Nov. 29, 1932. E. H. HENDERSON 1,889,315

ELECTRICAL TYPEWRITING MACHINE

Filed Sept. 18, 1929 4 Sheets-Sheet 1

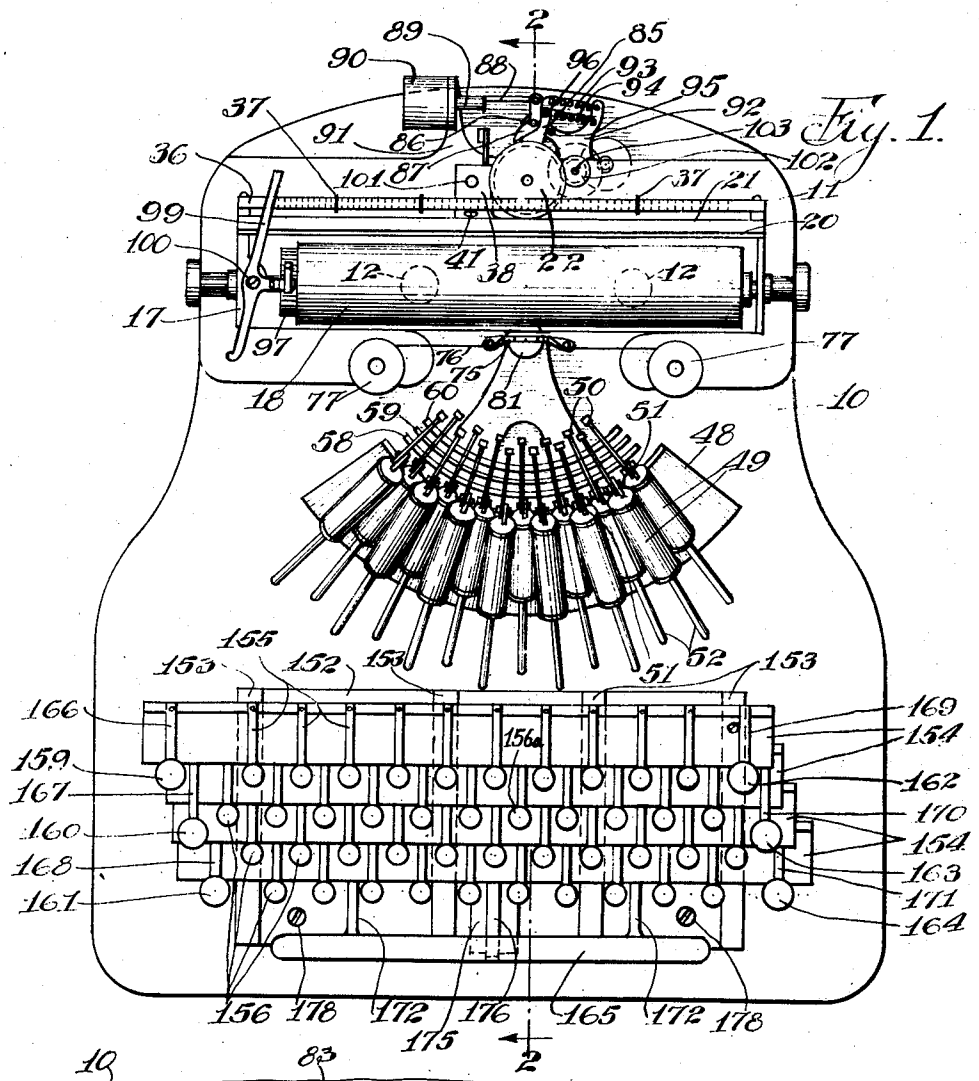


Fig. 1.

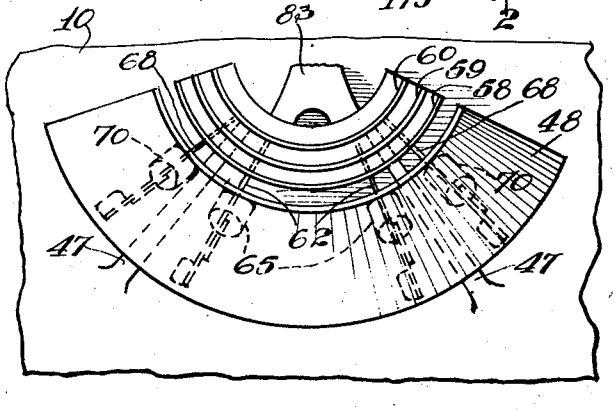


Fig. 6.

INVENTOR
ELIAS H. HENDERSON.

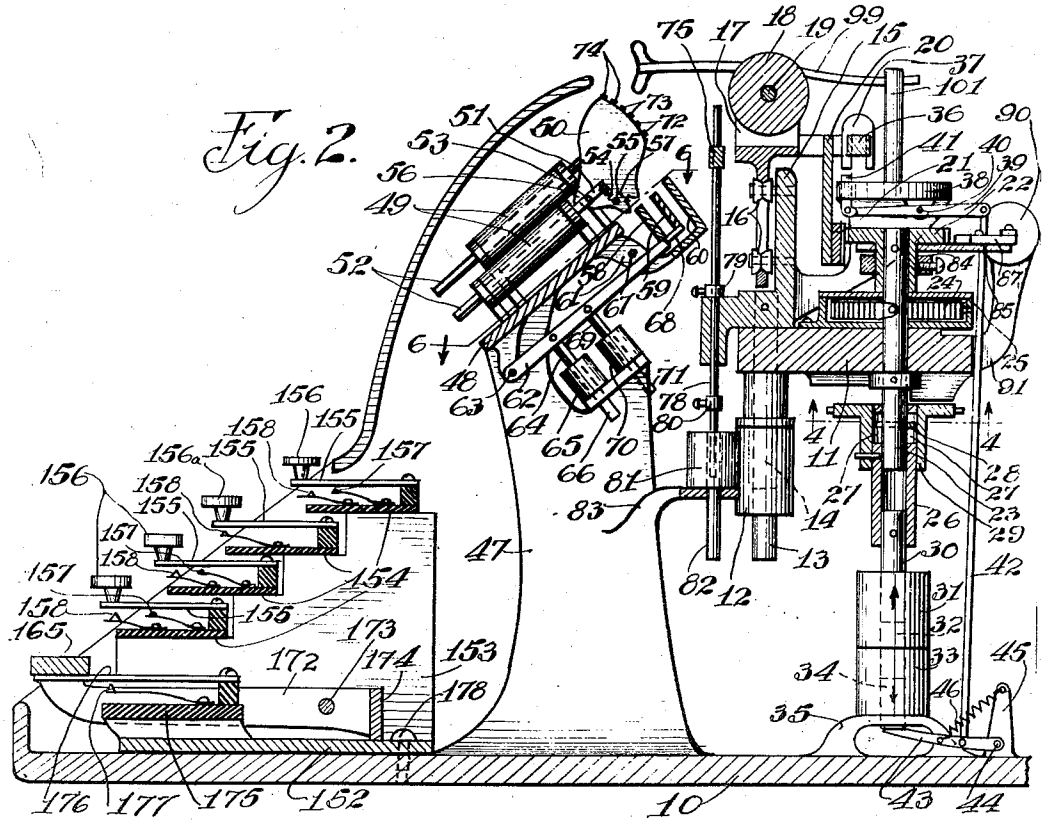
BY Albert C. Bell
ATTORNEY.

Nov. 29, 1932. E. H. HENDERSON 1,889,315

ELECTRICAL TYPEWRITING MACHINE

Filed Sept. 18, 1929 4 Sheets-Sheet 2

Fig. 2.



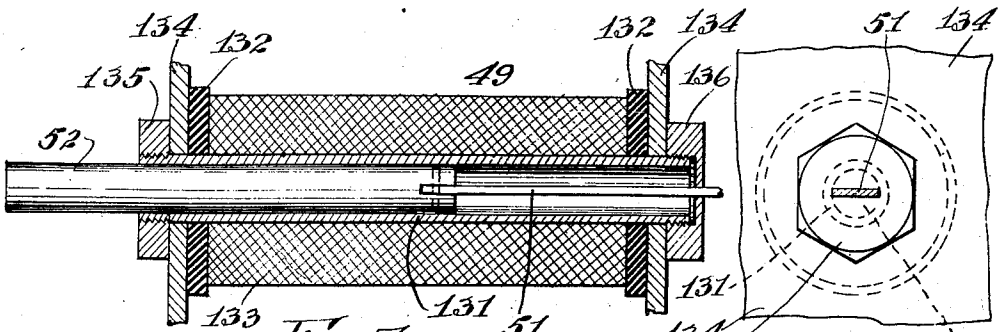


Fig. 7.

Fig. 8.

INVENTOR
ELIAS H. HENDERSON.

BY Albert C. Bell

ATTORNEY.

Nov. 29, 1932. E. H. HENDERSON 1,889,315

ELECTRICAL TYPEWRITING MACHINE

Filed Sept. 18, 1929 4 Sheets-Sheet 3

Fig. 3.

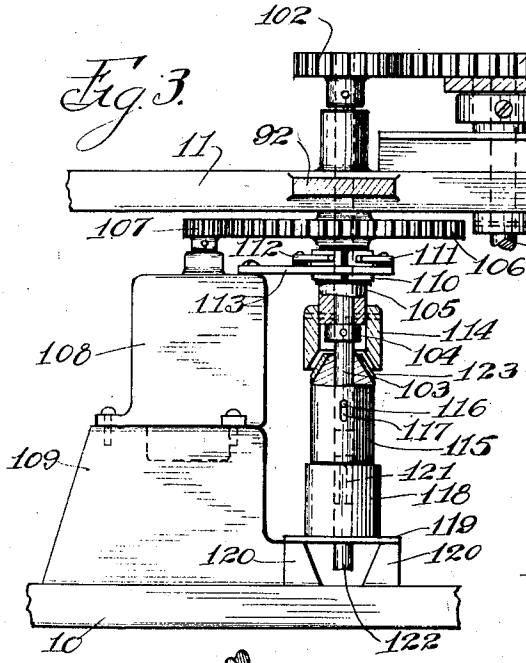
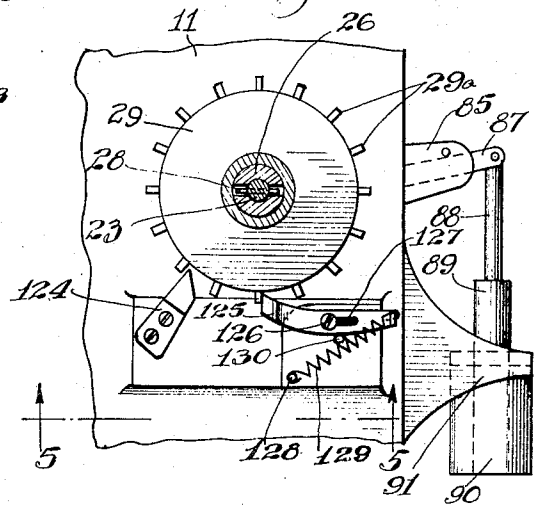


Fig. 4.



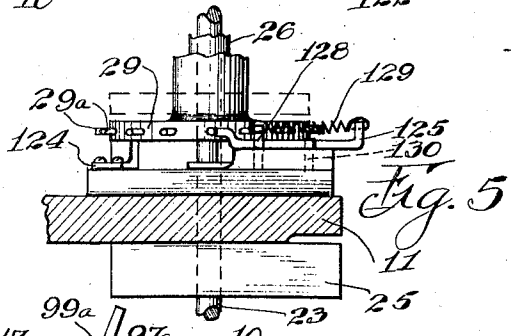


Fig. 5

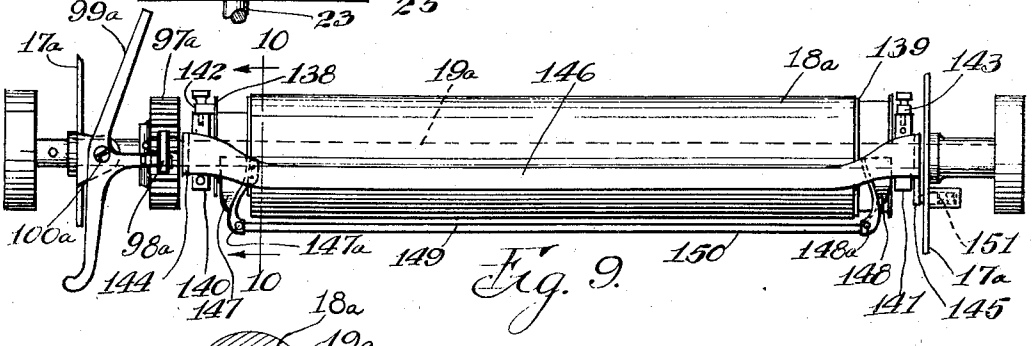


Fig. 9.

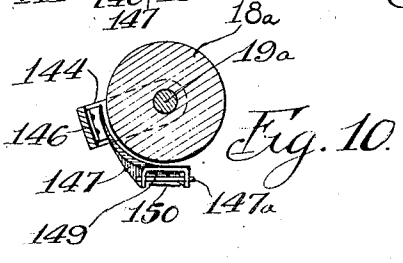


Fig. 10.

INVENTOR
ELIAS H. HENDERSON.

BY Albert C. Bull

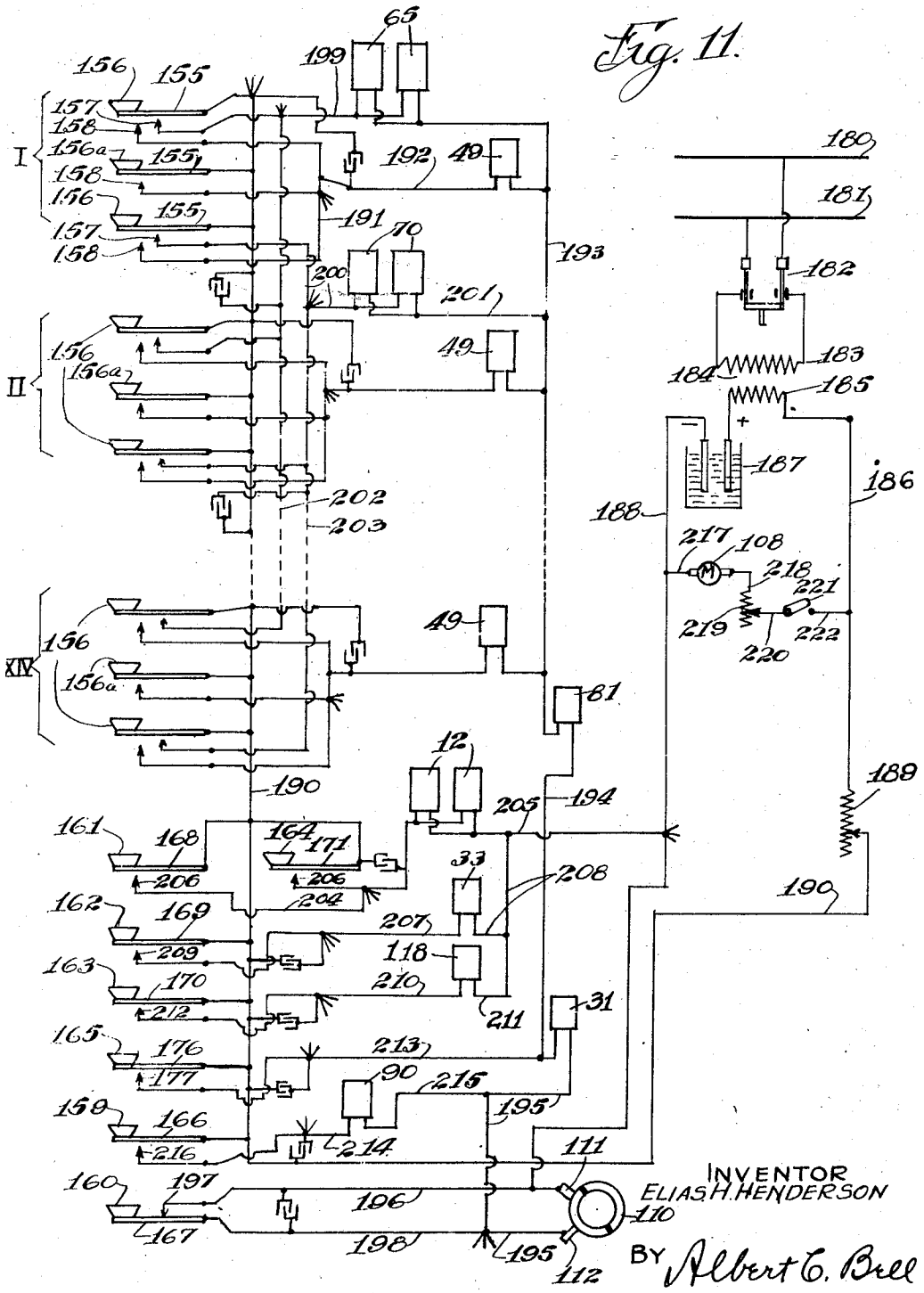
ATTORNEY

Nov. 29, 1932. E. H. HENDERSON 1,889,315

ELECTRICAL TYPEWRITING MACHINE

Filed Sept. 18, 1929 4 Sheets-Sheet 4

Fig. 11.



INVENTOR
ELIAS H. HENDERSON

BY Albert C. Bell

ATTORNEY

Patented Nov. 29, 1932 1,889,315

UNITED STATES PATENT OFFICE

ELIAS H. HENDERSON, OF CHICAGO, ILLINOIS

ELECTRICAL TYPEWRITING MACHINE

Application filed September 18, 1929. Serial No. 393,335.

My invention consists of a typewriting machine having a novel form and arrangement of type plates, each operated by a solenoid in a manner to press a selected type carried by the plate, against the paper carried by the platen of the machine, as distinguished from effecting the printing by impact alone, with the result that the machine is much more quiet in operation than where impact is depended upon to do the printing. Furthermore, by my construction I provide a plurality of pairs of type on each type plate and employ electrically actuated mechanism for selecting a particular pair of type to do the printing at any time. In addition, I provide electrical actuating mechanism for effecting the several operations which are necessary in connection with a typewriting machine, for example, spacing, tabulating, shifting the carriage, back spacing, and returning the carriage at the end of a printed line and line spacing, all of these actuating mechanisms being selectively controlled by a keyboard having keys preferably in the arrangement of the standard typewriter keyboard, which keys selectively operate electric contacts closing corresponding circuits to correspondingly operate the various electrical operating mechanisms of the machine. In addition, I provide a repeat key by the depression of which the machine will print or operate repeatedly in a manner depending upon which of several of the other keys may be depressed at the same time.

By my invention I also provide an improved form of escapement mechanism, an improved form of solenoid construction adapted to the purpose under consideration, and an improved ribbon arrangement for ink printing a plurality of copies at the same time without the use of carbon paper.

My invention will best be understood by reference to the accompanying drawings showing a preferred embodiment thereof, in which

Fig. 1 shows my machine in plan view,

Fig. 2 is a sectional view to an enlarged scale, of the parts shown in Fig. 1 taken along the line 2—2,

Fig. 3 shows in rear elevation to an enlarged scale, the devices employed to effect the carriage return at the end of each printed line or otherwise, and also the automatic switching mechanism for effecting repeated operation of a desired part of the machine,

Fig. 4 is a sectional view to an enlarged scale of a part of the construction shown in Fig. 2, taken along the line 4—4,

Fig. 5 is a sectional view of the parts shown in Fig. 4 taken along the line 5—5,

Fig. 6 shows in a view similar to Fig. 1, the devices employed to control the selective movement of the type plates, to print from a desired one of the type on an operated plate, the type plates and printing solenoids being removed in this figure,

Fig. 7 shows in longitudinal sectional view to an enlarged scale, one of the printing solenoids used to operate the type plates,

Fig. 8 is an end view of the construction shown in Fig. 7,

Fig. 9 shows in plan view a form of platen construction, carrying ribbon reels and ink ribbons, for making a multiple number of copies at the same time and without the use of carbon paper,

Fig. 10 is a sectional view of the parts shown in Fig. 9, taken along the line 10—10, and

Fig. 11 is a diagrammatic circuit drawing of the electrical connections employed in my machine.

Similar numerals refer to similar parts throughout the several views.

As shown in Figs. 1 and 2, my machine consists of a base 10 having a raised shelf 11, carrying solenoids 12, one of which is shown in Fig. 2, provided with cores 13 of magnetic material, from which operating rods 14 of non-magnetic material extend upwardly through guides in the shelf 11 to hold a frame 15 in position, or move it upwardly to shift the carriage of the machine when it is desired, for example, to write capital letters instead of small letters. The frame 15 carries a plurality of guide rollers 16 supporting a carriage 17, which in turn supports the platen 18 in printing position, on a shaft 19.

The carriage 17 has secured thereto back of the frame 15, a downwardly extending

plate 20 carrying on its lower portion, a rearwardly projecting rack 21 engaging a gear wheel 22 carried by a vertical shaft 23, mounted to rotate in suitable bearings carried by the shelf 11. The shaft 23 has connected thereto, one end of a spiral spring 24, the other end of which is secured to a spring housing 25 containing said spring and rigidly secured to the shelf 11, said spring being under sufficient tension to hove the carriage 17 during the operation of the machine. The lower end of the shaft 23 enters a sleeve 26 with a sliding fit, said sleeve having slots 27 through its upper end to receive a pin 28 extending through and secured to the shaft 23, so that the sleeve 26 may move vertically on the shaft 23 but be incapable of rotation of said shaft. The upper end of the sleeve 26 has rigidly secured to it, an escape wheel 29 for effecting step-by-step movement of the gear 22 by the operation of the machine, in a manner to be described. The sleeve 26 has secured to its lower end, a rod 30 of non-magnetic material, extending part way through a first solenoid 31, and there connected with a core 32 of magnetic material, which core extends beyond the lower end of the solenoid 31 and into the upper end of a second solenoid 33, the lower end of said core having connected thereto, a rod 34 of non-magnetic material extending to the lower end of the solenoid 33. The solenoids 31 and 33 are supported in the position indicated, by a bracket 35 extending upwardly from the base 10. As a result, energization of the solenoid 31 raises the core 32, and therefore also raises the escape wheel 29 to effect step-by-step movement of the carriage 17, whereas energization of the solenoid 33 moves the core 32 downwardly and thus moves the escape wheel 29 from engagement with its retaining devices to permit tabulation.

The carriage 17 has secured to it back of the plate 20, a notched bar 36, the notches of which are arranged to receive tabulating stops 37 projecting below the lower part of the bar. The frame 15 has extending rearwardly therefrom a bracket 38 to which a lever 39 is pivotally connected at 40, one end of said lever being connected with a stop 41 extending through and supported by the bracket 38, below the plane of the lower ends of the tabulating stops 37. The other end of the lever 39 is connected with one end of a rod 42, the other end of which is connected with a second lever 43 pivotally supported at 44 by a bracket 45 extending upwardly from the base 10, the free end of the lever 43 extending under the rod 34 so that downward movement of the rod 34 upon energization of the solenoid 33, depresses the lever 43 and moves the stop 41 upwardly into the path of the tabulating stops, when the escape wheel 29 is moved downwardly to free it from its retaining devices and permit free movement of the carriage 17 under the action of the spring 24, excepting as said movement may be limited by the tabulating stops. A spring 46 is connected with the lever 43 and the bracket 45 to hold the lever 43 in its uppermost position when the solenoid 33 is not energized.

The base 10 has projecting upwardly therefrom in front of the carriage 17, two brackets 47, one of which is shown in Fig. 2, to support at their upper ends, a conically shaped plate 48 on which the printing solenoids 49 are mounted. As more clearly shown in Fig. 1, the solenoids 49 are so mounted that their axes converge and meet in a vertical line through the printing point on the platen 18, as a result of which, the type plates 50, pivotally connected with bars 51 of non-magnetic material extending from the solenoids, are moved by the action of the solenoids selectively to printing position, The bars 51 extend part way through the solenoids 49, where they are connected with the cores 52 of the solenoids, which cores are of magnetic material.

As illustrated for the type plate 50 shown in Fig. 2, each of the type plates is pivotally connected at 53 with a corresponding bar 51, the bar 51 being extended beyond the pivotal connection to engage one end of a spring 54, the other end of which is secured to the type plate 50 as indicated at 55. The spring 54 tends to move the type plate 50 around to the left as shown in Fig. 2, on its pivotal support 53, movement of the type plate in that direction being limited by a lug 56 carried by the type plate and extending over the edge of the bar 51. The axes of the solenoids 49 incline upwardly towards the printing position, at an angle that will insure the return of the cores 52, the bars 51 and the type plates 50 to their normal position by gravity.

The lower edge of each type plate 50 is provided with a notch 57 for engagement selectively with the edges of the conically shaped plates 58, 59 and 60. The plate 60 is rigidly supported by brackets 61 from the plate 48, in such a position that if the notch 57 does not engage the upper edges of the plates 58 and 59, it will engage the upper edge of the plate 60. The plate 58 is supported by two arms 62, one of which is shown in Fig. 2, said arms in turn being pivotally supported by the plate 48 as indicated at 63. The arms 62 are connected with rods 64 of non-magnetic material, extending part way through solenoids 65 and connected with the cores 66 of said solenoids, which cores are of magnetic material and extend beyond the lower ends of the solenoids so that their energization will raise the cores into the solenoids. The solenoids 65 are supported from the brackets 47 as indicated. A pin 67 extending from each of the brackets 61, limits upward movement of each of the arms 62, so that when the sole-

noids 65 are energized, the upper edge of the plate 58 will be in proper position to be engaged by any of the notches 57. The plate 59 is supported by two arms 68, one of which is shown in Fig. 2, in a manner similar to that described for the plate 58, and the arms 68 are similarly supported and are connected with rods 69 of non-magnetic material, extending into the solenoids 70 and connected with their cores 71 of magnetic material, to move the plate 59 upwardly so that its upper edge is in the path of any of the notches 57, this upward movement being limited by the other ends of the pins 67. When the notch 57 of an actuated type plate 50 engages the plate 60, one of the two type 72 is effective in printing a corresponding character; when the notch 57 engages the plate 59, one of the two type 73 is effective in printing a corresponding character; and when the notch 57 engages the plate 58, one of the two type 74 is effective in printing a corresponding character; the one of the two type so selected, which is effective in printing the desired character in any case, is determined by whether the carriage 17 is in its shifted or upper position, or its normal or lower position. In this manner, each of the type plates 50, is capable of printing three different characters by the selective engagement of its notch 57 with the plates 58, 59 and 60, and for each of these three positions of the type plate, either of two characters may be printed depending upon whether the carriage is in its lower or upper position, thus making a total of six characters that may be printed by means of a single type plate and therefore by the energization of a single one of the solenoids 49, for the illustrative construction shown in the drawings.

The turning movement of each type plate in printing each character, results in printing the character by a pressure action instead of by direct impact, the printing pressure being produced by the printing solenoid 49 then energized, and controlled by the reactive pressure upon the actuate type plate, of the one of the plates 58, 59 and 60 involved in printing the character. This insures much more quiet action of the machine than if the printing were by direct impact.

A ribbon guide 75 is supported immediately below the printing position on the platen 18, to lead an inked ribbon 76 from one to the other of the ribbon reels 77, in a manner usual in typewriting machines. Since the operating mechanism for the ribbon reels may be of any well known type, and constitutes no part of the present invention, it is not shown. The ribbon guide 75 is supported in the position indicated, by a rod 78 extending through a guideway therefor carried by the frame 15, collars 79 and 80 being secured to the rod above and below the frame 15 to limit its downward and upward movement, the collar 80 being so positioned that when the rod 78 is raised as far as the collar 80 will permit, the ribbon is in proper position to print a selected character. The rod 78, which is of non-magnetic material, is extended below the collar 80 into a solenoid 81 where it is connected with the solenoid core 82 of magnetic material, said solenoid being supported by a bracket 83 extending between the brackets 47. The core 82 is so proportioned that whether the frame 15 is in its lower or its upper position, energization of the solenoid 81 will move the rod 78 upwardly until the collar 80 is in engagement with the frame 15, and thus will move the ribbon to its printing position for either the lower or the upper position of the frame 15.

As shown in Fig. 2, the gear 22 has supported on its hub by a collar 84 for angular movement thereon, a lever 85, which lever, as more clearly shown in Fig. 1, has pivotally secured thereto at 86, a pawl 87, one arm of which engages the gear wheel 22 when the pawl is operated, and the other arm of which is connected with a rod 88 extending from the core 89 of a solenoid 90, which solenoid is supported by a bracket 91 from the shelf 11. A bracket 92 extending from the shelf 11, has secured thereto one end of each of the springs 93 and 94, the other ends of which are connected respectively with the pawl 87 and the lever 85. The bracket 92 carries stop pin 95 for limiting movement of the lever 85 under the action of the spring 94, and the lever 85 carries a stop pin 96 for limiting movement of the pawl 87 under the action of the spring 93. The spring 93 is preferably weaker than the spring 94 so that energization of the solenoid 90 first moves the pawl 87 on its pivotal support 86, until the pawl is in engagement with the teeth of the gear 22, after which, continued movement of the core 89 swings the lever 85 about the axis of the gear 22, carrying the gear with it to move the carriage to the right in Fig. 1, to effect back spacing.

As shown in Fig. 1, the platen 18 has connected with it, a ratchet wheel 97 engaged by a pawl 98 carried by the short arm of a bell crank lever 99 pivotally mounted on the carriage 17 at 100. One longer arm of the bell crank lever extends rearwardly from the carriage, beyond the tabulating bar 36 and to a position engaging the upper end of a post 101 extending upwardly from the bracket 38, when the carriage is moved to its right hand position, with the result that this engagement moves the bell crank lever 99 to effect line spacing of the work being written by the machine. Another longer arm of the lever 99, is provided, which extends forwardly for manual operation, when desired.

As more clearly shown in Fig. 3, the gear 22 meshes with a gear 102 secured to the up-

per end of a shaft 103 mounted to rotate in a bearing carried by the shelf 11. The shaft 103 has rigidly secured to it below the shelf 11, a collar 104 between which and the shelf 11, a sleeve 105 is mounted on said shaft and free to rotate. The upper end of the sleeve 105 has rigidly secured to it a gear 106 meshing with a pinion 107 carried by the shaft of an electric motor 108 supported with its shaft in vertical position by a block 109 carried by the base 10 of the machine. The sleeve 105 also carries a commutator 110 having brushes 111 and 112 bearing thereon, which brushes are supported by and insulated from a plate 113 carried by the housing of the motor 108. The commutator 110 is so constructed that its rotation alternately makes and breaks electrical connection between the brushes 111 and 112, at a rate depending upon the speed of rotation of the sleeve 105. The lower end of the sleeve 105 has rigidly secured thereto, one member 114 of a clutch, the other member 115 of which is mounted for longitudinal movement on the lower end of the shaft 103, rotation of the member 115 on the shaft being prevented by a pin 116 rigidly carried by the shaft and extending through slots 117 in the clutch member. The lower end of the clutch member 115, for the disengaged condition of the clutch members, rests on the upper end of a solenoid 118 supported by a plate 119 on brackets 120 extending upwardly from the base 10. The clutch member 115, which is preferably of non-magnetic material, has extending from its lower end, a rod 121 also of non-magnetic material, which connects at its lower end with the solenoid core 122 of magnetic material, which core extends below the lower end of the solenoid so that energization of the solenoid raises the core and the clutch member 115, to engage the clutch member 114 to rotate the shaft 103 and thereby the gear 102, to in turn rotate the gear 22 and move the carriage 17 to its right hand position in Fig. 1 to begin the next line of the printing. The clutch surface of the clutch member 115 may be faced with suitable material, for example leather, as indicated at 123, to cushion the shocks that might otherwise be imparted to the mechanism by the engagement of the clutch members.

As shown in Figs. 4 and 5, the escape wheel 29 is provided with a detent 124 and a pawl 125, supported from the under side of the shelf 11, to effect a step-by-step movement of the escape wheel in the direction indicated by the arrow, during the operation of the typewriting machine. As shown in Fig. 5, the detent and pawl are in different planes, the detent being in a plane above the pawl. The detent 124 is rigidly secured to the shelf 11 as indicated, and the pawl 125 is pivotally secured to said shelf at 126, said pawl being slotted at 127 to permit longitudinal movement of the pawl on its pivotal support, of an amount less than the pitch distance of the teeth 29*a* of the escape wheel 29. One end of the pawl 125 is connected with a pin 128 carried by the shelf 11, by a spring 129, which spring tends to move the pawl 125 to the left as far as its slot 127 will permit, and at the same time, tends to move the pawl into engagement with the teeth 29*a*, as far as a stop pin 130 carried by the shelf 11, will permit. As a result of the construction described, when the solenoid 31 is energized, which occurs at the same time that each of the solenoids 49 is energized, the escape wheel 29 is raised to release it from the pawl 125 and to effect engagement between one of the teeth 29*a* and the detent 124, without perceptible rotation of the wheel 29. This permits the spring 129 to move the pawl 125 longitudinally on its pivot 126 to a position to engage the next tooth of the escape wheel. This condition continues until the opening of the circuit through the printing solenoid 49, when the deenergization of the solenoid 31 permits the wheel 29 to drop by gravity to its position indicated in Fig. 2, from engagement with the detent 124, and into engagement with the pawl 125. The spring 129 permits the pawl to move on its pivot 126 by the action of the spring 24, in a manner to advance the carriage one space. A further result of the construction described, is that when the wheel 29 is moved downwardly from its position shown in Fig. 2, to the position shown in dotted lines in Fig. 5, it is free from the detent 124 and the pawl 125, and therefore free to rotate with corresponding movement of the carriage, until one of the tabulating steps 37 strikes the stop 41 then in the path of the tabulating stops due to the energization of the solenoid 33.

In Fig. 6, I illustrate the relation of the supporting plate 48 and the selective plates 58, 59 and 60 to each other, as well as the relation of the brackets 47 to these plates. It will be noted that one of the solenoids 65 is adjacent each of the brackets 47 and that the same is true concerning the solenoids 70, which facilitates locating the stop pins 67 and brackets 61 illustrated in Fig. 2, as above described, and also affords two supports for each of the selective plates 58 and 59 to insure their proper location at all times.

As shown in Figs. 7 and 8, I prefer to construct each solenoid 49 of a tube 131 of non-magnetic metal, for example brass, on which insulating heads 132 are rigidly secured to hold the winding 133 between them, the winding being insulated from the tube by suitable insulating material. The tube 131 extends beyond the heads a sufficient distance to receive supporting plates 134 and outside of the plates, the tube has threaded on its ends nuts 135 and 136. A cylindrical core 52 of magnetic material, for example iron, is

mounted in the tube 131 with a free sliding fit and is rigidly connected with the inner end of one of the flat-sided bars 51, which is of non-magnetic material, the nut 136 being continued across the end of the tube and slotted to form a sliding fit on the bar 51. In this manner the bar is positively guided and prevented from turning, with the result that the corresponding type plate 50 is held in proper position for operation as described above, since the solenoids are assembled on the plate 48 with the slots in the nuts 136 extending in vertical planes.

In Figs. 9 and 10, I illustrate a form of platen and ink ribbon arrangement, which I prefer to use where it is desired to print a plurality of copies at the same time by the operation of my machine. In this construction, a platen 18*a* is mounted on a shaft 19*a* with ink ribbon reels 138 and 139 mounted on said shaft adjacent the ends of the platen. Outside of the ribbon reels, the shaft 19*a* has rigidly secured to it collars 140 and 141 carrying eccentric lugs 142 and 143 capable of being turned to engage or free the reels 138 and 139 respectively, as desired. Outside of the collars 140 and 141, a U-shaped frame comprising end members 144 and 145 and a cross bar 146 is mounted for turning movement on the shaft 19*a*. The bar 146 carries spirally shaped guides 147 and 148 for changing the direction of the ribbons carried by the reels 138 and 139, to direct the ribbons longitudinally along the printing line of, and adjacent to the surface of the platen 18*a*, as illustrated at 149 and 150. As shown for the guide 147 in Fig. 10, the guides have edge flanges restraining the ribbons from movement out of the printing line, and pins 147*a* and 148*a* extend across the guides separating the ribbons from each other along the printing line, facilitating feeding sheets of paper between them.

The shaft 19*a* is extended beyond the end member 144 and has rigidly secured to it a ratchet wheel 97*a* engaged by a pawl 98*a* operated by a bell crank lever 99*a* pivotally supported at 100*a* from the carriage 17*a*, in substantially the manner that the ratchet wheel 97, pawl 98 and bell crank lever 99 are supported as above described and for the same purpose. The end member 145 is extended adjacent to the corresponding wall of the carriage 17*a*, for engagement with a spring plunger 151 carried by the carriage, tending to hold the U-shaped frame either with the ribbons 149 and 150 in printing position, or raised above printing position by rotation of the U-shaped frame around the shaft 19*a*, as desired. In operating this construction, the reels 138 and 139 may carry two ribbons, and assuming that the reel 139 is the supply reel, the lug 143 is turned so that the reel 139 will rotate freely on the shaft 19*a*. At the same time, the lug 142 is turned to engage the reel 138 so that the reel 138 will rotate with the platen 18*a*. Since the ribbon guides 147 and 148 cannot rotate on account of the action of the plunger 151, rotation of the platen winds the ribbons on the reel 138 and from the reel 139. When it is desired to reverse the direction of winding of the ribbons, the lug 143 is turned into engagement with the reel 139 and the lug 142 is turned from engagement with the reel 138. In using two or more ribbons, I find it desirable to employ thin transparent or semi-transparent paper for the outermost copy, which sheet is placed outside of the ribbon 150; a heavy sheet of paper and one that is not transparent is placed between the ribbons 149 and 150, and where more than two copies are desired, a sheet of thin transparent or semi-transparent paper is preferably placed back of the second sheet of paper and also between the ribbons 149 and 150; and then a heavy non-transparent sheet of paper is placed back of the ribbon 149 adjacent the platen 18*a*. In this manner each ribbon makes two copies, one on the back of a transparent or semi-transparent sheet, so that the written matter may be read through the sheet, and the other on heavier paper with the same effect that first copy work is usually produced on a typewriting machine. Similarly, more than two ribbons may be used, to produce a greater number of copies. Where only two copies are required, it is necessary to use but one of the ribbons 149 and 150 and the supply reel 138 or 139 may be correspondingly wound with a single ribbon. In inserting the paper between the ribbons, I find it desirable to move the ribbons from printing position, which may be effected by angular movement of the U-shaped frame upwardly around the platen, which carries the guides 147 and 148 with it and permits the sheets of paper to be fed through the usual feeding rollers so that their edges are in the printing line. In this position, the upper edges of the sheets may be separated and the ribbons 149 and 150 may be placed between them by moving the U-shaped frame downwardly. The spring plunger 151 affords a convenient means for holding the U-shaped frame in either of its positions described, and the cross bar 146 may be employed to hold the sheets of paper against the platen and guide them upwardly and rearwardly after they have been printed.

To control the electrical circuits of the solenoids described, operating the corresponding parts of the machine, I provide a keyboard including switching mechanism, as illustrated in Figs. 1 and 2. The keyboard and switching mechanism consists of a base plate 152 from which a plurality of stepped plates 153 extend vertically to support strips 154 of insulating material as indicated. Each strip 154 has secured to it one end of each of a plurality of contact springs 155, to the other

end of which a key 156 is secured. Each strip 154 also carries beneath the contact springs 155 for the printing keys, electrical contacts 157 and 158, so that each contact spring 155 makes electrical contact with both of the contacts 157 and 158 beneath it, when the corresponding key 156 is depressed. It will be noted that some of the printing keys, as shown at 156*a*, are provided only with contacts 158, for a purpose to be described. It will also be noted that where the printing keys are provided with two contacts 157 and 158 each, the contact 157 is closer to the contact spring 155 than is the contact 158. As will be described, the contacts 157 control the energization selectively of the solenoids 65 and 70 and the contacts 158 control the energization of the printing solenoids 49. This insures that a selected one of the plates 58 and 59 will be operated in time to engage the type plate 50 which is actuated at that time.

In addition to the printing keys 156 and 156*a* referred to, the strips 154, as more clearly shown in Fig. 1, carry additional keys 159, 160 and 161 at the left hand side of the keyboard and additional keys 162, 163 and 164 at the right hand side of the keyboard, which together with the space bar 165 at the front of the keyboard, may be called the control keys of the machine, as distinguished from the printing keys, each of the printing keys serving to operate one of the solenoids 49 and also to selectively operate the solenoids 65 or the solenoids 70 when the characters to be printed so require. The control keys 159–164 inclusive may control the energization respectively of the solenoids 90, a circuit effecting repeated operation of the typewriter mechanism, the solenoids 12, the solenoid 33, the solenoid 118, and the solenoids 12, to respectively effect back spacing of the carriage, repeated operation of any part of the typewriting machine, shifting of the carriage, tabulation, the return of the carriage at the end of a printed line, and shifting of the carriage, there being purposely two carriage shifting keys 161 and 164 to make the operation of the keyboard convenient to the operator. The keys 159–164 inclusive are mounted on contact springs 166–171 inclusive respectively, which are similar to the contact springs 155 of the printing keys. The spacing bar 165 is carried by two arms 172 pivotally supported on a rod 173 extending through the vertical plates 153, the arms 172 being preferably connected by a cross bar 174 back of the rod 173 to afford a rigid support for the spacing bar 165. The base plate 152 supports a plate 175 of insulating material, below the spacing bar 165, and the plate 175 in turn supports a contact spring 176 extending under the mid portion of the spacing bar 165 and in engagement therewith to hold said spacing bar in its upper position when it is not operated. The plate 175 also supports a contact 177 for electrical connection with the contact spring 176 when the spacing bar 165 is depressed. Each of the control keys 159 to 164 inclusive is provided with a single electrical contact similar to the contact 177, instead of with two electrical contacts as shown for some of the printing keys. The contact springs and the electrical contacts connected therewith, control the energization of the various solenoids in a manner to be described.

From the construction described, it will appear that the keyboard and electrical contact mechanism for operating the machine, constitute a unitary self-contained structure, and bearing in mind that the only operating connection between this keyboard and contact structure as a whole, and the typewriting machine, consists of electrical conductors, it will appear that the keyboard and contact mechanism as a whole may be given any desired location, either on the base 10 of the typewriting machine, or any other desired location separate from the machine. In Figs. 1 and 2 the keyboard and contact mechanism is illustrated as located on the front portion of the base 10 where it may be conveniently secured by screws 178.

With the machine described, no devices are shown in connection with the platen 18, for handling and feeding the paper employed, nor are there devices shown for limiting the amount of rotary movement imparted to the platen by its operating pawl, since such devices are no part of the present invention, and may be of any kind known to the art.

In Fig. 11 I illustrate diagrammatically the circuit connections I employ to operate the various solenoids by the keys described. In this figure, the keys 156 and 156*a* are shown in groups of three keys each, said groups being marked I, II and XIV, since each solenoid 49 is operated by three keys to selectively print one of the three pairs of characters carried by the corresponding type plate 50 as above described.

Current may be supplied to the system by alternating current feed wires 180 and 181 through a main switch 182 connected with the primary winding 183 of a transformer 184 having a low voltage secondary winding 185. The terminals of the winding 185 are connected with a direct current feed wire 186 and with one terminal of a rectifier 187, the other terminal of which is connected with a second direct current feed wire 188. Where direct current is available, it will be understood that the direct current feed wires 186 and 188 may be supplied directly from the direct current source without the use of the transformer and rectifier.

The wire 186 connects with one terminal of a rheostat 189, the other terminal of which connects with wire 190 which extends through the contact system and is connected with the

contact spring of each of the keys 156, 156*a*, 159 and 161–165 inclusive.

The contact 158 of the first key 156 in group I, is connected by wire 191 with the contacts 158 of the second and third keys of the same group, and this wire is connected by wire 192 with one terminal of one of the printing solenoids 49, the other terminal of which is connected with wire 193 extending to one terminal of the ribbon shifting solenoid 81, the other terminal of which is connected by wire 194 with one terminal of the letter spacing solenoid 31, the other terminal of which is connected by wire 195 with the brush 112 bearing on the commutator 110. The other brush 111 on the commutator 110 is connected with wire 188. The wire 188 is connected by a wire 196 with the contact 197 of the repeat key 160, the contact spring 167 of which is connected by wire 198 with wire 195. The contact 197 and contact spring 167 are so related that the contact and contact spring are in engagement with each other to electrically connect the brushes 111 and 112, excepting at such times as the repeat key 160 is depressed. From the circuit just traced, it will appear that depressing either of the keys 156 or the key 156*a* of group I, will complete a circuit from the wire 190 through the corresponding printing solenoid 49 to wire 188 and thus energize said solenoid 49.

The contact 157 of the first key 156 of group I, is connected by wire 199 with one terminal of each of the solenoids 65, the other terminals of which are connected together and with wire 193. The contact 157 of the other key 156 of group I, is connected by wire 200 with one terminal of each of the solenoids 70, the other terminals of which are connected together and are also connected by wire 201 with wire 193. As a result of the connections just described, when the first key 156 of group I is depressed, current flows from the wire 190 through the solenoids 65, in addition to the current flow which occurs immediately afterwards through the corresponding solenoid 49. On the other hand, if the key 156*a* of group I is depressed, current is caused to flow through the solenoid 49 since this key is provided with a contact 158, but there is then no current flow through either the solenoids 65 or the solenoids 70. Again, if the other key 156 of group I is depressed, the solenoids 70 are energized just before the corresponding solenoid 49 is energized. This provides for the selective operation of the corresponding type plate 50 in the manner described.

A wire 202 is connected with wire 199 and a wire 203 is connected with the wire 200 and these wires 202 and 203 extend through the keyboard for connection with the contacts of the other groups of keys, in the same manner described for the keys of group I, as a result of which depressing the first key of any group of keys causes the energization of the solenoids 65 and immediately afterwards, the energization of the solenoid 49 corresponding to the group of keys then actuated, depressing the second key of said group serves to energize the said solenoid 49 without energizing the solenoids 65 and 70, and depressing the third key of said group, serves to energize the solenoids 70 just before the corresponding solenoid 49 is energized. In this way but two solenoids 65 and but two solenoids 70 are required for each machine, and one solenoid 49 is required for each group of three printing keys.

It will be understood that in Fig. 11 for the sake of clearness, groups III to XIII are omitted, since each of these groups is identical as to its connections with the wires 190, 202, 203 and 193, with the connections shown for group XIV of the printing keys. It will be observed that when any printing key is depressed and a corresponding printing solenoid is energized, the ribbon shifting solenoid 81 and the letter spacing solenoid 31 are also energized, as a result of which the ribbon is brought into printing position, and at the end of the printing operation, the carriage 17 is moved one step for letter spacing, by the escapement mechanism as above described.

It will be observed that the path of the current flow from the wire 195 to the wire 188 is through wire 198, contact spring 167 and contact 197 of the repeat key 160, to wire 196 connected with wire 188. This provides that with the repeat key 160 in its uppermost position, the solenoids energized by the depression of any one of the printing keys, will remain energized as long as the corresponding key is depressed. It sometimes occurs that it is desirable, particularly in connection with some of the characters or marks provided on the type plates, to have the character repeated, for example in making a dotted line. This may be effectively done by depressing the corresponding one of the printing keys, and at the same time depressing the repeat key 160, which completes a circuit through one of the paths already traced, with the exception that the circuit between the wires 195 and 188 must now be completed through brush 112, commutator 110 and brush 111. As indicated in Fig. 11, the commutator 110 is related to the brushes 111 and 112 so that the brushes are electrically connected by a part of each rotation of the commutator, and that they are insulated from each other for another part of each of its rotations. This serves to alternately connect the wires 195 and 188 electrically and to disconnect them, which operation is repeated as long as the repeat key 160 is depressed. For this condition, even if the selected printing key is held in its depressed position, the effect is the same as though the printing key were operated a number of times in rapid succession without

the presence of the repeat key in the system.

The keys 161 and 164 have their contacts 206 connected by wire 204 which also connects with one terminal of each of the solenoids 12, the other terminals of which are connected together and in turn connected by wire 205 with wire 188. The contact springs 168 and 171 of the keys 161 and 164 are connected with wire 190. In this manner, by depressing either one of the carriage shifting keys 161 and 164, a circuit is closed from the wire 190 through the solenoids 12 directly to the wire 188, since there is no occasion to impart a rapid succession of shifting movements to the carriage.

The contact 209 of the key 162 is connected by wire 207 with one terminal of the solenoid 33, the other terminal of which is connected by wire 208 with the wire 205. The contact spring 169 of the key 162 is connected with wire 190. In this way, operation of the tabulating key 162 energizes the solenoid 33 by closing a path for current flow from the wire 190 through the solenoid to wire 188.

The contact 212 of the key 163 is connected by wire 210 with one terminal of the solenoid 118, the other terminal of which is connected by wire 211 with the wire 208 and thus with wire 205 and in turn with wire 188. The contact spring 170 of the key 163 is connected with wire 190 and thus operation of the carriage return key 163 closes a path for current flow from the wire 190 through the solenoid 118 to the wire 188. Since the tabulating operation effected by the solenoid 33, and the carriage return at the end of each printing line, effected by the solenoid 118, in the manner above described, are single operations which are not required to be repeated rapidly, the current path for these solenoids is shown through the wire 205 to the direct current feed wire 188, instead of to the wire 195 and through the brushes 111 and 112.

The contact 177 of the key 165 is connected by wire 213 with wire 194, and the contact spring 176 of said key is connected with wire 190. In this manner, by depressing the spacing key 165, current is caused to flow directly from wire 190 to the wire 194 and thus through the solenoid 31 and the path already traced, to the wire 188, to effect letter spacing when the type plates are not operated. It will be noted, that this may produce either a single spacing movement of the carriage 17, or successive movements while the key 165 is held in depressed condition, depending upon whether the repeat key 160 is in its upper or operated position.

The contact 216 of the key 159 is connected by wire 214 with one terminal of solenoid 90, the other terminal of which is connected by wire 215 with wire 195. The contact spring 166 of the key 159 is connected with wire 190, from which it will be observed that depressing the back-spacing key 159 causes current flow through the solenoid 90 to the wire 195 and through the path above traced to wire 188, thus effecting a single operation of the back spacing mechanism, or repeated operations thereof with the key 159 held in its depressed position, depending upon whether the repeat key 160 is in its upper or depressed position.

One terminal of the motor 108 is connected by wire 217 with wire 188 and the other terminal of said motor is connected by wire 218 with a rheostat 219, the other terminal of which is connected by wire 220 with a switch 221, the contact of which is connected by wire 222 with wire 186. In this manner the circuit through the motor 108 may be closed and opened as desired by the switch 221 and the speed of the motor may be controlled by the rheostat 219. For the construction shown, the motor 108 is in continuous operation when the typewriting machine is being used, so when the main switch 182 is closed to supply current to the circuits of the machine, the switch 221 is also closed to insure that the motor 108 will be running when it is required to either return the carriage at the end of a printed line, or to make and break the circuit through selected solenoids by means of the commutator 110 and the brushes 111 and 112.

The rheostat 189 provides a convenient means for adjusting the voltage on the several circuits to insure the proper current flow through the several solenoids to effectively operate them. It will be noted that fixed condensers are shown connected across the contacts of the several keys. This I find desirable to avoid sparking when the circuits are opened by movement of the key contact springs. It will be noted that at certain junctions of the circuit wiring, short branches are indicated. These indicate the places in the wiring where branch leads may be taken from the keyboard mechanism to extend to similar arrangements of solenoids and operating circuits, since it will be observed that the same keyboard mechanism may be employed to simultaneously operate a plurality of typewriting machines, provided circuit connections are extended from the keyboard mechanism to each one of the typewriting machines in the manner described above for the connection of the solenoids described, provided that the several typewriting machines have similar operating solenoids similarly connected electrically to accomplish similar results.

While I have shown my invention in the particular embodiment above described, it will be understood that I do not limit myself to this exact construction as I may employ equivalents known to the art at the time of the filing of this application without departing from the scope of the appended claims.

What I claim is:

1. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them.

2. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, electric solenoid mechanisms respectively connected with said bars to operate them, a carriage supporting said platen and movable vertically to print a desired one of the pair of characters so selected, and electric solenoid mechanism connected with said carriage to move it vertically.

3. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them, said devices comprising a plurality of members each effective to control said selective movement of all of said type plates.

4. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them, said devices comprising a plurality of members each effective to control said selective movement of all of said type plates, and electric solenoid mechanism operating said selective devices.

5. In a typewriting machine, the combination of a type plate carrying a plurality of printing characters, first electric solenoid mechanism connected with said plate to move it towards its printing position to print a first character, second electric solenoid mechanism controlling the relation of said plate to said first solenoid mechanism to print a second and different character, a source of current, a first key having contacts and circuit connections including said source and extending only to said first solenoid mechanism to actuate it, and a second key having contacts and circuit connections including said source and extending to both of said solenoid mechanisms to actuate them.

6. In a typewriting machine, the combination of a type plate carrying a plurality of printing characters, first electric solenoid mechanism connected with said plate to move it towards its printing position to print a first character, second electric solenoid mechanism controlling the relation of said plate to said first solenoid mechanism to print a second and different character, third electric solenoid mechanism controlling the relation of said plate to said first solenoid mechanism to print a third and still different character, a source of current, a first key having contacts and circuit connections including said source and extending only to said first solenoid mechanism to actuate it, a second key having contacts and circuit connections including said source and extending to said first and said second solenoid mechanisms to actuate them, and a third key having contacts and circuit connections including said source and extending to said first and said third solenoid mechanisms to actuate them.

7. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them.

8. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them, said devices comprising a plurality of members each effective to control said selective movement of all of said type plates.

9. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of printing charac-

ters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them, said devices comprising a plurality of members each effective to control said selective movement of all of said type plates, and electric solenoid mechanism for operating said selective devices.

10. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them, each of said solenoid mechanisms including a structure holding the corresponding type plate in substantially a fixed plane throughout its movement.

11. In a typewriting machine, the combination of a platen, a type plate carrying a printing character, a bar pivotally connected with said plate to move said character to printing position on said platen, a device engaging and turning said plate on said bar during printing movement of said plate, and electric solenoid mechanism connected with said bar to operate it, said solenoid mechanism including a structure holding said type plate in substantially a fixed plane throughout its movement.

12. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them, each of said solenoid mechanisms including a structure restraining the corresponding bar from axial turning movement.

13. In a typewriting machine, the combination of a platen, a type plate carrying a printing character, a bar pivotally connected with said plate to move said character to printing position on said platen, a device engaging and turning said plate on said bar during printing movement of said plate, and electric solenoid mechanism connected with said bar to operate it, said solenoid mechanism including a structure restraining said bar from axial turning movement.

14. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, and electric solenoid mechanisms respectively connected with said bars to operate them, said bars being flat sided, and each of said solenoid mechanisms including a structure engaging the corresponding bar with a sliding fit and restraining it from axial turning movement.

15. In a typewriting machine, the combination of a platen, a type plate carrying a printing character, a bar pivotally connected with said plate to move said character to printing position on said platen, a device engaging and turning said plate on said bar during printing movement of said plate, and electric solenoid mechanism connected with said bar to operate it, said bar being flat sided, and said solenoid mechanism including a structure engaging said bar with a sliding fit and restraining it from axial turning movement.

16. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, electric solenoid mechanisms respectively connected with said bars to operate them, and means holding said type plates in substantially fixed planes throughout their movement.

17. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, electric solenoid mechanisms respectively connected with said bars to operate them, and means restraining said bars from axial turning movement.

18. In a typewriting machine, the combination of a platen, a plurality of type plates each carrying a plurality of pairs of printing characters, bars having straight line movement and pivotally connected respectively with said plates to move them to printing

position, devices for selectively turning an operated plate on its said pivotal connection to print one of a desired pair of said characters carried by it and so selected, electric solenoid mechanisms respectively connected with said bars to operate them, said bars being flat sided, and means engaging said bars with sliding fits and restraining them from axial turning movement.

In witness whereof, I hereunto subscribe my name this 14th day of September, A. D. 1929.

ELIAS H. HENDERSON.