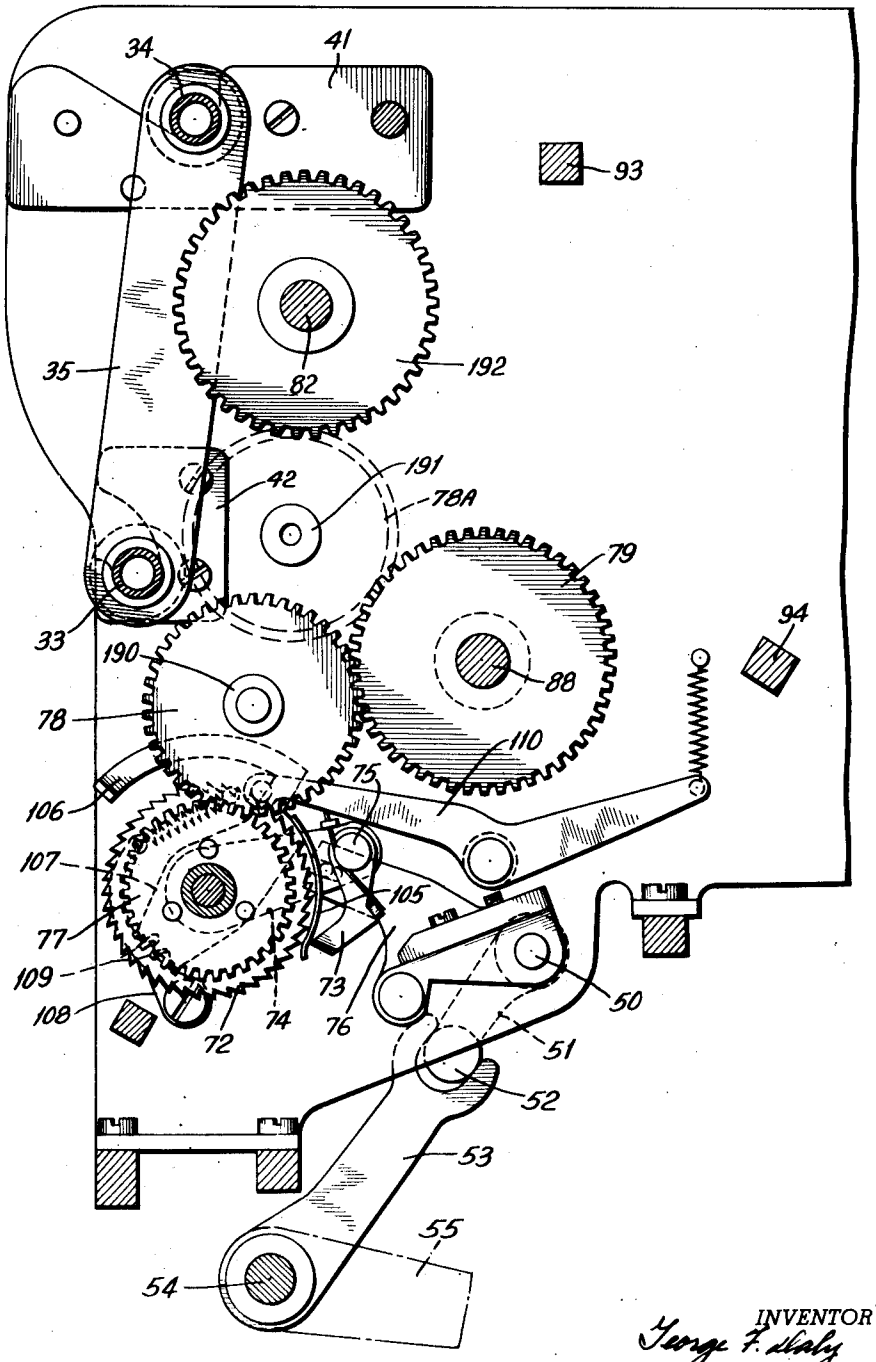
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Filed Feb. 19, 1943 11 Sheets-Sheet 7

FIG.7.



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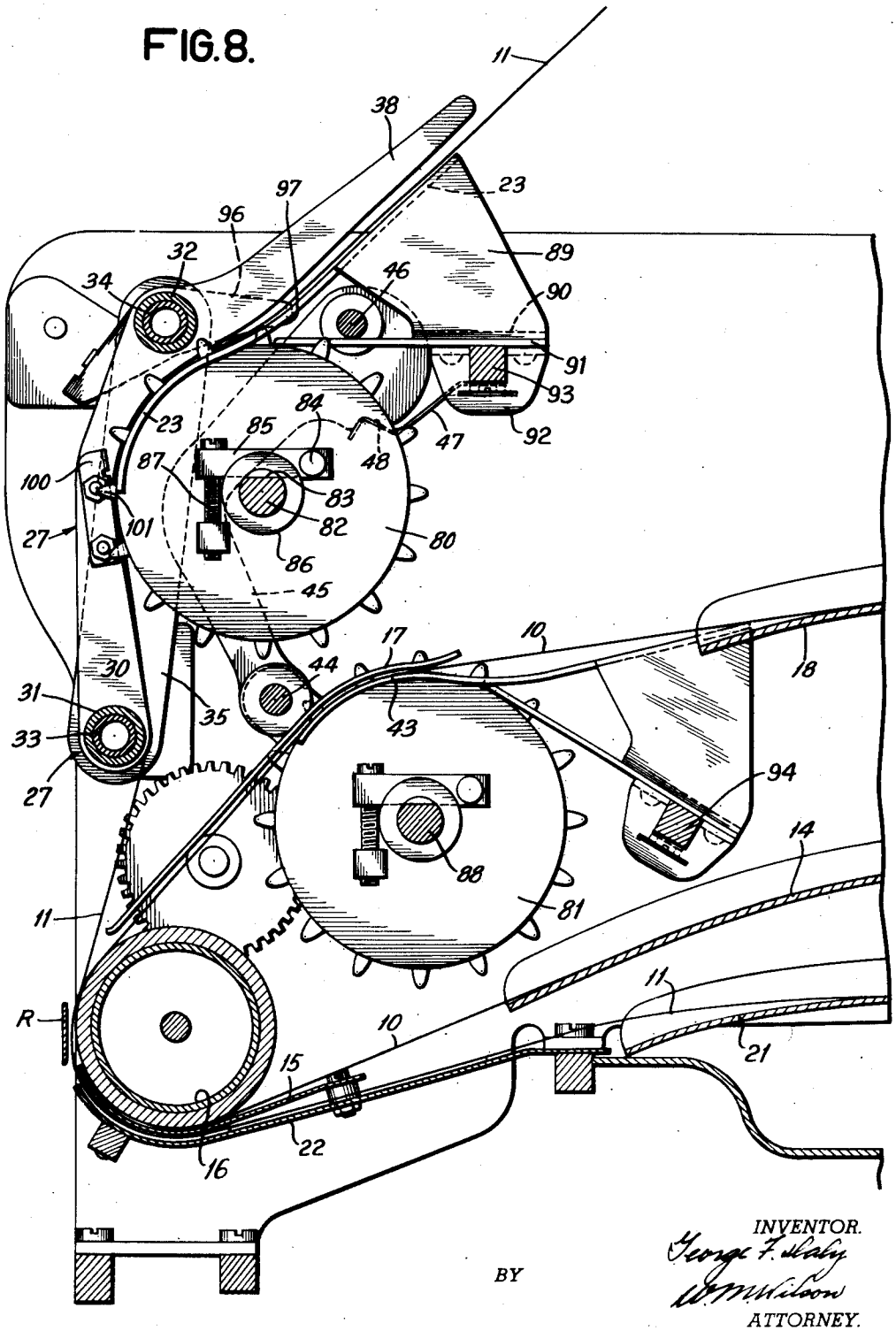
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Filed Feb. 19, 1943 11 Sheets-Sheet 8

FIG. 8.



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Filed Feb. 19, 1943 11 Sheets-Sheet 9

FIG. 9.

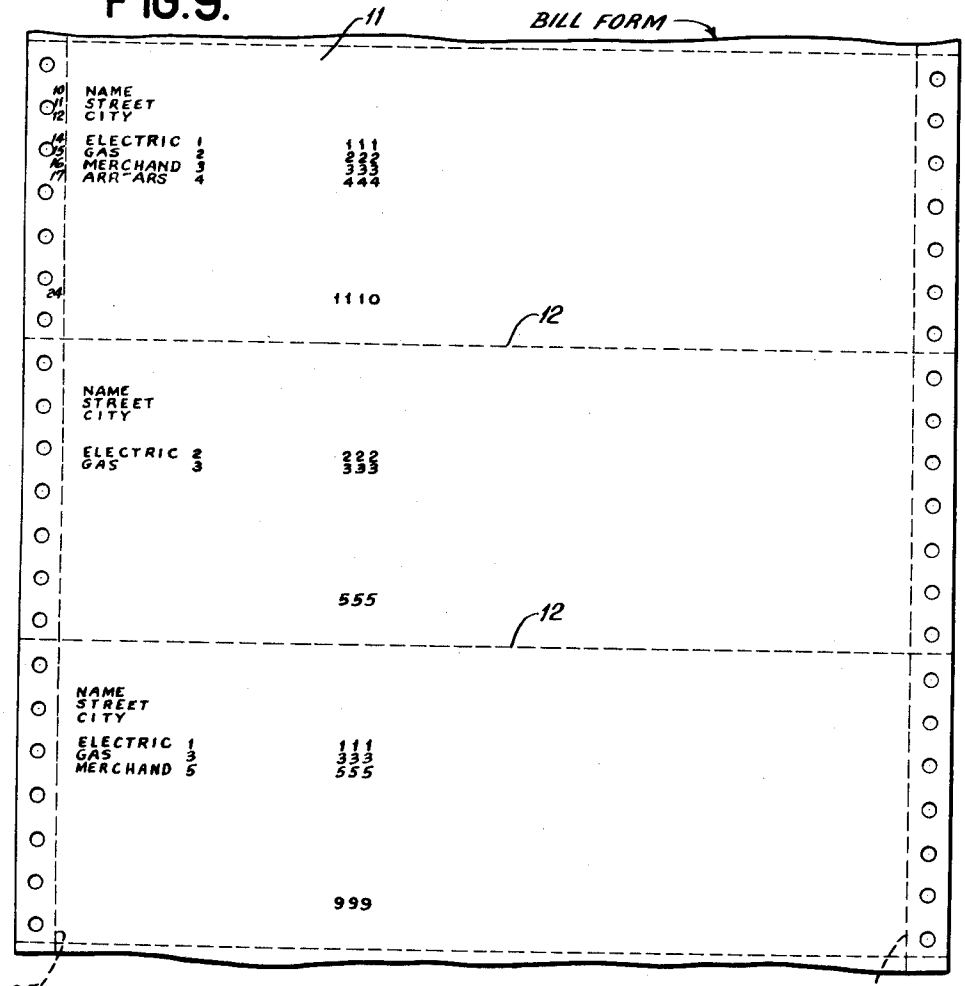
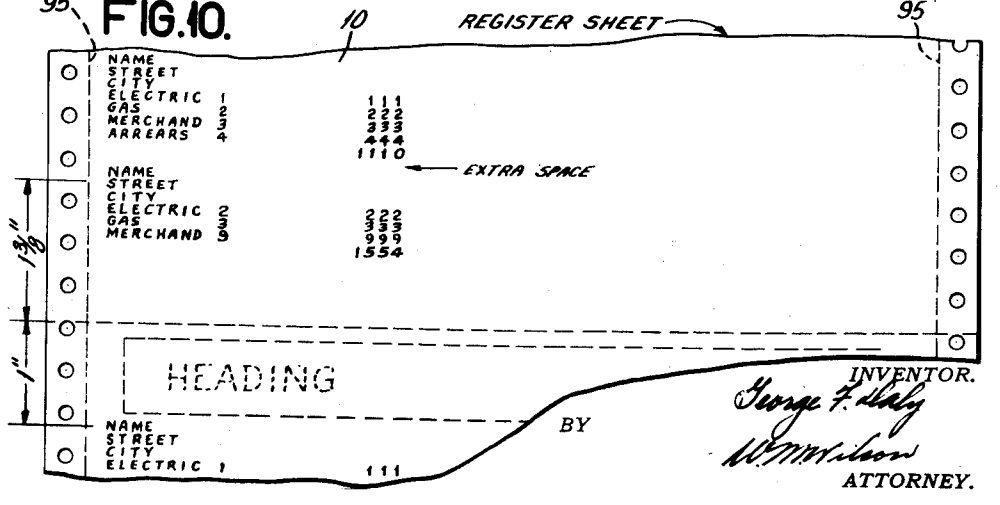


FIG. 10.



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Filed Feb. 19, 1943 11 Sheets-Sheet 10

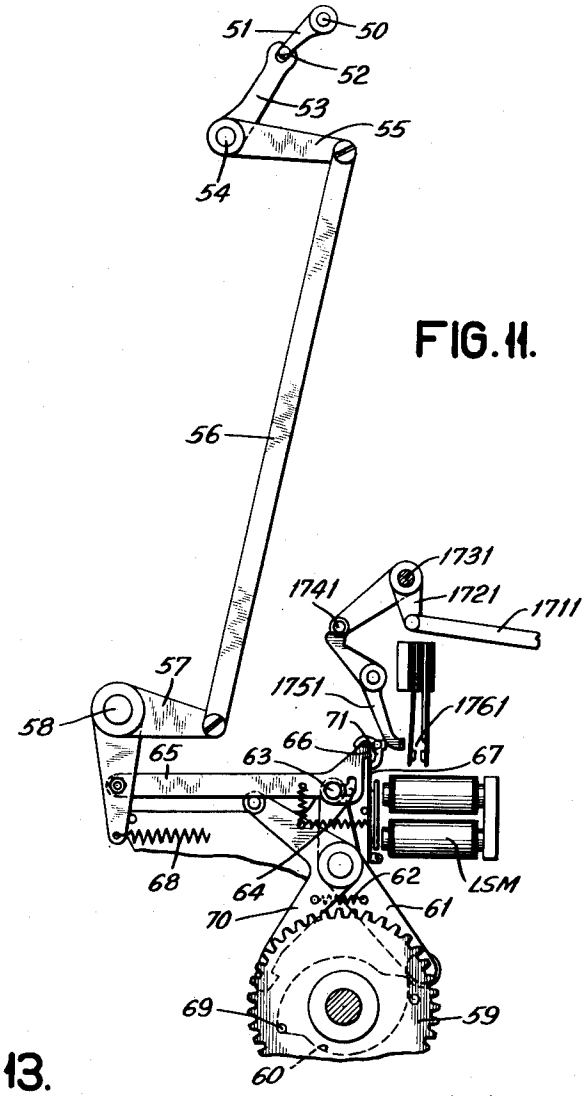
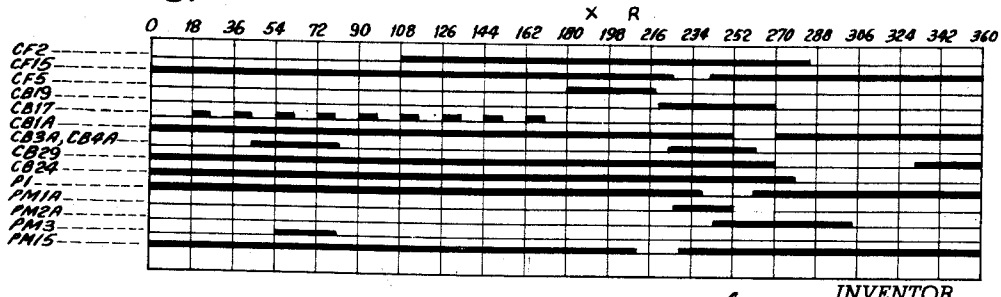


FIG. 11.

FIG. 13.



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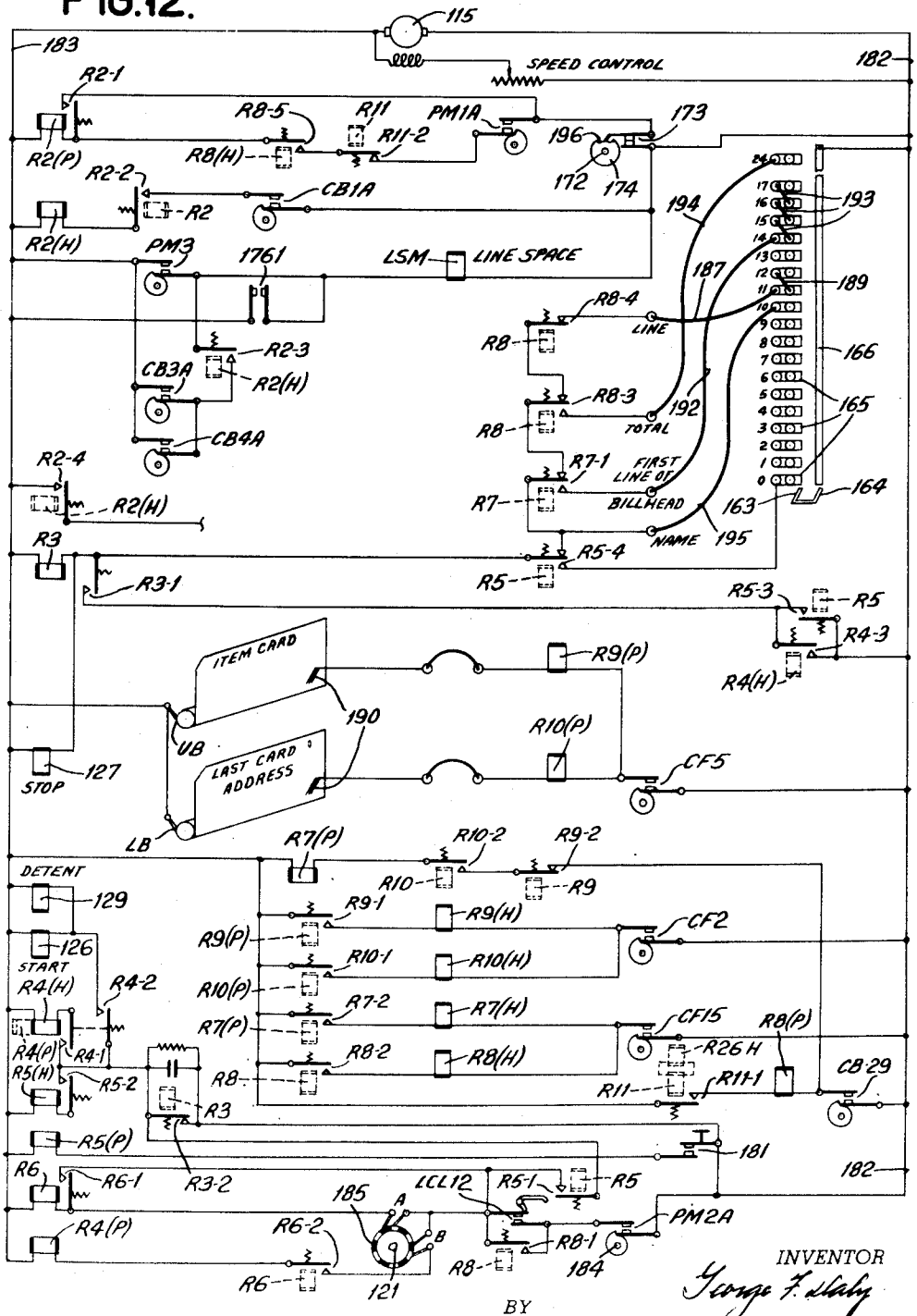
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PAPER FEEDING MECHANISM

Filed Feb. 19, 1943 11 Sheets-Sheet 11

FIG. 12.



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Patented May 2, 1944

2,348,059

UNITED STATES PATENT OFFICE

2,348,059

PAPER FEEDING MECHANISM

George F. Daly, Endicott, N. Y., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application February 19, 1943, Serial No. 476,421

13 Claims. (Cl. 197—133)

This invention relates to paper sheet feeding devices and more particularly to the type arranged to feed paper sheets variable amounts to post data on predetermined lines so that such data is in the form of a bill. This data usually consists of names, addresses, items of a bill, and a related total.

The main object of the invention is to provide an improved arrangement to effect variable sheet feeding of a bill form according to preset devices in the machine and to accompany such sheet feeding operations by feeding of a register sheet by line spacing operations to provide for presentation of the same data on the register sheet but in a condensed manner.

A still further object of the invention is to provide for positively feeding the bill form and the register sheet by a pin feed sheet feeding mechanism which is known in the art to consist of rotatable sheet feeding wheels having projections cooperating with marginal perforations of the paper sheet to be fed.

A still further object resides in the provision of connections from a line spacing mechanism to pin feed wheels to cause the latter to line space the register sheet and to provide for connections from the variable spacing operating mechanism to other pin feed wheels to positively feed the bill form to the predetermined extents.

Another object of the invention is to provide a variable bill form spacing mechanism of the start-stop type with related electromagnetic controls enabling spacing operations for the bill form to be predetermined by transmitting timed electrical impulses to such electromagnetic controls.

Another object of the invention is the provision of electrical means to initiate impulses to the start electromagnetic control upon completion of printing of a line of data and to provide for electrical plug connections which are preset by the operator to enable the transmission of a timed electrical impulse to the stop electromagnetic control when the predetermined extent of spacing of the bill form has been effected.

A still further object of the invention is to coordinate such electromagnetic controls with the item printing and total printing mechanism so that paper spacings for the bill form are provided to the predetermined extent when printing either items or totals. An advantage of this arrangement is to enable printing of the total at a predetermined line at the bottom of a bill, and upon printing a total to cause name and address printing to be started on a certain line of the next section of the bill.

In connection with the printing of names and addresses followed by printing the related items of the bill, a still further object resides in the provision of a sensing arrangement which determines when the last line of the address has been posted on the bill form and which provides for the spacing of the bill form to a predetermined line to receive the first item of the related bill.

Another object of the present arrangement is to provide for printing the data of several bills on each section of the register sheet and to effect the spacing of the next section of the register sheet a sufficient extent to provide a head space at the top of each section.

A more specific object and relatively important object is to suppress such head spacing operations of the register sheet until all the data of the last bill at the bottom of a section is posted thereon.

In carrying out this object such suppression is effected until a total of the last bill is printed on the bottom of a section of the register sheet and upon completing the printing of a total such head spacing operations occur. In the present machine when the last line to be printed is occupied by a total imprint then head spacing operations to the maximum extent occur. By the provision of an electrical control this last line is sensed but until such total is printed it is ineffective to initiate head spacing operations.

Therefore, in carrying out this last named object of the invention the well known group control mechanism is coordinated with the initiating control and if a group control is sensed at the time the initiating control is effective then head spacing operations of the register sheet occur. However, if the initiating control is effective but the group control has not sensed a change in designation, head spacing operations are suppressed to enable the posting of the remaining items and the attendant total, and upon printing such total head spacing operations are initiated under the joint control of the initiating control and the group control mechanism.

Another object of the invention is to effect head spacing operations by successive line feeding operations of the register sheet and in the present machine this is accomplished by a supplemental control for the line spacing mechanism of the register sheet, and by idle operations of the tabulating machine in which the present improvements are incorporated, the register sheet is head spaced by successive line spacing operations.

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

In the drawings:

Fig. 1 shows the outline of a record controlled accounting or tabulating machine of a well known form with the improved sheet feeding arrangement associated with the printing mechanism of such machine.

Fig. 2 is a plan view of the improved sheet feeding arrangement, showing particularly the sheet guides and the associated pin feed driving mecnanism for both the register sheet and bill form.

Fig. 3 is a view in front elevation, showing particularly the layout of the driving gears and associated driven mechanisms for the pin feed mechanism for the bill form and register sheet and is taken on the line 3—3 of Fig. 2.

Fig. 4 is a plan view taken on the line 4—4 of Fig. 3.

Fig. 5 is a view in side elevation taken on the line 5—5 of Fig. 4, this view showing particularly the electrical control for the clutch which predetermines the extent of feed for the bill form.

Fig. 6 is a view in side elevation, showing particularly the gear drive mechanism from the motor and is taken on the line 6—6 of Fig. 4.

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 2, showing particularly the details of the line spacing mechanism for the register sheet.

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 2, showing particularly the construction of the pin feed sheet mechanism for the bill form and register sheet and associated guiding members therefor.

Fig. 9 is a view showing a fragment of the bill form, showing the manner in which it is divisible into separate bills and each showing the manner of printing different forms of bills.

Fig. 10 is a fragment of the register sheet, showing how the separate sections thereof receive the same printed data as occurs on the bill form but in a condensed manner.

Fig. 11 is a detail view showing the operating connections from the tabulating machine for operating the line space device shown in Fig. 7.

Fig. 12 is a wiring diagram.

Fig. 13 is a timing diagram of the electrical contacts.

Fig. 14 is a timing diagram.

Fig. 15 is a wiring diagram of a conventional automatic group control circuit coordinated with the present control circuits.

Record Materials

The record materials which are fed by the improved feeding mechanism shown herein constitute a file sheet or register sheet 10 and a bill form 11. The register sheet 10, as shown in Fig. 10, is a continuous strip, and the bill form shown in Fig. 9 is also in the form of a continuous strip provided, however, with weakened lines 12 which enable sections of the bill form to be divided into separate bills which are sent to the customers. The register sheet 10 is the file sheet which receives the same impressions made on the bill form 11 but in a condensed manner, as is indicated in Fig. 10.

Both the register sheet 10 and the bill form 11 are in a fanfold arrangement. As best shown in Fig. 1 the register sheet is drawn from a supply hopper 13 and is passed upwardly from the supply hopper so as to overlie a guide plate 14. As the register sheet 10 comes off the guide plate 14 it passes over a guide plate 15 (see Fig. 8) so as to partially surround a conventional platen 16, and is then directed upwardly and rearwardly beneath a pair of laterally adjustable guide plates 17, the register strip then being guided rearwardly of the machine by a fixed guide plate 18 so that in passing off the extremity of the guide plate 18 the printed register sheet drops into a storage hopper 19.

The bill 11 is drawn from a supply hopper 20, then being guided to the front of the machine by a curved guide plate 21; (Fig. 8) then passing forwardly over a guide plate 22 but underneath the guide plate 15 and in turn also passing around the platen 16 over the sheet 10. Adjacent the bill form is a conventional inking ribbon R so disposed that when the differentially adjusted type bars 18' (Fig. 1) are struck by a hammer to effect the printing impression, the imprint will be made upon the bill form 11. For providing carbon imprints of such impressions on the register sheet a carbon strip may be interleaved between the sheets 10 and 11 or it may be provided by a carbon coating underneath sheet 11. For the sake of simplicity it may be assumed that the underside of the bill form 11 is provided with a coating of carbon so that carbon imprints may be made upon the register sheet 10. Alternatively a carbon strip may be interleaved between the sheets 10 and 11 and fed in any suitable manner well known in the art.

The bill form 11 is passed upwardly so as to be fed by its own sheet feeding mechanism and to provide suitable guiding members for the sheet feed the following arrangement is preferably provided. The bill form 11, as it passes upwardly, passes over laterally adjustable curved guide plates 23 (Fig. 8) and is directed upwardly over a fixed guide plate 24 (see also Fig. 1) so as to be fed in the storage hopper 25 for the bill form. Further, guiding members consist of a plurality of bails designated by reference numerals 27, 28 and 29 which are adjustable, (see Fig. 2). Each of these bails is of similar construction as shown in Fig. 8 for the bail 27 and consists of side plates 30 which are fixed at their lower ends to a tube 31 and at their upper ends to a tube 32. The tubes 31 and 32 encircle tubes 33 and 34. To the tubes 33 and 34 side plates 35 and 36 are fixed to form a rigid frame on which bails 27, 28, 29 are slidably mounted. By means of fastening screws 37 the bail 27 and correspondingly the other bails 28 and 29 may be moved along the tubes 33 and 34 and fixed at any desired position, depending upon the width of the bill form to be printed. The side plates 30 of each bail 27, 28, 29 extend rearwardly so as to form integral curved guide fingers 38. It will be noted that the lower edges of the side plates 30 of each bail are curved and the fingers 38 are so formed at their lower edges that when the bails 27 and 28 are in the position shown in Fig. 8 they will force the bill form 11 firmly over the guide plates 23.

At the central portion of the tube 34 there are connected side plates 39 (see Fig. 2) which are joined at their extremities by a rod 40 constituting a bail; this bail being adapted to hold the bill form against the guide plate 24 (see Fig. 1).

The extensions of the tubes 33 and 34 fit in respective brackets 41 and 42 (see Fig. 7) and obviously by such arrangement the frame carrying the bails 27, 28, 29, and bail 40—39 may be

detached by the operator to enable the threading of the bill form over the guide plates 23 and thence over the guide plate 24, as indicated in Fig. 1. When the aforementioned frame is detached, convenient access may also be had to the register sheet 10 for the purpose of passing it beneath the guide plate 17 and over the guide plates 18.

The guide plates 17 are laterally adjustable but movable downwardly in the position shown in Fig. 8 so as to force the register sheet 10 against a pair of related guide plates 43, which are also laterally adjustable.

The guide plates 17 are adjusted at desired positions on a cross rod 44 supported by a pair of arms 45 attached to a rod 46. For the purpose of holding the guide plate 17 with a certain amount of pressure against the register strip, it will be noted that there is provided flat springs 47, each of which urges force against a shoulder 48 of the related arm 42 so as to rock arms 45 to press the guide plates 17 against the related guide plates 43 and hold the register sheet in the proper position.

As best shown in Figs. 9 and 10, both the bill form and register sheet are provided with marginal perforations; this being a well known form of sheet and are provided for the purpose of effecting the positive feed of the sheets the desired extent. To this end, the sheet feeding mechanism shown herein is provided with a pin sheet feed mechanism, preferably of the type now to be described in detail.

Pin Feeding Mechanism

The pin feeding mechanism includes a pair of wheels 80 for feeding the bill form and a pair of wheels 81 for feeding the register sheet. (Figs. 2, 3, 8.) Each of the wheels 80 and 81 is provided with pins for cooperation with the marginal perforations of the bill form and the register sheet in a well known manner. As premised hereinbefore the widths of the register sheet and bill form may vary and for this reason it is preferable to enable the wheels 80 and 81 to be laterally adjusted on their driving shafts so that the pins of the wheels will cooperate with the marginal perforations of the varying sizes of sheets.

The manner of securing this adjustment and clamping the wheels at the desired position on the related driving shaft is the same for all of the wheels 80 and 81 and will be described in connection with one thereof. As shown in Figs. 4 and 8, the driving shaft 82 for the pair of wheels 80 is provided with a flattened portion 83. Each wheel 80 has pivoted thereon at 84 (Fig. 8) a clamping plate 85 which extends through a slot of the hub 86 of the related wheel 80 and cooperates with the flattened portion 83 of the driving shaft 82. A clamping screw 87 clamps the wheel 80 to the driving shaft 82. Obviously, by loosening the clamp by untightening the screw 87 the wheel 80 may be laterally adjusted to any desired position. From Fig. 8 it will also be noted that the wheel 81 is adjustable on its driving shaft 88 and can be clamped thereto in the same manner. The guide plate 23 overlies the related pin feed wheel 80 and similarly the guide plate 43 overlies the related pin feed wheel 81 and, of course, these plates are slotted so that the pins of the pin feeding wheel may pass through such plates without interference to thereby feed the sheet overlying such guide plates.

Since the guide plate 23, for example, cooperates with the pin feed wheel 80, any adjustment of the pin feed wheel requires a similar adjustment of the guide plate 23 for proper coordination of the parts. To this end, the plate 23 is provided with depending ears 89 and an integral base plate 90. The base plate 90 is attached to a plate 91 which has depending ears 92 in which are formed square notches so as to be received by a support shaft 93. Obviously, such construction enables a support for the guide plate 23 and a lateral adjustment on the support rod 93 and such adjustment may be maintained and fixed by any suitable latching or fastening means.

In a similar manner, the guide plate 43 is also adjustably mounted upon a square support rod 94 so that the plates 43 may be coordinated with their related pin feed wheels 81 at the desired position and fastened in such position.

Marginal Severing Mechanism

From Figs. 9 and 10, it will be observed that both the register form and bill sheet are provided with scoring lines 95 which weaken the strip at the marginal perforations so that upon further cutting along this line the marginal edges carrying the perforations will be cut off from the remainder of the sheet. To this end a sheet severing mechanism is provided and is preferably coordinated with the bill form 10 to cut the marginal edges although so desired it may be associated with the pin feeding mechanism for the register sheet 10.

For simplicity, this severing device comprises a plate 96 (see Fig. 8) having a cutting projection or knife blade 97. This severing knife is carried by the side plate 30 of the adjustable bail 27 (see Fig. 3) and the guide plate 23 is suitably cut away so that when the detachable frame is in the position shown in Fig. 8 the knife blade 96 will pass through the scored line 95 to sever the sheet. This provides the severing mechanism for the left end of the bill form 11 as the bill form is fed and the severed margin feeds off to the left into any suitable receptacle.

A similar severing knife is designated by reference numeral 98 (see Fig. 2) and is carried by the right side plate 30 of the bail 28 to sever in a similar manner the right marginal edge of the bill form 11.

Attention is directed to the provision of an index plate 100 (see Fig. 8) which is also carried by the left side plate 30 of the bail 27. The index plate 100 carries an index or pointer 101. As the bill form is threaded over the pin feed wheels 80 a certain line of one form is coordinated with the index point 101 to thereby make certain that with preprinted headings on the bill form the data to be printed will occur at the proper places and each form will be fed to the proper extent from the normal starting position. The index plate 100 and associated pointer 101 are also shown in Fig. 3.

Line Spacing Mechanism for Register Sheet

Line spacing operations to the register sheet are carried out by an arrangement which is similar to that shown and disclosed in the patent to G. Ghertman, No. 2,181,992, dated December 5, 1939, and for the sake of convenience the mechanism is described in detail herein and shown in Figs. 7 and 11.

The pivot shaft of the platen 16 has loosely mounted thereon the usual ratchet wheel 72 and cooperating with the ratchet wheel 72 is the customary spring pressed feeding pawl 73 which is carried by an arm 74 loosely pivoted upon the shaft of the platen 16. The arm 74 carries a pin 75 which is received by the bifurcation of a rock

arm 76 which is secured to a rock shaft 50. The rock shaft 50 is given an invariable rocking movement for each item listing operation of the machine so as to cause the uni-directional rotation of the ratchet wheel 72. Attached to the ratchet wheel 72 is a gear 77 which, through an idler gear 78, drives a gear 79 secured to the pin feed wheel shaft 88. The extent of line spacing is regulated by a shield 105 which is interposed between the ratchet 72 and the pawl 73. By means of a manually adjusted part 106 the arm 107 which is integral with the shield 105 may be adjusted so that by the interposition of the shield 105 the extent of line spacing operations for the register sheet may be regulated. The adjustment of the shield 105 is maintained by an impositive pawl 108 which is spring pressed so as to cooperate with notches 109 formed on the arm 107. Alignment of the ratchet wheel 72 is also effected by the spring pressed pawl 110 cooperating with the ratchet wheel 72 in the usual manner.

The means for rocking the shaft 50 to effect line spacing operations is the same as that shown and described in the aforementioned patent to Ghertman, No. 2,181,992 and is also shown in Fig. 11 herein. For indicating similarity in construction the same reference numerals are used herein to designate the corresponding parts.

Fixed to shaft 50 is an arm 51 carrying a stud 52 cooperating with a bifurcated lever 53 secured to a stud shaft 54. To this stud shaft there is secured an arm 55 connecting through a link 56 with an arm 57 on shaft 58. In Fig. 11 it will be seen that the constantly running worm wheel 59 of the tabulating machine, in which the present improvements are incorporated, has fixed thereto a double cam 60 engaging a lever 61 urged by a spring 62 into contact with said cam. An upwardly extending arm of lever 61 carries a stud 63 which moves in an L-slot 64 of a link 65 connected to an arm on shaft 58. A nose 66 of link 65 rests upon armature 67. Magnet LSM is energized at a time when the follower roller of lever 61 is on the low portion of cam 60 and stud 63 is to the right in slot 64 which will permit link 65 to be drawn down into operative relationship with stud 63 so that as lever 61 is rocked counterclockwise, shaft 58 will be actuated to cause the operation of the line spacing device. A spring 68 restores shaft 58 and the connected links.

Following such paper spacing, a pin 69 in worm wheel 59 coacts with a bell crank 70 to raise link 65 positively out of active engagement with stud 63 and latch it on armature 67. A double arm lever 71 is provided to positively force link 65 down when armature 67 is actuated and in reverse order when link 65 is restored to positively restore the armature.

Summarizing, it will be evident that the tabulating machine includes an operating mechanism for effecting a predetermined extent of operation of the pin feed shaft 88 and therefore through the driven pin feed wheels 81 the register sheet will be line spaced for each item listing operation.

Sheet Feeding Mechanism for Bill Form

The bill form is advanced by a separately driven electric motor through a train of gears and an electrically controlled clutching mechanism, the latter having associated electrical controls therefor so that the bill form may be fed a predetermined extent, depending upon the presetting in the machine.

The driving motor is designated by reference numeral 115 (Figs. 4 and 5) and drives an armature pinion 116 (Figs. 4 and 6), meshing with a gear 117 pivoted on a stud shaft 118 and to said gear 117 there is secured a pinion 119 driving a gear 120 secured to a stud shaft 121. To the gear 120 there is attached a pinion 122 which drives a gear 123 secured to a shaft 124. Attached to the shaft 124 is a ratchet shaped clutch element 125. The motor 115 continually operates so that accordingly the ratchet wheel 125 is constantly rotated.

The clutch mechanism is of a special design which enables a differential extent of movement of the pin feed mechanism for the bill form and will now be described in detail. The electromagnetic control for the clutch consists of a start magnet 126 and a stop magnet 127, the energization of the start magnet 126 attracting an armature latch member 128 to release the clutch and the stop magnet 127 reversely attracting the armature latch member 127 to disengage the clutch. To further hold the parts of the clutch in normal position and to prevent retrograde movement there is provided a detent magnet 129 with an associated latch armature 136.

Loosely mounted upon the shaft 124 is an assembly which comprises a gear 130 (Fig. 4), a spacing disk 131, and a clutch disk 132. Mounted adjacent the disk 132 is a similarly shaped disk 133 pivoted on the shaft 124 but independently rotatable of the disk 132. Each of the disks 132 and 133 have external detent projections 134 and in the normal position of the parts the aligned projections 134 of the disks 133 and 132 are held by the cross plate 135 of the latch armature 128. The armature 136 of the detent magnet 129 is urged by a spring 137 so that it, in turn, cooperates with other aligned projections 134 of the disks 132 and 133 in the normal position of the parts. To the disk 132 there is attached a spring stud 138 and to the detent disk 133 there is attached a spring stud 139 and a normally tensioned spring 140 is fastened to each stud 138 and 139 so that understanding that the detent disks 132 and 133 are independently rotatable, it will be observed that by the energization of the start magnet 126 the armature latch 128 will be drawn outwardly to disengage it from the aligned pair of projections 134 of the disks 132 and 133, enabling the normally tensioned spring 140 to rock the detent disk 133 slightly clockwise. This takes place because of the fact that the detent disk 132 is now held immovable by the train of mechanism from such disk which overcomes the force of the spring 140 so that the resulting action is to rock the detent disk 133 slightly clockwise. Attached to the detent disk 133 is a disk 141 which is scalloped to receive the rounded end of a lever 142 which is pivoted upon a stud 143 secured to the detent disk 132. It will be seen that the stud 143 passes through an aperture 144 formed in the detent disk 133. Attached to the lever 142 is a clutch pawl 145 in the plane of the clutch wheel 125. Obviously, the slight clockwise rotation of the detent disk 133 when the clutch is released will cause the disk 141 to rock the pawl 145 to engage a tooth of the clutch wheel 125, this action being assisted by a spring 146 attached to the clutch pawl 145. In this manner the clutch is engaged and the detent disks 132, 133 rotate displaced relative to each other with the projection 134 of the disk 133 slightly ahead in a clockwise direction of the projection 134 of the detent disk 132 it was previously aligned with. It is also pointed out that when the start magnet 126 is energized the detent magnet 129 is also energized and is kept

energized for the length of time which varies according to the different extent of movement given to the driven members of the clutch. When the driven member of the clutch has been given a predetermined extent of rotation in a clockwise direction, the stop magnet 127 is energized by means of electrical controls to be later described and at this time the start magnet 126 is deenergized as well as the detent magnet 129. Hence, the latch member 128 will be positively drawn to the right so as to engage one of the projections 134 of the disks 132 and 133. The first one to be engaged due to the relative displacement of such detent disks 132 and 133 is the projection 134 of the disk 133 and this will be engaged by the cross plate 135 on the latch member 128, thereby holding the detent disk 133 and the member 141. The tooth of the ratchet clutch disk 125 is still engaged with the clutch pawl 145 and this will rotate the disk 132 clockwise independent of the disk 133, but since the member 141 is now stationary the resulting action is to rock the latch pawl 145 slightly clockwise to disengage it from the ratchet clutch 125 and at this time the projection 134 will be engaged by the cross plate 135 of the latch member 128. At the same time, the armature 136 of the detent magnet 129 will engage upwardly over the projections 134 of the disks 132 and 133 and rotation of the driven member of the clutch will have been terminated and effected in a differential manner.

The driving connections from the aforementioned clutch to the pin feed mechanism for feeding the bill form is shown in Figs. 4 and 6. It will be noted that the driven pinion 130 of the clutch meshes with a gear 150 which is secured to a shaft 151. The shaft 151 has a coupling connection 152 (Fig. 3) with the shaft 82 which is the pin feed drive shaft for the bill form. Obviously, the differential rotation of the shaft 82 will, through associated pin feed wheels 80 drive the bill form to the predetermined extent.

Commutator Control for Stopping of Feeding of Bill Form

Of the electrical controls for determining the extent of the feed of the bill form, one consists of a commutator arrangement best shown in Figs. 4 and 5. In general, the driven member of the clutch drives a rotating brush assembly of a commutator which includes the brush assembly, a common conductor ring and commutator segments. This unit is known as the stop commutator. The pin feed driving mechanism for advancing the bill form is directly geared to the brush assembly and operates in synchronism therewith. The commutator segments are so arranged that each spaced segment represents a printing line of the bill form and each time the brush assembly passes a commutator segment, the bill form advances one line and does so until a commutator segment which is rendered effective for circuit connections is engaged by the brush assembly, and as will be subsequetly pointed out this stops the feeding of the bill form.

From Fig. 4 it will be observed that to the shaft 151 there is secured a gear 155 having internal gear teeth 156 which mesh with a pinion 157 loosely mounted upon a stud carried by the frame plate 158. The pinion 157 meshes with a gear 159 which is attached to a stud shaft 160 rotatably mounted in a collar 161 carried by the side frame 158. The brush assembly consists of a member 162 attached to stud shaft 160 and carrying brushes 163 and 164 which contact with commutator segments 165 and the common conductor ring 166. Obviously, by the above arrangement the brush assembly is driven synchronously with the driven member of the clutch and the bill form pin feed mechanism. The function of this commutator will be more apparent when the operation of the machine is described in connection with the circuit diagram.

Register Sheet Overflow Cam Control

From Fig. 10 it will be observed that the register sheet 10 is divided by a horizontal dash-dot line into sections, each of which receives a limited number of lines of printing. It is especially desirable that the item and total printing of a bill be completed on the bottom of a section and then spacings follow to provide a heading for the next section. In this case, after printing the total of the last bill the register sheet 10 is automatically spaced to the first printing line of the next section of the register sheet below the heading and a cam control to initiate such operation is included in the present machine and is best shown in Fig. 6.

The pin feed drive shaft 88 for the register sheet has secured thereto a pinion 170 meshing with a gear 171 and to the gear 171 there is secured a cam 172. Associated with the cam 172 are contacts 173 which are normally open by the high portion 174 of cam 172 while printing is effected upon certain lines of a section of the register sheet. When a certain line from the bottom of a section of the register sheet has been printed, the upper blade of contacts 173 will drop off from the high part 174 of cam 172, to a low part 196 whereupon contacts 173 will close. As will be described later on in connection with the circuit diagram, this will cause, after printing one or more items and a total of the last bill, the spacing of the register sheet to the next section and during this time card feeding operations of the tabulating machine will be held up.

Operation of Machine in Connection with the Circuit Diagram

1. *Reset of commutator*

As a prerequisite to the proper feeding of the bill form to the end that the printings occupy the desired positions on the bill form, the commutator should be at the normal or zero index point position and the bill form should be aligned with respect to the index pointer 101 (see Fig. 8). Means is preferably provided to bring the commutator to the zero position which is indicated when a pointer 180 (Fig. 5) is at the zero position. When this zero position is obtained, the bill form is inserted in the machine and aligned with respect to the pointer 101 and proper feeding will then ensue.

It may be possible that the commutator is not at the zero position in which case a reset key 181 (Fig. 12) is depressed and a circuit will be made from the line 182 to the line 183 through contacts closed by the reset key 181 to energize the pickup coil of relay R5. Relay coil R5 like others is a dual-wound relay which consists of a pickup coil and a holding coil which are respectively designated P and H, which designation is also made for other similar coils. The holding coil of relay R5 or R5(H) will be picked up by contacts R5—2, a stick circuit for R5(H) then extending back to the line 182 through such contacts and relay contacts R3—2 now closed. Hence, depression of the reset key 181 will cause

the energization and maintained energization of relay coil R5 which will transfer its contacts R5—4, and close its contacts R5—1, R5—2 and R5—3.

The start circuit which provides an electrical control whereby the clutch is engaged so that the commutator may be reset to its zero position will now be described. The energization of the relay coil R5 closes its contacts R5—1 to thereby close the circuit from the line 182 through relay contacts R3—2, through relay contacts R5—1, thence through A circuit breaker contacts (to be subsequently described), through relay coil R6 to the line 183. A holding circuit for the relay R6 is established through stick contacts R6—1, contacts R5—1, and contacts R3—2 now closed, back to line 182. Relay coil R6 will now close its contacts R6—2 so that when the B circuit breaker (to be subsequently described) closes, an impulse will be directed from line 182, relay contacts R3—2, the R5—1 contacts now closed, the B circuit breaker contacts, through R6—2 contacts to the pickup winding of relay coil R4. The latter closes its contacts R4—1 to pick up and maintain relay coil R4(H) energized by a circuit from line 183, relay coil R4(H), relay contacts R4—1, relay contacts R3—2, to line 182.

The energization of the start relay R4(H) will close its contacts R4—2 so that a circuit will be made from the line 182 through contacts R3—2 now closed, through contacts R4—2 now closed, thence through the start magnet 126 and also through the detent magnet 129, both of these being held energized as long as contacts R3—2 are closed. The energization of both of these magnets will cause the clutch to be engaged and the commutator will rotate from the position in which it is in, if it is off the zero starting position, and will continue until the commutator brushes 163 and 164 are at the zero position at which time a circuit will be closed from the line 182, through the common conductor ring 166, thence by brushes 163 and 164 through the 0 commutator segment 165, thence through relay contacts R5—4 now transferred, to the stop magnet 127. This same impulse is also directed to relay coil R3 and the latter opens its contacts R3—2 to thereby open the stick circuits for the holding coils of relays R4, R5, relay coil R6, start magnet 126 and detent magnet 129. Obviously, when the zero position of the commutator is reached, the energization of the stop magnet 127 will disengage the clutch and the commutator will remain at such normal starting position. The provision of the contacts R5—4 is to cause, by the opening of its upper contacts, the disconnection of the plug connections which may have been made and which are utilized to cause the energization of the stop magnet 127 when predetermined spacings of the bill form are to be made. The opening of such contacts, therefore, prevents such control when the reset key 181 is depressed to zeroize the commutator.

If reset key 181 is held depressed after the zero position of the commutator has been reached with the commutator brush on the insulating space between "0" and "1," the continued energization of relay R5 will transfer its contacts R5—4 to keep relay R3 energized, since a stick or energizing circuit for the latter is provided in this instance by R3—1 contacts, R5—3 contacts to line 182. As long as R3 is kept energized by holding key 181 depressed its R3—2 contacts are open to prevent another impulse from being directed to relay R6 to initiate a succession of resetting cycles.

2. *Spacing of bill form to predetermined extents*

There will now be described in connection with the circuit diagram the manner in which predetermined spacings of the bill form are effected with the normal operation of the tabulating machine and under control of previously made plugging connections.

As stated before, the improvements are incorporated in the form of tabulating machine shown in the patent to Peirce, No. 2,042,324, dated May 26, 1936, and the patent to Mills, No. 2,079,418, dated May 4, 1937, such machine having a printing mechanism shown in the patent to Mills, No. 2,016,682, dated October 8, 1935, which printing mechanism is capable of printing numerals and alphabetic characters.

The tabulating machine is provided with a card feeding mechanism which is shown in Fig. 6 of the Peirce patent, No. 2,042,324 and cards are successively passed through the machine, first to the upper analyzing brushes and thence to the lower analyzing brushes so that for each cyclic operation of the machine after the first card cycle a card passes the upper and lower analyzing brushes concurrently, during which time operation of the printing mechanism occurs under control of the card at the lower brushes. Tabulating machines of this type are provided with several one-revolution shafts which are adapted to carry cams which open and close contacts. The present tabulating machine includes an additional cam contact designated "PM2A" shown in the circuit diagram of Fig. 12 and which has the timing for each total and item entering cycle shown in Fig. 13. It will be noted that this cam closes its contacts at approximately 243° of the cycle and the print drive shaft 184 therefor is rotated one revolution for each operation of the printing mechanism. As will be made clearer later on, cam contacts PM2A render the circuit breaker 185 operative at 243° of the tabulator print cycle. The circuit breaker 185 is driven by motor 115 and is not in any way mechanically operated by the tabulating machine.

In the present machine, the cards which are successively passed through the machine comprise: First, a name card having perforations thereon representing the name to be printed on the bill, then two successive address cards, which latter are followed by one or more item cards. Upon the change in classification of the item cards a total is automatically taken as is well known and during such total taking operations as will later be described in detail the bill form feeding operation is initiated after printing a total and this initiates, with the plugging arrangement shown in the circuit diagram, the feeding of the bill form and stopping it at line 10 of the sheet shown in Fig. 9. During the next cyclic operation of the tabulating machine the name card now passes by the lower brushes and the printing mechanism is adjusted so as to print the name on line 10 of the bill form and through the carbon printing sheet upon the register sheet. During this cyclic operation of the machine the line spacing mechanism of the tabulating machine spaces the register sheet a single line, as is shown in Fig. 10. During the cycle of operation in which the name is printed, cam contacts PM2A close at 243° after the printing operation so that a circuit is closed from the line 182, through

contacts PM2A, thence through card lever contacts LCL12. Such card lever contacts are provided in the machine to enable the circuit closure now being described only when cards are beneath the lower brushes and such form of card levers and associated contacts is well known. The circuit then extends from such card lever contacts through the A circuit breaker to cause the energization of the relay coil R6. The latter closes its contacts R6—1 so that a stick circuit extends back through the card lever contacts LCL12 and cam contacts PM2A to line 182. During the time the relay coil R6 is energized and its contacts R6—2 are closed, the B circuit breaker contacts close so as to extend the circuit from card lever contacts LCL12 through the B circuit breaker contacts, thence through relay contacts R6—2 to the pickup coil of start relay coil R4.

Attention is also directed to the use of the two circuit breakers A and B. The relative lap timing conditions with respect to the clutch are shown in Fig. 14 and the purpose of this arrangement is to provide a full and correctly timed start impulse to the start relay R4 so that the clutch pawl 145 will engage a tooth of ratchet wheel 125 at the proper time. The two circuit breaker contacts A and B are shown in Fig. 5 and the commutator 185, therefore (Figs. 4 and 5), is secured to the stud shaft 121 which, it will be observed from Fig. 7, is driven by the driving motor 115. Contacts PM2A are located in a tabulator, and A and B circuit breaker contacts are driven by motor 115 so that it is necessary to provide the correct timing of an impulse and this is effected by setting the commutator of the circuit breakers. Three different conditions can exist.

(1) In the event that cam contacts PM2A close before circuit breaker contacts B close, the circuit breaker contacts A will be closed at this time so that the impulse can be directed to relay R6 and thereafter when the B circuit breaker contacts close the start relay R4 will energize and at this time a ratchet tooth of the ratchet wheel 125 will be properly coordinated with the clutch pawl 145 (see Fig. 5).

(2) If circuit breaker contacts B and PM2A close at the same time then A circuit breaker contacts are not closed so that no impulse will be directed to relay coil R6 and start relay coil R4 will not be energized.

(3) If PM2A contacts close after the B circuit breaker contacts close, in this case A circuit breaker contacts will not be made and relay coil R6 will not energize.

Summarizing, relay contacts PM2A must first close. The A circuit breaker contacts presense this condition, causing the energization of relay coil R6 and then when the B circuit breaker contacts close, a correctly timed impulse will be transmitted to the start relay coil R4.

Assuming that the desired synchronization has been obtained and start relay coil R4 has been energized, the hold coil R4(H) energizes through the closure of relay contacts R4—1, the stick circuit for the hold coil being maintained through contacts R4—1 and relay contacts R3—2 back to line 182. At the same time, an impulse will be sent by the closure of contacts R4—2 to both the start magnet 126 and the detent magnet 129, thereby initiating the engagement of the clutch after printing the name on the bill form and register sheet. Since, in the previous total taking operation the sheet was advanced to line 10 of the bill form, the brush assembly of the commutator will advance to the next position and with the present plugging arrangement commutator segment 11 of the group 165 is effective to terminate feeding of the bill form after it has spaced one line, this being effected by a circuit now to be described in detail:

When relay coil R4(P) is picked up by the circuit arrangement previously described it will close its stick contacts R4—1 providing a stick circuit for R4(H) extending back to line 182 through R4—1 contacts and R3—2 contacts now closed. It should be noted also that relay coil R4(H) will maintain contacts R4—2 closed, thus causing detent magnet 129 and start magnet 126 to be retained energized by a circuit extending back to line 182 through relay contacts R4—2 and R3—2. When relay coil R4(H) is energized it also closes its relay contacts R4—3 which is in the stick circuit of relay R3, the stick circuit for relay R3 extending back to line 182 through relay contacts R3—1 and R4—3.

Upon the passage of the brush assembly of the commutator from contact point 10 to contact point 11, a circuit will be closed from line 182 through the common conductor ring 166, through the brush assembly 163, 164 when contact point 11 is engaged, and thence by means of a plug connection 187 a circuit will be extended to contacts R8—4 now closed, thence through contacts R8—3 now in the position shown, thence through contacts R7—1 now in the position shown, thence through contacts R5—4 now in the position shown, through the stop relay coil R3 to the line 183, the impulse also being directed to the stop magnet 127.

When relay coil R3 energizes it closes its stick contacts R3—1 to thereby provide a stick circuit for the relay coil R3 and the stop magnet 127 back to line 182 through the relay contacts R3—1 and R4—3 now closed.

The energization of relay coil R3 will open its contacts R3—2 to deenergize relay coil R4(H), the start magnet 126 and the detent magnet 129. Deenergization of relay coil R4(H) will open its contacts R4—3 to deenergize relay R3 and the stop magnet 127.

This action (energization of stop magnet 127 and deenergization of start magnet 126 and detent magnets 129) moves armature 128 into position to declutch the clutch mechanism and stopping the brush of the commutator as the brush 163 just passes the eleventh segment to contact the next insulating space. The bill form is now at the eleventh printing line.

During the cycle of the tabulating machine in which the first address card is used to control the operation of the printing mechanism, a printing operation will take place so as to print this data on line 11 of the bill form, and on the register sheet which is line spaced in the customary manner. After such printing, cam contacts PM2A again close to cause a repetition of the feeding of the bill form to the next line, this being effected by means of the plug connection 189 and a feeding of the bill form will then take place to line 12. After printing the second line of the address, feeding of the bill form ensues in the manner just described but due to the plugging connection shown, spacing operations are effected to space the bill form to line 14 of the bill form. However, in printing the second line of the address on the register sheet, the spacing mechanism of the tabulating machine operates so as to space the register sheet a single line, thus causing printing of the data in duplicate on the register sheet but in a condensed manner. The circuit for effecting the

feeding of the bill form from line 12 to line 14 will now be described in detail:

X-Head Card Selection Circuit

It is preferable to initiate the feeding of the bill form to the first line of the item imprint by a control now to be described in detail.

In general, the feeding of the bill form from line 12 to line 14 receiving the first amount of the bill is initiated upon the passage by the lower brushes of the last address card and concurrently the first item card past the upper brushes. This is determined by a control coordinated with the same column of all the address cards and the first item card. All of the name and address cards are perforated at the X index point position of this controlling column but the item cards are not, and if two successive name and address cards are so perforated the control will be inoperative. However, upon the feeding of the last address card past the lower analyzing brushes and the first item card past the upper brushes, the control will be operative to cause the spacing of the bill form to the first heading which receives the first item print.

This control is shown diagrammatically in the wiring diagram and it will be seen that the upper and lower contact roller of the upper and lower analyzing brushes, respectively, are connected to the line 183. Brushes 180 are coordinated with this position so that upon the passage of two successive name and address cards having perforations at the X index point position relay coils R9 and R10 will both be energized, the circuit being continued to the line 183 through card feed cam contacts CF5 which are closed at the time the X index point position is analyzed. Relay coils R9(P) and R10(P) will pick up respective hold coils R9(H) and R10(H), the stick circuit extending back to line 182 through cam contacts CF2. The cams controlling the card feed contacts designated CF, of which CF5 and CF2 are two, are driven by a shaft which is rotated during card feed operations. This shaft corresponds to the shaft designated 385 in the patent to Peirce, No. 2,042,324 in Fig. 4 thereof which shows similar CF cams and contacts. Contacts R10—2 are closed upon the energization of the relay coil R10 and contacts R9—2 are opened by the energization of the relay coil R9 so that it will be seen from the obvious circuit shown that under such conditions relay coil R7 will not be energized.

However, when the last address card which bears a perforation at the X index point position passes by the lower brushes to energize relay coil R10 and when the first item card concurrently passes by the upper brushes and which does not bear a perforation at the X index point position, relay coil R9 will not be energized so that upon the closure of relay contacts R10—2 relay coil R7(P) will now be energized, the circuit being extended to line 182 through cam contacts CB29. The pickup coil of relay coil R7 will close its contacts R7—2 to thereby cause the energization of the hold relay coil R7(H) and the hold coil H will continue to keep contacts R7—2 closed as long as cam contacts CF15 remain closed. From Fig. 13 it will be observed that card feed contacts CF15 will maintain relay coil R7(H) energized during the remaining part of the cycle and also for a greater portion of the next cycle, such contacts being continued closed for the same purpose as the aforementioned contacts CB1—A. That is to say, it is desirable to keep relay coil R7 energized and its contacts R7—1 transferred to enable the spacing of the bill form to the maximum extent determined by the width of the sections of the bill form.

During the tabulating machine cycle that the last address card is utilized as a control to print the last line of the address, the clutch for the bill form spacing mechanism will be engaged in the manner previously described and in the problem assumed the brush assembly of the commutator will move from contact point 12 to contact point 13 but since such contact point has not been plugged for circuit connection it will be ineffective and the brush assembly will move to make contact with contact point 14 and at this time the circuit will be closed from the line 182 through the commutator and extended by a plug connection 192 so that the circuit will be continued through contacts R7—1 now transferred, thence through relay contacts R5—4 now in the position shown, to the relay coil R3 and the stop magnet 127. Thus, bill form spacing operations will terminate when line 14 of the bill form has been presented to the printing line.

After this, successive item cards pass through the machine and by means of cross plug connections 193 the bill form is spaced line by line as the items represented by the item cards are printed under controlling thereof. Concurrently, with such line spacings of the bill form there is effected line spacings of the register sheet 10. Such operations continue and in the present example ten lines have been allocated for receiving such item imprints and these will vary with each customer's bill. When the last item card has passed by the upper brushes, the first name card for the succeeding bill passes by the upper brushes and a control in the machine ensues in a well known manner which is designated as minor control. This control initiates total taking and total printing operations and upon taking the total the bill form is spaced from the last printed line to line 24 in the present example so that the total may be printed on line 24 of the bill form, but upon the next successive line of the register sheet after the last item print thereon.

Minor Auto Control of Bill Form Spacing Operations

The spacing of the bill form to line 24 in the present example is initiated by the well known auto control. This form of control is well known in the tabulating machine in which the present improvements are incorporated and is fully shown and described in the aforementioned patent to Mills, No. 2,079,418, dated May 4, 1937. In general, the tabulating machine is provided with group control devices for sensing and comparing the group number perforations on successive cards under the upper and lower brushes. All of the name, address and item cards of each group are perforated to represent the same account number. Obviously, when the last item card passes by the upper brushes the first name card of the succeeding group passes by the upper brushes with the well known group control described in the aforementioned patent, a minor group control magnet designated MI in the above patent to Mills is energized.

In order that operations to be subsequently explained are properly timed with the group control mechanism it is preferable to utilize in the present machine the group control circuits fully shown and described in the application of D. W. Rubidge, et al., Serial No. 347,436, filed July 25, 1940. Recourse may be had to such disclosure for a com-

plete understanding of the group control mechanism but for convenience in reference the group control circuits involved in the present machine are illustrated in Fig. 15.

Referring to Fig. 15, reference character 233 refers to the upper group control contacts and 234 designates the lower group control contacts. It is known that upon an agreement in perforations in the same card column of the cards at the upper and lower brushes, contacts 233 and 234 will be simultaneously shifted from normal position and will not close a circuit path. If either of the contacts 233 or 234 is transferred first and before the other contacts the following circuit will be made, from line 183, through cam contacts CB17, through contacts 233 and 234, one of which is transferred and the other is at normal position, thence through the pick-up coil of relay coil 126 to line 182. Relay coil 126 closes its contacts 126a, picking up the hold coil of relay R126 through the stick contacts CB24. The hold coil of relay 126 will close its contacts 126b to pick up a relay coil R26 by a circuit from line 183 to cam contacts CB19, pickup coil of relay R26, relay contacts 126b to the line 182. Hence, during the cycle in which a change in group designations is sensed, relay coil R26 will be energized. The pickup coil of relay R26 will close its contacts R26c, closing a stick circuit from the line 183 through relay contacts R26c, the hold coil of relay R26, cam contacts PM15 to the line 182. From the timing of the PM15 contacts shown in Fig. 13 is will be observed that relay coil R26 will be energized for the remainder of the cycle in which a change in group designations is sensed and for a greater part of the next cycle, which is the total taking and total printing cycle. The above circuit is similar in its timing to the group control circuit shown in the patent application to D. W. Rubidge et al., above mentioned and in the present machine a relay coil R11 is shunted across the hold coil of relay R26 and therefore this coil is energized the same length of time that the relay coil R26 is energized; that is to say, the relay coil R11 is energized during the time that PM15 contacts are closed. From Fig. 12 it will be observed that relay R11 functions as a control for circuits now to be subsequently described in detail.

Referring to the wiring diagram of Fig. 12, relay coil R11 will close relay contacts R11—1 thereby closing a circuit during the cycle the change in group designations is sensed from the line 183 through such contacts, thence through relay coil R8 and cam contacts CB29 to the line 182. The pickup coil R8(P) will close its stick contacts R8—2, thereby causing the energization of the hold coil R8(H) and the latter will cause contacts R8—1 to be closed, R8—3 to be shifted and R8—4 to be opened. It will be observed from the wiring diagram that the circuit to energize R8(H) is under control of card feed contacts CF15 and the closure of such contacts for the time shown in Fig. 13 will enable the relay coil R8 to be maintained energized to the end of the cycle the change in group designations is sensed during the total cycle, and for a greater part of the next card feed cycle. Relay coil R8 will transfer its contacts R8—3, such contacts remaining closed to the end of the cycle because R8(H) keeps R8—2 contacts closed and at the beginning of the total taking operation CF15 contacts are normally closed. During the cycle in which the last item is printed upon the bill or the cycle in which the change in group designations is sensed the clutch for spacing the bill form will be engaged by the circuit connections previously described and the clutch will remain engaged in the present example until the brush assembly makes contact with contact 24 of the group 165, extending the circuit through a plug connection 194, relay contacts R8—3 now transferred, relay contacts R7—1, relay contacts R5—4 to the stop relay R3 and the stop magnet 127. This will cause the spacing of the bill form to line 24 so that during the subsequent cycle which is a total taking cycle, the total will be printed on line 24 as shown in Fig. 9. The line spacing mechanism of the tabulating machine will operate in the usual manner so that the total will be printed on the line following the line of the register sheet receiving the last imprint, also as shown in Fig. 10.

After the total has been printed the start circuit for engaging the clutch for spacing the bill form will be energized during the total taking cycle in the same manner, it being understood that contacts PM2A also close during the total taking cycle. The bill form will then be spaced from line 24 to the next commutator segment from which a plug connection has been made and this, in the present example, constitutes the commutator segment numbered 10. By means of the plug connection 195 from this segment the impulse is directed to the stop relay R3 and the stop magnet 127 by the circuit connection previously described in detail. The next successive section of the bill form will now be in position for receiving the printing of the name of the next group.

It is also desirable that upon the passage of the last item card of the last group that the bill form be spaced from the total printing position to the next section and from the circuit diagram it will be observed that contacts LCL12 would be open upon the passage of the last card by the lower brushes. The transmission of the impulse to the relay coil R8 is effected under such circumstances through the closure of relay contacts R8—1 instead of through card lever contacts LCL12 which are now open. Hence, during the total taking operation for the last group the bill form will be spaced to line 10 of the next section of the bill form.

Double Spacing of Register Sheet 10 During Total Printing Cycles

It is desirable that the register sheet 10 receive an extra space so as to separate the total printed from the data relating to next bill as shown in Fig. 10 and this is preferably effected by means fully shown and described in the aforementioned patent to Peirce, No. 2,042,324, dated May 26, 1936. Upon the closure of contacts PM3 (Fig. 12) an impulse is sent to the line space magnet LSM (Fig. 11) at the time that the follower roller of lever 61 is on the low portion of cam 60.

As stated in this patent the double rise on cam 60 permits a second paper spacing actuation of the line spacing instrumentalities. Thus, when taking a total, after the total has been printed magnet LSM is again energized when the aforementioned follower roller of lever 61 is on the second low portion of cam 60. During a total taking cycle, by the operating means disclosed in the Peirce Patent No. 2,042,324, link 171 (Fig. 11) is drawn to the right, rocking an arm 172 on rod 173. Secured to this rod is an arm carrying a pin 174 which engages the lever

1751 to close contacts 1761. As shown in the diagram in Fig. 12, closure of such contacts sends a second impulse to the magnet LSM and thus a spacing of the register sheet will follow after printing the total. This will separate the total printed from the first line of the next data to be printed by one line space, thus segregating related printed data.

REGISTER SHEET OVERFLOW CONTROL

It is desirable to have sections of the register sheet 10 divided up into predetermined sections (Fig. 10) which will vary with the requirements and to have such sections receive carbon prints of a number of bills in a condensed manner. It is further desirable that when a certain line from the bottom of the section has been reached that successive spacing operations be given to the register sheet 10 alone so that the data relating to the next bill can be started below the heading of the next section. It is further desirable that when the certain line from the bottom of a section has been reached that such spacing operations be prevented until the remaining items, if any, and the total of the items of the last bill has been printed upon the bottom of a section, as shown in Fig. 10 for the final bill having the total —1554. After printing such items and total the successive spacing operations will follow to effect the heading and to correlate the first line of the next section with the printing devices. In the present machine each section of a register sheet is by way of example about 16 inches long and it is desirable that if the total of the last bill does not occur at 1⅜" from the bottom of a section successive item printings and a related total to complete the last bill are effected so after printing this total successive spacing operations may be effected to give about a 2 inch heading for the next section. The maximum extent of feeding in the head spacing occurs when the total of the last bill on a section occurs at 1⅜" from the bottom. To this end the cam 172 shown in Fig. 6 is so designed. When the register sheet is in such a position that an item imprint is made 1⅜" from the bottom of a section, cam contacts 173 will be closed by virtue of one of the blades of contacts 173, dropping from the high portion 174 of cam 172 to its lower cutout portion 196. This will attempt to effect the closure of the circuit from line 182 through contacts 173, thence through cam operated contacts PM1A, thence through the R11—2 contacts now closed if a change in group designations has not been sensed, through relay contacts R8—5 now open if a change in group designations has not been sensed, to open at this point the circuit to energize the pickup coil of relay R2.

It usually happens that overflow operations under control of cam 174 are to take place before a total of the last bill has been printed on a section, or even the remaining items of the last bill. It is desirable to enable printing of the remaining items and the related total and provision is made to suspend overflow register sheet feeding operations until such items and a related total have been printed.

This is provided for by means of relay contacts R8—5 which are retained open until the machine is conditioned to take a minor total. The R11—2 contacts in the circuit are controlled by the relay R11 which is in shunt with the minor control relay R26(H) in the form of tabulating machine incorporating the present improvements and it will be recalled that relay R11 is energized during the final part of the cycle in which a change in designation is sensed and during the greater part of the total taking cycle, determined by the timing of PM15 contacts. The latter open about 210° in the total cycle before PM1A contacts close so that relay contacts R11—2 are closed when cam contacts PM1A close in the total cycle.

When the change in group number is sensed after printing the last of the remaining items the relay coil R8(H) is energized as previously stated and is held energized to close contacts R8—5 during a total taking cycle because CF15 contacts are at rest and closed at the beginning of a total taking cycle. After the total has been printed on the register sheet, cam contacts PM1A close and with contacts R11—2 and R8—5 now closed the circuit can be closed to the relay coil R2(P), thereby initiating successive register sheet feeding operations and which are terminated when the register sheet has been fed a sufficient extent to provide for the desired 1 inch heading for the next section.

Two holding circuits are provided for the relay coil R2; one for R2(P) is through its stick contacts R2—1, through the contacts 173 back to the line 182. The pickup coil of relay R2 closes its contacts R2—2 which are the stick contacts for relay coil R2(H) so as to close the circuit from line 183 through the hold relay coil R2(H), through contacts R2—2, thence through cam operated contacts CB1A to the line 182. From Fig. 13 it will be observed that the closure of such contacts CB1A retains relay coil R2(H) closed during the last portion of the cycle in which the total is printed and also during the greater portion of the next cycle.

It will be observed that relay coil R2(H) closes contacts R2—3, thereby shunting contacts CB3A and CB4A across the cam operated contacts PM3. From Fig. 13 it will be seen that the cam operated contacts CB3A and CB4A provide two successive impulses to the line space control magnet LSM for each cycle of operation of the tabulating machine which automatically follows the total print. As will be made clear later on the initiation of such register sheet spacing operations will terminate card feeding so that in the absence of card feed and printing operations contacts PM3 will not be operated to be closed during such successive tabulating machine operations. Hence, cam contacts PM3 will be idle during such spacing operations. The two impulses transmitted to the line space magnet LSM will cause for each cycle of operation of the tabulating machine a double space of the register sheet and this is effected until the high portion 174 of cam 172 opens contacts 173, causing the deenergization of the relay coil R2(P). At this time card feed operations are resumed and cards will be successively fed to resume printing of data upon the next section of the register sheet.

An explanation for the provision of the two holding circuits for relay R2 will now be given. The purpose of the stick circuit for R2(H) controlled by cam contacts CB1A is to hold R2(H) energized and relay contacts R2—3 closed until both spacing impulses have been given by cam contacts CB3A and CB4A in the cycle in which contacts 173 open to indicate the termination of head spacing. Since contacts 173 are opened by the rise in the cam 172 and since the cam 172 is accurately timed for the drop from the high portion 174 to the low portion 196 to transmit the impulse for initiating head spacing operations, some tolerance is desirable in the adjust-

ment in the timing of opening contacts 173 by cam 172. With R2(H) relay coil kept energized under control of cam contacts CB1A, cam 172 may open contacts 173 after either the first or second impulse directed by cam contacts CB3A and CB4A to the line space magnet LSM and such can be effected without deenergizing relay coil R2(H). Thus, the deenergization of relay R2 at a controlled time in the cycle will insure proper spacing operations and also that a full automatic start impulse is directed by contacts R2—4 to the card feed clutch of the tabulating machine as will now be described.

STOPPING OF CARD FEEDING OPERATIONS DURING REGISTER SHEET OVERFLOW OPERATIONS

The utilization of the tabulating machine for effecting successive feeding of the register sheet when an overflow occurs makes it necessary to stop the operation of the card feeding mechanism of the tabulating machine until the next section of register sheet has been fed to provide the desired heading. From the circuit diagram of Fig. 12 it will be observed that relay coil R2(H) is provided with contacts R2—4 which are inserted in series connection with the circuit controlling the energization of the card feed clutch magnet in the tabulating machine. This circuit is well known in the tabulating machine referred to and is fully shown and described in the patent to Peirce, No. 2,042,324 and particularly the patent to Mills, No. 2,079,418. Contacts R2—4 are inserted between contacts MII and the CFCM magnet shown in the wiring diagram of Fig. 13 of the patent to Mills. The opening of such contacts will break the circuit to the card feed clutch magnet CFCM to discontinue card feeding and printing operations. After the overflow register sheet feeding operations have terminated, relay contacts R2—4 will again close so that an impulse can be directed through relay contacts CL4, switch AS and cam contacts P1 which are closed at 360° of the last total cycle, to the card feed clutch magnet, which circuit is shown in Fig. 13 of the Mills Patent No. 2,079,418. This circuit is known as the automatic start circuit and since it is well known in tabulating machines, a further description of this part of the machine appears to be unnecessary.

CONCURRENT FEEDING OF FORMS OF THE SAME SIZE

The preceding description has been devoted to the utilization of the separate sheet feeding mechanisms for feeding a bill form which is smaller in size than the register sheet. While the above described mechanism is particularly useful for feeding a short bill and a relatively longer register sheet, it is desirable at times to feed both a bill form and register sheet which are of the same size and to the same extents. By rearranging certain gears of the present machine, both the bill form and register sheet may be fed to the same extent, utilizing the two pin feed sheet feeding devices.

Referring to Fig. 7, this is accomplished by removing gear 78 from the fixed stud 190 on which it is mounted and placing it upon a fixed stud 191 to mesh with the gear 79. This removal will disconnect the gears 77 and 79 so that the latter and therefore the shaft 88 cannot be driven by the customary line spacing mechanism of the tabulating machine and the line spacing mechanism is therefore inoperative as a result of this change. Placing the gear 77 on the stud 191, which is shown by the dotted line gear designated 78A, will intermesh it with a gear 192 fixed to the upper pin feed drive shaft 82. The drive shaft 82, it will be recalled, is driven to the predetermined extents, depending upon the previous plugging connections made and therefore the rotation given to shaft 82, will, through the gears 192 and 78A drive the gear 79, and therefore the lower pin feed driving shaft 88 will be rotated to the same extent.

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. In a machine for feeding a record sheet, feeding means for said sheet, driving means, a clutch interposed between said driving means and said feeding means, a start magnet for engaging the clutch, a stop magnet for disengaging said clutch, a line selecting commutator comprising, a movable brush driven synchronously with the said feeding means, and contact points successively engaged by said brush, multiple pluggable circuit connections between said stop magnet and selected contact points for energizing said stop magnet through said brush and any of the plugged contact points, and means for energizing said start magnet after each printing operation to engage said clutch to initiate the operation of said feeding means and including means to retain said clutch engaged, thereby moving said brush until the latter contacts with the next contact point plugged and through the related plug connection to said stop magnet to energize the latter and disengage the clutch at a line position of the sheet predetermined by the said next contact point plugged.

2. In a machine for feeding a record sheet, feeding means for said sheet, driving means, a clutch interposed between said driving means and said feeding means, a start magnet for engaging the clutch, a stop magnet for disengaging said clutch, a line selecting commutator comprising, a movable brush driven synchronously with the said feeding means, and contact points successively engaged by said brush, multiple pluggable circuit connections between said stop magnet and selected contact points for energizing said stop magnet through said brush and any of circuit connections to the plugged contact points, said multiple plugging connections including for one or more successive line spacings one or more interconnections between successive contact points, one of which has a plug connection to said stop magnet, and means for energizing said start magnet after each printing operation to engage said clutch to initiate the operation of said feeding means and including means to retain said clutch engaged, thereby moving said brush until the latter contacts with the next contact point plugged to said stop magnet or a contact point having an interconnection therewith and through a plug connection to said stop magnet to energize the latter and disengage the clutch when said sheet is at a line position predetermined by the said next contact point plugged.

3. In a machine for feeding a record sheet on which data is printed, feeding means for said sheet, driving means, a clutch interposed between said driving means and said feeding means, a start magnet for engaging the clutch, a stop magnet for disengaging said clutch, a line selecting commutator comprising, a movable brush driven synchronously with said feeding means, and contact points, successively engaged by said brush, said contact points being spaced by intermediate insulation, pluggable multiple circuit connections between selected contact points and said stop magnet for energizing said stop magnet through said brush and the circuit connection to any of the plugged contact points, a single impulsing means operative after each printing operation for energizing said start magnet when the brush is on said insulation to engage said clutch to initiate the movement of said feeding means and said brush, thereby moving said brush past the said next contact point plugged to rest on the insulation, and by the contact of said brush and the next contact point plugged to energize the stop magnet and disengage the clutch at a line position of the sheet predetermined by the said next contact point plugged, and by said brush resting on the insulation opening the circuit to said stop magnet to deenergize the latter.

4. In a machine for feeding a record sheet on which a series of items and a total thereof are printed by item and total printing operations, means for feeding said sheets, driving means, a clutch interposed between said driving means and said sheet feeding means, a start magnet for engaging the clutch, a stop magnet for disengaging said clutch, a line selecting commutator comprising, a movable brush driven synchronously with the driven element of said clutch, and contact points successively engaged by said brush, pluggable circuit connections intermediate selected contact points and said stop magnet for energizing said stop magnet through circuit connections to any of the plugged contact points, a single impulsing means operable after each printing operation for energizing said start magnet to engage said clutch and including means to retain said clutch engaged, thereby moving said brush until the latter contacts with the next contact point plugged to energize said stop magnet and disengage the clutch at a line position of the sheet predetermined by the said next contact point plugged.

5. In a machine for feeding a record sheet at predetermined line positions comprising feeding means for said sheet, driving means, a line selector commutator including selectively pluggable contact points and a rotatable brush driven synchronously with said feeding means, a clutch interposed between said driving means and said feeding means, a start magnet and a stop magnet having a common armature which is attracted by said start magnet to move said armature in one direction to engage said clutch and by the energization of said stop magnet to reversely move said armature to disengage said clutch, means for energizing said start magnet after printing an item on the strip to engage said clutch to initiate the operation of said feeding means and said commutator brush, means to retain said clutch engaged, and multiple pluggable circuit connections between said stop magnet and the selected contact points of the said commutator whereby said commutator brush engaging the next plugged contact energizes said stop magnet to disengage the clutch when said sheet is at a line position predetermined by the said next plugged contact point.

6. In a machine for feeding a record sheet, means for feeding said sheet, driving means, a clutch interposed between said driving means and said platen, a start magnet for engaging the clutch, a stop magnet for disengaging said clutch, and a detent magnet energized concurrently with said start magnet to hold said clutch disengaged, a line selecting commutator comprising a movable brush driven synchronously with the said feeding means and contact points successively engaged by said brush, pluggable circuit connections between selected contact points and said stop magnet for energizing said stop magnet, means for energizing said start magnet to engage said clutch and to energize said detent magnet to release said clutch and including means for holding both said start magnet and said detent magnet energized, thereby moving said brush uninterruptedly until the latter contacts with the next contact point plugged to energize the stop magnet and disengage the clutch at a line position of the sheet predetermined by the said next contact point plugged, and means controlled by said stop magnet for disabling the means for holding said detent and start magnets energized, whereby said detent magnet is again operable to hold said clutch disengaged and said start magnet is effective to again engage said clutch.

7. In a machine for feeding a record sheet at predetermined line positions comprising feeding means for said sheet, driving means, a line selector commutator including selectively pluggable contact points and a rotatable brush driven synchronously with said feeding means, a clutch interposed between said driving means and said feeding means, a start magnet and a stop magnet having a common armature which is attracted by said start magnet to engage said clutch and by said start magnet to disengage said clutch, a detent magnet energized with said start magnet and having an armature to hold the clutch disengaged when the detent magnet is deenergized, means for energizing said detent magnet to release said clutch and said start magnet after printing an item on the strip to engage said clutch to initiate the operation of said feeding means and commutator brush, means to retain both said start magnet and said detent magnet energized, multiple pluggable circuit connections between said stop magnet and the selected contact points of the said commutator whereby said commutator brush engaging the next plugged contact energizes said stop magnet to disengage the clutch when said platen is at a line position predetermined by the plugged contact point, and further means operative through said circuit connections for disabling the means to retain both said start and detent magnets energized when said brush engages the said next plugged contact point, whereby said detent magnet holds the clutch disengaged when disengaged by said stop magnet, and said start magnet is again effective to engage said clutch.

8. In a machine for feeding a record sheet on which data is printed, means for feeding said sheet, driving means, a clutch interposed between said driving means and said feeding means, a start magnet and a stop magnet having a common armature attracted by said start magnet for engaging the clutch and reversely at-

tracted by said stop magnet for disengaging said clutch, a line selecting commutator comprising, a movable brush driven synchronously with said feeding means, and contact points successively engaged by said brush, said contact points being spaced by intermediate insulation, pluggable multiple circuit connections intermediate selected contact points and said stop magnet for energizing said stop magnet through any of the plugged contact points, a single impulsing means operative after each printing operation for energizing said start magnet when the brush is on said insulation to engage said clutch to initiate the operation of said feeding means and said brush, means for holding said start magnet energized, thereby retaining the clutch engaged for moving said brush past the next contact point plugged to rest on the insulation, and by the contact of said brush and the said next contact point plugged to energize the stop magnet and reversely attract the armature to disengage the clutch at a line position of the sheet predetermined by the said next point plugged, and by said brush resting on the insulation opening the circuit to said stop magnet to deenergize the latter, and further means operative through said circuit connections for disabling the means for holding the start magnet energized when said brush engages the said next plugged contact point, whereby said start magnet is again effective to be energized to attract the armature to engage the clutch.

9. In a machine for feeding record cards and printing data under control of said records on a sheet, said records comprising address cards and following item cards, means for sensing said address cards and following item cards to determine the presence of the first following item card, means for feeding said sheet, driving means, a line selector comprising selectively pluggable contacts and a rotatable brush driven synchronously with the feeding means, a clutch interposed between said driving means and said feeding means, a start magnet to engage said clutch, a stop magnet to subsequently disengage said clutch, a single impulsing means to energize said start magnet after each printing operation to engage said clutch and initiate rotation of said brush and the operation of said feeding means, a relay energized under control of said sensing means when the latter senses the presence of the first item card, and multiple circuit connections comprising individual plugging connections between selected contacts and said stop magnet, with one of said plugging connections having in series therewith relay contacts closed by said relay when it is energized, for energizing said stop magnet.

10. In a machine for feeding a sheet printed by an accounting machine comprising, feeding means for said sheet, a driving means operable independently of the operating means for said accounting machine, a clutch interposed between said driving means and said feeding means, a start magnet for engaging said clutch, a stop magnet for subsequently disengaging said clutch, a cam operated contact driven by the operating means for said accounting machine and timed to close after each printing operation, a circuit breaker driven by said driving means and including means for synchronizing the closure of contacts by the circuit breaker and said cam operated contacts, circuit connections including both said circuit breaker and said cam operated contacts for energizing said start magnet after each printing operation to engage said clutch and initiate sheet feeding operations, a line selector commutator comprising contact points and a related brush driven synchronously with said feeding means, and circuit connections including a selected contact and said brush to energize said stop magnet to disengage said clutch when a line position of the sheet predetermined by a selected contact has been reached.

11. In a machine for printing on a register sheet having each section divided into a plurality of forms, data under control of record cards divided into groups with each group including address cards and amount cards, each section having a heading, means for line spacing said register sheet after each printing operation is effected under control of each card, said spacing operations bringing one section of said sheet to a predetermined line at the bottom of a section when a predetermined number of lines have been printed on the last form of a section, detecting means operable during the printing of a predetermined number of forms for detecting the approach and presence of said predetermined line of each section of the register sheet, means under control of said detecting means for initiating the operation of said line spacing means when said predetermined line has been reached for effecting successive line spacings of said sheet to feed said sheet to the bottom of the section, past the heading of the next section and to the first line of the next section, group control devices for sensing changes in designations of the card groups, and means under control of said group control devices for rendering upon detecting no change in group designations said detecting means inoperable to initiate said successive line spacing operations until the last amount card of a group controls amount printing on the last form of a section below said predetermined line, and upon sensing a change in group designations to cause said successive line spacing operations to an extent determined by said detecting means.

12. In a machine for printing on a register sheet having each section divided into a plurality of forms, data under control of record cards divided into groups with each group including address cards and amount cards, and each section having a heading, means for line spacing said register sheet after each printing operation is effected under control of each card and including means to provide an extra space for said sheet to separate the data derived from successive groups of cards, said spacing operations bringing one section of said sheet to a predetermined line at the bottom of the section when a predetermined number of lines have been printed on the last form of a section, detecting means operable during the printing of a predetermined number of forms for detecting the approach and presence of said predetermined line of each section of the register sheet, means under control of said detecting means for initiating the operation of said first named line spacing means when said predetermined line has been reached and occupied by amount printing for effecting successive line spacings of said sheet to feed said sheet to the bottom of the section, past the heading of the next section and to the first line of the next section, group control devices for sensing changes in designations of the card groups, and means under control of said group control devices for rendering upon detecting no change in group designations said detecting means inoperable to initiate said successive line spacing opera-

tions until the last amount card of a group controls amount printing on the last form of a section below said predetermined line, and upon sensing a change in group designations to thereafter cause said successive line spacing operations to an extent determined by said detecting means.

13. In a machine for printing on a register sheet having each section divided into a plurality of forms, data under control of record cards divided into groups with each group including address cards and amount cards, each section having a heading, means for line spacing said register sheet after each printing operation is effected under control of each card, and after printing a line of data related to each group at the bottom of each form, said spacing operations bringing one section of said sheet to the end of a form when a predetermined number of lines have been printed on the last form of a section, detecting means operable during the printing of a predetermined number of forms for detecting the approach and presence of said predetermined line of each section of the register sheet, means under control of said detecting means for initiating the operation of said line spacing means when said predetermined line has been reached and occupied by said line of data printing for effecting successive line spacings of said sheet to feed said sheet to the bottom of the section, past the heading of the next section and to the first line of the next section, group control devices for sensing changes in designations of the card groups and for initiating the printing of said line of data, and means under control of said group control devices for rendering upon detecting no change in group designations said detecting means inoperable to initiate said successive line spacing operations until the last amount card of a group controls amount printing on the last form of a section below said predetermined line, and upon sensing a change in group designations to cause the printing of said line of data to thereafter cause said successive line spacing operations to be effected to an extent determined by said detecting means.

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