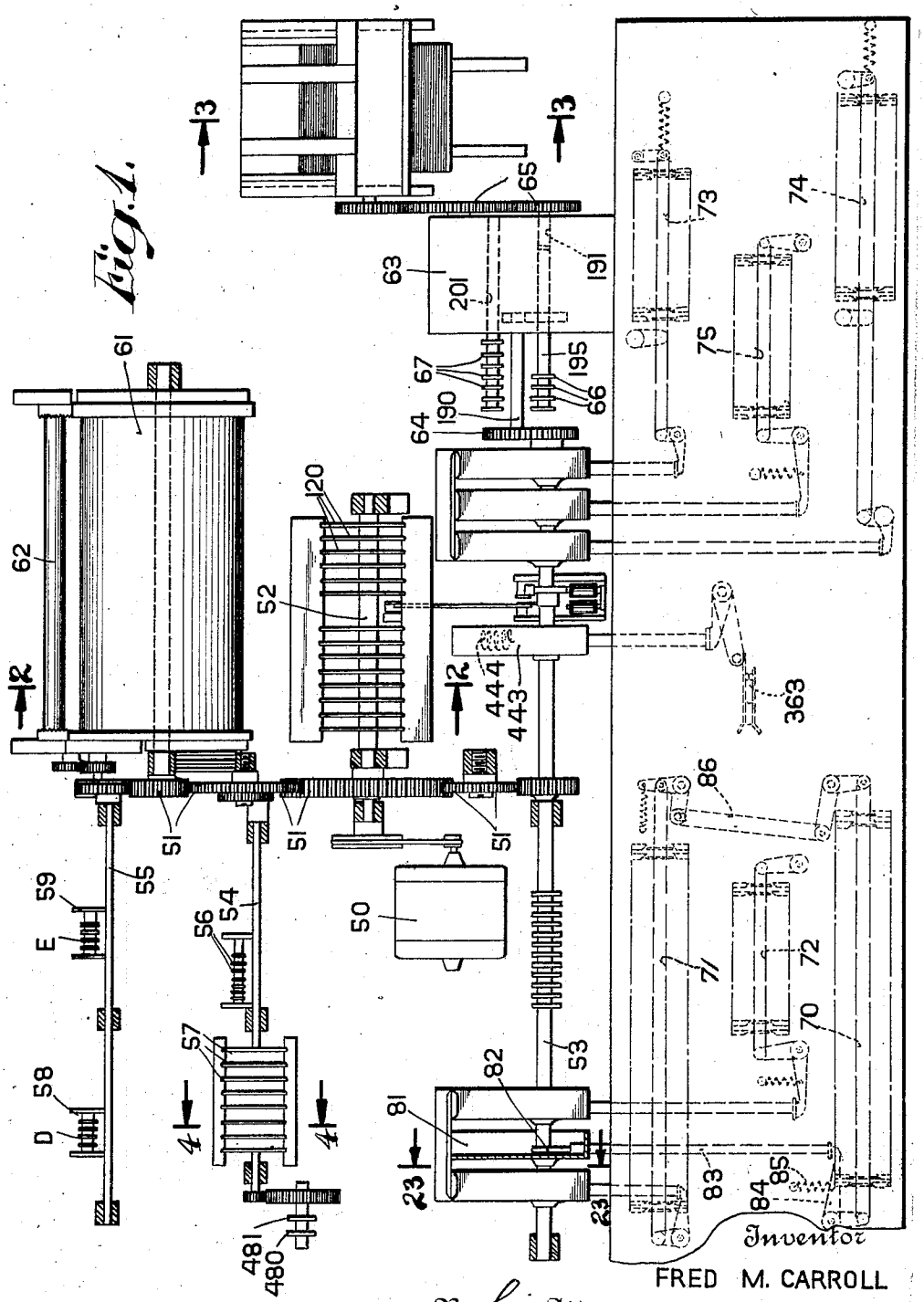
Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

Filed April 22, 1927 15 Sheets-Sheet 1

Fig. 1.



Inventor
FRED M. CARROLL

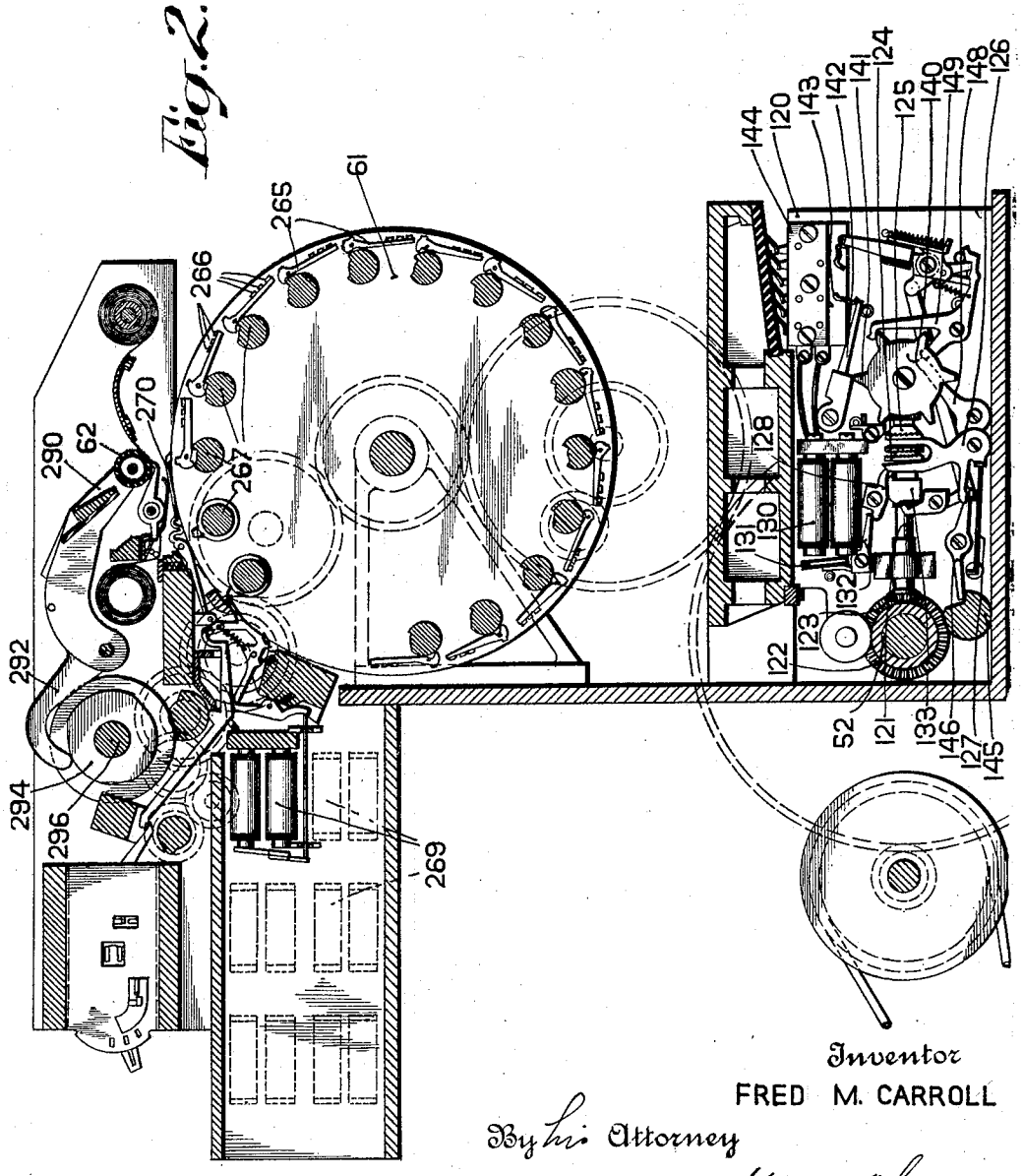
By his Attorney
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Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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Fig. 2.



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Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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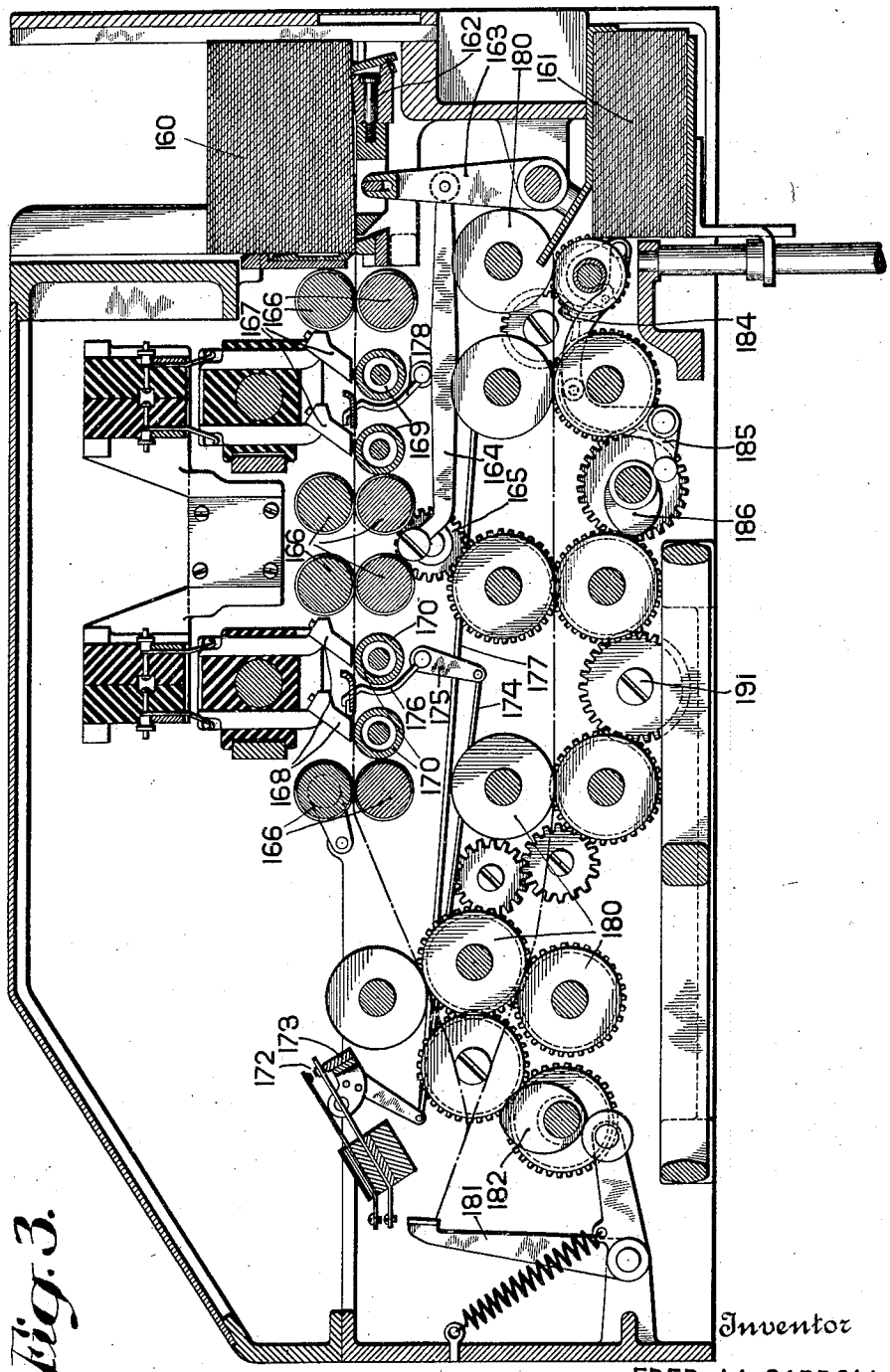


Fig. 3.

Inventor
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By his Attorney
O. M. Wilson

Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

Filed April 22, 1927 15 Sheets-Sheet 4

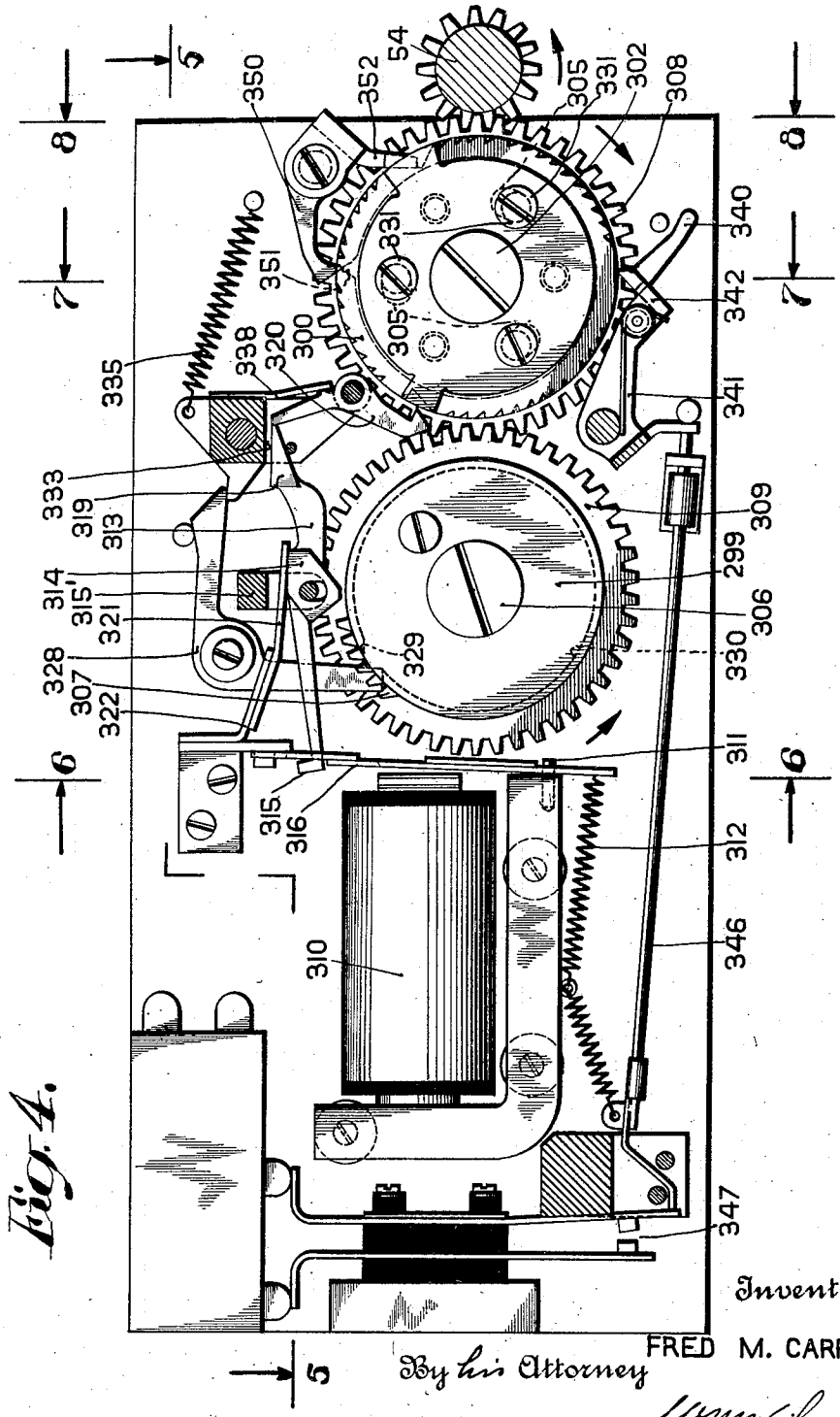


Fig. 4.

Inventor
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By his Attorney
W. M. Wilson

Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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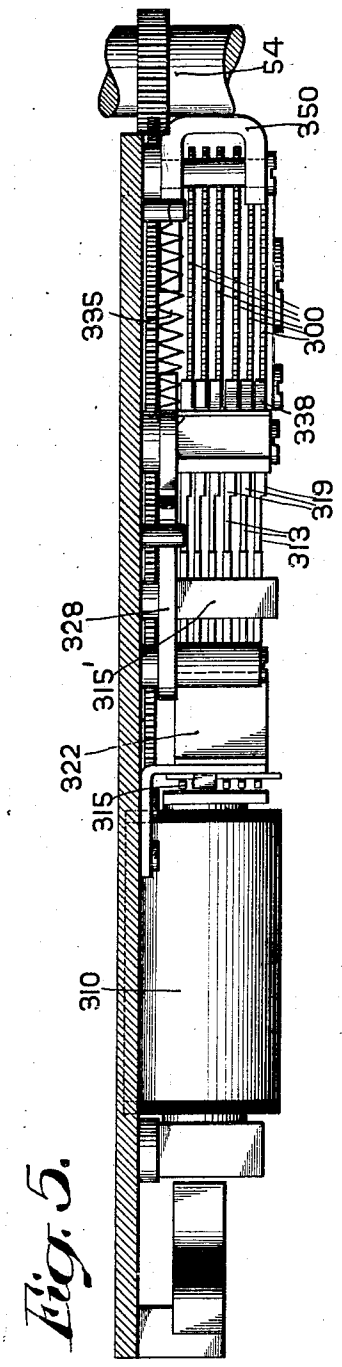


Fig. 5.

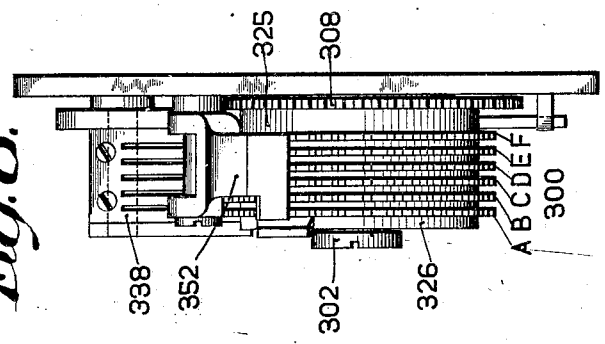


Fig. 8.

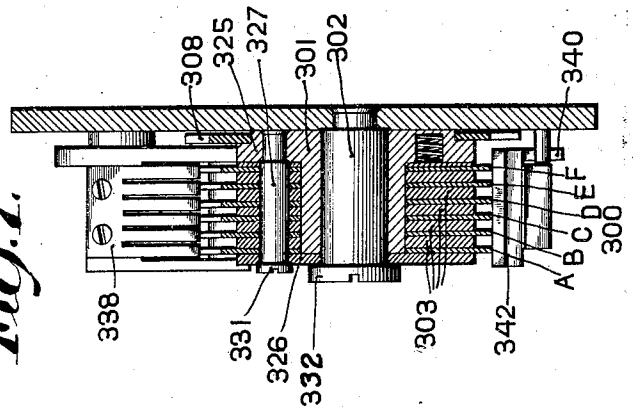


Fig. 7.

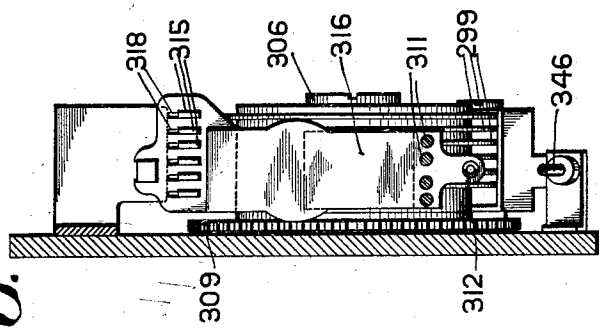


Fig. 6.

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Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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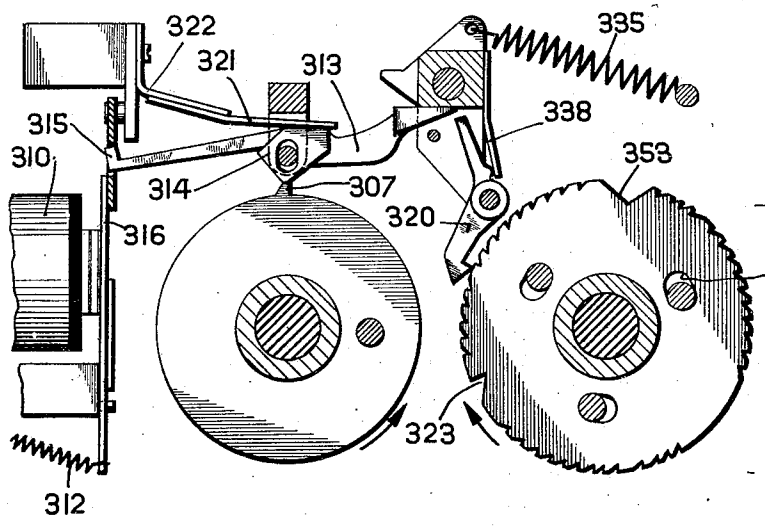


Fig. 9.

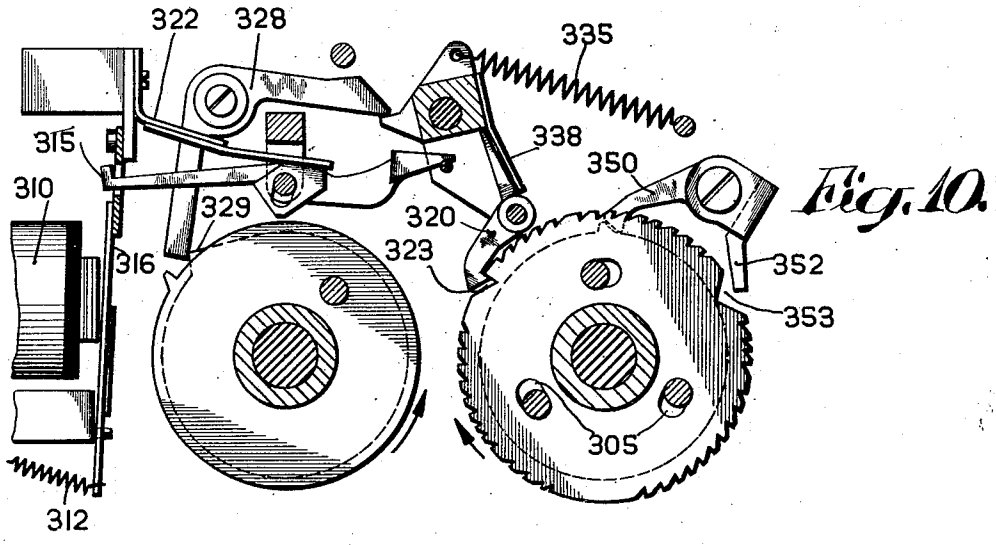


Fig. 10.

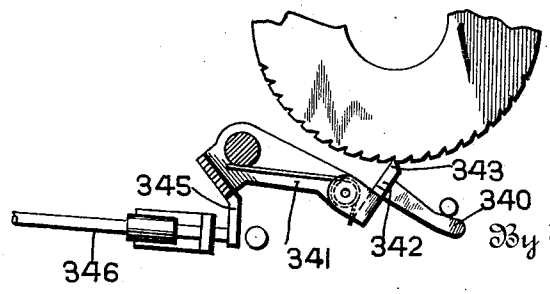


Fig. 11.

Inventor
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By his Attorney
W. Marshall

Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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Fig. 12.

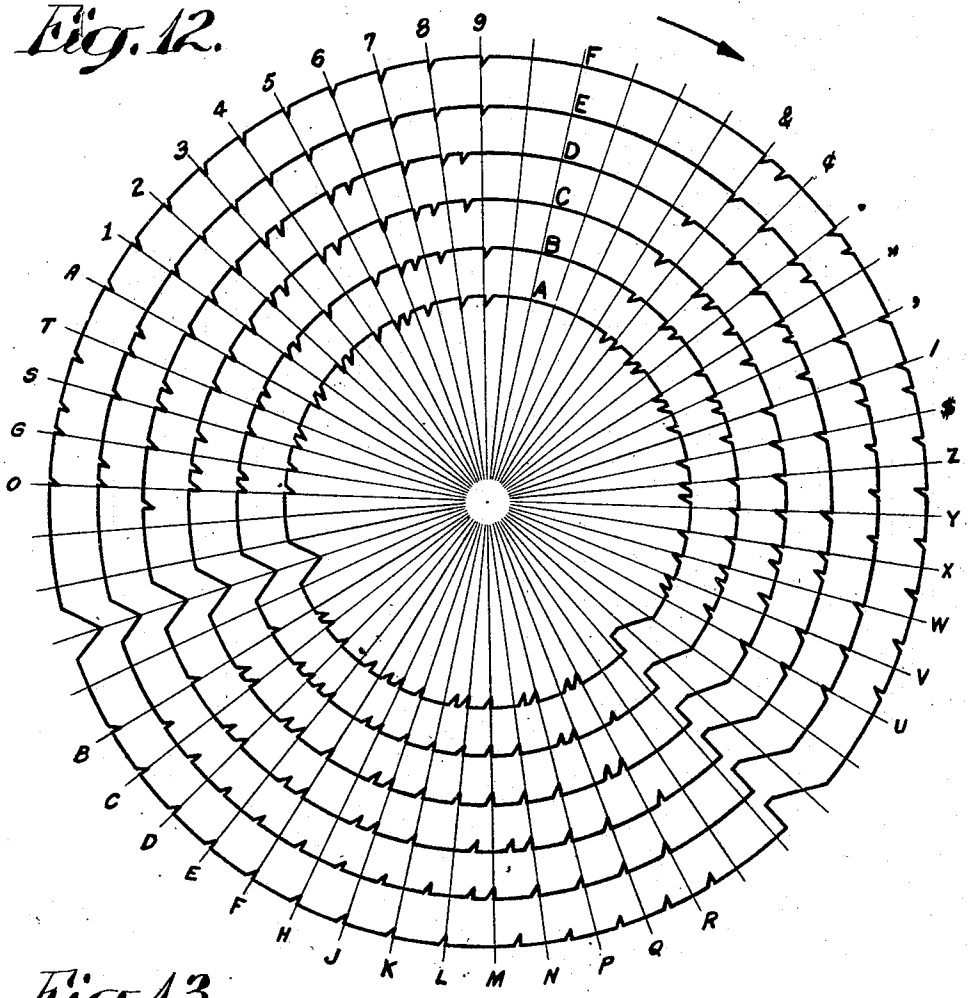
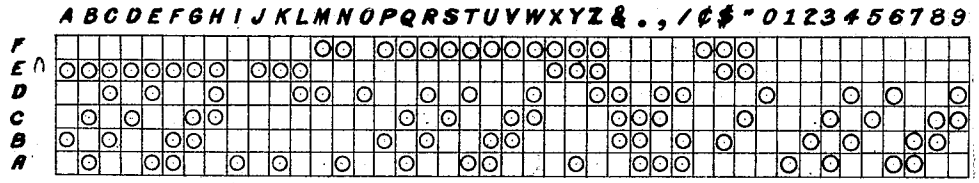


Fig. 13.



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ROTARY ALPHABET PRINTING TABULATOR

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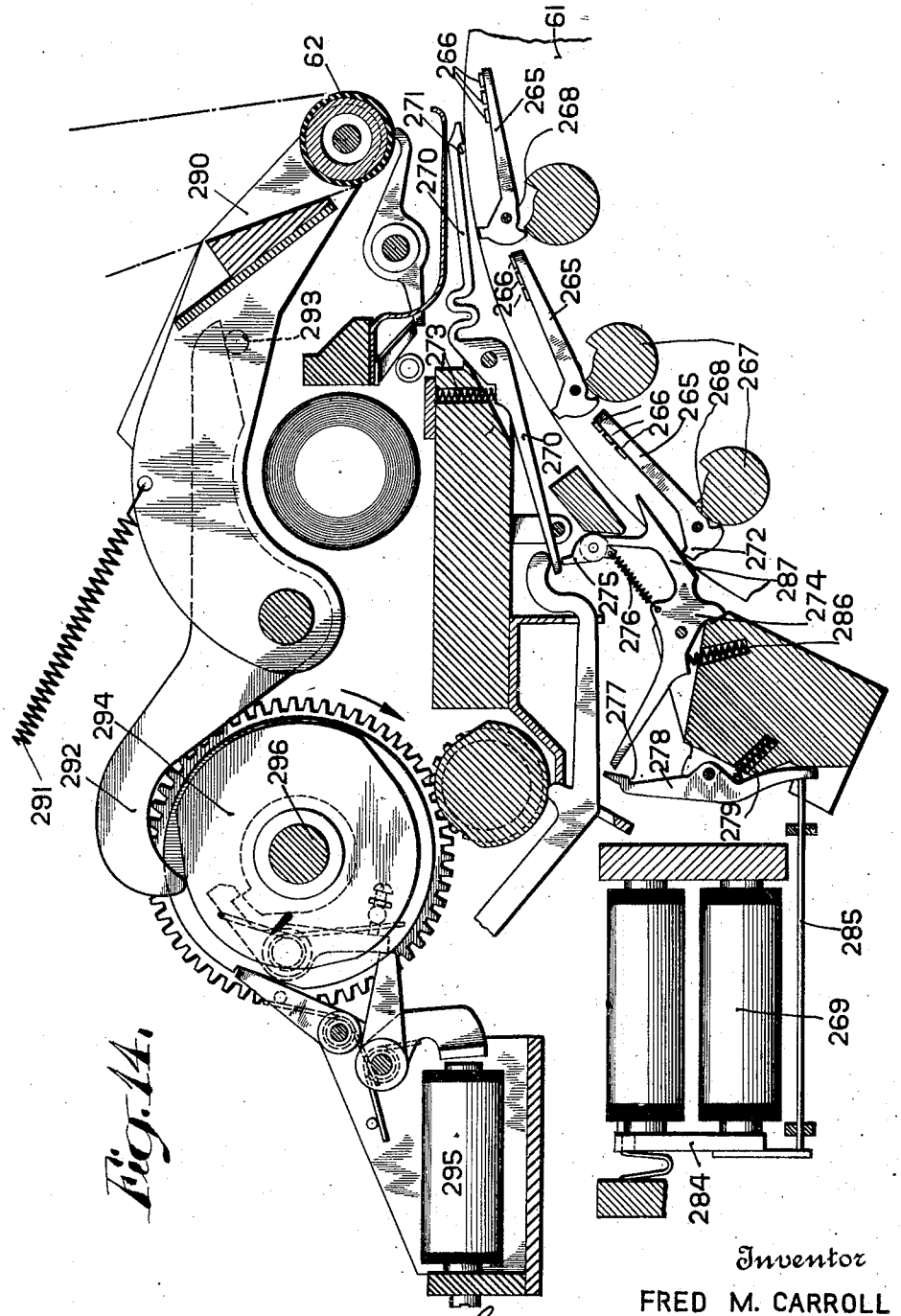


Fig. 14.

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By his Attorney
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Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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Fig. 15.

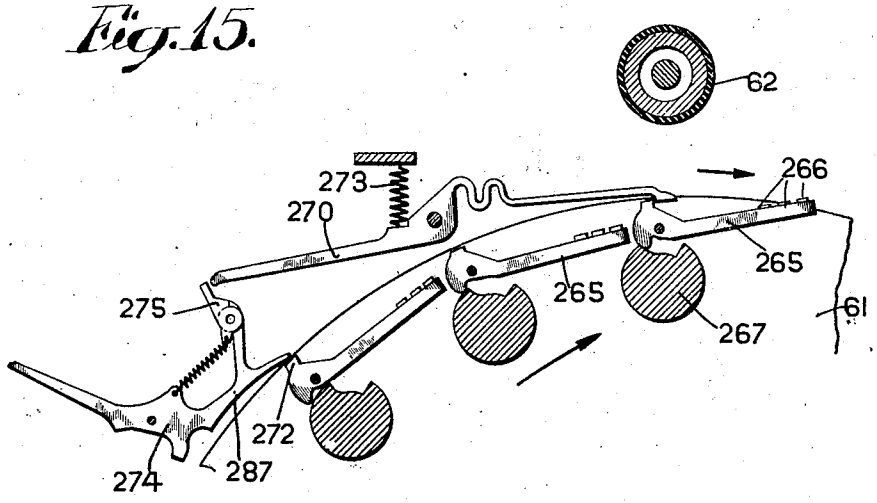


Fig. 16.

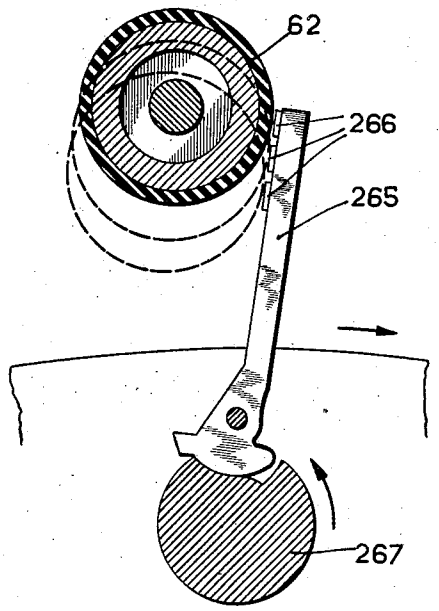
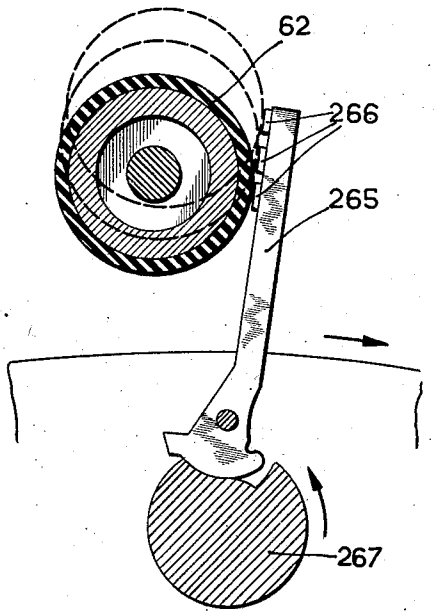


Fig. 17.



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By his Attorney
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Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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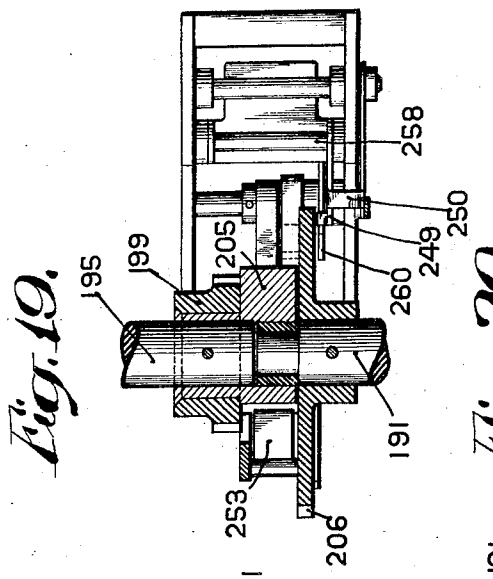


Fig. 19.

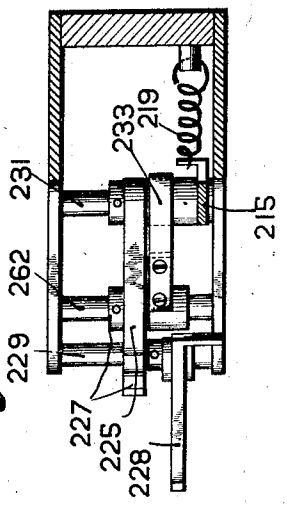


Fig. 20.

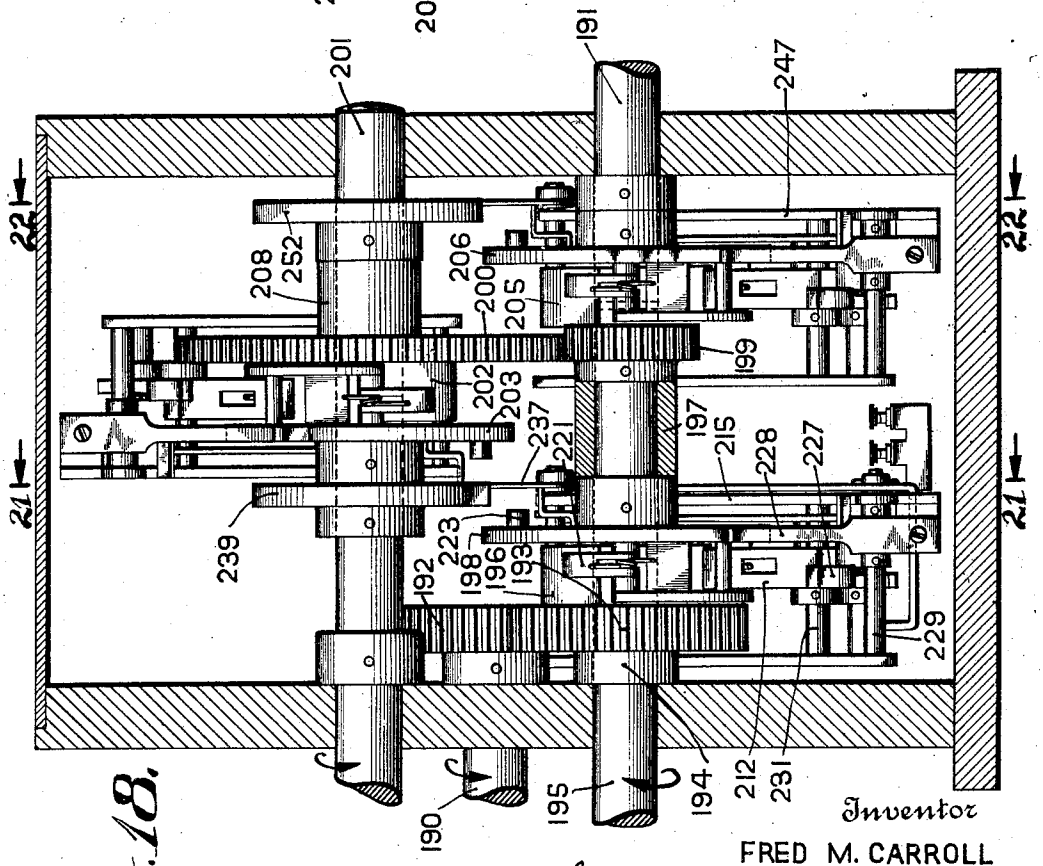


Fig. 18.

Inventor
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By his Attorney

Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

Filed April 22, 1927 15 Sheets-Sheet 11

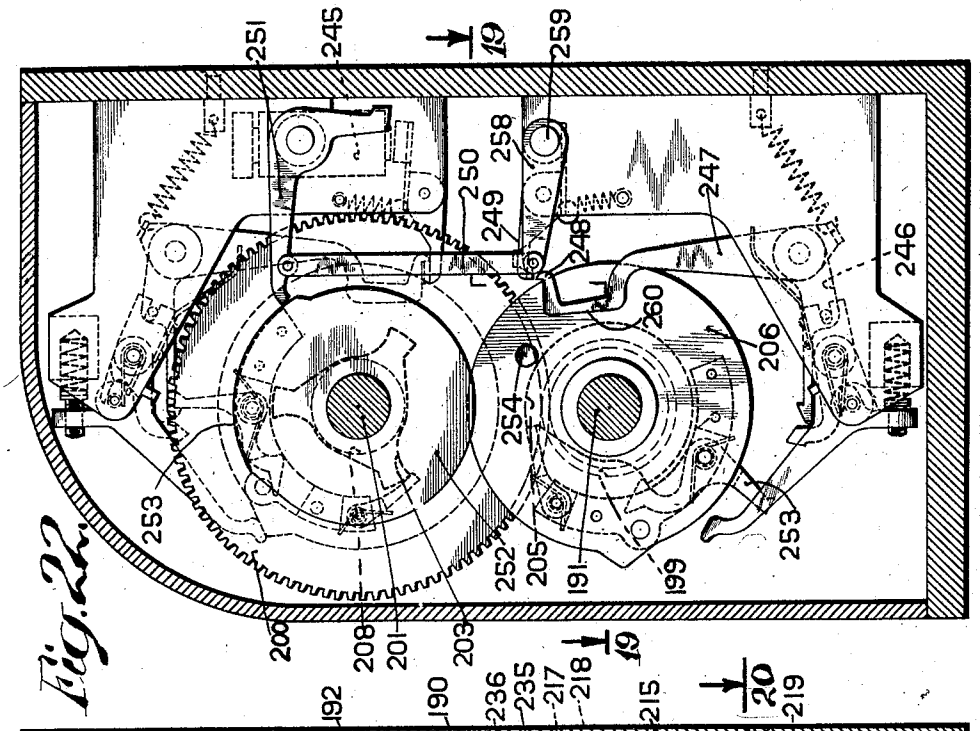


Fig. 22.

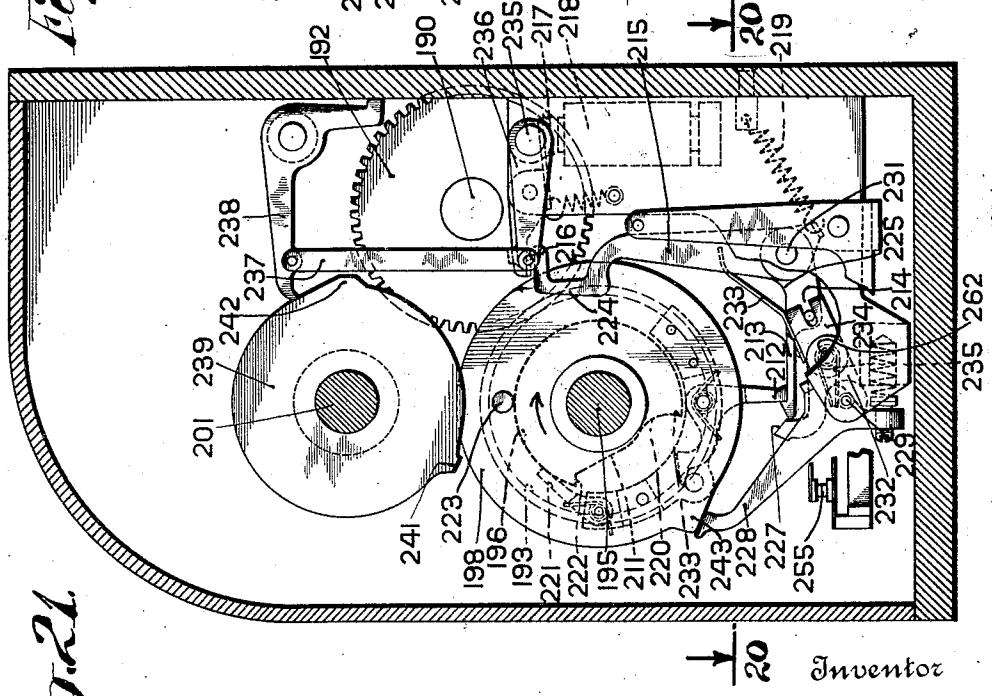


Fig. 21.

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ROTARY ALPHABET PRINTING TABULATOR

Filed April 22, 1927 15 Sheets-Sheet 12

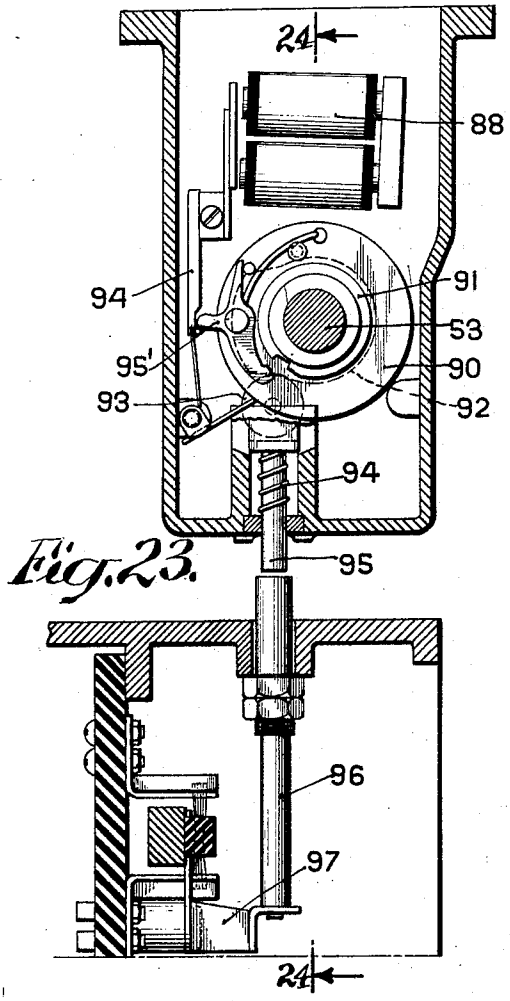


Fig. 23.

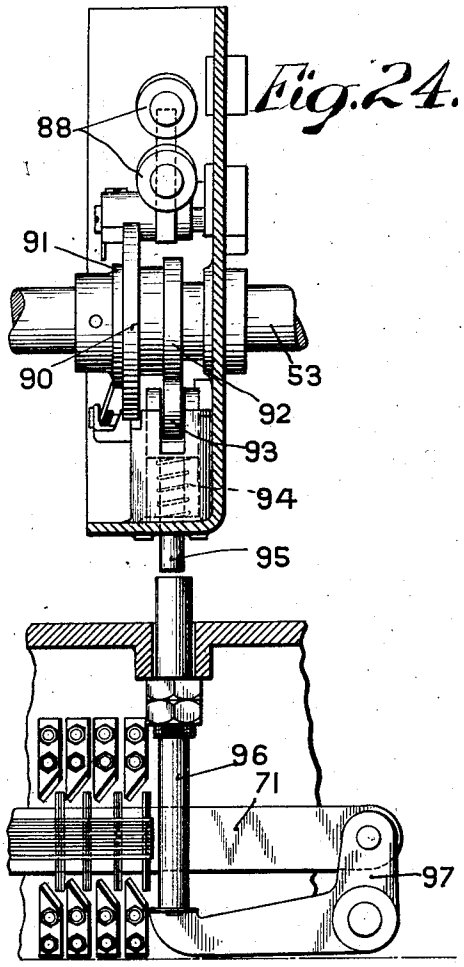


Fig. 24.

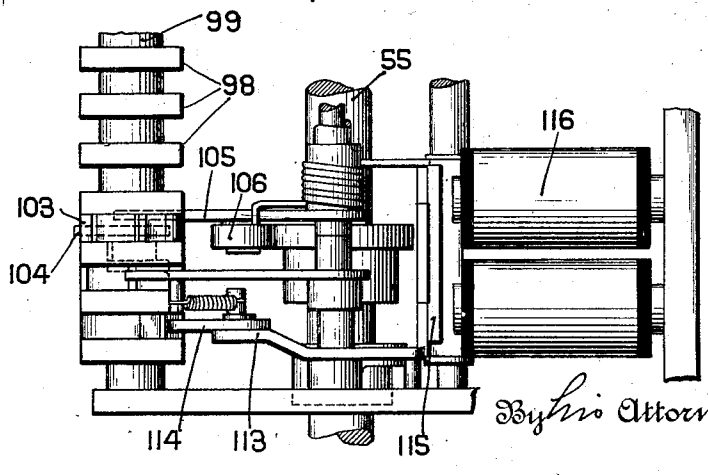


Fig. 25.

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W. W. Nelson

Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

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Fig. 26.

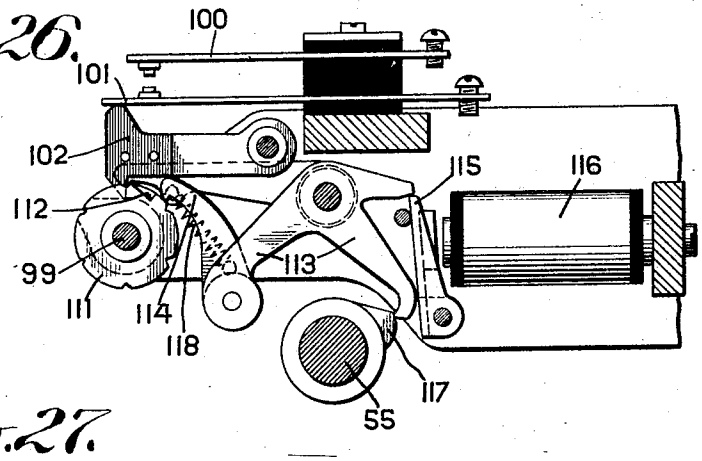


Fig. 27.

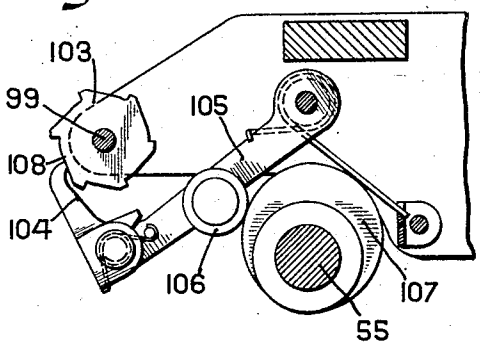


Fig. 28.

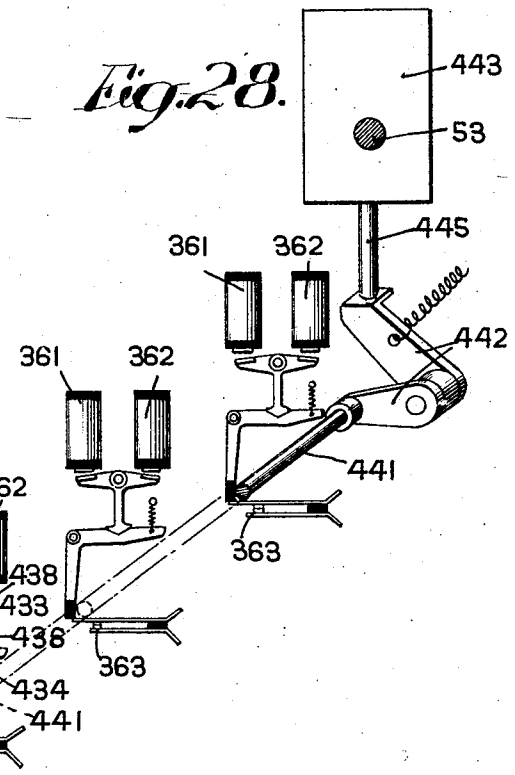
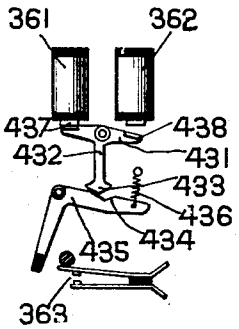


Fig. 29.



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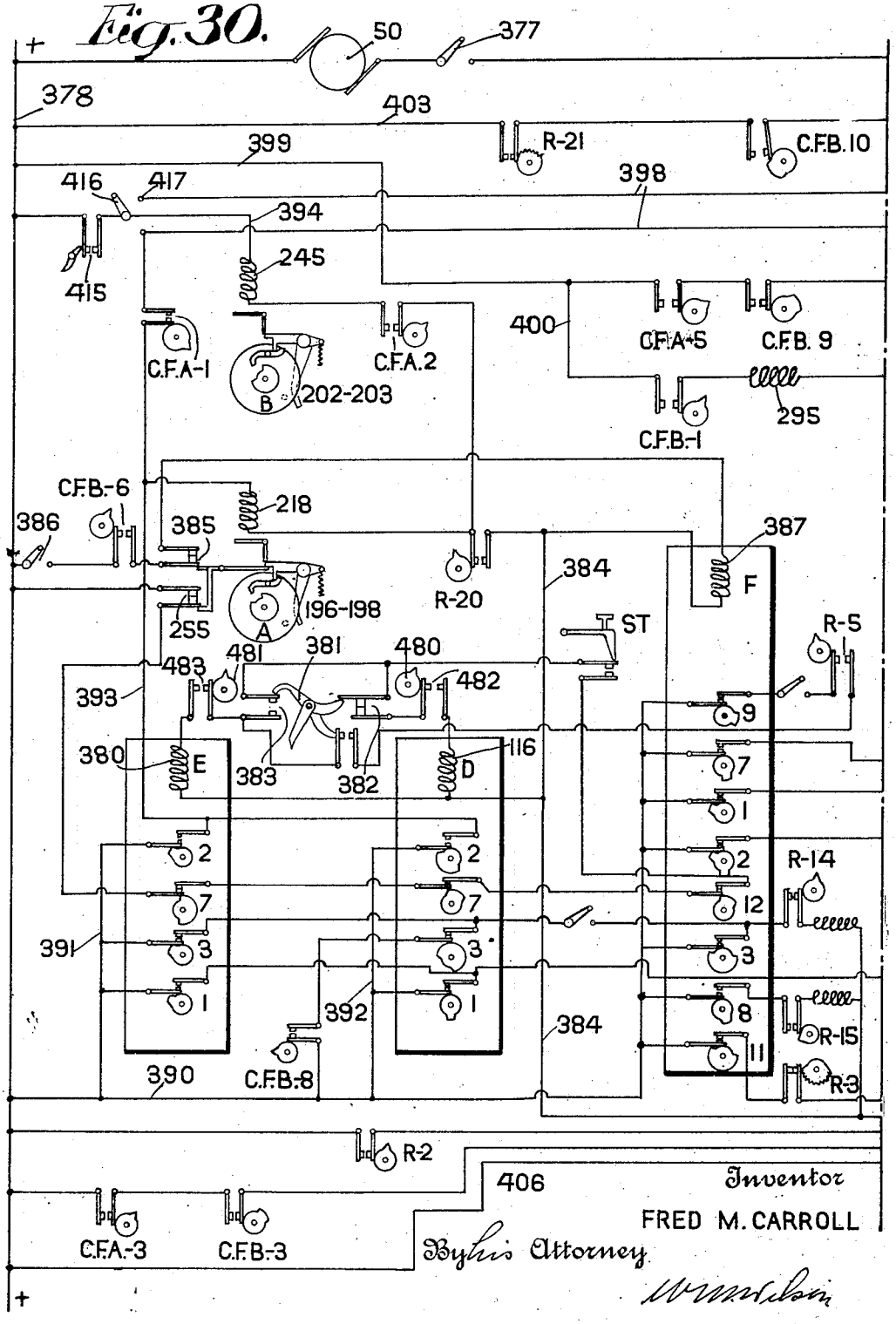
By his Attorney
W. W. Wilson

Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

Filed April 22, 1927 15 Sheets-Sheet 14

Fig. 30.



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By his Attorney

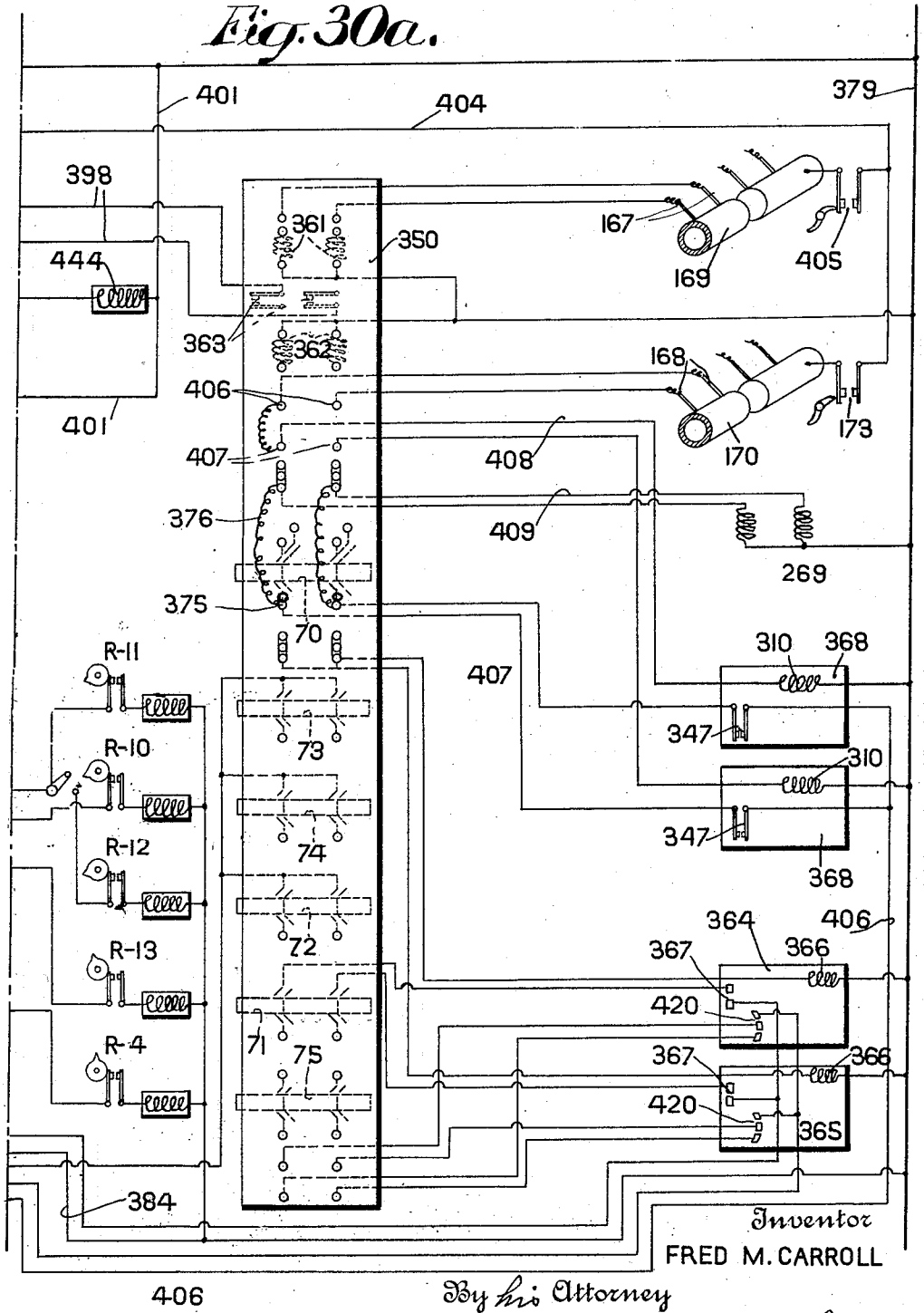
W. W. Wilson

Sept. 3, 1929. F. M. CARROLL 1,726,539

ROTARY ALPHABET PRINTING TABULATOR

Filed April 22, 1927 15 Sheets-Sheet 15

Fig. 30a.



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By his Attorney

Patented Sept. 3, 1929. 1,726,539

UNITED STATES PATENT OFFICE.

FRED M. CARROLL, OF YONKERS, NEW YORK, ASSIGNOR TO THE TABULATING MACHINE COMPANY, OF ENDICOTT, NEW YORK, A CORPORATION OF NEW JERSEY.

ROTARY ALPHABET-PRINTING TABULATOR.

Application filed April 22, 1927. Serial No. 185,711.

The invention concerns automatic printing machines and more particularly accounting machines designed to print letters of the alphabet as well as figures.

The usual type of accounting machine on which letters as well as figures may be printed has very long type carrying bars or the type carriers must be turned or twisted, as well as moved longitudinally to bring one of a plurality of sets of type into operation. These alphabetical printers also have reciprocating type carriers entailing periodic shocks for the machine during its operation. According to the present invention it is proposed to use a rotary drum printer for alphabet as well as figure printing of the type disclosed in my prior U. S. Patent No. 1,516,079, November 18, 1924, which obviates the use of reciprocating parts and results in substantially smooth machine cycles. The printing drum disclosed in the patent carries a plurality of rows of pivoted type carriers on each of which is disposed a printing type. As the drum rotates these type carriers reach a predetermined printing position successively and suitable call mechanism may be activated to rotate any type carrier about its pivot when it reaches printing position and cause its type to strike a paper carrying platen. This rotation of the type carrier about its pivot is effected while the drum is in motion and consequently the machine is a remarkably quick acting printer of its type. Furthermore the printing drum is constantly rotating and therefore does not impart sudden shocks to the machine in its operation. The drum disclosed in the patent, however, prints only numerals, having no provision for alphabet printing. It would be quite possible, of course, to place a type for each letter of the alphabet on separate type carriers and dispose these carriers around the periphery of the drum so that each might be independently selected for printing in the same way as the numeral types are selected. This would involve a drum of rather large dimensions entailing increased cost of production and operation difficulties due to its size. According to the present invention it is proposed to provide a drum of substantially the same dimensions as that disclosed in the patent and to provide the extra printing capacity necessary to include the letters of the alphabet by mounting a plurality of type one below the other on each pivoted type carrier. The type carriers as before are moved successively through a predetermined printing position and may be selected for printing when they reach this position by means substantially similar to that disclosed in the patent. Each type carrier in the present case when it is in printing position may print one of several different characters and the platen carriage is shifted to different positions to select the particular type which is to print. Ordinarily the type carriers will not be provided with more than three type, making it necessary to shift the platen carriage to three separate positions.

The alphabet is usually represented on tabulating cards by what is known as a combinational index point system meaning that the designation of a character in the different card columns may be represented by two or more perforations. The cards are analyzed while in motion from which it follows that the analyzing mechanism will sense the different perforations of a combination successively. A translator is provided which is set up in accordance with the successive analyzing of the different perforations of the combination and after the set up for a combination is complete it is converted into a single timed operation corresponding to the particular character represented. In connection with a printing device, of course, this timed operation is made effective to select the type carrier on which the character corresponding to the particular designation is mounted for printing. The mere selection of the type carrier does not in itself determine which particular type on the carrier is to print as this also depends on the position of the platen. The type are divided into three groups one group including the upper type, another the intermediate type and the third the lower type. As the machine operates, the platen carriage is moved successively to assume a position for receiving printing impressions from the upper type during one machine cycle, to a position to receive impressions from the intermediate type during the succeeding machine cycle and to a position for receiving impressions from the lower type during a third machine cycle. Obviously then each card which is analyzed requires three separate machine cycles in order that all possible characters which may be represented on it can be printed. This is taken care of in the present case by feeding a card

during one machine cycle in which its index perforations are analyzed and then suspending the card feed during the two following cycles. Any character belonging to the first or upper group of type will be selected for printing during a first printing cycle corresponding to the card feeding cycle. During this first cycle the platen carriage remains in position to cause printing of the upper type of the carriers. Then while the card feed is suspended the platen carriage moves to its intermediate position and during a second printing cycle any characters belonging to the second or intermediate group of type which might be set up in the translators cause the proper type carrier to print from the intermediate type. During a third printing cycle, at the beginning of which card feed is still suspended the platen carriage is moved to its third position to receive printing from the third or lower group of type for which setups have been effected in the translating device during the feeding of the card. At the end of three card cycles another card feeds to the analyzing device and the operation is repeated, each successive card thus requiring three printing cycles for printing of the complete data represented on it.

The principal object of the invention is to provide an alphabetical printer for an accounting machine of new and improved construction and arrangement of parts to the end that alphabet printing on machines of this type may be speeded up and that the printing may be effected with smooth machine cycles.

Another object of the invention is to provide a rotary alphabetical printer for accounting machines.

Another object is to provide an alphabetical printer for accounting machines whose dimensions are small in comparison to the number of possible printing operations which it can perform.

Another object of the invention is to provide an alphabetical printer for an accounting machine which is free from heavy reciprocating type carriers.

Another object of the invention is to provide an alphabetical printer in which the type are moved constantly from home position through their printing positions and back to home position with an uninterrupted motion.

Another object of the invention is to provide an alphabetical printer for an accounting machine in which a plurality of type carriers are provided for each printing column each of which carriers may be provided with a plurality of type and in which a platen and the type carriers are shifted relatively to each other to select the different type of the carriers for printing.

The invention may be clearly understood from the following detailed description which should be read in connection with the accompanying drawings, in which the same parts are identified by the same reference numerals throughout the several views and in which

Fig. 1 shows diagrammatically a representation of the mechanical elements of a complete machine;

Fig. 2 is a section through the printing drum and accumulator on line 2—2 of Fig. 1;

Fig. 3 is a section through the card feeding and analyzing devices on line 3—3 of Fig. 1;

Fig. 4 is a section through the translating mechanism showing a translating device in elevation, being along line 4—4 of Fig. 1;

Figs. 5, 6, 7 and 8 are sections on lines 5—5, 6—6, 7—7 and 8—8 respectively of Fig. 4,

Figs. 9, 10 and 11 are details of the translating mechanism showing the parts in different positions;

Fig. 12 is a diagrammatic development of the translating mechanism illustrating the method of translating a multi-hole combination into a single timer operation;

Fig. 13 represents a card field with the character code represented thereon;

Fig. 14 is a detail of the platen carriage shifting mechanism;

Figs. 15, 16 and 17 are details illustrating the operation of the type carriers during a printing operation;

Fig. 18 is a section through the card feed clutch box;

Figs. 19 and 20 are detail sections of parts of one of the clutches in Fig. 18, being taken on lines 19—19 and 20—20 of Figs. 22 and 21, respectively;

Figs. 21 and 22 are sections on lines 21—21, and 22—22 of Fig. 18;

Figs. 23 and 24 are sections at right angles to each other of one of the jacks for operating the switch bars shown in Fig. 1, the former being taken on line 23—23 of Fig. 1 and the latter on the line 24—24 of Fig. 23;

Figs. 25, 26 and 27 are details of one of the timers shown in Fig. 1, Fig. 27 being a section on line 27—27 of Fig. 25;

Fig. 28 is an isometric detail of the automatic control mechanism;

Fig. 29 is a detail of the automatic control mechanism showing the parts in different position from that in Fig. 28, and,

Figs. 30 and 30^a show the circuit diagram of the machine and Fig. 28^a should be placed to the right of Fig. 28 to form a complete circuit diagram.

Referring first to Fig. 1 the motor for driving the machine elements is shown at 50, connected by a belt and pulley to a gear train indicated generally at 51 and which through suitable extensions operates the tabulating shaft 52, the shaft 53 on which the jacks for the switch bars and automatic control restoring mechanism and the regular cam contacts are mounted and shafts 54 and 55, the former of which operates the total timer 56 and the

translating elements 57 and the latter of which operates the starter timers 58 and 59. The printing drum 61 and the platen 62 are likewise driven from the gear train 51. The shafts 53, 54, 55 and the drum 61 rotate constantly as long as the motor 50 is in operation. The card feed clutches, enclosed in the clutch box 63, are driven from the shaft 53 through a gear train 64. As will be hereinafter explained, the card feed mechanism is driven from clutches through a gear train 65 and the clutches are so arranged that one card will be fed to the analyzing mechanism every fourth cycle as long as the card feed clutches are in operative position. That is, a card will be fed to the analyzing mechanism during one cycle and the card feed will then be suspended during the two following cycles. The machine requires certain card feed cam contacts which are closed every cycle and certain other card feed cam contacts which are closed every three cycles. The former are shown at 66 and the latter at 67 and the shafts on which they are mounted are driven from the gear train 65 as indicated.

The machine is provided with a plurality of switch bars indicated at 70, 71, 72, 73, 74 and 75. Switch bar 70 is called the adding and listing switch bar, 71 is called the total print switch bar, 72 is the grand total switch bar, 73 and 74 are the total with reset and total without reset switch bars respectively and 75 is the group indicating switch bar. The purpose of these switch bars is to connect certain operating devices with their controls in the proper machine cycles to carry out predetermined operations. Their operation has been fully described in my copending application, Serial No. 147,960 filed November 12, 1926 to which reference may be had for a complete description of them. It may be stated generally that each switch bar carries a plurality of bridging contacts which are moved into circuit closing engagement with stationary contacts to close certain controlling circuits.

The adding and listing switch bar serves to connect the accumulators and printing call magnets with the analyzing mechanism or brushes during adding and listing cycles while the total switch bars connect the printing call magnets with the accumulating devices for control thereby in totaling. In the drawing each switch bar is shown in open circuit position. The adding and listing switch bar is controlled from a jack 81 which consists of a cam 82 mounted on shaft 53. As the shaft rotates the cam permits a rod 83 to rise and release the bell lever 84 thereby permitting a spring 85 to move the switch bar 70 to circuit closing position during the tabulating and listing portion of each machine cycle. The switch bar 70 tends to move to circuit closing position during every machine cycle but during total cycles the total print switch bar 71 through linkage 86 locks the adding and listing switch bar in open circuit position whereby the release of the bell crank 84 is ineffective to move the switch bar 70 to circuit closing position.

The total switch bars and the group indicating switch bar are normally held out of circuit closing position by a jack as illustrated in Figs. 23 and 24. The shaft 53 extends through the jack casing and mounted on the shaft within the casing is a one revolution clutch whose elements are indicated at 90 and 91. The element 91 is pinned to the shaft 53. The element 90 is freely mounted on the shaft and has a cam 92 rigidly attached to it. Energization of a control magnet 88 attracts its armature and releases a latch 94 from latching engagement with a pawl 95 on the normally stationary clutch element 90. The pawl 95 when released by its latch engages a notch in the clutch member 91 by spring action thereby coupling the members 90 and 91 together and causing the member 90 with its cam 92 to rotate with the shaft 53 for a single revolution. During this revolution the high portion of the cam 92 depresses a cam follower 93 against the action of a spring 94. The cam follower 93 is mounted on a rod 95 whose lower end cooperates with the upper end of an operating rod 96 for the bell crank 97, one of whose arms is pivoted to the switch bar 71. Depression of the cam follower 93 and rod 95 likewise depresses the rod 96 and rocks the bell crank 97 to force the switch bar 71 into circuit closing position. The switch bar 71 remains in circuit closing position for the major portion of the printing cycle and is moved to open circuit position at the end of the cycle by a spring, not shown in Figs. 23 and 24 but indicated in Fig. 1, when the cam follower 93 moves upward onto the lower portion of the cam 92 which is presented to it before the end of the totaling cycle. The remaining total switch bars and group indicating switch bar operate in a similar manner and it will be noted that energization of a control magnet is required to move each of these switch bars into circuit closing position and that when so moved they remain in circuit closing position for a single cycle, differing in this from the adding and listing switch bar which moves to circuit closing position during each machine cycle unless it is positively locked out.

The timers 56, 58 and 59, driven by the shafts 54 and 55, respectively, are detailed in Figs. 25, 26 and 27. These timers consist essentially of a group of cam operated contacts whose function is to close certain controlling circuits at certain predetermined times during machine operation. These timers do not operate constantly but only when the card feed is initiated and during total taking operations.

The timers 58 and 59 control the starting

of card feed and the timer 56 controls total taking. Each of these timers when set into operation is operative for six machine cycles to control contacts as will be hereinafter described.

Referring now to Figs. 25, 26 and 27 the timer cam shaft 99 carries a plurality of cams 98 which are properly shaped to open and close contacts 100 and 101 as required. The contacts are actually closed by pivoted members 102 each having a portion resting on one of the cams 98 and a portion in engagement with the lower contact 101. The driving mechanism for the timer cam shaft 99 is best shown in Fig. 27. A ratchet wheel 103, provided with six teeth, is rigidly attached to the cam shaft 99. An operating pawl 104 is pivoted at the end of a fulcrumed arm 105 which carries a cam follower 106 cooperating with a cam 107 on the shaft 55. Once each cycle the cam 107 rocks the arm 105 clockwise forcing the operating pawl 104 upward. When the timer is in normal position the pawl 104 slides back and forth on an elongated tooth 108 which is long enough to prevent the pawl from slipping off it and engaging the next tooth. The remaining teeth of the ratchet 103 are dimensioned so that when the pawl 104 is riding on any one of them, each of its movements in response to the cam 107 causes it to first rotate the ratchet together with the shaft 99 through $\frac{1}{6}$ of a revolution and then on its downward stroke to engage the next tooth whereupon the subsequent revolution of the cam 107 will cause the ratchet and shaft to rotate through another $\frac{1}{6}$ of a revolution. After the timer has once been started in operation then its shaft 99 will be rotated once during six cycles of machine operation.

The timer is started by the mechanism shown in Fig. 26. A disc 111 having a notch 112 in its periphery is mounted on the shaft 99. A pivoted multi-armed lever 113 has a pawl 114 pivoted on one of its arms, which pawl normally rests on the brink of the notch 112 in the disc 111. The lever 113 is latched in this normal inoperative position by the supporting structure 115 of the armature of a control magnet 116. A third arm of the lever cooperates with a cam 117 mounted on the shaft 55. This last named arm, however, is normally held out of the path of the cam by the latching structure 115. Energization of the magnet 116 attracts its armature releasing the latch 115 whereupon the lever 113 is rocked clockwise by a spring 118 permitting the end of the operating portion 114 to drop into the notch 112 in disc 111. In its next revolution the cam 117 engages its coacting arm on the lever 113 and rocks the latter counterclockwise pulling the pawl 114 down and imparting a slight rotation to disc 111 and the shaft 99. This rotation is sufficient to cause the operating pawl 104 (see Fig. 27) to slide off the surface of the elongated tooth and engage the next ratchet tooth whereupon the cam shaft 99 will be operated through a complete revolution during the ensuing six cycles of machine operation. The movement of the timer cam shaft 99, of course, terminates after one complete revolution when the operating pawl 104 again engages the surface of the elongated tooth.

The tabulating shaft 52 drives the several counter elements 120 of the machine. Each counter element (see Fig. 2) is provided with an individual driving shaft 121 geared to the tabulating shaft through bevelled gear 122 and bevelled pinion 123 and constantly rotated thereby. Fixed on the shaft 121 is a clutch member 124 and freely mounted on the shaft 121 is a slidable member 125 which corresponds to the usual counter element of accumulators. The members 124 and 125 have cooperating clutch teeth on their adjacent faces and when the counter element 125 is shifted to bring its clutch teeth into engagement with those on the member 124 the member rotates with the shaft 121. The shifting mechanism consists of a lever 126 which is urged by a spring 127 to constantly force the member 125 into clutching engagement with a member 124. This shifting action is normally prevented by latch 128 whose end takes under an arm on the shift lever 126. Energization of the counter magnet 130 attracts its armature 131 and an extension 132 thereon rocks the latch 128 from beneath the arm of shift lever 126. The lever thereupon shifts the member 125 into engagement with the member 124. A lug on a sleeve member 133 fixed to the shaft 121 engages the shift lever 126 at a predetermined point in the cycle and rocks it into latching position disengaging the counter element 125 from the driving element 124. The magnet 130 is energized in response to perforations on a controlling record and the clutch kick out is timed so that the movement of the counter element 125 corresponds to the number represented by the perforation.

Total printing is controlled by disc 140 which through a crown gear on its rear face and an elongated pinion on the member 125 is driven by the latter. The disc 140 is provided with extensions 141 which coact with an arm 142 carrying a total printing bridging contact 143 at its end. Whenever the counter element 125 passes through a zero position one of the extensions 141 engages a cam surface on arm 142 and rocks the arm forcing its contact 143 into engagement with total printing control contacts in the terminal block 144. The bridging of these latter contacts closes the total printing circuit during total printing operation.

Total printing may be effected either with or without reset of the accumulator element and the reset selection is effected through a

notched rock shaft 145. With this shaft in the position shown in the drawing the spring 127 is constantly tensioned by a pivoted lever 146 cooperating with the edge of the notch in the shaft 145. A total printing operation is initiated by energizing the counter element 130 permitting the shift lever 126 to shift the counter element 125 to clutching engagement with the member 124 as in accumulating. In this case the counter element rotates through ten points and operates the total switch lever 142 as it passes through zero position and is kicked out at the end of ten points of operation by a lug on sleeve 133. The number originally standing on the counter element is therefore restored to it.

Totaling with reset of the accumulator may be effected by rocking the shaft 145 to release the lever 146 whereupon the spring 127 is tensioned for the time being by a lever 148 held in spring tensioning position by a lever 149. When the counter element 125 reaches zero position in this case one of the extensions 141 rocks the lever 149 from beneath the end of lever 148 whereupon the tension in spring 127 is released and the ensuing straightening action of the spring shifts the shift lever 126 to unclutch the counter element 125 in zero position. The mechanisms thus far described are common to my printing tabulator disclosed in the copending application referred to above to which reference should be had for a complete explanation of them. They have been described very briefly in the present case merely to aid in an understanding of the present invention.

The card feed mechanism has been modified to conform to the peculiar operation of the machine which makes it necessary to suspend the card feed during certain operative printing cycles. Other improvements have also been incorporated in the card feed, for example, the discharge stack through which the card is delivered after being analyzed is placed directly below the card magazine making each readily accessible to the operator from a common vantage point.

Referring to Fig. 3 the card magazine having a stack of cards therein is indicated at 160, and the discharge rack directly below it at 161. The cards are fed from the magazine 160 by a picker 162 which is operated by an oscillating lever 163 driven by a connecting rod 164 whose end distant from the lever 163 is eccentrically pivoted on a gear wheel 165 driven during one cycle and remaining idle during the two following cycles as will hereinafter be explained. As the picker oscillates it feeds the lower card of the stack in the magazine to an upper set of feed rolls 166, likewise driven by the gear 165, passing the card successively to the control analyzing brushes 167 and the adding analyzing brushes 168. It will be noted that two control brushes and two adding brushes have been provided for each card column. The character code making use of a combinational system of perforations requires much less card space than the system in which each character is represented by a single perforation and the numerals and alphabet under the combinational system can be compressed into a card field about half the width of that necessary in the single perforation system. It is quite possible therefore to provide two card fields one below the other on a tabulating card of the usual size and different items may be independently represented on these two fields. The two brushes in each pair 167 and 168 are spaced apart so that as a card feeds under them, one of the brushes cooperates with an index point position in one field of the card while the other cooperates with the corresponding index point position on the other card field, that is, as the card passes under the brushes one brush analyzes one field while the other brush analyzes the other at exactly the same time. Items on the two card fields may thus be entered into different accumulators or printed on different printers. The brushes as usual cooperate with conducting cylinders shown at 169 for the brushes 167 and at 170 for the brushes 168. The machine is provided with the usual card lever contacts which are shown at 172 for the adding brushes 168. These contacts are closed whenever a card is under the brushes 168 by a bail 173 which is operated through a rod 174 pivoted to a pivoted arm 175 of which an extension 176 extends into the path of a portion of the card being analyzed. A card in passing rocks the extension 176 of the lever 175 counterclockwise, pulling the rod 174 to the right as shown in the figure and rocking the bail 173 to close the contacts 172. Similar contacts for the control brushes are provided, which do not show in the drawing as they are located directly behind the contacts 172, and these are controlled by a similar rod 177 operated from an extension 178 cooperating with the cards under the control brushes.

The path of the cards in feeding is indicated by the dot-dash line and each card after passing through the upper set of rolls is delivered to a lower set of feed rolls 180 which are driven from the drive mechanism of the upper rolls. A pivoted member 181 is rocked during each card feeding cycle by a cam 182 also driven from the gear train driving the feed rolls and the movement of the member 181 is timed so that as the card feeds along the conveyor system its edge eventually encounters the member 181 and shortly after the cam rocks the member 181 forcing the card to the lower rolls 180 which eventually deliver it to the discharge rack 161. A positive feed is provided for forcing the card from the last set of lower rolls 180 in the form of a member 184 which is operated to engage the trailing edge of each card through a link 185 and cam 186.

The mechanism for operating the card feed will now be explained in connection with Figs. 18 to 22, inclusive. Referring to Fig. 18, the shaft 190 is driven from the gear train 64 (see Fig. 1) and rotates constantly while the drive motor is in operation, making one revolution for each machine cycle. The card feed mechanism including the picker and the feed rolls, as just described is driven from the shaft 191 mounted in alignment with the shaft 195 and driven therefrom through a one revolution clutch. The shaft 190 through one to one gears 192 and 193 drives one element 196 of a one revolution clutch freely mounted on shaft 195. The other element 198 of this clutch is fixed to the shaft 195 and clutching engagement between the elements 196 and 198 may be effected by a card feed clutch magnet in which case shaft 195 rotates revolution for revolution with the constantly rotating shaft 190. The shaft 195 must drive the card feed shaft proper 191 under two different conditions; first, when the machine is started with no card under its upper brushes, in which case the first card will feed from the card magazine to the upper brushes during one machine cycle and from the upper to the lower brushes during the succeeding cycle; and second, when successive cards are feeding past the lower brushes in which case each successive card must feed to the lower brushes during one machine cycle and card feed must then be suspended during the two following cycles. The shaft 195 has the driving element 205 of a second one revolution clutch fixed to it of which the driven element 206 is fixed to the shaft 191 (see also Fig. 19). This clutch is normally engaged and consequently when the machine is put into operation with no card under the upper brushes the shaft 191 will make two revolutions with the shaft 195 feeding the first card first under the upper brushes and then under the lower brushes during successive machine cycles. When the first card reaches the lower brushes of course the second condition prevails and card feed must now be suspended for two machine cycles after which another card is fed to the lower brushes and analyzed. The shaft 195 carries a gear 199 which meshes with a gear 200 fixed to a sleeve 208 freely mounted on shaft 201. The gear ratio in this case is one to three so that sleeve 208 makes one revolution for every three revolutions of the shaft 195. Also fixed to the sleeve 208 is a driving element 202 of a third one revolution clutch whose driven element 203 is fixed on shaft 201. This clutch is controlled by a secondary card feed clutch magnet which is energized only when there is a card under the upper brushes and the clutch 196—198 is in operation. When this third clutch engages the shaft 201 rotates with a one to three ratio with shaft 195. A cam 239 through suitable linkage then insures that when the clutch 196—198 is once engaged it will remain engaged for three machine cycles or revolutions and a cam 252 through suitable linkage causes the clutch 205 to engage during one machine cycle and to disengage during the two following cycles. This complete operation will be more fully described in connection with the following explanation of the clutch mechanical details and in the explanation of the circuit diagram.

The details of the clutch mechanisms, whose novel features are claimed in my copending application, Serial No. 198,905, filed June 15, 1927, will now be described. Referring to Fig. 21 the one revolution clutch for driving the shaft 195 from the shaft 190 consists of a disc 196 rigid with the gear 193 and having a notch 211 of a peculiar form in its periphery. This disc, of course, is free on shaft 195 and rotates whenever the shaft 190 rotates. The second element 198 of the clutch fixed on shaft 195 carries a pivoted operating pawl 212 urged by a spring to constantly engage in the notch 211 but normally restrained from doing so by a latch 213. The latch 213 is mounted on one element 225 of a toggle indicated generally at 214, the element 225 being fixed to a shaft 231 to which is also fixed an extending arm 215 having a hooked portion 216 at its upper end which is engaged by a coacting hook on the pivoted structure supporting the armature 217 of the card feed clutch magnet 218. The other element of the toggle consists of an arm 234 pivoted on a shaft 262 and connected with the element 225 by a pin and slot connection. Fixed to the shaft 262 (see also Fig. 20) is a member 227 having a double bevelled upwardly extending portion projecting into the path of the tail piece of the pawl 212. The member 227 is also provided with a notch 232 which straddles a shaft 229 and limits the movement of the member. A light spring 235 urges the member 227 counterclockwise holding the lower edge of the notch 232 against shaft 229. Energization of the magnet 218 attracts its armature 217, rocking the pivoted armature supporting structure and releasing the arm 215 which moves counterclockwise in response to the action of spring 219. The toggle 214 breaks causing the latch 213 to release the pawl 212. The pawl then rocks clockwise under action of its spring and its nose moves to the bottom of notch 211 in moving member 196, while its tail piece snaps past the bevelled end of member 227, the biasing spring of the latter yielding to permit this action. The trailing edge of the notch 211 as indicated at 220 consists of a smooth curved surface terminating at the periphery of the disk in a slightly undercut portion 233. As the disk 198 on which pawl 212 is pivoted still tends to remain stationary, the curved surface

220 on the moving disk 196 cams the pawl counterclockwise forcing its tail piece against the left hand bevelled surface on the upper end of member 227, thereby forcing the disk 198 in a clockwise direction, that is, in the same direction as the disk 196 is moving. Owing to the configuration of the curved surface 220 this camming action on the pawl starts the disk 198 rotating with a gradually increasing speed and when the nose of the pawl reaches the undercut portion 233, clutching the disks together, the two disks 196 and 198 are moving at substantially the same speed and the clutching operation has been effected with no shock to the several parts. When the nose of the pawl engages the undercut portion 233, a latch pawl 221 on the disk 198 slips into the notch 211 and engages a flat edge 222 of the notch, firmly locking the members together in a predetermined relative position. The shaft 195 is now rotating with the shaft 190 and will continue to do so until the pawl 212 is again latched by latch 213. The latter, of course, has been moved out of the path of the extending tail piece of the pawl by the breaking of the toggle 214 and cannot reengage the pawl until the toggle is restored to the position shown in Fig. 21. As previously stated when the magnet 218 is once momentarily energized during normal running of the machine, it is necessary that the shaft 195 rotate for three revolutions. Once each revolution a pin 223 on disk 198 encounters an offset portion 224 on member 215 and rocks it clockwise to its latching position. This restores the toggle and if the pivoted supporting structure of armature 217 is in latching position at this time, its hook will engage the hook 216 on member 215 and hold toggle 214 in its restored position as in Fig. 21. During the two machine cycles following that in which the magnet 218 is energized, however, the armature structure is rocked clockwise to its inoperative or unlatching position by a cam 239 on shaft 201 coacting with a pivoted cam follower 238 to which is pivoted the upper end of a link 237 whose lower end is pivoted to a lever 236, fulcrumed on the supporting shaft of the armature structure. The shaft 201 as previously explained is driven from the shaft 195 during normal running card feed with a one to three ratio both clutches 196—198 and 202—203 (Fig. 18) being engaged. During the first portion of the initial cycle in which the magnet 218 is energized the cam follower 238 rides on the lower concentric surface of cam 239 and hence has no effect on the latching mechanism. Shortly after the member 215 has been rocked to latching position by pin 223 during this cycle a projection 242 on cam 239 encounters cam follower 238 and rocks it clockwise. The lever 236 is likewise rocked clockwise through link 237 and a pin or roller 235 on the rearward extension of the arm presses on the supporting structure of the armature 217 and rocks the structure clockwise to the position which it would normally assume if the magnet 218 were energized. This releases the member 215 and permits the toggle 214 to break moving the latch 213 out of the path of the tail piece of pawl 212 and the clutching engagement between disks 196 and 198 continues for another revolution of shaft 195. During this second revolution this action is repeated; the cam follower 238 in this case being rocked by a projection 241 on cam 239 and the clutching action continues for another or third revolution of shaft 195.

If at the end of this third cycle the magnet 218 is not reenergized the clutch 196—198 will disengage as there is no projection properly positioned on the cam 239 to release the arm 215 after it has been rocked to latching position by the pin 223. Considering then that the toggle 214 remains in its restored position as in Fig. 21 a leaf spring 233 fixed on toggle member 234 projects into the path of the tail piece of pawl 212 and when the tail piece encounters this spring the pawl is rocked counterclockwise causing its nose to move out of the slot 211 and releasing the clutching action between disks 196 and 198. Due to the momentum of the parts, however, the disk 198 coasts a short distance and just before the tail piece of the pawl reaches the latch 213 a projection 243 on the disk encounters a spring pressed braking and impositive latching arm 228 whereupon its momentum is further overcome and the latch 213 encounters the tail piece of the pawl and latches it after the motion of disk 198 has practically ceased. The end of arm 228 now rides onto the trailing edge of projection 243 and forces the disk 198 to cause the tail piece of the pawl to seat firmly against the latching hook of latch 213 unless it is already in this position and thereafter holds the disk 198 firmly in its rest position. It will be apparent that this construction provides a clutch of the one revolution type which performs all the functions of the prior ones but operates smoothly without shock to the several operating members.

The shaft 201 is driven from the shaft 195 by a similar clutch shown in the upper portion of Fig. 22. The operating mechanism of the clutching pawl is exactly similar to that just described and it is unnecesasry to explain it in detail. It will be noted, however, that the driving member 203, fixed to the freely rotatable sleeve 208, is provided with three notches in which the pawl may engage instead of only one as is the case with the driving member 196 (Fig. 21). The driving member 203 is driven one third of a revolution for each revolution of the shaft 195 and the driving member may stop in any one of three positions when the shaft 195 comes to rest in its home position. The provision of the three equally spaced notches insures that

the shaft 201 will always start in the proper phase with the shaft 195 when the clutch magnet 245 of the clutch 202—203 is energized.

The shaft 191 is driven by a clutch 205—206 shown in the lower portion of Fig. 22 whose clutching elements are exactly similar to those disclosed in connection with Fig. 21 but which is controlled from a cam on the shaft 201 instead of by a magnet. As previously stated one element 205 of this clutch is fixed to the shaft 195 and the other element 206 is fixed to the shaft 191. The clutching pawl is released by a toggle 246 exactly similar to toggle 214 in Fig. 21 which is operated by an arm 247 provided with a hook 248 at its upper end which engages a latch on a pivoted arm 249. The arm 249 is similar in its structure and operation to the supporting structure for armature 217 (Fig. 21) and is operated by a pivoted arm 258 connected through a link 250 with a rock lever 251 whose end rides on a cam 252 fixed to shaft 201. The cam 252 is provided with a raised surface 253 which once each revolution of shaft 201 rocks the arm 251 clockwise raising the link 250 and rocking the arm 258. A rearward extension of the latter carries a pin 259 which engages the latch 249 rocking it clockwise to release the lever arm 247. This raised portion 253 is so located on the cam 252 that in the normal rest position of the shaft 201, the toggle 246 will be broken permitting the clutch elements to engage. Now as long as the shaft 201 remains stationary the clutch 205—206 remains engaged and shaft 191 rotates with shaft 195. Thus when the machine is started with no card under the upper brushes the shaft 191 will make two revolutions with shaft 195 to feed the first card under the lower brushes. During these two cycles, of course, the driving element 203 rotates freely on the shaft 201 and the latter does not rotate. But now if the magnet 245 is energized to engage the clutch 202—203 the shaft 201 rotates and shortly thereafter the arm 251 drops to lower portion of cam 252 permitting the latch 249 to move to latching position. During this cycle a pin 254 on the element 206 engages the offset surface 260 on the arm 247 and moves it to latching position and it is latched by latch 249. At the end of this revolution the clutch elements 205—206 disengage and remain disengaged during the following two cycles while the end of arm 251 is still riding on the low portion of cam 252. The shaft 191 therefore does not rotate and card feed is suspended during these two cycles. During the next cycle the arm 251 again rides to the high portion of cam 252 releasing the arm 260 whereupon the clutch 205—206 again engages and the shaft 191 again makes another revolution with shaft 195. This operation then continues providing for the rotation of shaft 191 during one out of three machine cycles as long as shaft 201 continues to rotate.

The usual card feed clutch contacts are shown at 255 (Fig. 21) which in the well known manner are closed when the clutch elements are disengaged and opened when they are engaged.

The printing mechanism is shown generally in Fig. 2 and consists of a drum 61 which as previously stated is rotated constantly as long as the motor 50 is in rotation. This drum carries a plurality of pivoted type carriers 265 on each of which are mounted a plurality of type 266 placed one below the other, three being the usual number of type on a type bar. Coacting with each type carrier is a locking cam 267 which through a suitable gear train (not shown) is rotated in synchronism with the drum, each cam making one revolution for each revolution of the drum. The printing operation will be explained in connection with Fig. 14 in which the parts are shown to a larger scale unless other figures are specifically designated. Each type carrier is provided with a cam surface 268 with which the cylindrical surface of its locking cam 267 engages, as indicated in connection with the type carrier to the extreme left, except when the type carrier is in printing position or in other words when it is opposite the platen 62 as is the case with the extreme right hand type carrier in Fig. 15. In this printing position a suitable notch in the locking cylinder 267 is presented to the type carrier to permit it to be rotated about its pivot if it is selected for printing at this time. The type are selected for printing by a call magnet 269. The type carrier is actuated by a printing finger 270 having a hook 271 at its end adapted to engage an extension 272 on the type carrier if the printing finger is rotated about its pivot and this engagement, owing to the inertia of the rotating drum 61, forces one of the type on the carrier against the platen as indicated in Figs. 16 and 17 to effect printing on a record sheet carried thereby. The finger 270 is normally held out of printing position as in Fig. 2 by a compression spring 273 (Fig. 14). A pivoted lever 274 has a dog 275 pivoted to one of its arms which normally rests against the tip of the printing finger 270 as in Fig. 2. The dog is free to rotate about its pivot but is urged in a clockwise direction against suitable stops by spring 276. Another arm of the lever 274 is normally engaged in a notch 277 in the pivoted latch lever 278, the latch lever being urged to latching position by a spring 279. The finger 270 is normally in non-selecting position and the latch lever in latching position as illustrated in Fig. 2. Energization of the magnet 269 attracts its armature 284 and an extension thereon forces a call rod 285 to the right as shown in Fig. 14

in which position the rod rocks the lever 278 against the action of its spring and releases the lever 274, which under the action of a spring 286 rocks clockwise causing the dog 275 to snap under the end of printing finger 270. Shortly after this a cam surface 287 formed on the lever 274 is engaged by a projection 272 on a type carrier behind the one which is to print and the lever 274 is rocked counterclockwise. The dog 275 being under the printing finger 270 thereupon rocks it against its spring 273 and forces the hook 271 into the path of the extension 272 on a type carrier which is thus called for printing. The camming action between the extension 272 and the cam surface 287 continues after the proper type is actually selected for printing and the dog 275 slips from beneath the end of printing finger 270 as indicated in Fig. 15 whereupon the spring 273 returns the printing finger to normal inoperative position and the latch lever 278 again engages the lever 274 and prevents its further operation until the call magnet 269 is again energized.

Referring to Figs. 16 and 17 the platen is shown in full lines in one printing position and in dotted lines in its other printing positions. As previously stated it is necessary to shift the platen successively to its three printing positions so that when a type carrier is rotated about its pivot the proper type will strike the platen. The mechanism for shifting the platen is illustrated in Fig. 14. The platen 62 is journalled in a pivoted frame 290 normally held by a spring 291 so that the platen 62 assumes its upper position as in Fig. 16. An operating lever 292 pivoted on the shaft supporting the frame 290 has one arm operatively engaging a pin 293 on the frame and the other riding on the surface of a cam 294. This cam through a one revolution clutch controlled by magnet 295 may be clutched to the shaft 296 which through a gear train of suitable ratio is connected to the driving motor of the machine so that this shaft makes one revolution for every three machine cycles. As long as the magnet 295 is energized at the proper point of the machine cycle the shaft 296 continues to rotate. The cam 294 is provided with three dwells each covering approximately one-third of its periphery and each at different radial distances from its center. Normally the lever arm 292 rests on the lowest dwell of the cam permitting the spring 291 to hold the platen 62 in its uppermost position. If the cam 294 is not clutched to the shaft 296 the platen remains in this position. After the cam is clutched to the shaft 296 the platen 62 remains in its uppermost position during one machine cycle at the end of which the next higher dwell of the cam comes under the arm 292 rocking it clockwise to rock the frame 290 clockwise until the platen 66 arrives at its intermediate position where it will remain for one machine cycle. At the beginning of the third machine cycle the end of arm 292 rides to the upper dwell on cam 294 and the frame 290 is forced to its lowermost position holding the platen as shown in Fig. 17 during this third cycle. At the end of this cycle the arm 292 rides on the lowest dwell of the cam 294 and the operation is repeated. Each position of the platen as may be seen from Figs. 16 and 17 causes a different type on the type carriers to print.

The code of the combinational index point system by which the different characters are designated is indicated in Fig. 13. A portion of a card field as on the usual tabulating card is divided by vertical and horizontal lines into horizontal rows and vertical columns. The index point positions on the card correspond to the little squares formed by these lines. The columns vertically contain six index point positions represented by the letters A, B, C, D, E and F to the right of the diagram, A designating the lowest index point position, B the next highest, and so on. The alphabet, digits and other desired characters are indicated at the top of the several columns. The corresponding code of perforations by which they may be represented on the card field is shown in the column directly beneath them. In this system a character may be represented by either one, two or three perforations in a column. For example, the letter I is represented by a single perforation in the A position, the letter D is represented by a perforation in the C position in combination with a perforation in the E position and the letter C is represented by a combination of perforations in the D, B and E positions. This code requires only six index point positions to represent all the characters in general use and two of these card fields may be conveniently placed one below the other on the controlling card now in use, in effect doubling its capacity.

The present machine as will be understood from the previous description analyzes each column of a card field with a single brush and the analysis is made while the card is in motion. This means that the perforations of any given combination are not analyzed simultaneously but successively and as the printing and accumulating requires a single timed impulse to properly select the required type or to properly initiate the accumulating operation these successive analyses of the perforations in a given combination must be set up, held temporarily and converted into a single timed operation.

The method by which this is done will be first explained generally in connection with Fig. 12 which shows a development of six discs A, B, C, D, E and F corresponding to

the several index point positions in Fig. 13. These discs although actually all of the same size have been represented by concentric circles in Fig. 12 for the purpose of clearly showing their cooperation. The discs are frictionally driven on a common shaft and may be shifted slightly thereon as will hereinafter be explained. The indentations in the circles represent notches in the disks and normally any character will be printed if notches in the disks are aligned along the radial line corresponding to the character. The printing of any character then requires six notches to be aligned along a radial line. Notches on the disks corresponding to the index point positions which are not actually involved in the combination corresponding to a character are normally aligned. For example along the radial line representing the character A notches in the F, D and C and A disks are on the radial line while notches in the E and B disks corresponding to the index point combination for the letter A are not on this line. As the card passes under the brush the brush senses the positions A, B, C in order. When it encounters a perforation in the B position the disk B is shifted to bring a notch therein along the radial line corresponding to A. This is still not sufficient to select the A type for printing as the E disk still has no aligned notch. When the brush reaches the E position and encounters a perforation, the E disk is shifted on the shaft bringing a notch thereon to the radial line A whereupon each disk has a notch on the radial line corresponding to A. The disks rotate continuously regardless of this relative displacement and at a given point in the cycle a suitable member drops into the aligned notches and selects the printing type corresponding to the character for printing.

It will be noted that the characters are divided into three groups around the periphery of the disks, the first group consisting of all the digits and the letters A, T, S and G. The second group consists of a number of special characters and the letters of the alphabet from U to Z respectively while the third group consists of the remaining letters of the alphabet. The member which searches the aligned notches is placed in a definite location past which each group moves during a separate machine cycle. Thus three machine cycles are required to pass the three groups past the searching member. If the letter A has been sensed as just explained, causing alignment of notches in the six disks along the radial line A, when this line reaches the searching device the latter drops into the notches for an instant while the disks are in motion and operates suitable mechanism to energize the proper call magnet to print the letter A, this operation, of course, being a single timed operation adapted to the selection of the type on the printing drum.

The printing drum makes three revolutions for each revolution of the translator disks and the upper type on the carriers correspond to the characters in the first group. During one cycle then if any combination on the card represents one of the characters in this first group the type carrier on which the type is located will be selected during this cycle. During the second cycle the platen goes to the intermediate position to select the middle type on the carriers which correspond to the second group and the aligned notches in this case will select the proper type carriers to print characters of the third group. During the third cycle the platen goes to its lowermost position to effect printing of any characters in the third group and aligned notches in this group will select the carriers during this cycle. At the end of the three cycles any character represented in the card which has been analyzed will be printed and any digit represented may be entered into the accumulators and accumulated.

The translators which are diagrammatically represented by the notched circles in Fig. 12 are illustrated in detail in Figs. 4 to 8 inclusive. Referring to Fig. 4 a complete translator for a denominational order is shown driven from the shaft 54 (see Fig. 1). The translator comprises generally two sets of disks represented at 299 and 300 which are driven with a one to three ratio from the shaft 54. The disks 300 correspond to the notched circles A, B, C, etc., in Fig. 12 and are frictionally mounted on a sleeve 301 freely rotatable on a stud 302 (see Fig. 7). The sleeve 301 is provided with a flange 325 and the disks A, B, C, etc. are separated by friction disks 303 and the whole assembly is mounted on the sleeve and held against the flange by a retaining plate 326. The plate 326, the friction disks 303 and the disks A, B, C, etc. are perforated to fit over tapped studs 327 fixed in the flange. The friction disks 303 are provided with holes closely fitting the studs so that there is no relative movement between them and the sleeve, while the studs pass through slots 305 in the disks A, B, C, etc. (see Fig. 4) so that the latter disks, while they will always rotate with the sleeve are permitted a limited movement relative thereto. Suitable machine screws 331 coacting with internal threads in the studs 327 hold the assembly of disks firmly on the sleeve but permit ready removal if it becomes necessary to replace any disk. The sleeve 301 is similarly held on the stud 302 by a screw 332. The limited movement of the disks 300 on the sleeve 301 is utilized to align the notches in the disks as explained in connection with Fig. 12. The disks 299 (Fig. 6) are similarly mounted on a stud 306 but these

disks are rigidly fixed to their supporting sleeve so that there is no relative movement between them. Each of these disks also corresponds to one of the index point positions A, B, C, etc. and each is provided with a single extension 307 (Fig. 4) which extensions correspond in position to the position of the machine in analyzing the index point position to which it corresponds.

The translator is controlled by a single magnet 310 whose armature is pivoted on a plurality of pins 311 and urged away from the magnet core by a spring 312. A lever 313 corresponding to each of the disks 299 and having a downward extension 314 extending into the path of the extension 307 on the corresponding disk 299 is supported through a pin and slot connection by a cross member 315', the pin and slot permitting the central portion of this lever to move freely up and down in response to actuations by the extensions 307. One end of each of these levers is provided with an upward extension 315 which extends through a perforation 318 in the supporting structure of the magnet armature (Figs. 4 and 6) while the other end of the lever comprises a latch 319 for an operating pawl 320 and normally holds this pawl in inoperative position. As long as the armature remains in the position shown in Fig. 4 the left end of the levers 313 are free to rise and the coaction of the extensions 307 with the levers does not release the latches 319. When the armature 316 is attracted by the magnet 310 in response to an index point perforation in a card column the upward extension 315 is directly below a portion of the armature structure which forms a pivot for it as shown in Fig. 9. At the time of energization of the magnet then any extension 307 which moves under the downward extension 314 of its corresponding lever 313 rocks the lever upwardly about the extension 315 as a pivot releasing the pawl 320. The magnet 310 is energized instantaneously for each index point encountered by the analyzing brushes. Consequently during the passage of the entire card any levers 313 corresponding to the index point positions encountered by the brushes will be raised to release their operating pawls 320. A spring 321 fixed to a bracket 322 on the frame of the translator unit normally forces the central portion of levers 314 downwardly.

An operating pawl 320 cooperates with each of the disks 300. Any pawls which are released during the cycle ride on the periphery of the disk as shown in Fig. 9 until they reach a notch 323 in their disks whereupon each is actuated by an individual spring 338 to engage a deep notch 323 as indicated in Fig. 10. After the necessary pawls 320 have been released and engage their notches 323 in this manner a bell crank 328 is rocked by a projection 329 on a disk 330 also driven by the gear 309 and this bell crank rocks the pivoted supporting structure of the pawls 320 against the action of spring 335 as shown in Fig. 10. This causes each operating pawl 320 which has engaged a notch 323 in its associated disk to shift the disk about the sleeve 301 in a clockwise direction to the end of its travel as limited by the slots 305. The disks 300 rotate during this operation and after it, so that after the shifting all the disks continue to rotate in their new relationship. This shifting, of course, aligns the proper notches as explained in connection with Fig. 12 so that somewhere around the periphery of the disk there will be a series of aligned notches in each of the disks 300 and, of course, for any given card column there will only be one series of aligned notches as only one character can be represented in the column.

The disks continue to rotate until the aligned notches reach a searching mechanism indicated at 340 (Figs. 4 and 11) which consists of a pivoted structure 341 carrying at one end a pivoted member 342 which is spring-pressed into engagement with the periphery of the disks 300. When a series of aligned notches is presented to the member 342 a bevelled edge 343 on the latter engages the notches and the member 342 is rocked about its pivot on the member 341 causing the latter to rotate clockwise as indicated in Fig. 11 whereupon an extension 345 on structure 341 forces a rod 346 to the left as indicated in Fig. 11. This rod 346 (see Fig. 4) when forced to the left closes a pair of contacts 347 which are included in the proper printing call magnet circuit to select the proper type. It will be understood that the rotation of the disks 300 is properly timed with the rotation of the drum so that any character manifested by aligned notches will not only select the proper type carrier but will select it during the machine cycle in which the platen is in proper position to receive the type representing the character.

After the disks 300 have practically completed a revolution a pawl 350 (Fig. 4) is engaged by an extension 351 on a disk also mounted on the sleeve 301 and rocked clockwise to force an extension 352 on the pawl into a bevelled notch 353 on the disks 300 which shifts all disks back to their normal position in which no complete line of notches is present. The translator is then in condition to set up and translate another combinational hole character.

Before proceeding with the general explanation of the circuit diagram the automatic control system will be briefly described in connection with Figs. 28, 29 and 30a. The control system comprises a pair of magnets 361 and 362 for each card column used for controlling. Each magnet 361 may be plugged to any upper brush 167 and each lower magnet 362 may be plugged to a cor-

responding lower brush 168 (see Fig. 30ª). Each pair of magnets (Fig. 28) operates a pivoted balanced armature structure 431 which has an extension 432 thereon provided with a double bevelled end 433 which normally seats in a notch 434 in one arm of a bell crank 435. The bell crank is urged in a counterclockwise direction by a spring 436 and when the end 433 is thus seated the balanced structure 431 is yieldably held in mid position as in Fig. 28. With the bell crank in this position the other arm thereof holds a pair of automatic control contacts 363 closed. On opposite sides of the pivot of structure 431 are mounted armatures 437 and 438 for the magnets 361 and 362 respectively. Now as long as both magnets of a pair are deenergized or both are energized the structure 431 remains in its mid position and the control contacts are held closed. But if one magnet of a pair is energized while the other remains deenergized, one of the armatures 437 or 438 will be attracted, rocking the structure 431, and the end 433 of extension 432 will move out of notch 434 and force bell crank 435 clockwise in opposition to the spring 436. The contact engaging arm of the bell crank will then disengage the contacts 363 and the latter will open under their own resiliency as indicated in Fig. 29.

Referring to Fig. 30ª the automatic control contacts 363 are located on the panel board and any number of them may be plugged in series in the automatic control circuit 398 in the usual manner. When the magnets 361 are properly plugged to the upper brushes of the control columns and the magnets 362 are properly plugged to corresponding lower brushes of the control columns it is obvious that as long as the perforations in the controlling columns of the cards under the upper and lower brushes agree the automatic control contacts 363 will remain closed, as in this case the magnets 361 and 362 will be energized and deenergized concurrently. As soon as the controlling perforations of the card under the upper brushes do not agree with those on the card under the lower brushes, however, at some time in the card feeding cycle one magnet will be energized while its mate is deenergized and the automatic control contacts 363 will open which, as will hereinafter appear, causes the machine either to stop or take a total.

As the card feeding cycles occur in groups of three in the present machine it is desirable that when the automatic control contacts 363 once open they remain open for the card feeding cycle and the two following cycles so the card feed clutches may not become energized to resume card feed before all operations in connection with the card group which has just been operated upon are terminated.

Referring to Fig. 28 a bail 441 is provided to close the automatic control contacts 363. This bail is connected at one end to a bell crank 442 which is operated from a jack 443 operated by the shaft 53 (see also Fig. 1). This jack is entirely similar to the jacks for operating the total switch bars as detailed in Figs. 23 and 24, but its magnet 444 (see Figs. 30 and 30ª) is controlled by a cam contact CFA—5 which closes once for each revolution of shaft 195 and a cam contact CFB—9 which closes once for each revolution of shaft 201. The shaft 201 makes one revolution for every three revolutions of the shaft 195 and the cam contacts are arranged to energize the magnet 443 during the third cycle of each card. Referring again to Fig. 28 the operation of jack 443 on energization of magnet 444 causes depression of rod 445 which rocks bell crank 442 and through bail 441 restores any contacts 363 which might be open to closed position. It will be obvious then that although the control contacts open during the cycle in which the first card of a new group is fed to the upper brushes they are not restored until two cycles later.

The general operation of the device will now be explained in connection with Figs. 30 and 30ª of the drawings of which Fig. 30ª should be placed to the right of Fig. 30 to form a complete circuit diagram. In connection with this explanation it should be borne in mind that during normal running conditions a card is fed beneath the lower or adding brushes during one machine cycle and its combinational holes sensed to effect a set up in the translator. This set up is held on the translator during three printing cycles. During the first printing cycle the translator is searched for set ups corresponding to type of the first or upper group. During the second cycle the translator is searched for set ups corresponding to type of the second or intermediate group and during the third cycle for set ups corresponding to type of the third or lower group.

This sequence of feeding and printing cycles is effected through the two card feed clutches described above which are represented in Fig. 30 at A and B, A being the clutch controlled by the magnet 218 and B being the clutch controlled by the magnet 245. The card feed cam contacts indicated generally at 66 in Fig. 1 are identified in the circuit diagram by the letters CFA followed by a numeral and the card feed contacts of the group at 67 in Fig. 1 are identified in the circuit diagram by the letters CFB followed by a numeral it being understood that the contacts CFA close once per machine cycle while the A clutch is engaged and the CFB contacts close once during three machine

cycles while the B clutch is in operation. In the diagram the upper or control brushes 167 are connected to sockets on a plug board 350 while the lower brushes 168 are connected to similar sockets on the plug board.

A plurality of counters have been indicated at 364 and 365 which are of the type disclosed in my copending application Serial No. 147,960, filed November 12, 1926, whose counter magnets 366 are connected to sockets on the plug board 350 and whose total printing control contacts 367 are connected to the stationary contacts on one side of the total printing switch bar 71. The machine is started in operation by one of the starting timers D and E and is controlled when total printing is desired by the total timer F. The contacts on the starting timers operate the group indicating switch bar 75 and the card feed clutches and paper feed while the contacts on the F timer control the operation of the total printing control bars 71, 72, 73 and 74. The operation of all these devices are fully explained in my copending application above referred to and will be very briefly described in the present case.

The translators are indicated at 368 having their control magnets 310 each connected to an individual socket on the plug board 350 through which any one may be plugged to any desired analyzing brush 168. The printing control contacts 347 of the translators are connected to sockets 375 through which by suitable jumpers indicated in the present case at 376 may be connected to any desired printing magnet 269. It will be understood that the plugging arrangement indicated also permits any counter to be associated with any lower analyzing brush for control thereby and any printing magnet to be associated with any lower analyzing brush for listing and with any counter element for total printing either with or without reset of the counter element which controls it.

The motor 50 which drives the mechanical elements of the machine is controlled by switch 377, closure of which connects the motor directly to the supply mains 378 and 379 of which the former has been designated + and the latter −. Card feed may be initiated by depressing the start key ST whereupon a circuit through either the E starting coil 380 or the D starting coil 116 will be completed. The selection of the D or E timer depends on the position of the card lever 381, which, when no cards are under the upper brushes, assumes the position shown in the drawing closing the contacts 382 and opening the contacts 383. In this case the D timer will be selected. The D timer controls the machine through several initial tabulating cycles permitting the first card to feed from the card magazine beneath the upper or control brushes during one machine cycle and to the lower brushes during the succeeding cycle after which the control of the machine is assumed by the automatic control circuit. If there is a card under the upper brushes when the start contacts ST are closed, the card lever 381 is moved to its alternative position closing the contacts 383 and opening the contacts 382. In this case the E timer will be selected. The E timer controls machine operation to feed the card which is under the upper brushes to the lower brushes after which the machine is controlled by the automatic control circuit. The total or F timer is controlled by the contacts 385 which are closed by the A card feed clutch elements whenever they are disengaged and opened when they are engaged. A switch 386 permits automatic or manual control of the total timer. If this switch is closed when the A clutch disengages at the end of a card group the timer starting coil will be automatically energized through a circuit extending from line 378 through switch 386, contacts 385 to the total timer starting coil 387 and through the common return 384 to the negative side of the line 379. The contacts of the total timer are operative during a plurality of machine cycles to selectively close the total printing switch bars during certain cycles so that printing with reset or without reset may be effected from any desired counter element.

The control of the card feed mechanisms in which the present system differs materially from the former one will now be explained. Certain timing problems are involved in the starting operation which will be appreciated after a brief consideration of Fig. 1. The translators 57 are driven from the shaft 54 and their disks rotate as long as the motor 50 is in operation. These translators, then, rotate synchronously with the printing drum 61 and in a fixed relationship thereto. Now the card feed must always be coordinated with the translators and drum so that during the first printing cycle after card analysis the translators will be in position to control printing from the first or upper group of type. Otherwise the translator might select type of either the second or third group when the card actually calls for printing from the first group. The card feed cannot be initiated at random, then, but must always start so that the analysis of the first card will terminate just before the translator disks reach that portion of their revolution in which set-ups for the first or upper group of type will be picked off. Provision is made for this in the form of two cams 480 and 481 driven by shaft 54 through a gear train with a one to three ratio. These cams control contacts 482 and 483 in series with the starting coils 116 and 380 respectively of the D and E starting timers (Fig. 30). The cams close their contacts once every three machine cycles and hence the starting timers can only be started

to initiate card feed during those cycles which will insure a proper coordination between the card feed and the translators. The starter key ST may be depressed at any time but it must be held down until either contacts 482 or 483 close whereupon the card feed operation will be properly initiated.

It may now be assumed that a stack of cards from which it is desired to list data have been placed in the magazine and that no card is under the upper brushes. The upper card lever contacts 415 will now be open preventing energization of the B clutch magnet 245 and the upper card lever 381 will be in the position shown in the drawing, closing contacts 382 to select the D timer for starting. Depression of the start key ST will complete a circuit through the D timer starting coil as follows: From line 378 through contacts 255, closed when the A clutch is disengaged, through safety contacts E—7, D—7 and F—12 on the timers to start key contacts ST, thence through contacts 382 and contacts 482, closed during the proper machine cycle, to D starter coil 116 and through common return 384 to the other line 379. The D timer contacts D—2 close and remain closed for two full cycles closing a circuit through the A clutch magnet 218 as follows: From line 378 through wires 390 and 392 to contacts D—2, thence through wire 393 and A clutch magnet 218 to R—20, closed at the proper point in each cycle, and through common return 384 to the other line 379. The clutch magnet 218 being thus energized for two cycles during the first of which the secondary clutch magnet 245 cannot be energized owing to the open condition of upper card lever contacts, the clutch 205—206 (referring to Figs. 18 and 22) remains engaged as well as the clutch 196—198 and the first card from the magazine feeds to the upper brushes and the lower brushes during successive machine cycles. When this first card reaches the upper brushes the upper card lever contacts 415 close and a circuit through the secondary clutch feed magnet 245 is completed as follows: From line 378 through contacts 415, magnet 245 cam contacts CFA—2 and R—20, closed synchronously at the proper time in the cycle, and through common return 384 to the other line 379. The energization of the B clutch magnet 245 concurrently with the operation of the A clutch effects suspension of the card feed for two cycles after each card is analyzed by the lower brushes as explained in connection with Figs. 18 to 22. The first card now being under the lower brushes the control of the A card feed clutch shifts to the automatic control circuit 398 as the timer contacts D—2 have now opened. The control circuit for the magnet 218 now extends as follows: From line 378 through upper card lever contacts 415 and switch 416, closed for automatic control, and then through the automatic control circuit 398, including the series contacts 363, to cam contacts CFA—1, thence to magnet 218 and to the other line 379 as before. The card feed then continues as long as the control perforations in the cards under the upper and lower brushes agree, maintaining the contacts 363 closed.

As soon as the card group changes meaning that the control perforations of the card under the upper brushes do not agree with those under the lower brushes one or more of the pairs of contacts 363 open, preventing energization of the clutch magnet 218. The B clutch, of course, provides for the two extra printing cycles required for the card under the lower brushes but at the end of these as neither the control circuit for the A clutch magnet 218 nor the control circuit for the B clutch magnet 245 makes, card feed ceases and the machine either stops or takes a total depending on its setting.

If the machine is to be started with a card under the upper brushes, meaning that upper card lever contacts 415 and 383 are closed, depression of the start key ST energizes the starter magnet 380 of the E timer, the circuit being similar to that traced above the D timer starter magnet. Also in this case the B clutch magnet 245 is energized shortly after the A clutch magnet owing to the fact that card lever contacts 415 are closed and the card under the upper brushes feeds to the lower brushes for analysis after which card feed is suspended for two cycles. The control is then assumed by the automatic control circuit and from this point the card feed is identical with that described above.

Each card is analyzed as it passes the lower brushes 168 and every perforation in a given column energizes the control magnet 310 of one of the translators 368. The energizing circuit extends from line 378 through wire 403, regular contacts R—21, controlled as usual by a dentated wheel, contacts CFB—10, wire 404 and lower card lever contacts 173 to conducting cylinder 170, hence through the card perforations to one of the analyzing brushes 168 and through the associated socket 406 and a suitable jumper to socket 407 connected to the control magnet 310. One or more energizations of this magnet sets up a combination on the translating disks which during one of the three machine cycles associated with the particular card effects closure of the contacts 347. Closure of these contacts establishes a circuit through the corresponding printing call magnet 269 to select the proper type for printing. This circuit extends as follows: from line 378 through wire 406 to contacts 347, thence through wire 407 to socket 375 and through jumper 376 and wire 409 to printing magnet

269 which is connected to the negative line 379.

As long as the B clutch is in operation the clutch magnet 295 of the platen shift mechanism is energized once every three cycles to provide for shifting of the platen. The operating circuit for this magnet is controlled by the contacts CFB—1 and extends from line 378 through wire 399, contacts CFB—1, magnet coil 295 and wire 401 to negative side of the line 379. It will be understood from the preceding explanation that the energization of the printing call magnet circuit for each combination is timed not only to select the proper type carrier but to select it during the cycle in which the platen is in position to receive an impression from the type corresponding to the set-up in the translator.

While the cards are being fed through the machine the letters of the alphabet represented thereon can be printed and the numerals represented can be listed and entered into the accumulators. The usual transfer circuit is controlled by the card feed contacts CFA—3 and CFB—3, these contacts being timed to supply a single pulse of current to the transfer contacts 420 of the counter elements toward the latter part of the last cycle pertaining to each card. The lower contacts 420 are bridged when the counter element stands at nine at the end of the last cycle and the upper contacts 420 are bridged whenever the counter elements pass through zero during the cycles. The lowermost and middle contacts 420 are connected to sockets on the plug board 350 and the lowermost contact may be plugged to the counter magnet of any other counter to effect transfer thereto and the middle contact may be plugged to the lower contact of any other counter element. In this manner any counter element which passes through zero will transfer one unit to the next higher counter element and any counter element which stands at nine will transfer a unit to the next higher counter only if it receives a transferred unit from its lower adjacent counter element.

Total taking may be automatically initiated at the end of the card group by closing the switch 386. In this case as soon as the A clutch 196—198 disengages towards the end of the last tabulating cycle, closing the contacts 385, the starter magnet coil 387 of the total timer will be energized through these contacts and the contacts CFB—6. The total timer then starts operation and its contacts control the operation of the total printing switchbars so that during one totaling cycle totaling with reset may be effected from certain selected counter elements and totaling without reset may be effected from other selected counter elements during another totaling cycle. These operations are fully explained in my copending application and will not be further described herein. It will be understood that in total printing the numerals are read directly out of the accumulators or counters and that every number on an accumulator of a certain class is printed during a single cycle. It will be recalled that all the numeral type are included in the first group which comprises the upper type on the carriers and hence during total printing, the platen should remain in its uppermost position where any type carrier selected will effect printing from its upper type. During total printing cycles the contacts CFB—1 are open and the platen control magnet 295 is not energized permitting the platen to remain in its uppermost position during all total printing operations.

The invention has now been disclosed in connection with what is at present believed to be the preferred embodiment but it will be understood that many changes will readily occur to those skilled in the art which may be made without departing from the spirit of the invention. I intend to be limited only as indicated by the scope of the following claims:

1. A printing machine including a printing drum having type spaced thereabout, means for selecting said type for printing in accordance with predetermined type spacing, said type being spaced about the drum at less than the predetermined spacing and means for compensating the type spacing to permit selection of all type.

2. A printing machine including a printing drum having a group of type spaced thereabout, means for selecting said type for printing in accordance with their spacing, an additional group of type spaced about said drum intermediate the type of the first group and means for compensating the group spacing to permit type of each group to be selected by said selecting means.

3. A printing machine including a printing drum and a platen, a group of type spaced about said drum and means for relatively moving said drum and platen to permit printing by the several type, an additional group of type spaced about said drum intermediate the type of the first named group and means for superimposing additional relative motion between the drum and platen to permit printing by the additional group of type.

4. A record controlled printing machine including a rotary printing drum, pivoted type carriers mounted thereon, one or more alphabet type on each of said carriers and means controlled by records for actuating said type carriers and means for selecting the several type on the carriers.

5. A record controlled printing machine including a rotary printing drum, pivoted type carriers mounted thereon, a plurality of type on each of said carriers and means controlled by records for actuating said carriers

and selecting the several type thereon for printing.

6. A record controlled printing machine including a rotary printing drum, pivoted type carriers mounted thereon, a plurality of type on each carrier, means controlled by records for actuating said carriers, a platen and means controlled by records for relatively shifting said platen and drum to select the several type on the carriers.

7. A record controlled printing machine including a rotary printing drum, a plurality of type spaced about said drum, means operative at predetermined angular positions of said drum for selecting said type, said type having an average spacing about said drum less than the angular distance between the printing positions of said drum and means for compensating the spacing of the type to permit selection of all type at the predetermined angular positions.

8. A record controlled printing machine including a rotary printing drum, a group of type spaced about said drum, means for selecting said type for printing at predetermined positions of the drum, an additional group of type spaced about said drum intermediate the type of said first named group and means for compensating the spacing of said additional group to permit selection thereof by the selecting means.

9. A record controlled printing machine comprising a type carrier having a plurality of type mounted thereon, record controlled means for selecting said carrier, a platen and means for relatively moving said platen and type carrier to select printing from the several type on the carrier.

10. A record controlled printing machine comprising a type carrier having a plurality of type mounted thereon, a platen and means for relatively moving said platen and carrier to successive positions to effect printing from the several type and record controlled means for actuating said carrier to effect printing operations in accordance with the data on a controlling record and in accordance with the relative positions of the platen and carrier.

11. A record controlled printing machine comprising a rotary drum, a plurality of type carriers mounted thereon each provided with a plurality of type, a platen and means for rotating said drum to bring its type carriers successively into printing position with respect to said platen, record controlled means for actuating said type carriers and means for selectively shifting said platen to different positions to receive impressions from the different type on said carriers.

12. A record controlled printing machine comprising a rotary drum, a plurality of type carriers mounted thereon each provided with a plurality of type, a platen and means for rotating said drum to bring its type carriers successively into printing position with respect to said platen, means for shifting said platen to different positions to receive impressions from the different type on said carriers and record controlled means for actuating said type carriers, said last named means including means for timing said actuation in accordance with the designations on the record to effect printing by the corresponding type.

13. A record controlled printing machine comprising a rotary drum, a plurality of type carriers mounted thereon each provided with a plurality of type, a platen and means for rotating said drum to bring its type carriers successively into printing position with respect to said platen, means for successively shifting said platen to different positions in each of which it is adapted to receive impressions from type with a given location on the carriers, record controlled means for actuating said type carriers and means for delaying the actuation until the platen is shifted into position to receive an impression from the type corresponding to the designation on the controlling record.

14. A record controlled printing machine comprising a plurality of type carriers provided with type of a group similarly located thereon, and provided with one or more type of an additional group in several different locations thereon, a platen and means for relatively shifting the platen and carriers to permit printing from all type, record controlled means for selecting the carriers for printing and means for suspending the shifting operation for printing from the type of the first named group only.

15. A record controlled printing machine comprising a rotary drum, a plurality of type carriers mounted thereon provided with type of a group similarly located thereon and provided with one or more type of an additional group in several different locations thereon, a platen and means for rotating said drum to bring its type carriers successively into printing position with respect to said platen, means for successively shifting said platen to different positions in each which it is adapted to receive impressions from type with a given location on the carriers, record controlled means for actuating the type carriers and means for suspending the shifting of the platen during printing from the first named group of type alone.

16. A record controlled printing machine comprising a plurality of type carriers provided with numeral type similarly located thereon and alphabet type located in several different positions thereon, a platen and means for relatively shifting the carriers and platen to permit printing from all type on the carriers, record controlled means for ac-

tuating the carriers and means for suspending the shifting operation for printing from the numeral type alone.

17. A record controlled cylically operable printing machine comprising a plurality of type carriers having a plurality of type on each, a platen and means for successively moving said platen and type carriers relatively to each other to establish printing cooperation therebetween for the different type for the carriers during different machine cycles, record controlled means for actuating said type carriers and means for coordinating the actuation to the relative movement of the platen and type carriers to select the proper type for printing.

18. A record controlled tabulator comprising a plurality of type carriers having a group of single type similarly located thereon operative during listing and totaling, an additional group of type on said carriers located in different positions thereon operative during listing only, a platen relatively movable with respect to said carriers to establish printing cooperation with all type on said carriers, means for moving said platen to its different position during listing cycles and for preventing movement thereof during totaling cycles.

19. A record controlled tabulator comprising a rotary drum, a plurality of type carriers thereon having type in a plurality of positions, a platen and means for rotating said drum to move its type carriers successively into printing position with respect to said platen, record controlled means for actuating said type carriers, said means comprising means for analyzing records and means for predetermining certain machine cycles in which record designations corresponding to the several type shall become effective, and means for shifting said platen to receive impressions from the differently located type during successive machine cycles.

20. A record controlled tabulator comprising a rotary drum, a plurality of type carriers thereon having type in a plurality of positions, a platen and means for rotating said drum to move its type carriers successively into printing position with respect to said platen, record feeding means, means for analyzing records and means controlled thereby for actuating said type carriers, means for periodically shifting said platen into different positions during successive machine cycles to select the several type on the carriers and means for interrupting operation of the record feeding means after record analysis until the platen has been shifted to its several positions.

21. A printing machine including a printing drum having a group of type spaced thereabout, means for selecting said type for printing in accordance with their spacing, an additional group of type spaced about said drum, each type of said last named group being intermediate two type of the first named group and means for compensating the group spacing to permit type of each group to be selected by said selecting means.

22. A printing machine including a printing drum having a group of type spaced thereabout, means for selecting said type for printing in accordance with their spacing, a plurality of additional type intermediate two adjacent type of the group and means for compensating the spacing of the additional intermediate type to permit selection of all type by said selecting means.

23. A printing machine including a printing drum and a platen, a group of type spaced about said drum and means for relatively moving said drum and platen to permit printing by the several type, an additional group of type spaced about said drum, each type of said last named group being intermediate two type of the first named group and means for superimposing additional relative motion between the drum and platen to permit printing by the additional group of type.

24. A printing machine including a printing drum and a platen, a group of type spaced about said drum and means for relatively moving said drum and platen to permit printing by the several type, a plurality of additional type intermediate two adjacent type of said group and means for superimposing additional relative motion between the drum and platen to permit printing by the additional intermediate type.

25. In a record controlled printing machine, record feeding mechanism and printing mechanism, means for cyclically operating the printing mechanism and means for operating the record feeding mechanism periodically and controlling mechanism for the record feed operating means to delay initiation of operation of the latter until a predetermined phase relationship exists between the record feeding and printing mechanisms.

26. In a record controlled printing machine, a constantly cyclically operable printing mechanism, a record feeding mechanism for feeding records intermittently during predetermined cycles only of said printing mechanism and means for initiating operation of the record feeding mechanism, said last named means including mechanism for delaying initiation of record feed until the succeeding suitable cycle of operation of the printing mechanism.

27. In a record controlled printing machine, a constantly cyclically operable printing mechanism, record feeding mechanism including devices for selectively feeding records cycle for cycle with said printing mechanism or during predetermined cycles of operation only of said printing mechanism and means for controlling the feeding mechanism to select the different feeding operations.

28. In a record controlled printing machine, a constantly cyclically operable printing mechanism, record feeding mechanism including devices for selectively feeding records cycle for cycle with said printing mechanism or during predetermined cycles of operation only of said printing mechanism and record controlled means for controlling the feeding mechanism to select the different feeding operations.

In testimony whereof I hereto affix my signature.

FRED M. CARROLL.