Nov. 3, 1936. E. H. DREHER 2,059,215

PAPER FEED MECHANISM

Filed Aug. 22, 1934 8 Sheets-Sheet 1

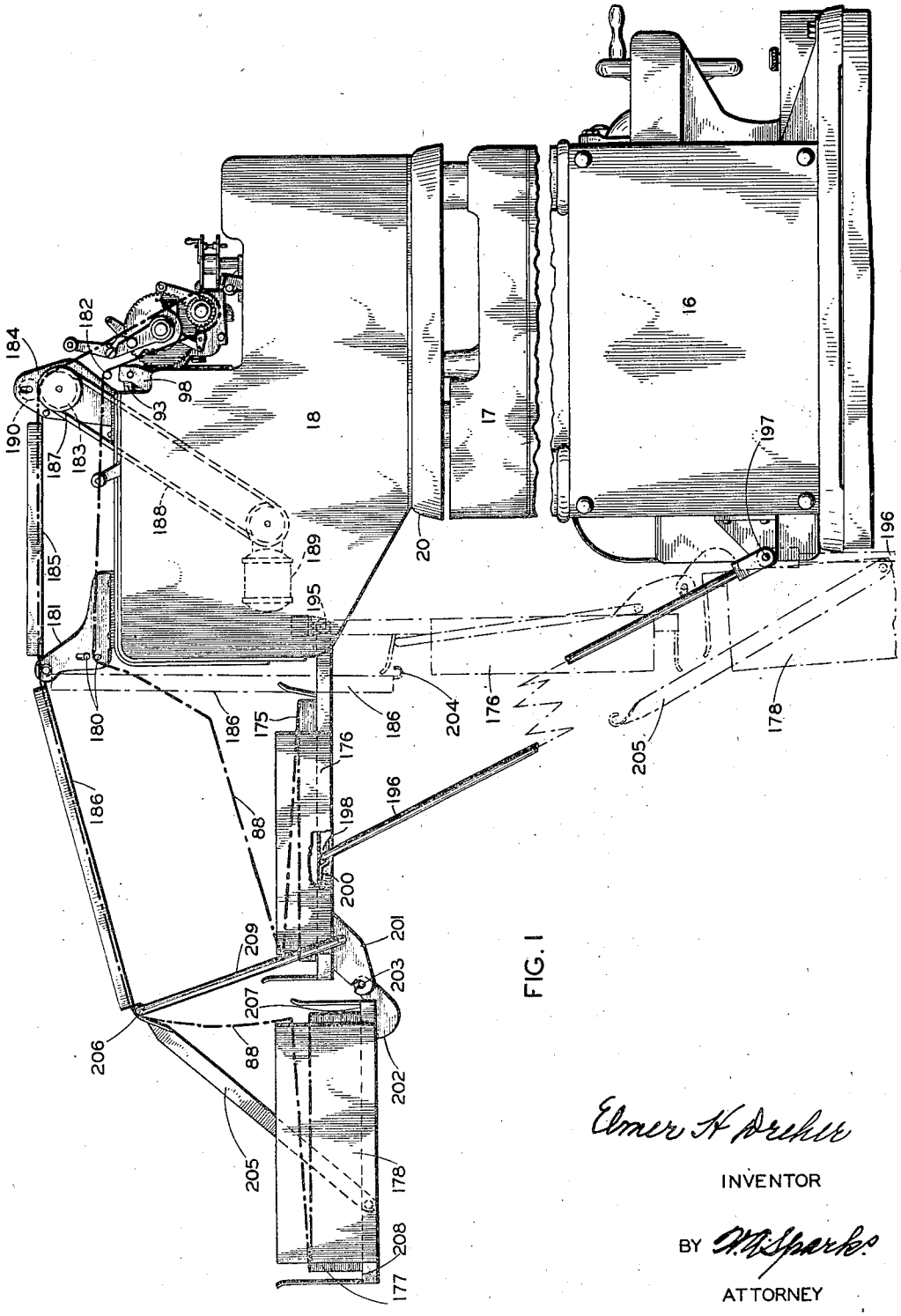



FIG. 1

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INVENTOR

BY W. B. Sparks

ATTORNEY

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PAPER FEED MECHANISM

Filed Aug. 22, 1934 8 Sheets-Sheet 2

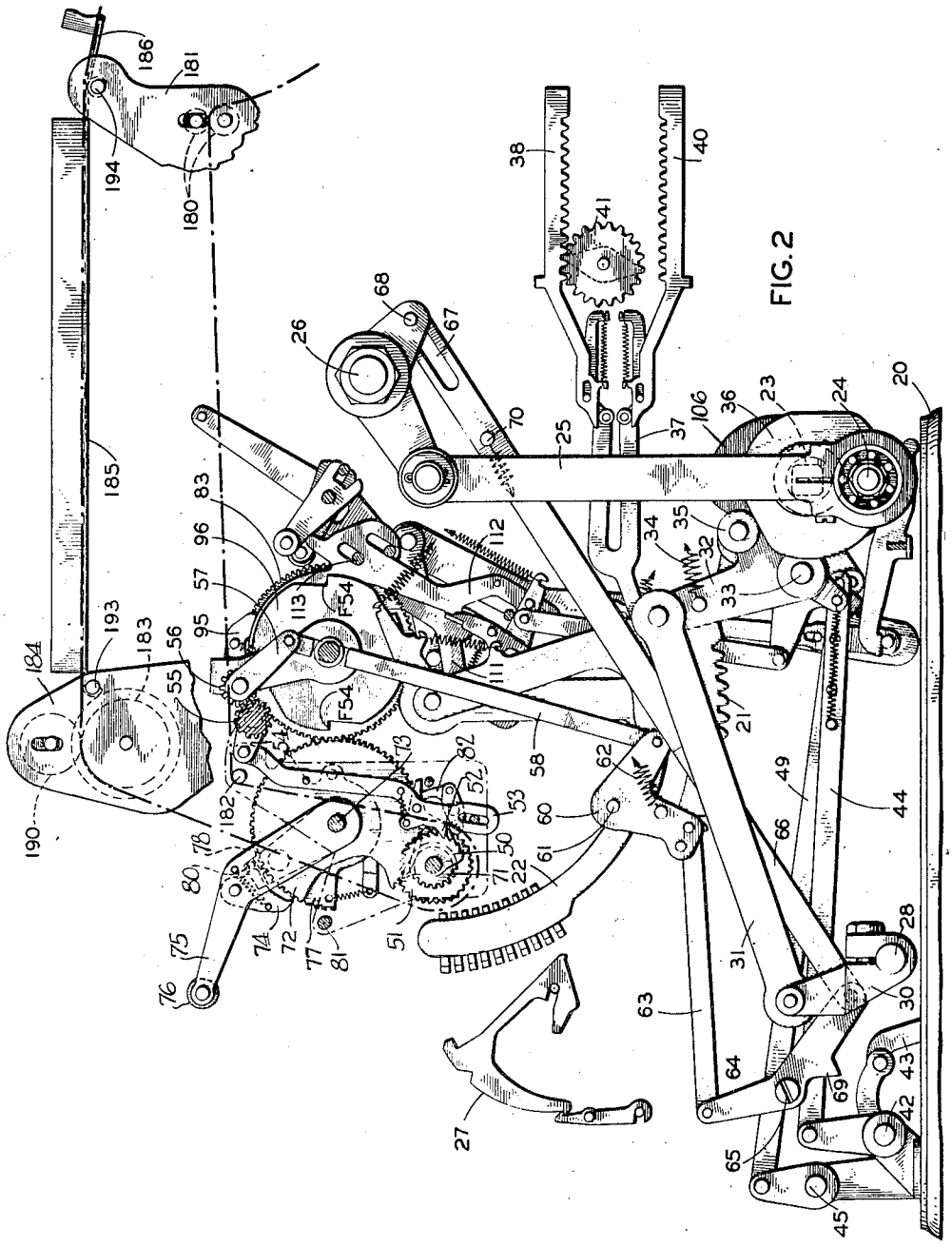


FIG. 2

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PAPER FEED MECHANISM

Filed Aug. 22, 1934 8 Sheets-Sheet 3

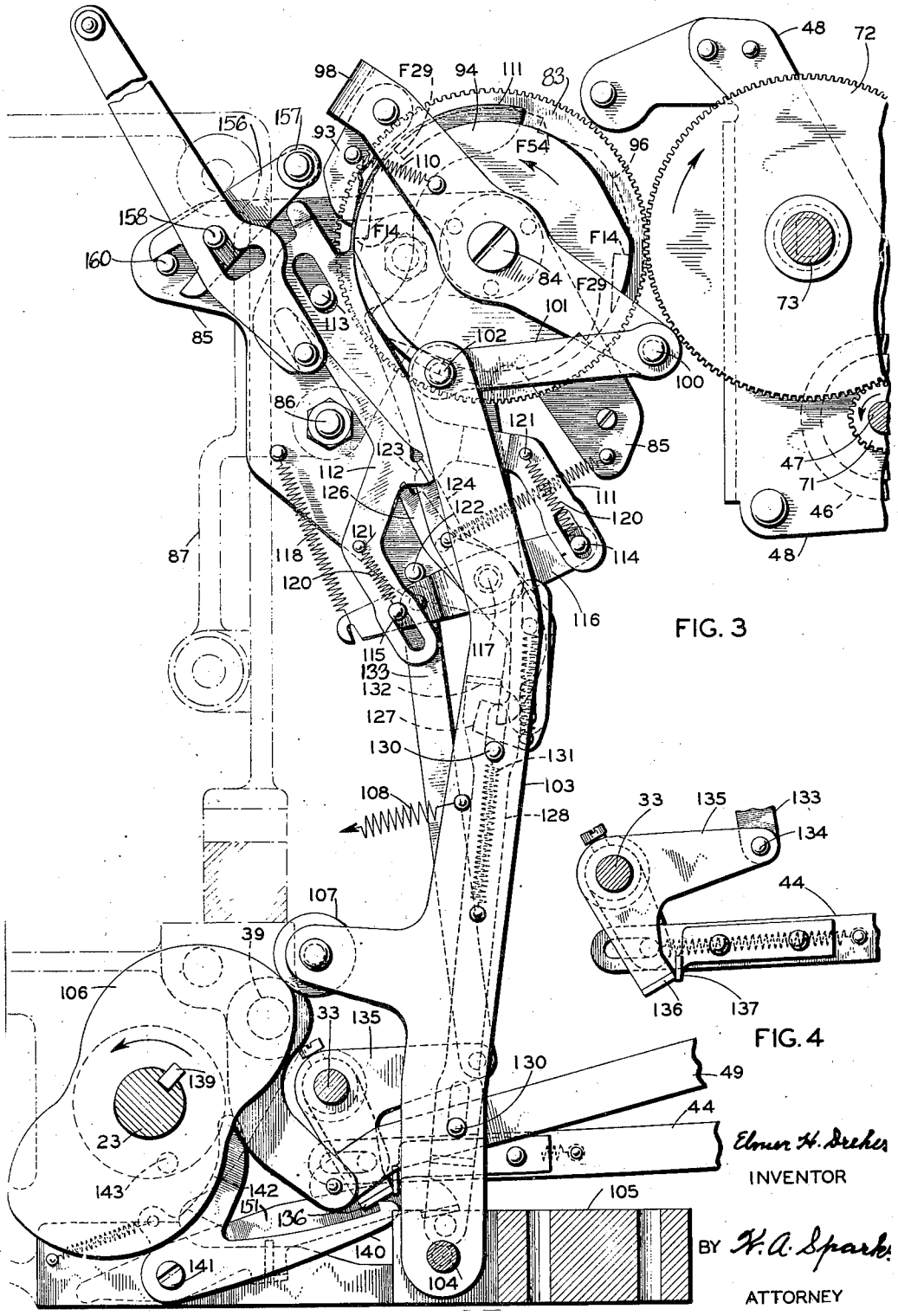



FIG. 3

FIG. 4

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PAPER FEED MECHANISM

Filed Aug. 22, 1934 8 Sheets-Sheet 4

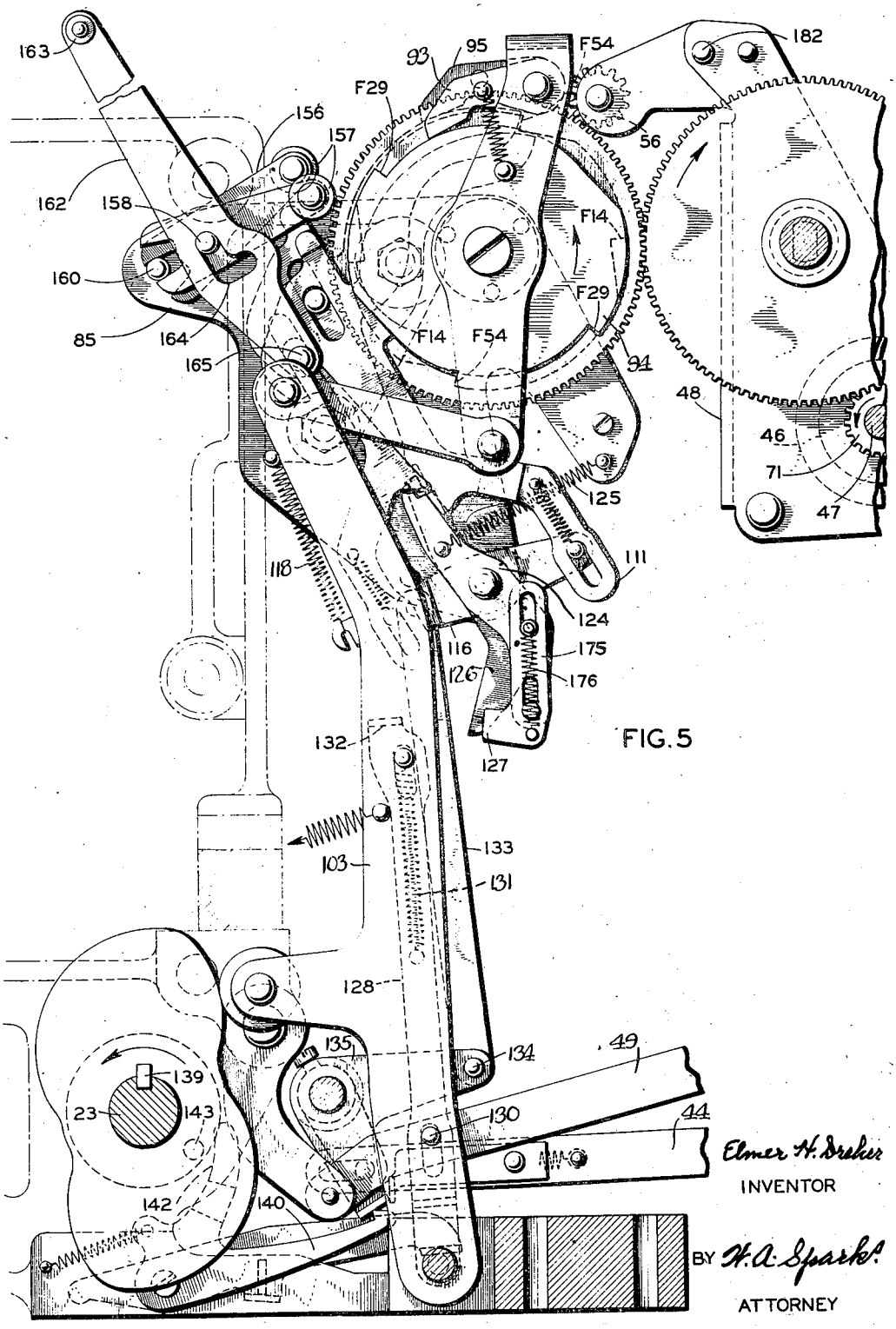



FIG. 5

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PAPER FEED MECHANISM

Filed Aug. 22, 1934 8 Sheets-Sheet 5

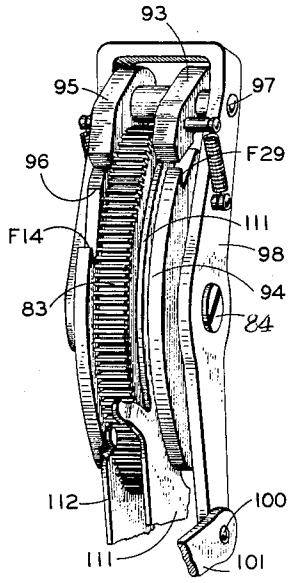



FIG. 6

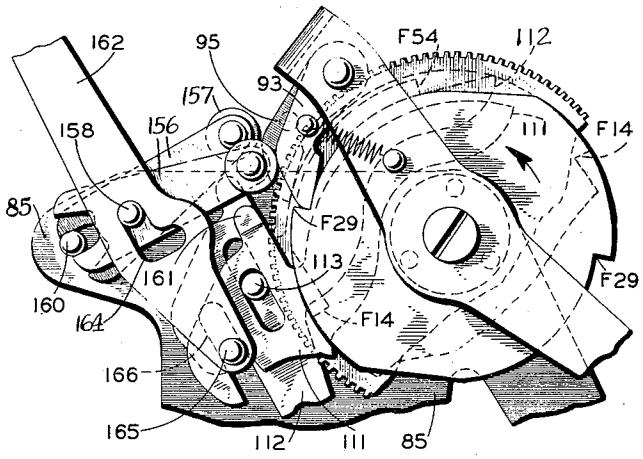



FIG. 7

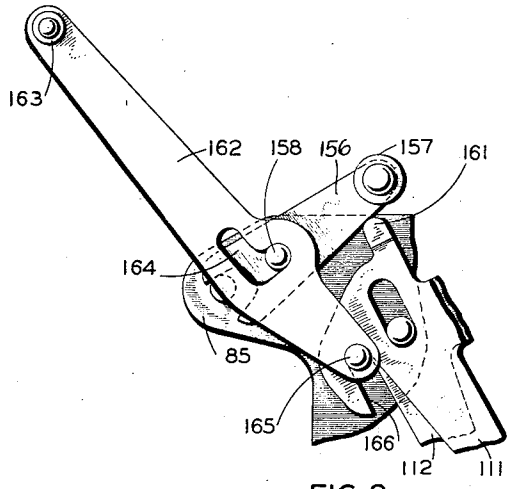



FIG. 8

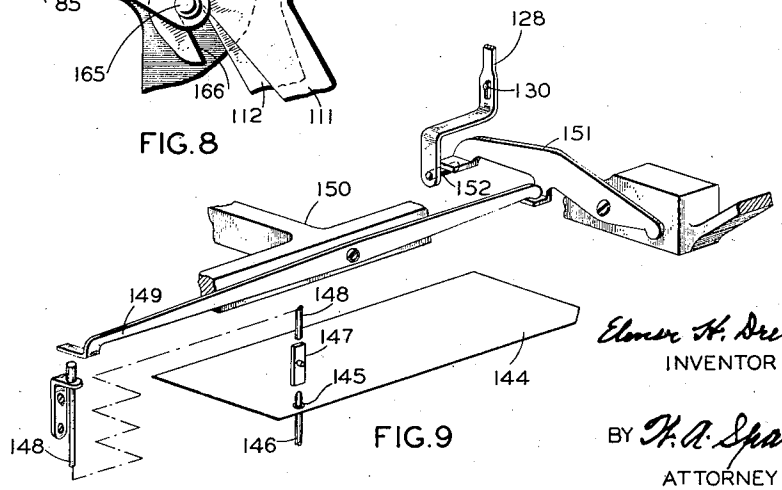



FIG. 9

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PAPER FEED MECHANISM

Filed Aug. 22, 1934 8 Sheets-Sheet 6

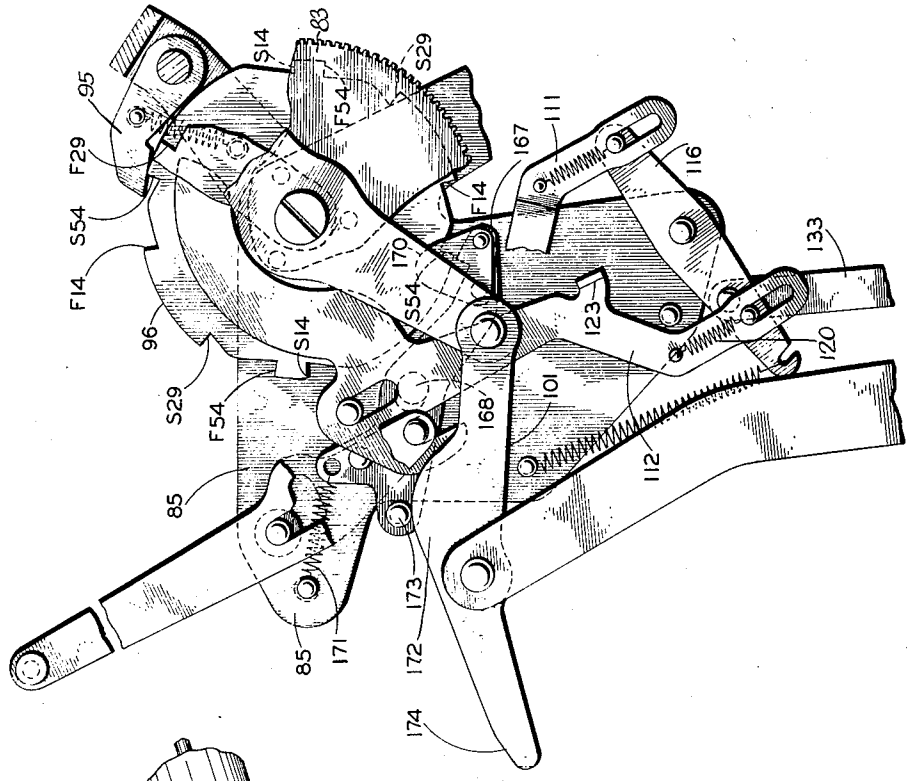



FIG. 10

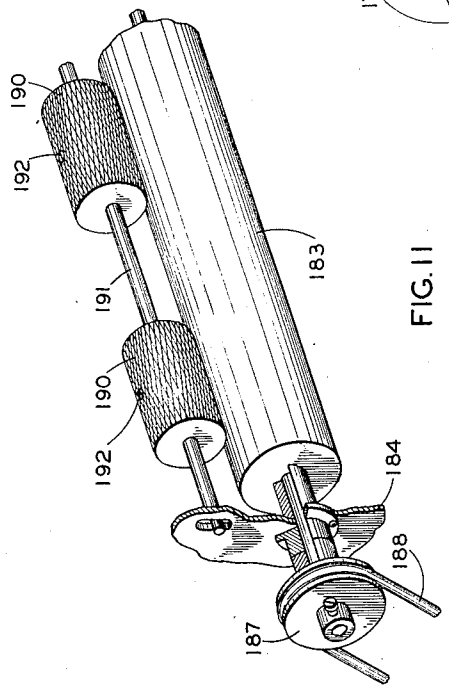



FIG. 11

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Filed Aug. 22, 1934 8 Sheets-Sheet 7

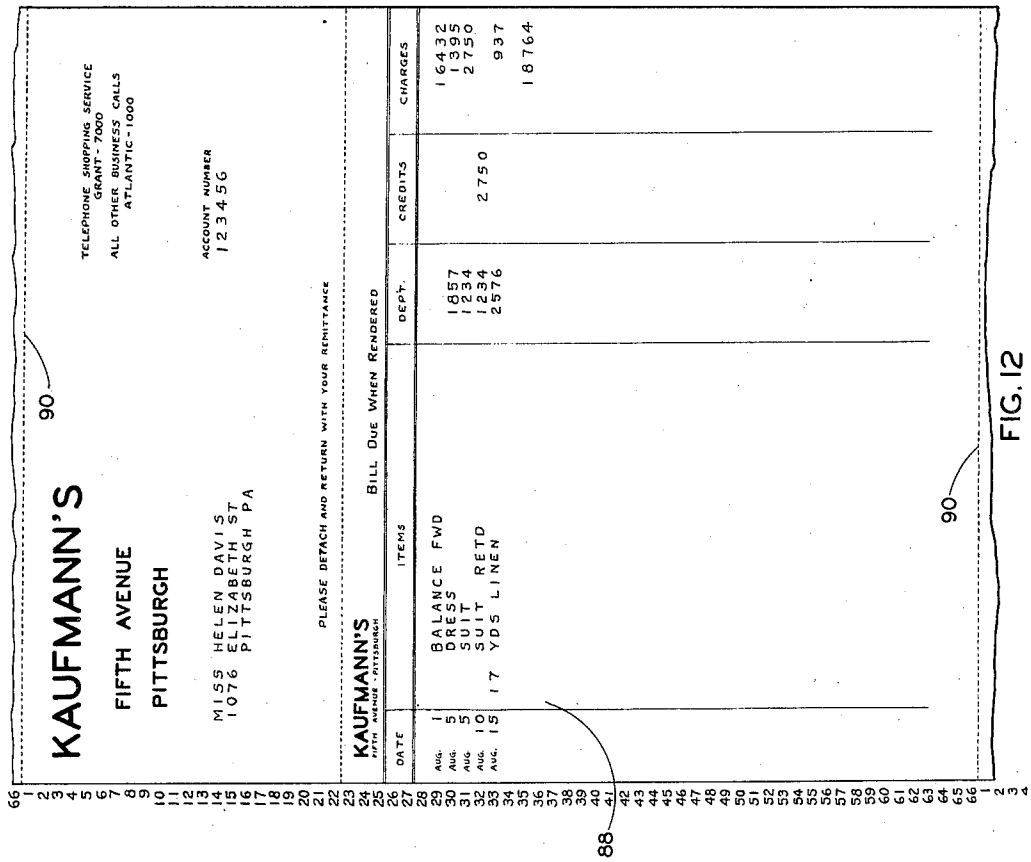



FIG. 12

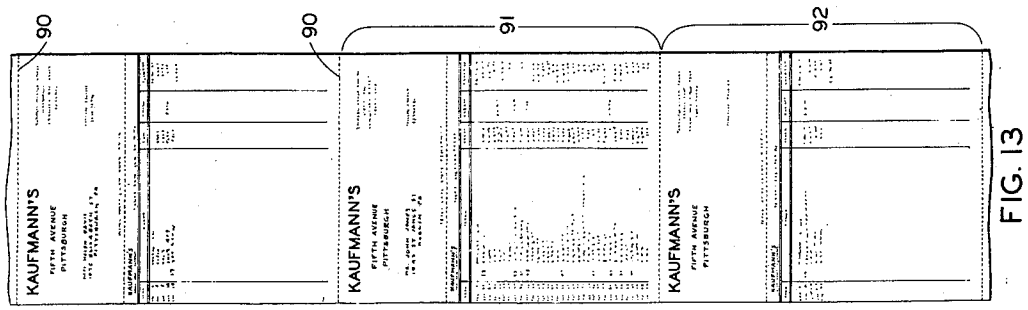



FIG. 13

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PAPER FEED MECHANISM

Filed Aug. 22, 1934 8 Sheets-Sheet 8

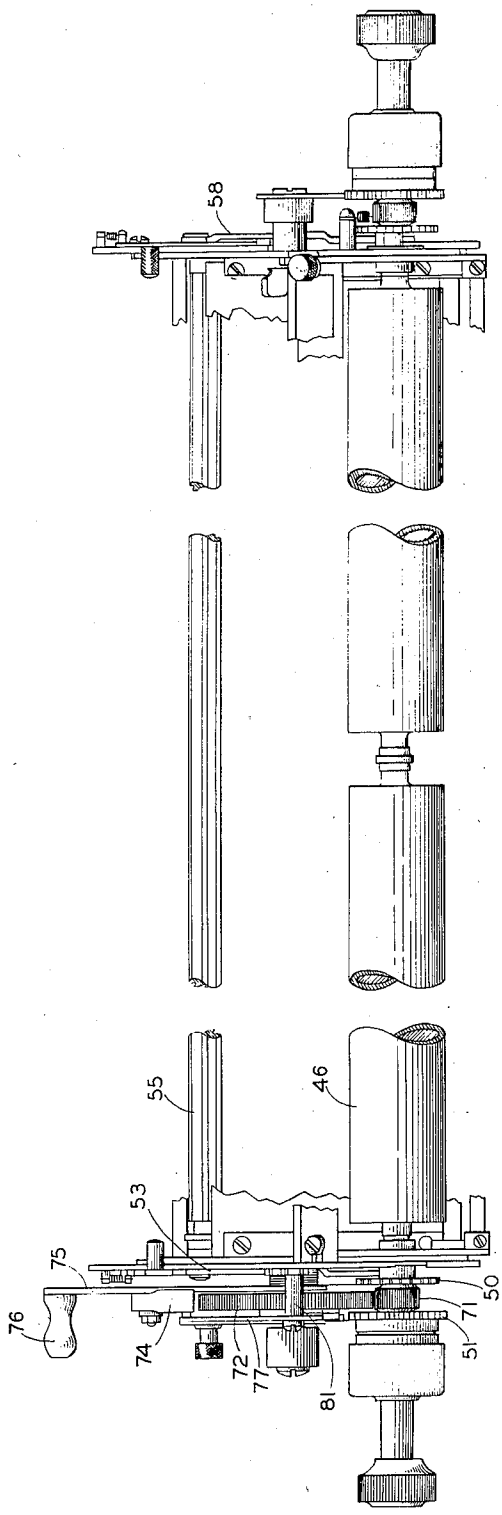



FIG. 14.

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Patented Nov. 3, 1936 2,059,215

# UNITED STATES PATENT OFFICE

2,059,215

## PAPER FEED MECHANISM

Elmer H. Dreher, Brooklyn, N. Y., assignor to Remington Rand Inc., Buffalo, N. Y., a corporation of Delaware

Application August 22, 1934, Serial No. 740,859

11 Claims. (Cl. 197—133)

The invention relates to the paper feed mechanism of bookkeeping and like machines. Some of the features of the invention are applicable to such machines generally, but certain features of it are especially applicable to record controlled tabulating machines.

Generally stated, the invention has for its principal object to provide certain improvements in the means for handling long webs of paper, and especially where such webs are pre-printed to constitute a succession of separable forms, and more especially where it is also pre-folded. The invention includes means for causing a long web to pass smoothly through the machine and to be disposed in neat and convenient form after being printed on by the machine, and without attention by the person operating the machine.

The invention has for one of its objects to provide means for imparting long feed movements to the paper under conditions and requirements more complex than usual, and preferably for doing so entirely automatically, without personal intervention.

The invention also contemplates various improvements in mechanism of the character indicated.

To the above and other ends as will appear in the course of the description, the invention consists in certain features of construction and combinations and arrangements of parts, all of which will be fully set forth herein and particularly pointed out in the claims.

The invention is capable of various applications and of embodiment in various forms. One specific embodiment and application of it are shown and described herein.

The invention is herein described as embodied in a Powers tabulating machine, for tabulating records consisting of punched cards, and as applied to making out the monthly statements of the charge customers of a department store. The statements are printed by the machine on a web of paper pre-printed in a succession of forms, the paper being in fanfold form and being restored to that form after passing through the machine. The mechanism causes the name and address and account number of the customer to be automatically printed under the control of punched cards in a space provided for the purpose in the heading of the form. The mechanism then automatically imparts a long feed to the paper, to position it for the entry of the first item of the statement. When the last item of the statement has been printed, the machine automatically prints the total or balance of the account, and immediately and automatically imparts a second long feed to the paper, to the point or line of the next succeeding form for the printing of the name and number of the next customer. There are thus two different long feeds of the paper to two different positions. A third long feed of the paper is also provided for in case the number of items in an account exceeds the number of line spaces provided for items on the form. In that event, the paper is automatically advanced from the last line of one form to the first line provided on the next form for items, the heading and the printing lines thereon for the name and address being in this instance skipped or passed over without stopping. The applicant is not aware of any prior paper feed mechanism having this variousness of automatic operation.

The machine is equipped with the usual line-to-line feed which operates as usual between the long feeds. It may also be equipped with a known form of hand paper injector and ejector which imparts long feeds to the paper, and there is no interference between that and the long-feed mechanism of the present invention. Means are provided for disabling the latter, by a simple setting of a handle, leaving the machine free to be operated as heretofore; and the long feed of the present invention may be brought back into use at will by resetting said handle.

In the accompanying drawings;

Fig. 1 is a left-hand side view of the machine with parts broken away.

Fig. 2 is a right-hand side view of some of the operating and paper feed and other mechanisms of the tabulator head, with most of the frame and most of the mechanism omitted.

Fig. 3 is a right-hand side view of the long-feed mechanism.

Fig. 4 shows a detail.

Fig. 5 is a view similar to Fig. 3 but with the parts in different positions.

Fig. 6 is a rear perspective view of a portion of the long-feed mechanism.

Fig. 7 is a fragmentary view similar to parts of Figs. 3 and 5, but with the parts in still another position.

Fig. 8 is a detail showing the means for disabling the long-feed mechanism.

Fig. 9 is a fragmentary schematic view of a portion of the mechanism in perspective.

Fig. 10 is a view similar to part of Figs. 3 and 5, but with the parts in another position and illus-

trating also a preferred form of overthrow preventing means.

Fig. 11 is a fragmentary perspective view of a power driven means for assisting in the paper feed.

Fig. 12 is an illustration of a bill form such as the machine is adapted to print.

Fig. 13 is a view of a section of the web of which the form, shown in Fig. 12, is a part.

Fig. 14 is a front elevation of the carriage.

As the simplest way to make the invention understood, one specific embodiment and application of it will be described in detail, extending even to the exact number and positions of the lines on a statement, it being understood that in other instances these details would be varied to suit the different requirements.

The invention is shown applied to the well known Powers tabulating machine which has been in commercial use for many years and which is described in a line of patents and patent applications beginning with the patent to James Powers, No. 1,245,502, dated November 6, 1917. Such machines are controlled by records consisting of cards punched to represent data expressed in numbers, letters of the alphabet, etc. The Powers tabulator comprises a "base" 16 (Fig. 1) having a motor and means for feeding the cards from a stack through a sensing chamber where their perforations are sensed by feeling pins; a "multiple translator" 17 containing translator wires for conveying the control of the sensing pins to the head; and the head 18 itself, where the data are utilized by accumulating them in registers, printing them on suitable sheets or webs of paper, totalizing them, etc. As far as the present invention is concerned, the tabulator may be of any suitable construction. There is shown in the drawings only so much of one form of Powers tabulator as is necessary to an understanding of the application of my invention thereto.

Some of the mechanism of the tabulator head is shown in Fig. 2 of the drawings in which 20 represents the frame base plate of said head. The head 18 contains several tabulator units, each of which may include the usual register-actuating rack sectors 21 and numeral printing typesectors 22; but in the present specific instance there is preferably at least one unit or section occupied by alphabet type sectors for printing certain data as will hereinafter appear. The operating mechanism comprises a continuously rotating transverse drive shaft 23 geared to make one rotation for each machine cycle and connected by a stud shaft 24 on cam 36 and link 25 to oscillate a transverse shaft 26, which carries a series of arms (not shown) which are connected by links to the restoring bails for the numerical type sectors 22 and the printing hammers 27. The usual main rock shaft 28 which, among other things, moves the registers into and out of mesh with the racks 21 has, in this instance, an arm 30, connected by a link 31 with a rocking lever 32 pivoted at 33, urged rearward by a spring 34, and having a follower roller 35 bearing on a cam 36 fast on the drive shaft 23, said cam being so shaped as to swing the shaft 28 forward and back at the proper times.

Some of the units contain the direct subtraction mechanism familiar to users of this machine and described in a certain application for Letters Patent, filed by William W. Lasker. This comprises reciprocatory pieces 37 linked to the respective type sectors 22 and each controlling an adding rack bar 38 and a subtracting rack bar 40, the register wheels 41 being between said rack bars and movable into mesh with either of them. The usual forward total shaft 42 is rocked on occasion by the usual link 43, and it in turn rocks the rear total shaft 33 by means of the link 44, as usual, in order to take a total from the rear registers 41. The projecting end of the shaft 33 furnishes a convenient pivot for the lever 32. The forward grand total shaft is shown at 45, together with the link 49 through which it is actuated from the rear grand total shaft 39 (Fig. 3). The mechanism partially shown and just described, is more fully set forth in the application of W. W. Lasker, Ser. No. 535,842, filed May 8, 1931.

The platen 46 (Fig. 3) has its shaft 47 journaled as usual in the paper carriage 48. In the particular machine described, the platen is divided in two in a familiar way, and the novel feed mechanism is applied to the left-hand half of it; but this is immaterial.

For step-by-step line spacing, the platen is provided at its left-hand end with the usual ratchet wheel 50 and detent wheel 51 shown in Fig. 2 in which these parts are seen from the right hand side, the platen being sectioned away. Said ratchet is actuated one or two of its teeth at a time, or not at all according to manual adjustment, by a pawl 52, pivoted to a sliding link 53, which link is pivoted to an arm 54 on the left-hand end of the usual long pinion shaft 55, which extends the entire length of the platen and is journaled in the carriage. Near its right-hand end, this pinion shaft is engaged by a pinion 56 on a stub shaft having an arm 57 connected by a link 58 with a bell crank 60, pivoted at 61 to the right-hand end frame member of the tabulator head and influenced by a spring 62. This bell-crank is connected by a link 63 with an angle lever 64 pivoted to said frame member at 65 and having one arm thereof pivoted to a long link 66. The latter has at its upper end a slot 67 engaging a stud 68 on an arm projecting from the rock shaft 26. The construction is such that the rocking of this shaft, acting through the train of mechanism described, rocks the pinion 56 and pinion shaft 55, and reciprocates the pawl 52 to impart a suitable feed to the platen at each machine cycle, unless something intervenes to prevent such an operation.

In the Powers tabulator such intervening means is something applied in the form of a stop set in the path of a shoulder 69 on the lever 64, in which event the stud 68 plays idly in the slot 67 and the spring 62 is therefore unable to operate the line space mechanism. Said spring has one end attached to a stud 70 on the link 66. The distinction between single, double and no spacing is made by differential stops set in the path of the return movement of the slide link 53.

The usual pressure rollers co-operate with the platen to feed the paper.

In explanation of Fig. 2, it may be stated that most of the operating mechanism of the tabulator head thus far described is situated at the right-hand side of the machine. This includes the links 25, 31, 58, 63, and 66, and the parts immediately associated therewith. The link 44 and the corresponding grand total link 49 are, however, at the left-side of the machine. All of the platen feed mechanism shown in this figure, and to be hereinafter described, except the arm 57 and pinion 56, is situated at the left-hand end of the tabulator head. and in this

figure is seen, as if looking through the machine. These parts are shown in left-hand side view in other figures of the drawings.

Just to the left of the ratchet wheel **50**, the platen shaft is provided with a pinion **71** having the same number of teeth as said ratchet wheel and driven by a gear **72**, journaled on a stud **73**, secured to the left-hand end plate of the carriage. The Powers tabulator, as heretofore manufactured, has sometimes included this gear, driven by a pawl **74** pivoted to a lever **75**, which lever is pivoted on the stud **73** and is provided with a handle **76**. This constitutes a hand device by which the platen may be rapidly rotated either for the original insertion of a new bill sheet, or for the ejection of the old one. The wheel **72** is shown in Fig. 2 broken away to disclose a fixed toothed segment **77**, the notches of which may be engaged by a tooth on an adjustable piece **78** which may be set so as to limit the spring-impelled return motion of the lever **75**. This it does by means of a pin **80**, which is struck by the pawl **74**, and which lifts said pawl out of engagement with the wheel **72**. On the forward stroke of the handle, the pawl is arrested by a fixed stop **81**. For convenience of illustration, the stop **80** is shown set for a short throw of the pawl. The detent wheel **51** is engaged by a roller on the lower arm of a spring-pressed lever **82**. For some of the uses of my invention this sweep mechanism need not be employed, but the gear **72** is utilized. It meshes with another large gear **83**, which in turn is journaled on a stud **84** secured to a special frame plate **85**, which is detachably secured in any convenient manner as, for example, by bolts **86** to the outside of the left-hand frame member **87** (Fig. 3). The invention includes automatically acting means for imparting to this wheel **83**, and from it to the platen, measured movements of different extents as required. The Powers paper carriage can be removed from the machine by sliding it endwise, in which case the gear **72** slides out of engagement with the gear **83**, and it slides back into engagement when the carriage is replaced.

The specific application of the invention shown and described herein is in connection with the department store system, described in Patent No. 1,801,981 to Rogal and Woodruff, dated April 21, 1931, and in the patent to Nelson No. 1,927,556, dated September 19, 1933. In that system each sale to a charge customer is recorded on an ordinary Powers 90-column card perforated to designate the number of the customer's account, the date of sale, the name of the goods sold, the department of the store from which they were sold, and the amount of the charge, or in other words, the price; also when the customer makes a payment on account, a similar card is punched, but punched with the amount of the payment instead of the price of the goods, and this card is so punched as to indicate that it represents a credit instead of a debit. At the end of the month these charge account cards are sorted according to the customers' account numbers, and the result of this sorting operation is a stack of cards arranged in groups, each group including all of the debit and credit cards of a single customer arranged in the order of the dates. Into this stack there are inserted other cards for printing the name, account number and address of each customer. The cards are run through the tabulating machine which prints each customer's statement, as shown in Figs. 12 and 13. This statement is on a printed form including a heading and a part of the paper ruled for a statement of account. When the first card of Miss Helen Davis' account passes through the machine, her name and account number (in this instance, 123456) are automatically printed from a certain card at the first cycle of the machine. The second card contains her street address and the third card her Post Office address. There may be as many of these heading cards as desired; ordinarily two or three or four of them will suffice. It is not necessary for the purposes of the present case to explain how they are inserted in the stack of cards. Following the three cards giving Miss Davis' name, account number and address, is a card punched to represent the old balance of her account, and this is followed by the cards representing her individual transactions during the month. These item cards are so perforated, and the mechanism is so arranged that each debit card causes the date, a description of the transaction and the amounts to be printed, as shown in said Fig. 12. It will be seen that there is a column in which to print the department of the store concerned and there is, of course, a corresponding field in the card. There is also a column on the paper in which is printed any credit item designated by suitable perforations in a credit card. Any debit items are printed in the column entitled "charges" as shown. Each credit card causes the amount to be printed in the credit column on the paper and to be subtracted from the register wheels **41** instead of added as are the "charges". The machine is so constructed and arranged, as described in a certain application of W. W. Lasker, that as soon as a card perforated in accordance with another account number, comes into the sensing chamber, that card is automatically delayed there and temporarily rendered ineffective, while the machine goes through a totaling operation which results in the printing of the customer's balance at the foot of the column of figures on the statement (in this instance $187.64). The bill forms **88** are printed on a continuous web, as shown in Fig. 13, the successive bills being separable from each other by lines **90** of perforations or other means of weakening. In the present instance this web of paper is folded in "fanfold" form and preferably the folds come at the lines **90** of separation.

The statement sheets illustrated in Figs. 12 and 13 are eleven inches long, and the machine has a single line spacing interval of six lines to the inch. For convenience of description the 66 possible lines on each sheet **88**, are designated in the margin in Fig. 12. It will be noted that the first line printed, namely, the customer's name and account number, is at line **14**, and that the first item printed in the bill is at line **29**. It is not desired to print closer to the bottom of the sheet than line **62**.

The requirements fulfilled by the mechanism to be described are as follows: If, as in the case of the sheet shown in Fig. 12, the number of items is within the capacity of the sheet, a total is printed at the foot of the series of items and the web of paper is then automatically fed forward to line **14** of the next succeeding form. The cards necessary to write the name and address of the next customer are then fed automatically through the machine, the number of such cards in this particular instance being three. The last

one of these three cards is perforated with a special control hole which causes the paper to be fed at the next operation to line 29, ready for the reception of the first line of the bill ("balance forward"). The machine will then feed the paper line by line, one line for each of the cards that pass through it after the last item of the account has been added and printed, the machine will automatically make a blank stroke, followed by a total, after which the paper will space forward again to line 14 of the next form. However, it may occasionally occur that there are more items to be entered in a statement than can be accommodated in one bill form, and such a bill is indicated in Fig. 13 at 91. The construction is such that after printing an item on line 62, the paper is automatically fed forward to advance the next suceeding form to printing position, but in this instance, the name and address of the customer are not repeated. The paper, therefore, instead of being fed forward to line 14 of the next form, is fed forward at once to line 29, and the list of items is continued from there on, as shown on the form 92 of Fig. 13. If the second sheet suffices to include all the items, a total will automatically be taken and the paper web will then be fed forward to line 14 of the next suceeding form. It will be seen that the requirements of this long-feed mechanism are more complex than is usual in devices of this character, for three different long feeds of the paper are required, each to be produced automatically at the proper time, viz., from the last line of the heading to line 29; from the last line of one form (line 62) to line 29 of the next form; and from the line in which a total is printed to line 14 of the next form.

As has been explained above, the jump from the name and address in the heading to line 29 is made under control of a special hole perforated for the purpose in the last card of the customer's address. This being so, it will be understood that there may be within limits any desired number of these cards, the persons operating the system taking care to put this control hole in the last one of them. The jump from the total of a bill to line 14 of the next bill, is done under control of the automatic total taking mechanism of the tabulator, that is to say, as will be more particularly described hereinafter, under the control of the total shaft 42.

As has been explained, the pinion 71 has the same number of teeth as the line space ratchet 50, and one tooth of the wheel 83 therefore corresponds to a line space feed of the platen. It has been found convenient to make this wheel with 132 teeth so that a half rotation of said wheel corresponds exactly to the feed of the web for the length of a single statement form.

The long feed of the paper to line 29 for the first or "balance forward" line of the statement, whether from the bottom line of the preceding form, or from the heading of the same form, is effected by a pawl 93 acting on a disc 94 which is in effect a two-toothed ratchet. The feed of the paper to line 14 for writing the customer's name and number following the printing of the total on the preceding form, is effected by a pawl 95 acting on a disc 96, Fig. 6, which is in effect a four-toothed ratchet. The discs 94 and 96 and the gear wheel 83 are all secured together on the same hub and constitute a single rigid wheel journaled on the stud 84, the disc 94 and pawl 93 being on the left-hand side of the gear and the disc 96 and pawl 95 on the right-hand side thereof, as will be apparent from Fig. 6 where they are seen from the rear. The two pawls are independently pivoted on a short shaft 97 inserted between the two branches of a bail-shaped lever 98 pivoted on the stud 84, and whose left-hand branch is prolonged below its pivot and has pivoted thereto at 100 a link 101 pivoted at 102 to the upper end of a long lever 103, the lower end of which is pivoted at 104 in a block 105 rigidly secured to the base plate 20 of the tabulator head. A cam disc 106 fast on the main drive shaft 23 controls a follower roller 107 journaled in the lever 103, the shape of the cam being such that a complete rotation of said shaft results in two oscillations of the lever 103 and, therefore, in two oscillations of the lever 98 which carries the pawls 93 and 95. The lever 103 is influenced by a strong spring 108 which presses the follower against the cam.

The pawls 93 and 95 are drawn into engagement with their ratchet discs by springs 110, and they are controlled as to their operativeness by two guide pieces, namely, a guide piece 111 for the pawl 93, and a guide piece 112 for the pawl 95. These guide pieces are situated one on the left and the other on the right of the wheel 83 in the space between said wheel and the respective ratchet disc. Each of the pawls has a width to lap over its guide plate, which latter has a guide edge concentric with the stud 84. In Fig. 7, the guide piece 112 is shown in its upper position holding the pawl 95 out of engagement with its disc 96, and the guide piece 111 is shown in its lower position where it permits the pawl 93 to engage its ratchet disc 94. Each of these guide pieces is movable up and down on a stud 113, projecting from the frame plate 85, said stud passing through guide slots in said pieces. From that point, they extend downward at an inclination toward the front of the machine, the piece 111 being then off-set toward the front, and the piece 112 offset toward the rear, as shown for example in Fig. 3. The lower end of the piece 111 has a longitudinal slot occupied by a pin 114, and the lower end of piece 112 has a similar slot occupied by a pin 115, said pins projecting from a lever 116 pivoted at 117 to the frame plate 85, said lever influenced by a spring 118 tending to rock its rear end upward and, therefore, normally holding the guide piece 112 in its upper position where it disables the pawl 95. Each of the guide pieces 111 and 112 is influenced downward by a spring 120 stretched between a stud 121 on the guide piece and the pin 114 or 115 on the lever 116. The construction is such that when the lever 116 is rocked clockwise in Fig. 3 by its spring 118 until arrested by a stop 122, the pin 115 will force the guide 112 to its upper position and the spring 120 connected to guide 111 will tend to pull the latter down to its inactive position, but this tendency may be resisted, resulting in the stretching of the spring 120. When the lever 116 is rocked counterclockwise to its alternative position, shown in Fig. 10, the opposite conditions prevail, that is to say, the guide 111 is forced to its upper disabling position and the guide 112 will be drawn down to its inactive position unless it is held up against the tension of its spring 120. Latches are provided, acting at times, to hold these two guide pieces in their upper position against the tension of their springs 120. The guide piece 111 has bent off therefrom an ear 123, which may be engaged, as shown in Fig. 3, by a suitable shoulder on a latch lever 124 controlled by a spring 125. In Fig. 5 the lever 116 is shown

in the same position as in Fig. 3, but the latch 124 has been tripped and the guide 111 has therefore moved down to its lower position. The guide piece 112 is similarly controlled by a latch 126. The two latches 124 and 126 extend below their common pivot 117, the depending arm of the latch 126 having a straight rear edge, as shown for example in Fig. 5. The latch 124, however, has its depending arm inclined more toward the front of the machine and ends in a finger-like projection 127 having an abrupt rear face. In order to trip these latches selectively, a slide bar 128 is mounted for vertical sliding motion on one face of the long lever 103, by pin and slot connection 130, this bar being drawn upward by a spring 131. An ear 132 bent off from its upper end is so located that when the bar 128 is in its lower position, shown in Fig. 5, the oscillation of the lever 103 toward the front of the machine will cause the ear 132 to strike both latches 124 and 126 and unlatch them, leaving both the guides 111 and 112 free to move to their lower positions, insofar as the latches are concerned. When, however, the bar 128 occupies its normal upper position its ear 132 stands above the finger 127, as shown in Fig. 3, and a rocking of the lever 103 to its front position as there shown, results in tripping the latch 126, but not in tripping the latch 124.

It will be perceived from the foregoing description that the operation of the long paper feed depends on the positions of the guides 111 and 112, and that this depends on the setting of two members, namely, the lever 116 and the bar 128. The lever 116 is rocked under the control of the total shaft 42, and the bar 128 is moved to its lower position under the control of the special perforation in the last of the name and address cards hereinbefore described.

Lever 116 is normally held in the position shown in Fig. 5 by the spring 118, and it is rocked to its alternative position, shown in Fig. 10, by a link 133, pivoted to said lever and at its lower end at 134 to a bell crank 135 loosely pivoted on the rear total shaft 33, as best shown in Fig. 4. The bell crank 135 has an ear 136 in position to be actuated by an ear 137 secured to the link 44 which conveys the motion of the front total shaft 42 to the rear total shaft 33. The shaft 42 is rocked at the beginning of every total taking operation of the machine, and it remains in its rocked position substantially throughout that cycle. Lever 116, therefore, occupies the position shown in Fig. 10 of the drawings during each total taking cycle.

For reasons which will appear hereinafter, it is necessary that it continue in that position during the first half of the next succeeding cycle. To this end, the bell crank 135, as best shown in Fig. 3, has its ear 136 in position to be engaged by a spring-urged latch 140, pivoted at 141 to the block 105. Said latch has an upstanding arm 142 which lies in the path of a pin 143 projecting from the face of a certain hub mounted on the shaft 23. In Fig. 5, the shaft 23 is shown at about the middle of a cycle, and it will be seen that, if the latch 140 were holding the lever 135, said latch would be tripped by the pin 143 early in the second half of the cycle. In the drawings the shaft 23 is shown with a spline 139, by observation of which the position of the shaft may be perceived. At the beginning of a cycle, this spline, as well as the center of the stub shaft 24 (Fig. 2) stands directly beneath the center of the shaft 23.

The means whereby the control hole in the card causes the shift of the bar 128, is best shown in Fig. 9. The card 144, which represents the last line of the customer's address, has a special control hole 145, in the present instance in position 12 in column 42. The feeler pin 146, as diagrammatically represented in Fig. 9, elevates a set-pin 147, which, like all such pins in the machine, when elevated becomes locked in its elevated position until released at the end of the cycle. This set-pin elevates its translator wire 148 which, at its upper end, rocks a lever 149 pivoted at its middle to a portion of the frame 150. The right-hand end of this lever overlies an ear formed on lever 151 which in turn has an ear formed on its free end which overlies a stud 152 projecting from the slide bar 128. The construction is such that whenever the pin 146 finds a hole, the bar 128 is pulled down from its normal position, shown in Fig. 3, to its operated position, shown in Fig. 5, and remains there throughout the cycle.

When the machine is first started to operate on a web of paper, the long-feed mechanism is set to the position it would occupy after taking a total, and said web is adjusted by hand so as to cause the first line of printing to come at line 14 of the first form. As the number of teeth in the wheel 83 is just double the number of line spaces per sheet, each line space position on the sheet corresponds to one of two definite positions of said wheel, said two positions being 180° apart. In operation, line 14 is brought to printing position by pawl 95 acting on disc 96 (Fig. 3), and this disc has, therefore, two teeth or shoulders 180° apart, one or the other of which, when engaged by the pawl, will bring line 14 to printing position. These teeth are designated F14 on the drawings. The paper is brought to line 29 by pawl 93, and the disc 94 accordingly has two diametrically opposite teeth F29. Obviously, one of these teeth is situated 15 tooth-spaces of the wheel 83 in advance of one of the teeth F14. For reasons which will presently appear, the disc 96 has two other diametrically opposite teeth each situated circumferentially something like half way between one of the teeth F29 and the next succeeding tooth F14. These teeth are designated in the drawings F54, meaning that when one of them is engaged by the pawl 95 the paper is fed to line 54. The discs 94 and 96 are in effect mutilated ratchets, and they will be so called herein.

The operation of the mechanism may be conveniently described by beginning with line 29, assuming that that line of the paper has just been brought to the printing point by the pawl 93 engaging the tooth F29, as shown in Fig.7, where said pawl is at the limit of its operating stroke. At that time the lever 116, Fig. 5, is in normal position, the guide 111 in its lower position leaving pawl 93 free to act, and guide 112 is in its upper position holding the pawl 95 out of action. During the printing of the items, pawl 93 sweeps back and forth over the disc 94, but idly, as its return motion is not sufficient to cause it to engage the next tooth F29. However, as each line is printed the regular line feed mechanism (ratchet 50, pawl 52, etc.) turns the platen and with it the wheel 83 and discs 94 and 96, so that said tooth F29 is creeping forward a step at a time. It is not desired to print beyond line 62, and if the bill is a long one, and an item is printed on that line, such item is printed at about the middle of the cycle when the shaft 23 is in the position shown in Fig. 5, from which it will be seen that the peak of the cam 106 has

already passed the follower 107, and the pawl 93 has therefore already begun its return stroke. It is, therefore, too late for said pawl to advance the paper in the last half of that cycle, and it will, therefore, be advanced to line 63 by the pawl 52, bringing tooth F29 into the range of motion of pawl 93. In the first half of the next cycle, therefore, the pawl must advance the paper from line 63 to line 29 of the next form, ready to receive the next item. The distance is thirty-two spaces; in other words, the next tooth F29 is then standing thirty-two spaces back of the position of the pawl 93 in Fig. 7. The cam 106 is, therefore, so designed as to allow to the pawl 93 an excursion of thirty-two spaces plus a sufficient fraction of a space to assure that the pawl will drop into engagement. The pawl 95 will, of course, have the same extent of movement. During this stroke the heading is passed over and completely skipped.

Perhaps only a few items remain to be printed on the second form. When the first card of the next group (those for the next customer) comes into the sensing chamber of the machine, the mechanism senses the change in the customer's number and initiates the movements necessary to print the total of the group just completed. It makes one blank cycle, in which pawl 52 advances the paper one line space. It then pulls the link 43, Fig. 2, rocking shafts 42 and 33, and also rocking lever 135, and, through link 133, rocking lever 116 to the position shown in Fig. 10, and thus raising guide 111 and disabling pawl 93. Lever 135 is latched in rocked position by pawl 140. All of this occurs at the beginning of the total-printing cycle. Guide 112 was already elevated, holding pawl 95 out of action, and it remains so temporarily, being held up by its latch 126. During the first half of the total printing cycle, therefore, both pawls are out of action. However, in the latter part of this half cycle the lever 103 is swung forward to its extreme position, (Fig. 3) with the result that the ear 132 trips the latch 126 and allows the guide 112 to drop and pawl 95 to engage disc 96; but said pawl is by that time so far advanced on its forward stroke that it has passed the tooth of disc 96, and its stroke is, therefore, ineffective.

Said pawl makes a second stroke in the second half of the total printing cycle and advances the paper to line 14, or to an intermediate position as will presently be explained. The pawl 52 makes its usual stroke at this time, but the pawl 95 is turning the platen at greater speed, and the stroke of pawl 52 is therefore ineffective.

It will be recalled that the extent of movement of the pawls was fixed at 32 spaces by the requirements as to pawl 93. Where a total is printed near the top of a form, the distance from there to line 14 of the next form is considerably in excess of 32 spaces. It is, therefore, necessary for the pawl 95 to act twice before the name and number of the next customer are printed at line 14 of the next form; and this is also highly advantageous for other reasons, as will be explained. It is for this reason that the extra tooth F54 is provided, and it is partly for this reason that the cam 106 is shaped to give two strokes to the pawls at each cycle. In the last half of the total printing cycle, therefore, the paper is advanced by pawl 95 engaging said total F54 and only to line 54. It will be understood that this precise point (line 54) is immaterial. The pawl 95 engages tooth F14 in the first half of the next cycle, and advances the paper to line 14 just before the printing of the name and number occurs. It is the beginning of this stroke of the pawl that is illustrated in Fig. 10 in which the disc 96 has the same teeth F14 and F54 as in the other figures, though it is shown modified in other respects as will be described. Tooth F54 is at the point where the pawl left it, and said pawl is ready to engage tooth F14. Guide 111 (broken away) is held in its upper position by lever 116, and it will remain in that position until its latch 124 is released some cycles later, as will be described.

If the bill contains enough items so that the total is printed within 32 spaces of line 14 of the next form, the paper would be advanced to that line (14) in the first of the two strokes above described, and the second stroke would be idle.

In case an account had no transactions during the month, but there was an unpaid balance, the total would be printed on line 31, and before printing the name of the next customer, that is to say, on the next machine cycle, the paper must be advanced from that point to line 14 of the next form, a distance of forty nine spaces, or more than eight inches. This is one of the most important reasons for causing the pawls to make two strokes at each cycle. By the present invention the paper is fed to line 54, for example, in the second half of the total cycle and from there to line 14 in the first half of the name-printing cycle, so that ample time is provided for this very long feed. If the paper were fed for such a distance in a single stroke, it would be necessary to feed it at a prohibitive speed, resulting in inaccuracy of movement due to slippage. By extending the feeding time as mentioned, a well known difficulty is avoided.

The lever 116 was rocked to the position shown in Fig. 10 by the total taking mechanism, but at the time there illustrated, that mechanism has already returned to normal position and this lever and its connected parts are held in operated position by the latch 140 engaging lever 135. The operation of this latch can be understood from Fig. 5, although that figure shows the mechanism at another stage in its sequence of operation. Fig. 5 shows the parts at the mid-point of a cycle, and shows that the pin 143 reaches the arm 142 at the beginning of the second half of each cycle. At the time illustrated in Fig. 10, the lever 135 was rocked and latched at the beginning of the total printing cycle, and the pin 143 tripped the latch at the beginning of the second half of that cycle, but ineffectually, because said lever was still held in rocked position by the total mechanism. The pin 143 will not again trip the latch until the second half of the next cycle, namely, that in which the new customer's name and number are printed. The pawl 95 will, therefore, continue active during the first half of that cycle, and will advance the paper to line 14, as described. The pawl 140 will then be tripped and the lever 116 will return to normal position and remain there, holding pawl 95 inactive, until the next total printing operation.

It has been explained that the pawl 93 must be inactive during the printing of totals and how this is accomplished by the total shaft rocking the lever 116. It is, of course, also necessary that pawl 93 remain inactive during the printing of the heading (name, number and address of the customer) and it is for this reason that, when lever 116 returns to normal, as above described, guide 111 is held up by its latch 124, and will so remain until released under the control of special hole 145 (Fig. 9) in the last heading card. Fig. 3

shows the mechanism in the latter part, but not at the end of the first half of the cycle in which the second line of the heading is printed. The guide 112 is held up by lever 116 and the guide 111 by its latch 124. Both pawls are, therefore, inactive and the platen is left to the control of the line-to-line feed mechanism (pawl 52). The ear 132 is tripping the latch 126, but ineffectively. Said ear passes above and does not act on the finger 127 of latch 124. The parts continue in this position until the last heading card 144 (Fig. 9) comes into the sensing chamber and causes the ear 132 to be drawn to its lower position, shown in Fig. 5. That figure shows the parts at the middle of that cycle; that is to say, at about the instant when the last heading line is being printed. The bar 128 and ear 132 were drawn down at about the beginning of the cycle. In fact, in this particular machine, they were drawn down so soon that said ear had, at the time, not entirely gotten away from above the finger 127, and said finger is, therefore, made yieldable downward, as shown, to avoid injury to the mechanism. It is made as a separate piece 175, slidably mounted on the latch 124 by pin and slot connection, and normally held up by a spring 176. In Fig. 5 the peak of the cam 106 has already passed the follower 107. When it did so, the ear 132 struck the finger 127 and tripped the latch 124, allowing guide 111 to drop and pawl 93 to engage the disc 94; but said pawl was then nearly at the end of its stroke and had already passed the tooth F29, so that no paper feed was caused. It is now being drawn back and will make another advance in the second half cycle, feeding the paper to line 29. It was at this point that the description of the sequence of operations was begun.

The means for arresting the long-feed mechanism in correct position, as shown in most of the figures of the drawings, comprises two arms 156, each carrying a roller 157, these rollers, when in operative position being adapted to be struck one by the pawl 93, and the other by the pawl 95, when said pawls reach the extreme limit of their working stroke. As shown in Fig. 7, the edge of the pawl 93 is so shaped that when it reaches the roller 157, the latter will jam the pawl into forcible engagement with the disc 96 and positively arrest its motion. Preferably the surface of the disc at the base of the tooth (see Fig. 10) is slightly undercut so as to make a very shallow notch into which the end of the pawl is forced by its engagement with the roller, so as to arrest the motion of the disc. The two levers 156 are pivoted at 158 to the frame plate 85, and each of them is capable of a rocking motion limited by a stop pin 160 projecting into a notch in one arm of the lever. When the lever is in effective position, as is the one nearest the observer in Fig. 7, the lower fork of the lever is in engagement with this stop pin and the lever, therefore, can rock no further. These stop rollers and levers would interfere with the motion of the pawls when the latter are held out of engagement by their guides 111, 112. Accordingly, when one of the pawls is elevated, its stop roller is also elevated, as shown in the case of the one farthest from the observer in Fig. 7. To this end, each of the guide pieces 111, 112 has a finger 161 projecting upward therefrom, so that when the guide piece is raised it moves the stop lever to ineffective position.

It is sometimes desired to disable this long paper feed mechanism altogether. To this end a lever 162 (Fig. 8), having a handle 163, is provided, having an L-shaped slot 164 embracing the pivot pin 158. The lower end of this lever has a pin 165 engaging in open-ended slots 166 in the two stop pieces 111 and 112. This lever 162 normally stands as shown, for example, in Fig. 7. The stud 158 occupies the top of the vertical branch of the slot 164. If this handle 162 be pulled up to the position shown in Fig. 8, it will raise both guide pieces 111 and 112 to make both feed pawls inoperative. The parts are maintained in that position by swinging the lever to the rear, thus bringing the stud 158 into the horizontal part of the slot. The tabulator may then be used as if the long-feed mechanism were not present in it.

Means for preventing an overthrow of the parts is shown in a preferred form in Fig. 10, in which the stop pieces 156, 157 are replaced by a single stop pawl 167 pivoted on a stud 168, projecting from the frame plate 85, and adapted to engage the ratchet disc 96. Said pawl is provided with a cheek-piece 170 lying in the space between the disc 96 and the wheel 83, to guide the pawl. Said ratchet disc is cut with six stop teeth or shoulders; that is to say, with three shoulders in each semi-circumference, said shoulders being designated S14, S29, and S54, the two digits of each number corresponding to the line on the paper at which each tooth, when engaged by the stop pawl, arrests the parts. At the point where said pawl is pivoted to the stud 168, the hole in the pawl is somewhat elongated so that the pawl may not only turn on the stud, but may slide a short distance. Said pawl is controlled by a tension spring 171, acting on it above its pivot, and drawing the pawl leftward in Fig. 10. The construction is such that the spring 171 holds the pawl normally pressed against the disc 96, and causes it to engage the shoulders made for the purpose in said disc, but when the pawl is moved out of engagement the spring 171 pulls it a little to the left so as to prevent it from re-entering the notch, and it is shown in Fig. 10 in that position with respect to the shoulder or tooth S54.

The means for withdrawing the stop pawl consists of the cam-like upper edge 172 of the actuating link 101, which acts on a stud 173 projecting from the pawl. This pawl is required to operate at the extreme end of the operative stroke of the link 101, at which time the inclined part 174 of the extended link 101 reaches the stud 173 and leaves the pawl 167 free to engage the disc 96.

It will be noted that a shoulder S29 is also provided in each half of the disc to arrest the parts when the pawl 93 brings the paper to line 29.

It will be recalled that the pawl 93 sometimes advances the paper from line 63 clear across the heading to line 29 of the next succeeding form. In this operation the shoulder S14 passes the tooth of the pawl 167, and means must, therefore, be provided to prevent the pawl from engaging that shoulder at that time. This means is provided by the edge 172 of the link 101 acting on the pin 173. Said shoulder S14 passes the pawl 167 at about the middle of the stroke, and the edge 172 is so shaped that at that period of the stroke the pawl is held out of contact with the disc. When, after a total-printing operation, the paper is brought to line 14 by the pawl 95, the shoulder S14 reaches the pawl 167 at the extreme end of the stroke of the link 101, at which time the incline 174 of the edge 172 has passed the stud 173, and the pawl engages said shoulder and arrests the parts.

Obviously, the mechanism thus far described

may be used to feed paper from any suitable source, such, for example, as a supply roll. Preferably, however, the paper is folded back and forth on itself along the weakened line **90**, in the manner sometimes called "fanfold". The supply of it is, therefore, in the form of a pile **175** (Fig. 1) lying on a shelf or tray **176** at the back of the machine; and after printing it is fed back and automatically refolded into a second pile **177** on a second tray **178**. From the pile **175** the paper web is drawn upward and forward between two guide rolls **180** (Fig. 2) mounted on top of the machine in brackets **181**, the upper roll having its spindle guided in vertical slots in said brackets so as to rest by its weight on the paper. From here the paper is drawn forward to a guide rod **182** on the carriage (Fig. 5), and thence downward about the platen. From the front of the platen the paper passes upward and over a power driven feed roll **183** journaled in brackets **184**, thence through a guide trough or chute **185** to another chute **186**, from the rear end of which it descends into the tray **178**, all as shown by the heavy dot-dash lines in Figs. 1 and 2.

The power-driven roll **183** (Figs. 1, 2, and 11) is an important element in this appliance. On its axle outside one of the brackets **184** it carries a pulley **187** driven by a belt **188** from any suitable source of power, such as a small electric motor **189** mounted on or in the tabulator head.

The paper is pressed into frictional engagement with the roll **183** by a roll **190**.

An advantageous form of this pressure roll is shown in Fig. 11. It consists of a plurality of metal cylinders strung at intervals along a shaft **191** to which they are fixed by set screws **192**. Said shaft extends through vertical slots in the brackets **184** so that the roll rests on the paper by its weight. It has been found by experiment that the action is improved by knurling the convex surface of these cylinders, as indicated by cross lines in Fig. 11. It may be worth while to remark that in the specific machine described, the roll **183** is made of a material known commercially as "Textolite tubing" about one and one-half inches in diameter and with a smooth surface, and is rotated at about 750 R. P. M., and that the roll **190** consists of steel cylinders about one inch in diameter.

The power-operated feeding means just described pushes the paper back through the chutes **185** and **186**, and it also improves the action of the feed of the paper by the platen. The paper is fed from line **14** of one form to line **14** of the next by a succession of steps, including a number of actuations of the line-to-line feed, and two actuations of the long feed. In apparatus for bringing a web of paper automatically to the first line of a succeeding form as constructed heretofore, it has been found that a certain amount of slip occurred between the platen and the paper which caused the first line of the second sheet to come not exactly to the printing line; and the error was cumulative. The third sheet would come a little further from exact position than the second, the fourth a little further still, and so on; and after a certain number of forms it became necessary to stop the machine and re-adjust the paper. The feed roll **183** maintains quite a strong tension on the paper at the delivery side of the platen, and this effects a marked improvement in the respect under consideration, so that a much greater length of web than formerly can be fed through the machine without an error of position occurring sufficient to require re-adjustment.

The chutes **185** and **186** may be of flat sheet metal with guide edges turned up and, preferably, also turned in over the edges of the paper. The chute **185** is supported on suitable cross rods **193** and **194** on the brackets **181** and **184**, and the chute **186** is hinged to the latter. The tray **176** has its side beams pivoted to the frame at **195** and it is held up by a brace consisting of a bail **196** whose arms are hinged to the framework at **197**. The cross-bar **198** of the bail rests in notches formed by securing clips **200** to the bottom of the tray. The tray **176** has two brackets **201**, each with an open slot or notch in which rests a rod or studs **203** carried by brackets **202** on the tray **178**. A bail **209** pivoted to the brackets **201**, has its cross bar resting in a sort of hook **204** made by bending back the floor of the chute **186**, whose free end is thus supported. One or more braces or ties **205** are pivoted to the tray **178** and hook over the bail **209** to support the free end of said tray. The construction is such that the upper ends of the bails **196** and **209**, and the tie or ties **205**, may be unhooked and the trays **176** and **178** and the chute **186** may all be caused to hang down behind the machine out of the way, as shown in broken lines in Fig. 1. Also the rod or studs **203** can be lifted out of their notches in the brackets **201**, and the tray **178** thus removed from the machine. It is found that the rolls **183**, **190** can push the paper along the chute **185** and **186**, especially if the latter has a suitable downward inclination.

With the arrangement shown, the paper is automatically piled in the tray **178**, provided only that the pile be properly started with the first fold or two. This works best when the distance from the point **206** to the point **207** at the forward foot of the pile is not greater than the length of a single form or fold, and it works well when such distance is somewhat less than the length of a single form; and preferably the distance from the point **206** to the point **208** at the rear foot of the pile is somewhat greater than the length of a form. In the present instance, where the forms are eleven inches long, these distances are about nine or ten inches and thirteen and a half inches, respectively. It is, of course, not necessary to adhere to these exact proportions. If the distance between points **206** and **207** is materially longer than a single form, the paper does not fold itself together so well. With the paper in the position shown in Fig. 1, as it is fed back, the last fold will settle down on top of the pile, and the nearly vertical section of paper will bow more and more toward the rear, settling down on the top of the pile. After the next fold passes the point **206**, its tendency to fold will cause the paper to bend far more at that point than at any other, and, as the paper continues to move rearward, the fold will become more pronounced until it lies on the pile. The next oncoming fold tends to break in the opposite direction. When it passes the point **206**, the paper is suspended between that point and the rear edge of the pile, and its weight therefore tends to cause the paper to hinge, as it were, along the pre-folded line. In short, due to the pre-folded condition of the paper, the stiffness of the paper between folds, and its weight, it automatically folds itself up into a pile as it is fed back. It is found in practice that it does this quite neatly. This process will continue until a considerable pile has been accumulated, and un-

til the distance from the point 206 to the proximate foot of the pile has become considerably less than the length of one of the folds.

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

1. The combination with printing means, of a long-feed element capable of feeding a web of paper to a predetermined line position from another predetermined line position or from intermediate positions, an alternative long-feed element capable of feeding the paper to such an intermediate position, and means for temporarily suspending the action of the first said element to permit printing in such intermediate position.

2. The combination of a long-feed element acting automatically to feed a web of paper divided into forms from the last line of one form, to a predetermined line of the next succeeding form, an alternative long-feed element for feeding the paper from a line short of the bottom of a form to another predetermined line of the next form, means acting to suspend the first recited element to permit of printing at said second predetermined line, and means for restoring the activity of the first said element which thereupon acts to feed the paper to the first mentioned advanced line.

3. The combination with printing instrumentalities, and line-to-line paper feeding means, of long-feeding means comprising a pawl and a ratchet having a tooth so situated as to feed a web of paper to a predetermined line, means for imparting to said pawl a measured sweep whereby said pawl will pick up said tooth when the paper reaches a predetermined line, a second pawl and ratchet having a tooth disposed to feed the paper to another predetermined line, and means for engaging and disengaging said pawls selectively.

4. In a bookkeeping machine having means for printing a line at each cycle of operation, the combination of a feed pawl for a long-feed mechanism for the paper, means for reciprocating said pawl twice at each cycle, and a mutilated ratchet having two teeth, one engaged by said pawl to feed the paper to an intermediate position and another engaged by the pawl on the next succeeding reciprocation thereof to feed the paper to a predetermined line position.

5. In a bookkeeping machine having printing means and means for causing a total-printing cycle of operation, the combination with the line-to-line paper feed mechanism, of long-feed mechanism normally inactive, means controlled by said total-causing means for rendering said long-feed mechanism operative during the total-printing cycle, and means for maintaining said long-feed mechanism active into the next succeeding cycle.

6. Long-feed mechanism for a web of paper comprising in combination a mutilated ratchet having drive teeth and stop teeth, a drive pawl acting on said drive teeth, a stop pawl acting on said stop teeth, and means acting during the stroke of said drive pawl to maintain said stop pawl out of engagement until near the end of said stroke and to move it into engagement in time to arrest said ratchet at the end of said stroke.

7. Long-feed mechanism for a web of paper comprising in combination a mutilated ratchet having a plurality of drive teeth and stop teeth, a drive pawl acting on said drive teeth, a stop pawl acting on said stop teeth, and means acting during a stroke of said drive pawl to maintain said stop pawl out of engagement with said ratchet while a certain stop tooth passes said pawl and to move it into engagement in time to arrest the proper stop tooth at the end of said stroke.

8. Long-feed mechanism for a web of paper comprising in combination a plurality of means each for imparting a long feed to the paper, a single mutilated ratchet having stop teeth appropriate to all of said feeding means, a stop pawl, and means acting during the operation of one of said feeding means to hold said pawl out of engagement with said ratchet during the passage of a stop tooth appropriate to another feeding means and for moving it into engagement in time to arrest the proper stop tooth.

9. Long-feed mechanism for a web of paper comprising in combination a ratchet, a drive pawl for said ratchet, means including a link for imparting a reciprocatory stroke to said pawl, a stop pawl, and means for controlling the engagement and disengagement of said stop pawl including a part of said link acting as a cam.

10. Long-feed mechanism for a web of paper comprising in combination two ratchets, a drive pawl for each ratchet, a guide for each pawl acting on occasion to hold its pawl out of engagement, means for moving said guides to disengaging position alternatively and tending when one guide is moved to disengaging position to move the other to engaging position, and a latch for holding said other guide temporarily in disengaging position, whereby there is an interval during which both pawls are disengaged.

11. In a long-feed for a paper web, the combination of a feed pawl and ratchet, a stop for arresting the pawl at the end of its stroke, means for lifting the pawl out of engagement with the ratchet to disable said pawl, and co-ordinated means for moving said stop from its pawl-arrest-position.

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