Sept. 21, 1937. J. W. BRYCE ET AL 2,093,545

PRINTING MACHINE

Filed Oct. 25, 1933 6 Sheets-Sheet 1

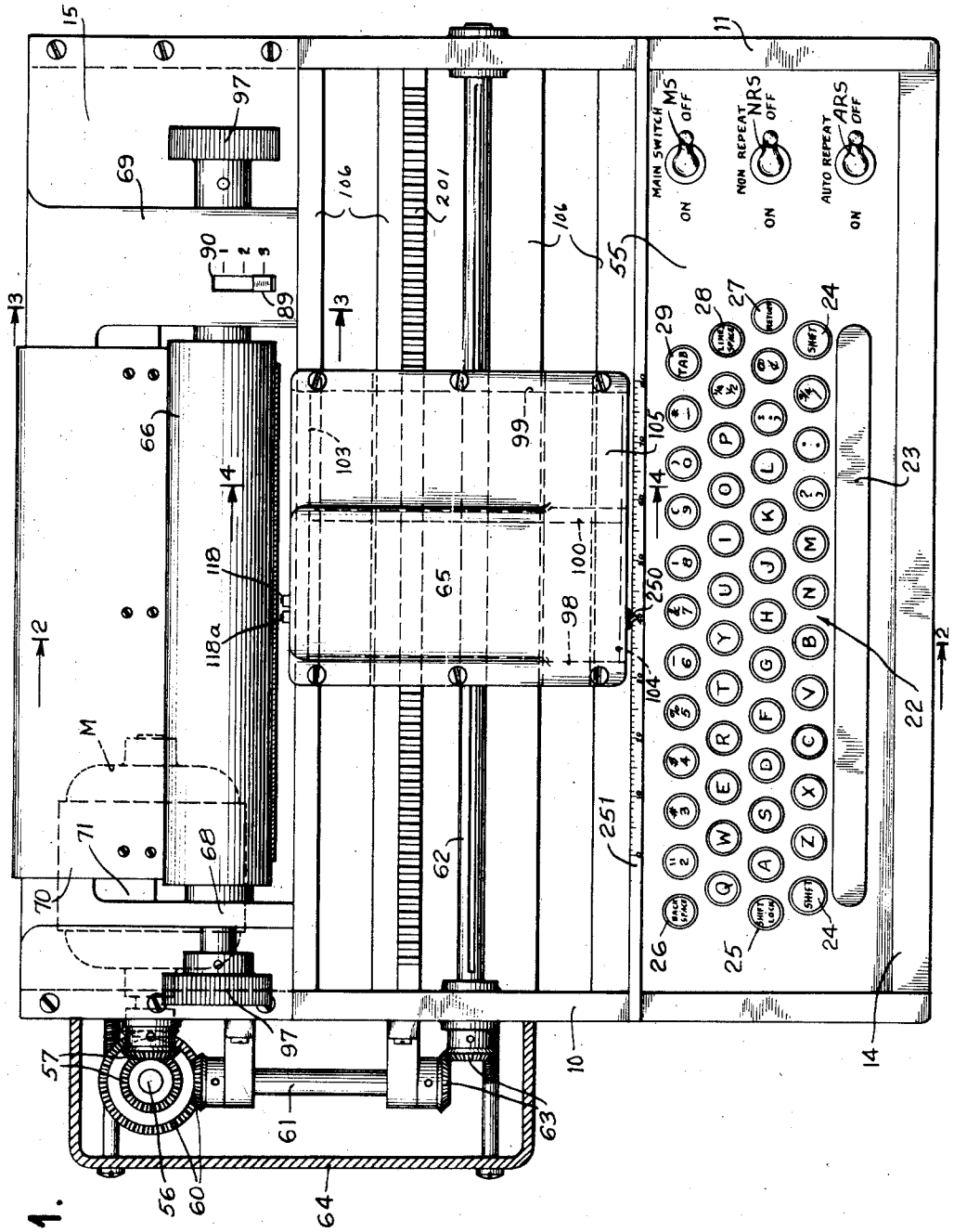

FIG. 1.

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PRINTING MACHINE

Filed Oct. 25, 1933 6 Sheets-Sheet 2

FIG. 3.

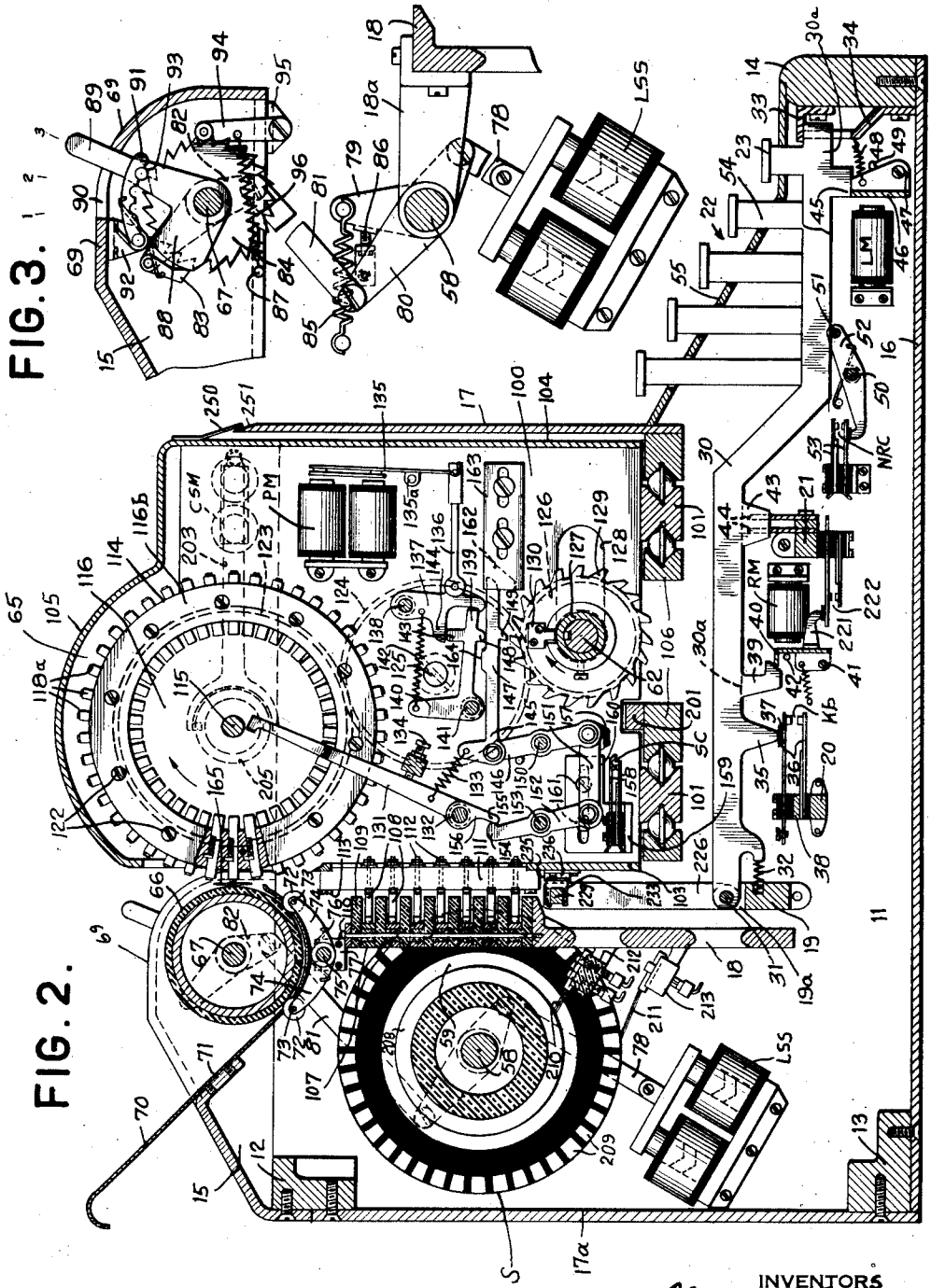

FIG. 2.

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PRINTING MACHINE

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FIG. 5.

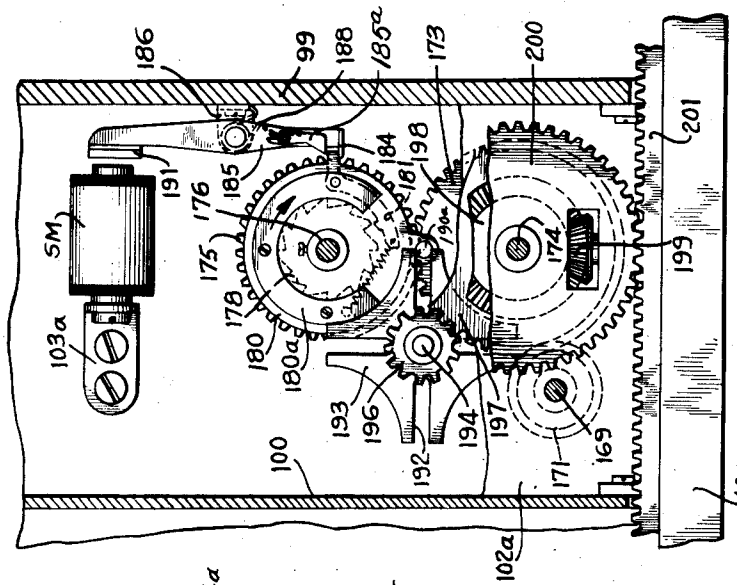
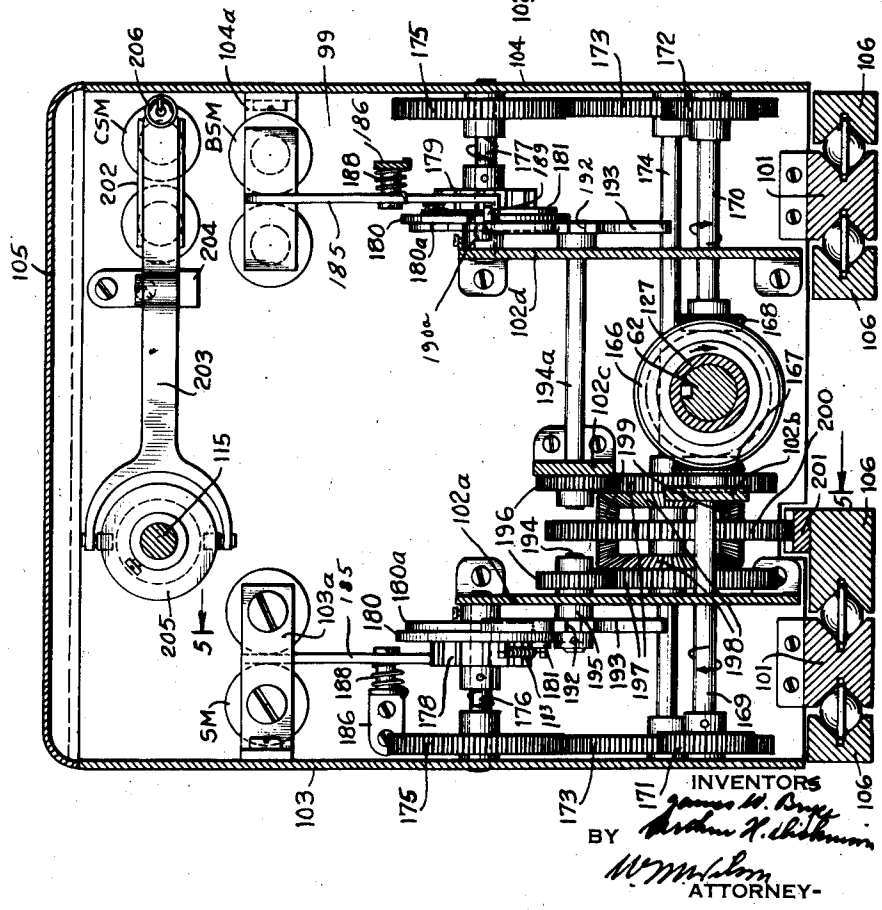


FIG. 4.



Sept. 21, 1937. J. W. BRYCE ET AL 2,093,545

PRINTING MACHINE

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FIG. 6.

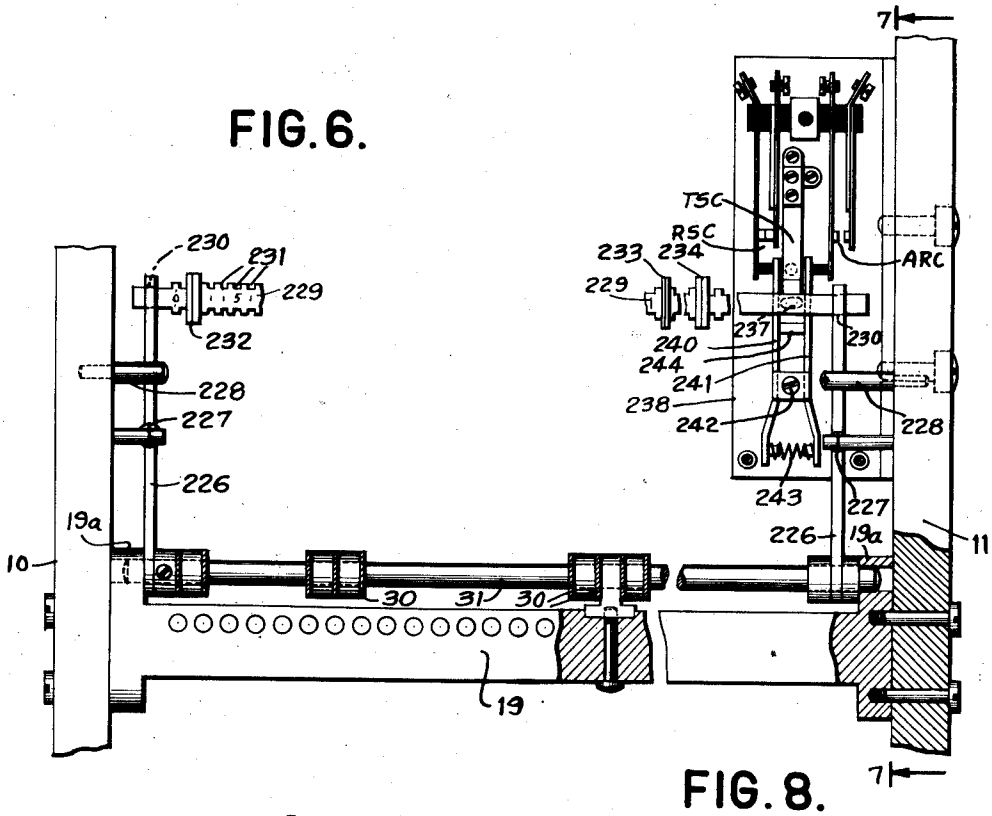


FIG. 7.

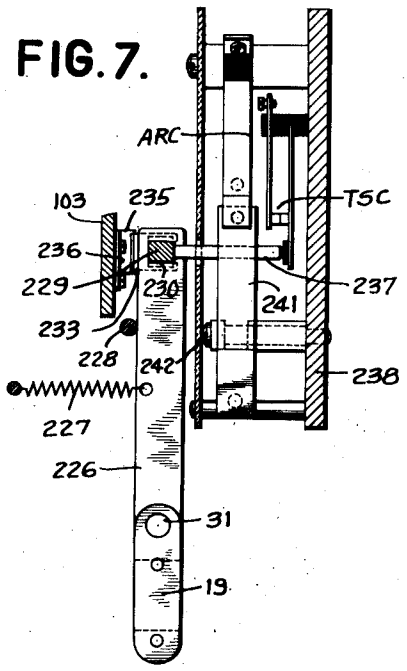
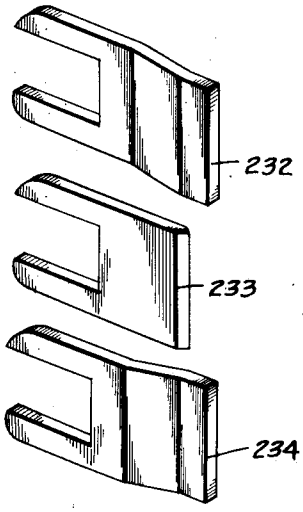


FIG. 8.



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PRINTING MACHINE

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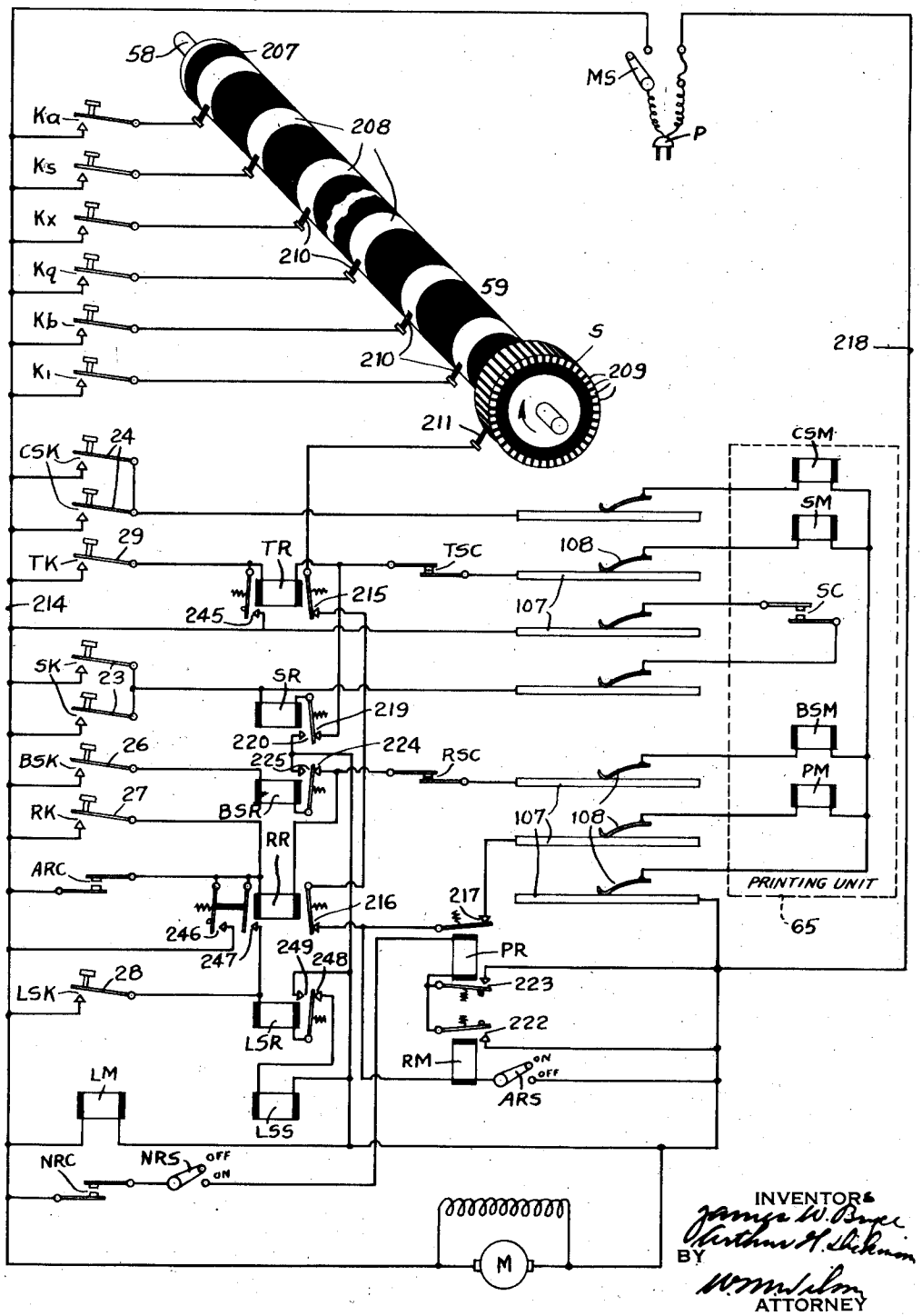
FIG. 9.



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PRINTING MACHINE

Filed Oct. 25, 1933 6 Sheets-Sheet 6

FIG.10.

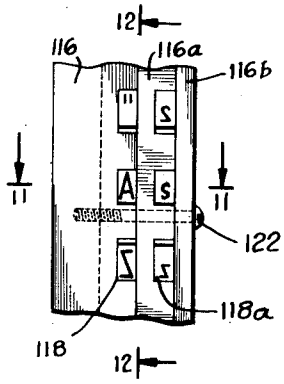


FIG.13.

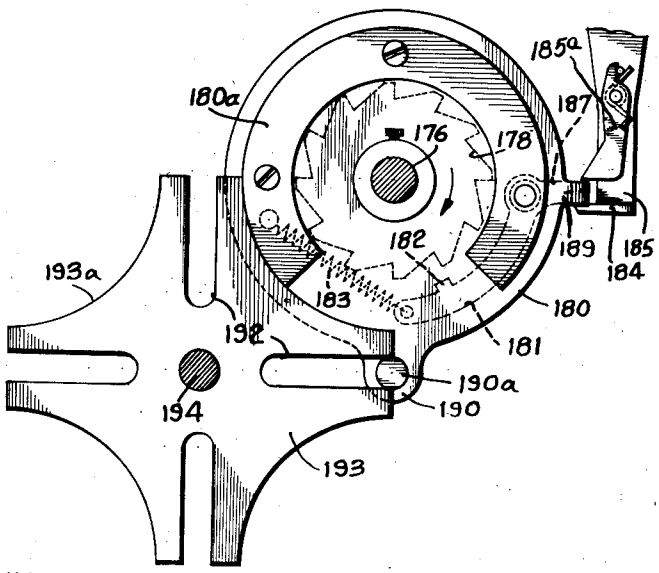


FIG.11.

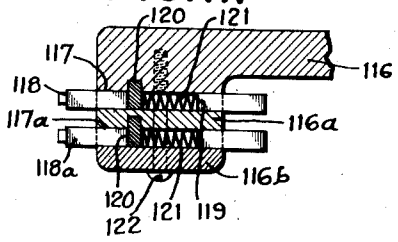


FIG.14.

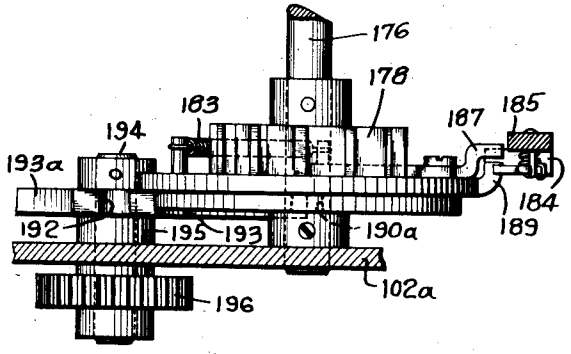
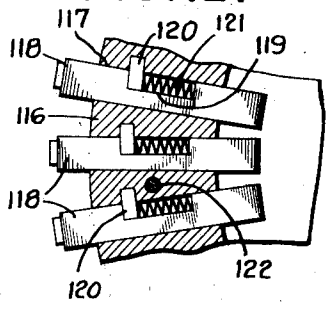


FIG.12.



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Patented Sept. 21, 1937 2,093,545

UNITED STATES PATENT OFFICE

2,093,545

PRINTING MACHINE

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Application October 25, 1933, Serial No. 695,090

35 Claims. (Cl. 197—12)

This invention relates to typewriting machines in general.

The broad object is to generally improve typewriting machines by making them simpler in construction, cheaper to build, and more reliable in their operation.

Another broad object is to provide a power driven typewriting machine which is completely electrically controlled by keys.

A further object is to provide a typewriting machine wherein printing is effected by a single type wheel which rotates continuously and whose motion is not interrupted even when the impression is made from a type element on the wheel.

Still another object is to provide a typewriting machine wherein the printing mechanism, letter spacing mechanism, back spacing mechanism, and case shifting mechanism are constructed as a simple compact unit movable axially of the platen.

Another broad object is to provide a typewriting machine with a printing mechanism capable of printing clearly while the platen and types are moving relative to each other in a letter spacing direction.

Still another broad object is to provide a typewriting machine adapted for use in connection with printing telegraph systems and automatic letter writing machines.

A further broad object is to provide a power driven, electrically controlled typewriting machine which has considerably fewer working parts than prior machines of this type.

Another broad object is to provide a typewriting machine which has few oscillating or reciprocating parts operating at high speed and is practically free of the bad effects of inertia which limit the speed of machines having type bars and the necessary operating linkages for the type bars.

A specific object is to provide an improved electrically controlled combined letter spacing and back spacing mechanism which also functions to produce tabulating movement of the printing unit and to return the latter to starting position preparatory to commencing a new line of typewritten matter.

Another specific object is to provide a typewriting machine in which shock absorbers or rebound devices are unnecessary. A further specific object is to provide a machine which is composed of a few unit assemblies each being more or less independent mechanically.

Some of the more specific objects are to provide mechanisms or means for performing and/or controlling the following functions.

Automatic repeating of any selected character as a result of a single depression of the desired key;

Preventing the repeating of a character when its key is held depressed by the operator;

Selective control of the last two functions;

Automatic repeating of any selected character as many times as desired with a number of automatic returns of the printing unit to starting position intervening one or more times;

Preventing two keys from being depressed in rapid succession without a printing operation under control of the first key depressed;

Preventing printing operations while the printing unit is in motion for tabulating purposes or being returned to begin a new line of typewritten matter;

Adjusting the point at which operation of the letter spacing mechanism commences;

Preventing the letter spacing operation from taking place before a printing operation takes place;

Automatically locking the machine against operation when current is turned off, whether accidentally or intentionally;

Shockless movement of the printing unit from one position to another;

Locking a selected character key in depressed position until the character has been printed.

Various other objects, advantages, or features will be pointed out in the following description and claims or will be apparent after a study of the description, claims, and drawings.

In the drawings:

Fig. 1 is a plan view of the machine.

Fig. 2 is a vertical section taken on the line 2—2 in Fig. 1.

Fig. 3 is a vertical section on the line 3—3 in Fig. 1.

Fig. 4 is a vertical section on the line 4—4 in Fig. 1.

Fig. 5 is a vertical section on the line 5—5 in Fig. 4 with certain parts broken away.

Fig. 6 is a front elevation of the stop bar and related parts.

Fig. 7 is a vertical section on the line 7—7 in Fig. 6.

Fig. 8 is a detail view showing various control stops in perspective.

Fig. 9 is a diagram of the electrical connections.

Fig. 10 is a fragmentary view of the rear face

of the type wheel, that is, as viewed from the left in Fig. 2.

Fig. 11 is a horizontal section taken on the line 11—11 in Fig. 10.

Fig. 12 is a vertical section taken on the line 12—12 in Fig. 10.

Fig. 13 is a large scale elevation of the spacing clutch.

Fig. 14 is a plan view of the clutch illustrated in Fig. 13.

Main framework

The various mechanisms of the typewriter are supported by the main frame which comprises side frames 10, 11 (Fig. 1) which are joined to form a rigid framework by cross bars 12, 13, and 14 (Fig. 2) and a top frame casting 15. The latter, together with the side frames 10, 11, a bottom plate 16, a front plate 17 and a rear plate 17a, form a housing which is tight enough to exclude dust.

Other cross bars or frames designated 18, 19, 20, and 21, further strengthen the main frame and also support various mechanisms and contacts to be described more fully later. These latter cross bars or frames with the mechanisms carried thereby are intended to be removable as units in order to facilitate assembly and repair.

Keyboard

The machine is completely controlled by a standard four-row keyboard generally designated 22 in Figs. 1 and 2. Besides the usual forty-two character keys there are the space bar 23, two shift keys 24, a shift lock key 25 of usual construction, a back space key 26, a return key 27, a line space key 28, and a tabulating key 29. Each key has a key lever 30 (Fig. 2) pivoted on a cross rod 31 which is journalled in lugs 19a formed in the cross bar 19 (see Fig. 6 also). Compression springs 32 hold the free ends of key levers 30 against a stop bar 33 secured to the rear face of the cross bar 14, a comb 34, also secured to said bar 14 guiding the free ends of the keys. Each key lever 30 has several lugs of different shapes formed therein.

The lug 35 of each character key lever 30 overlies and operates a pair of contact members 36 carrying contacts like Kb (Fig. 2) which control the printing of the character corresponding to the particular key which may be depressed. Thus, the contacts Kb in Fig. 2 are closed whenever the "B" key is depressed. The contact members have insulating buttons 37 upon which the lugs 35 press and are mounted on the cross bar 20. The lower contact members 36 are insulated from the bar 20 and from the upper contact members but make contact with a common bar 38 which corresponds to the left-hand wire in Fig. 9. This bar 38 greatly simplifies making the electrical connections of the machine and avoids a tangle of wires in the base of the machine where space is necessarily limited. The key levers 30 of keys 24, 26, 27, 28, 29 also control contacts like Kb.

The lug 39 is shaped like a hook and cooperates with a locking bar 40 which is common to all the character key levers 30 and is pivoted like at 41 to the side frames 10, 11. Lugs 39 are not provided in the cases of the two key levers 30a carrying the space bar 23 and the key levers of shift keys 24, return key 27, line space key 28, back space key 26, and tabulating key 29, but are present only on the 42 key levers corresponding to character keys. The bar 40 is held against stop pins, like 42 (Fig. 2) on each frame 10, 11, by a spring and whenever a character key is depressed its lug 39 hooks under the bar 40 holding the key depressed until the bar 40 is rocked by a release magnet RM to release the depressed key.

The lug 43 rides in slots in a pair of comb plates 44 which support a key arresting device of any desired type which permits only one key to be depressed at a time. Lugs 43 are not present on the case shift key levers as it is necessary to hold one of the case shift keys and a character key depressed to print an upper case character. The combs 44 are mounted on the cross bar 21.

The lug 45 is at the end of each key adjacent the bar 14 and overlies a bar 46 pivoted, as at 47, to the side frames 10, 11 and held by springs like 48 against stops like 49. A magnet LM, hereinafter called the locking magnet, is adapted to rock the bar 46 to remove the latter from beneath the lug 45 and permit any key to be depressed. The magnet LM prevents depression of a key when the supply of current is cut off as by opening the main switch MS (Fig. 9), a dead power line, or the pulling out of the connector plug P from its receptacle. This prevents misprints which might result from accidental depression of a key while the current is cut off.

Mounted on a cross rod 50 beneath the right-hand ends of all the character key levers 30 is a bail comprising a cross rod 51 and arms like 52 secured to the rod 50 which is journaled in the frames 10, 11 and urged upwardly by torsion springs against the lower edges of the key levers 30.

The arm 52 adjacent side frame 11 is extended to the left (Fig. 2) and underlies an insulating button on one member of a pair of contact members 53 carrying contacts NRC. The members 53 are mounted on and insulated from a bracket secured to the right side frame 11 and their contacts NRC will be termed the non-repeat contacts hereinafter as their function is to prevent repeated imprints in case a character key is held depressed by the operator for too long a period.

The fingerpieces of the keys are not permanently secured to the vertical stems 54 of key levers 30 but are frictionally held in place permitting the stems 54 to be inserted through suitable openings in a plate 55 which excludes dust. The plate 55 also supports the main switch MS (Fig. 1), non-repeat switch NRS, and automatic repeat switch ARS. The functions of the last two switches will be explained later herein.

Power drive

Power to operate the machine is furnished by a motor M, mounted adjacent the left side frame 10 (Fig. 1), which motor, through suitable gearing, drives a vertical shaft 56 journaled in suitable bearings on the frame 10. Bevel gears 57, (Fig. 1) connecting shaft 56 and a cross shaft 58, cause a commutator assembly 59 (see Fig. 9 also) to be rotated in a clockwise direction (Fig. 2) while bevel gears 60 (Fig. 1) on shaft 56 and a shaft 61 cause the latter to rotate a shaft 62 through other bevel gears 63. The shaft 58 does not extend as far as the right side frame 11, but is journaled in a suitable bracket 18a carried by the cross frame 18. As the details of the bearings for shafts 56, 58, 61, and 62 are of little importance they have not been illustrated. A suitable cover 64 protects the fingers of the op-

erator from the gears 57, 60, 63 and also prevents scattering of lubricating oil. The shaft 62 furnishes power to operate the printing unit 65 in its movements axially of the platen 66.

Platen and paper guide

The platen 66 (Fig. 2) is secured to a shaft 67 journalled in housings 68, 69 (Fig. 1) formed in the top frame casting 15. The housings 68 69 are at the ends of an opening formed in the front part of casting 15 into which opening the platen 66 extends. Extending partly around the platen 66 is a paper guide 70 secured to an inclined face 71 of frame casting 15, which face 71 constitutes the rear wall of the opening just mentioned. The paper guide has a number of openings through which project pressure rollers 72 carried by shafts 73 journaled in arms 74 pivoted in a cross shaft 75. The latter is mounted on the side frames 10, 11 and carries torsion springs like 76 which engage the arms 74 in such fashion as to normally hold rollers 72 against the platen 66. The ends of shaft 75 are seated in notched blocks 77 secured to the side frames 10, 11. With this construction the machine may be partly disassembled for cleaning and repairs by first removing the top frame casting 15 supporting the platen 66 and then lifting out the shaft 75.

Line spacing mechanism

The platen is rotated one or more line space distances by mechanism operated by a line space solenoid LSS (Fig. 3) which is mounted on the right-hand side frame 11 (Fig. 2). The solenoid LSS actuates a link 78 (Fig. 3) pivoted to one arm of a bell crank 79 rigidly mounted on a short shaft (not shown) which is coaxial with shaft 58 and journaled in the right side frame 11 and also in the bearing in arm 18*a* which supports shaft 58. The shaft carrying bell crank 79 also has secured thereto an arm 80 connected by link 81 to one arm of a bell crank 82 loosely mounted on the platen shaft 67.

The other arm of bell crank 82 carries a spring pressed pawl 83 which is adapted to engage the teeth of a ratchet wheel 84 secured to shaft 67. A spring 85, secured to an arm of bell crank 79, normally holds the parts in the position of Fig. 3 wherein an arm of bell crank 79 abuts an adjustable stop 86 mounted on side frame 11.

Energization of line space solenoid LSS causes link 78 to be drawn downwardly, rocking bell crank 79 and arm 80 in a clockwise direction, moving link 81 upwardly, and rocking bell crank 82 in a counterclockwise direction with the result that pawl 83 will engage the teeth in ratchet 84 and rotate said ratchet wheel until the end of the pawl engages a stop pin 87 which acts to prevent further movement of both the pawl and the ratchet.

Normally the pawl 83 is held out of engagement with ratchet 84 by a cam 88 forming part of a line space control lever 89 which extends through a slot 90 in the top frame casting 15 within convenient reach of the operator's right hand. The cam 88 governs the distance the pawl 83 must move before it can engage the ratchet wheel 84 and thus controls the number of line spaces of movement imparted to the platen 66. When the lever 89 and cam 88 are in the position 3 of Fig. 3 the platen will receive its maximum movement, or three line spaces, as the pawl will move ratchet wheel 84 the distance between four consecutive teeth. When lever 89 is in positions 1 and 2, the platen will be moved one and two line spaces, respectively. A spring pressed detent 91, pivotally mounted in a bracket 92 secured to the frame casting 15, has three notches co-operating with a pin 93 carried by lever 89 to hold the latter yieldingly in any one of its three positions. A spring operated arm 94, pivotally mounted in a bracket 95 secured to frame 15, carries an aligning roller which is held between the teeth of ratchet 84 by a spring 96 connected to arm 94 and a pin 87 secured to frame casting 15. The roller in arm 94 holds the ratchet 84 and the platen 66 against accidental displacement while a line is being typewritten but yields readily to movement of the ratchet wheel 84 by pawl 83.

The manner in which the line space solenoid is controlled will be explained hereinafter. The usual manual feed knobs 97 are provided for turning the platen by hand and are secured to the ends of shaft 67.

Printing unit

The printing unit 65 is best illustrated in Figs. 2, 4, and 5 and its framework includes side frames 98, 99 and a central frame 100 all secured to grooved bars 101 which hold the three frames in spaced relation. Four sub-frames 102*a* to 102*d* are secured to the frames 99, 100 and support various shafts in the compartment formed between the frames 99, 100. A back plate 103 of thick sheet metal, a front plate 104, and a top plate 105 of thinner metal, together with the side frames 98, 99 form a box-like housing which protects the printing mechanism against dust and tampering.

The printing unit 65 is mounted on suitable anti-friction bearings which may consist of balls or rollers carried by the grooves in bars 101 and similar grooves in four parallel rails 106 rigidly mounted in the frames 10, 11. Thus, the printing unit is movable transversely of the machine, that is, parallel with the platen. The mechanism for producing such transverse movement will be described more in detail hereinafter.

The frame 18 (Fig. 2) extends parallel with the bars 106 and, besides supporting the right hand end of the shaft 58 as described, also supports a number of contact bars 107 which cooperate with metallic contact strips or brushes 108 mounted on the back plate 103 of the printing unit. By this means the various control magnets and contacts carried by the printing unit 65 are connected to the magnets and contacts carried by the main framework of the machine. As will be seen in Fig. 2, the contact bars 107 are separated from each other and frame 18 by flat strips 109 of insulating material which are much wider than the contact bars to provide deep grooves into which extend the brushes 108. This construction prevents the operator's fingers from accidentally touching the live contact bars while the machine is in operation.

The contact bars 107 and insulating strips 109 may be secured to the top edge of frame 18 by long screws 110 which screws pass through holes in the contact bars and strips and are insulated from the contact bars by washers or collars of insulating material. The brushes 108 are mounted in rectangular notches in a block of insulating material 111 by means of terminal screws 112 which extend into the interior of the printing unit. The block 111 is set in a rectangular opening in the back plate 103 and secured thereto by screws 113.

The printing mechanism is best illustrated in

Fig. 2. It includes a type wheel 114 secured to a shaft 115 which is rotatably and slidably mounted in frames 98, 99, 100. The type wheel 114 is within the compartment between frames 98, 99 and comprises a flanged disc 116 (Figs. 10, 11, and 12) having 42 radial grooves 117 milled in the flanged part of the disc. In grooves 117 are slidably mounted 42 type elements 118 each bearing one of the upper case characters, that is the capital letters and certain special signs, punctuation marks, and so on. The grooves 117 are deep enough and wide enough to permit the type elements to slide freely when a ring 116a is clamped to the side of the flange in disc 116. Each type element 117 has a recess 119 into which extends a rectangular block 120 secured in a rectangular hole broached in the disc 116. The blocks 120 act as stops to prevent removal of the type elements 118 when ring 116a is secured to the side of disc 116. A spring 121, contained by each recess 119 and interposed between block 120 and the right hand shoulder of such recess 119 (Fig. 12), normally holds each type element in the position of Figs. 2 and 12 with the left-hand shoulder abutting block 120 in which position the type is out of contact with platen 66.

Ring 116a is similarly provided with 42 grooves 117a in which are mounted type elements 118a bearing the lower case characters. The type elements 118a have associated therewith blocks 120 and springs 121 exactly like those associated with type elements 118. A ring 116b retains the type elements 118a in their grooves and the two rings 116a, 116b are rigidly secured to disc 116 by a number of screws 122 to form a compact type wheel unit.

The type wheel 114 is rotated by means of a gear 123 secured to shaft 115 through a train of gears which comprises an idler gear 124 journaled on a screw stud 125 carried by a central frame 100 which idler, in turn, meshes with a gear 126 secured to a sleeve 127. The latter is slidably mounted on shaft 62 and extends between the side frames 98, 99 through a hole 128 in central frame 100. Mounted on the sleeve 127 between frames 98, 100 is a driving element 129 which has the general shape of a ratchet wheel. The hub of the driving element 129 is slotted as is the case with the sleeve 127, and secured to the side of the driving element 129 is a key 130 which extends through the slots in said sleeve 127 and the hub of driving element 129 into a key-way in shaft 62. It is clear that, as long as shaft 62 is turning, the sleeve 127, driving element 129, and gear 126, and hence type wheel 114, will be rotated and the printing unit may be moved to the right or to the left (Fig. 1) without disturbing the driving connection. The printing wheel is constantly rotating while the machine is being used and never stops rotating even for the very brief space of time during which an impression is being made by a selected type element.

An impression is taken from a selected type element by means of a printing hammer 131 which is pivoted on a stud 132 carried by frame 98 and is held by a spring 133 against an adjusting screw 134 carried by a lug secured to the frame 98. The printing hammer 131 is bent in such fashion as to extend into the space formed by the flange 116 and rings 116a, 116b. Normally the upper or striking end of the hammer 131 is in the plane containing the longitudinal axes of the lower case type elements 118a and is adapted to strike the right-hand end of any type element 118a which may have its character at the printing point whenever the printing hammer is operated.

The printing hammer 131 is operated by movement of driving element 129 through mechanism which is controlled by a printing magnet PM secured to the left side of the central frame 100.

The armature of magnet PM is secured to the upper end of a lever 135 pivoted at 135a to frame 100. The lower end of lever 135 is connected by a link 136 to one arm of a two-arm latch lever 137 pivoted at 138 to frame 98. One arm of lever 137 is hook shaped and engages the extreme right end 139 of a bell crank 140 pivoted at 141 to frame 98. A spring 142, interposed between one arm of bell-crank 140 and latch lever 137 holds the parts in the position of Fig. 2 where the end 139 of bell crank 140 is held up by the hook shaped arm of latch lever 137 and a lug 143 forming part of bell-crank 140 does not quite engage the lug 144 of latch lever 137.

A driving member 145 shaped like a bell crank is pivoted on the upper end of a lever 146 and to the vertical arm of said driving member is connected the spring 133 which tends to hold the horizontal arm 147 of driving member 145 against a round nosed lug 148 in bell-crank 140. The arm 147 has a hook shaped lug 149 which is out of the path of movement of the teeth in driving element 129 when the parts are in the position of Fig. 2.

The lever 146 is pivoted at its mid-point on a short shaft 150 journaled in the frames 98, 100 and the lower end of said lever is connected by a link 151 to the lower end of a lever 152 pivoted at its mid-point on a shaft 153 similar to shaft 150 and also journaled in frames 98, 100. The upper end of lever 152 has a rounded nose 154 abutting a similar nose 155 an arm 156 forming part of type hammer 131 and extending below stud 132. The link 151 has at its right-hand end (Fig. 2) an offset lug carrying an insulating block 157 which is adapted to engage the bent-over end of one member of a pair of spring contact members 158 carrying contacts SC. The contact members 158 are mounted on a lug 159 offset from a plate 160 which is adjustably mounted on frame 100 as by screws 161 extending through a slot in plate 160. Normally the contacts SC are separated, as in Fig. 2, and will be termed the spacing contacts hereinafter since their function is to control the letter spacing movement of the printing unit which takes place after each character is printed.

The operation of the parts just described will now be explained briefly. When magnet PM is energized the link 136 is drawn to the right (Fig. 2) rocking latch lever 137 counterclockwise to release the end 139 of bell crank 140. The combined action of spring 142 and lug 144 forces driving member 145 downwardly until lug 149 gets between the teeth of driving element 129 and is positively engaged by one of said teeth. As a result, driving member 145 will be drawn to the right (Fig. 2) rocking levers 146, 152 in a clockwise direction and, through the noses 154, 155, rocking the printing hammer 131 in a counterclockwise direction, to propel the upper end of the printing hammer against the right-hand end of the type element 118 or 118a which may be at the printing point. This will cause the type in the selected type element to make an impression on the work sheet.

The right-hand end of driving member 145 is guided in an inclined slot 162 in a block 163 adjustably secured to the central frame 100 which

slot acts to cam the right-hand end of member 145 upwardly to disengage lug 149 from the teeth of the driving element 129. The parts are so proportioned that the movement of the printing hammer 131 is extremely rapid and the selected type element is struck a very quick blow while the type wheel 114 is actually moving. The speed of operation of the printing hammer is so great that the type element makes its impression and is withdrawn practically instantaneously without affecting the motion of the type wheel 114 or causing a blurred impression.

During movement of member 145 to the right under the influence of driving element 129 a lug 164 on arm 145 will engage lug 148 and cam the right-hand end of bell crank 140 slightly upwardly (Fig. 2). When slot 162 becomes effective to cam the right-hand end of arm 147 upwardly as described, the right-hand end of bell crank 140 will be rocked a further distance upwardly until the end 139 of bell crank 140 is in a position slightly above the hook in latch 137 and is in readiness to be reengaged by the latter.

The lugs 143, 144 cooperate at this time to force the latch lever 137 into latching position and also force the armature of the magnet PM away from the poles of said magnet in case residual magnetism holds the armature against the poles. The spring 133 restores the printing hammer 131 and driving member 145 to the position of Fig. 2, the lug 164 being so proportioned and located with reference to lug 148 that restoration of member 145 is permitted without interference between lug 149 and the teeth in the driving element 129.

The manner in which magnet PM is controlled to print the proper character will be more clearly explained hereinafter.

Any suitable inking means may be used to produce the impression of the type on the paper, such as an inking ribbon 165, and any convenient ribbon feeding mechanism may be employed. The means for inking the type forms no part of the present invention and details of such means have been omitted from the drawings.

The compartment in the printing unit between the frames 99, 100, contains the mechanism for moving the printing unit axially of the platen to space after each impression, or letter spacing to use the common expression, and reversely moving the printing unit or back spacing as it is called. The mechanisms just mentioned are also used to cause tabulating movement and return the printing unit to starting position to begin a new line. All these mechanisms are electrically controlled and operated by shaft 62.

Secured to sleeve 127 between frames 99, 100 is a bevel gear 166 which meshes with two bevel gears 167, 168 fixed on shafts 169, 170 journaled in frames 102a, 102b, 102d, and plates 103, 104. Secured to shafts 169, 170 adjacent the back plate 103 and front plate 104, respectively, are pinions 171, 172 which mesh with idler gears 173 loosely mounted on a shaft 174 journaled in the plates 103, 104 and frames 102a, 102d. The idler gears 173, in turn, mesh with gears 175, secured to shafts 176, 177 journaled in back plate 103 and frame 102a, and front plate 104 and frame 102d respectively. Secured to the shafts 176, 177 are driving elements 178, 179 which may take the form of ratchet wheels. It is quite plain that the driving elements 178, 179 will rotate continuously when motor M is in operation. Loosely mounted on shafts 176, 177 adjacent driving elements 178, 179 are discs 180 which have the general shape shown in Fig. 13 which illustrates the construction of the left-hand disc in Fig. 4. Pivoted on each of these discs is a driving pawl 181 having a lug 182 adapted to engage the teeth of the driving elements 178, 179.

A spring 183, secured to a pin carried by each disc and to the free end of the associated driving pawl 181, normally tends to draw the pawl 181 toward the center of the disc 180 so as to force lug 182 between the teeth of the adjacent driving element. Such action is prevented, however, by coaction of an offset lug 184, formed in a rock lever 185 pivoted on a bracket 186, with the tail 187 of the driving pawl thus holding said pawl in the position shown in Figs. 5 and 13. A torsion spring 188 engaging bracket 186 and the lever 185 below its fulcrum, normally holds the lever 185 in the position of Figs. 5 and 13 with lug 184 engaging both the lug 187 and a lug 189 forming part of disc 180 and bent at right angles to the plane of disc 180 adjacent lug 187, both lugs being offset to prevent interference between a lug 190, forming part of disc 180, and lug 184. A spring pressed pawl 191 mounted in the lower end of lever 185 adjacent lug 184, coacts with the latter to prevent rotation of disc 180 in either direction.

The driving elements 178, 179, and their associated discs 180, together with pawls 181, constitute two one-revolution clutches, controlled by magnets acting upon armatures 191 secured to the upper ends of levers 185. The left hand clutch (Figs. 4 and 5) is controlled by a magnet SM, hereinafter called the letter spacing magnet, while the right hand clutch is controlled by a magnet BSM and will be termed the back spacing magnet. The magnets SM and BSM are mounted on brackets 103a and 104a carried by back plate 103 and front plate 104, respectively. The corresponding clutches will be termed the letter spacing clutch and back spacing clutch, respectively, for sake of brevity.

Due to the fact that shafts 176, 177 are rotated in opposite directions by bevel gears 167, 168, the positions of corresponding parts of the letter spacing and back spacing clutches are reversed but the parts are alike in all other respects.

The lugs 190 carry pins 190a (Figs. 13 and 14) which are adapted to ride in radial slots 192 formed in plates 193 which have the general shape of a Maltese cross. Normally each pin 190a occupies the position shown in Fig. 13 in which said pin is partly in one of the slots 192. The curved parts 193a of the plates 193 coact with a curved locking plate 180a secured to one side of disc 180. The plates 193 and associated discs 180, with the pins 190a and locking plate 180a, constitute irreversible Geneva gearing which has the ratio 1:4, that is, one revolution of each disc 180 causes ¼ of a revolution of each plate 193.

The plates 193 are secured, in the case of the left-hand or letter spacing clutch, to a stub shaft 194, (Figs. 13 and 14) journaled in a bushing 195 fixed to frame 102a, and, in the case of the back spacing clutch, to a short shaft 194a journaled in frames 102c and 102d (Fig. 4). The shafts 194, 194a have secured thereto pinions 196 (Fig. 4) which mesh with gears 197 loosely mounted on shaft 174. Secured to each gear 197 is a bevel gear 198 which meshes with two bevel pinions 199 journaled in a gear 200 also loosely mounted on shaft 174. The gear 200 meshes at all times with a rack 201 secured to the upper side of one of the grooved rails 106 supporting and providing a guide or track for the printing unit in its movements axially of the platen.

The gears 197 to 200 constitute differential

gearing whose purpose is to move the printing unit from left to right and vice-versa under control of magnets SM and BSM. Normally, however, since both gears 197 are locked (due to the fact that the Geneva gear connections associated with such gears are locked and irreversible), movement of the printing unit in either direction is positively prevented. The operation of the above mechanism will now be described briefly.

Energization of magnet SM causes lever 185 to rock counterclockwise to disengage lug 184 from the lugs 187, 189, releasing disc 180 and driving pawl 181 which will then be drawn by its spring 183 toward shaft 176 so that lug 182 will be caught by a tooth in the constantly rotating driving element 178. The latter will now rotate disc 180 in a clockwise direction (Figs. 5 and 13) and during the first quarter revolution of disc 180 the pin 190*a* carried thereby will ride in the slot 192 in plate 193 and turn the latter a quarter revolution before said pin leaves the slot 192 in plate 193. Thereafter one of the locking surfaces 193*a* will coact with locking plate 180*a* to prevent further movement of plate 193 for the next three-quarters of a revolution of disc 180.

Assuming magnet SM has been deenergized immediately after operating lever 185, the latter will be operated by its spring 188 to replace lug 184 in the paths of lugs 187, 189. Near the end of the single revolution of disc 180 the lug 184 will strike the lug 187 and rock pawl 181 out of engagement with the driving element 178. The lug 189 will also strike the lug 184 and the free end of pawl 191 will snap behind the lug 189 to hold the disc 180 in normal position and prevent rebound.

The ratio of the gearing is such that the quarter revolution imparted to plate 193 will cause gear 200 to be rotated clockwise (Fig. 5) the distance between two successive teeth on the rack 201, that is, the printing unit will move to the right a distance equal to one letter space. This movement of gear 200 can take place because the right-hand gear 197 (Fig. 4) is locked. The energization of magnet BSM causes a similar operation of the right-hand or back spacing clutch, but in this case the right-hand gear 196 will be rotated in a direction opposite to the rotation of the left-hand gear with the result that gear 200 will likewise move in a direction opposite to that caused by the left-hand gear 196 and the printing unit will be moved one letter space distance to the left.

It will be noted that the speed of rotation of each plate 193 under the influence of its pin 190 is not uniform but is variable, ranging from zero at the starting position of pin 190*a* in Fig. 13 to a maximum after ⅛ of a revolution of disc 180 and plate 193, and falling to zero at the point where pin 190 leaves slot 192, that is, after ¼ revolution of plate 193 and disc 180. Thus, the motion of the printing unit is first gradually accelerated from a position of rest, then decelerated to a position of rest so that the movement of the printing unit in letter spacing and back spacing is accomplished without shock. As will be explained more fully hereinafter, the tabulating and return movements of the printing unit are brought about by the mechanism controlled by magnets SM and BSM, hence it is plain that the Geneva driving connections from the two clutches to the differential gearing render rebound devices or shock absorbers unnecessary.

The manner in which the type wheel 114 is operated to effect printing of capital letters will now be explained. It will be recalled that shaft 115 to which the type wheel 114 is secured, is slidably mounted in frames 98, 99, 100 and has secured to it gear 123, and that normally the upper end of printing hammer 131 is in the plane of the lower case type elements 118*a*. The type wheel 114, shaft 115, and gear 123 are thus shiftable as a unit a distance sufficient to place upper case type elements 118 in position to be struck by the printing hammer 131 and this movement is accomplished by a case shift magnet CSM mounted on the frame 99. The magnet CSM actuates an armature 202 secured to a forked shift lever 203 pivoted on a bracket 204 secured to frame 99. The tines of the fork carry anti-friction rollers which project into a circumferential groove in a collar 205 secured to shaft 115. A coil spring 206, secured to the right-hand end of lever 203 and to frame 100, holds the shift lever in normal position. The idler gear 124 is wide enough to permit gear 123 and type wheel 144 to move to upper case position when magnet CSM is energized, without demeshing gears 123, 124.

Commutator device

The selection of the type element to be operated and the energization of magnet PM are controlled by the character keys through the operation of the commutator device 59. The specific details of construction of the commutator device are of little importance as a number of equivalent forms may be used. The principle upon which selection is based may be best understood by reference to Fig. 9 which shows a perspective view of one form of commutator device suitable for use in an electric typewriter constructed in accordance with the present invention.

Mounted upon shaft 58 is a suitable drum 207 of insulating material carrying a plurality of conductor rings 208, one for each character key. Also mounted upon the drum is a selecting commutator S having as many conducting bars 209 as there are rings 208 and character keys. Each ring 208 is connected to one of the bars 209 and the latter are arranged on the commutator S in the same order as the pairs of type elements 118, 118*a* appear on the type wheel 114. Co-acting with each ring is a wiping brush 210 which is connected to the upper contact member 36 (Fig. 2) corresponding to the character key associated with such ring. Thus for each character key there is a pair of contacts like Kb (Fig. 2), a brush 210, and a bar 209. A brush 211 wipes over the bars 209 of commutator S and is so positioned as to make contact with the bar 209 corresponding to a given character immediately prior to the time when the type element 118 or 118*a* bearing such character reaches the printing point. The brushes 210 are mounted on a bar 212 (Fig. 2) of insulating material secured to suitable bosses or brackets on the rear face of frame 18 while brush 211 is secured to a block 213 of insulating material mounted on a boss or bracket on the rear face of frame 18. Only a few of the contacts which, like Kb are closed by depression of character keys, have been shown in Fig. 9, and each has been designated by the letter K and a suffix denoting which character key operates the contacts. The contacts closed by the shift key 24, back space key 26, return key 27, line space key 28, and tabulating key 29, have been designated in Fig. 9 by the letters SK, BSK, RK, LSK, and TK, respectively, the letters prefixed to the letter K, indicating the nature of the control effected by such contacts.

Certain relays and magnets controlled by the

last named contacts have been designated by the letters R and M, respectively, prefixed with the same letters as those prefixed to the related K contacts which control said relays and magnets.

General operation

The general operation of the machine will be explained briefly prior to describing certain special features of the invention. It will be assumed that the main switch MS and non-repeat switch NRS are open, switch ARS closed, and the plug P has been inserted in the nearest receptacle connected to a suitable source of current. The locking magnet LM is deenergized so that bar **46** prevents depression of any of the keys. When switch MS is closed however, the bar **46** will be moved as described before herein to permit depressing of any key. It will also be assumed that only the "B" key is now depressed, closing contacts K*b* (Figs. 2 and 9) and resulting in the depressed "B" key lever **30** being held depressed by the bar **40** as described. Contacts NRC will likewise be closed by the depression of the bail **51**, **52**, but, as switch NRS is open, will have no effect.

Closure of contacts K*b* (Fig. 9) connects the bar **209** corresponding to the "B" type element to the left-hand line wire **214** making such bar "live." Eventually the live bar **209** will pass beneath the brush **211** which will occur a brief period of time before the "*b*" type element **118***a* reaches the printing point. A circuit will now be set up as follows: Line wire **214**, contacts K*b*, a brush **210** and a contact ring **208**, the "B" bar **209**, brush **211**, contacts **215**, **216**, **217** of relays TR, RR, and PR, respectively (all normally closed); one of the bars **107** and its brush **108**, printing magnet PM, the lowest brush **108** and its bar **107**, to right-hand line wire **218**. Energization of the magnet PM causes the printing hammer to be operated to strike the "*b*" type element **118***a* in the manner previously described. The brush **211** is so positioned that the printing hammer will be effective to strike the "*b*" type element a sharp blow at the instant said element reaches the printing point. The printing hammer is then instantly withdrawn, as described, before it can interfere with the rotation of the type wheel **114**.

During the movement of link **151** to the left (Fig. 2) contacts SC are closed thus setting up a circuit as follows: Line wire **214**, a bar **107** and its brush **108**, contacts SC, another brush **108** and coacting bar **107**, the winding of the letter spacing relay SR, contacts **219** of the letter spacing relay, tabulating stop contacts TSC (closed), a bar **107** and its brush **108**, letter spacing magnet SM, the lowest brush **108** and its bar **107**, to right-hand line wire **218**. The energization of relay SR causes its contacts **220** to close before its contacts **219** open, thus setting up a momentary holding circuit for the winding of relay SR from line wire **214** through contacts SC and winding of relay SR, contacts **220**, to line wire **218**. This action insures that only one impulse of brief duration will be given relay SR and magnet SM. The opening of contacts SC by restoration of the link **151** causes relay SR to become deenergized. The release magnet RM will be energized at the same time as magnet PM since the release magnet is in parallel with magnet PM over a shunt circuit leading from contacts **216**, through the winding of release magnet RM and switch ARS to line wire **218**.

The energization of magnet RM rocks bar **40** to release the depressed key. Also a lug **221** on the bar **40** operates to close contacts **222**, the purpose of which will be explained later. Energization of letter spacing magnet SM in the foregoing fashion causes the letter spacing clutch to become engaged with the result that the printing unit will be moved one letter space distance to the right (Fig. 1).

It should be noted that if any character key is held down by the operator while switch ARS is closed, the character corresponding to such key will be repeatedly printed as long as the key is held down. If switch ARS is opened and a character key, such as the "B" key, depressed once, the key lever **30** of the "B" key will remain locked in depressed position with the result that the letter "*b*" will be automatically printed as many times as desired since the circuit to the release magnet RM will be interrupted and the contacts K*b* will be held closed. When the operator desires to interrupt such automatic repeat printing, it will be merely necessary to move switch ARS to the "off" position (Fig. 1) or closed position (Fig. 9).

This automatic repeat printing and its selective control by switch ARS are novel features of the present invention and are very useful in certain kinds of work. As illustrations, it is sometimes desired to underline several lines of typewritten matter, or write rows of dashes, or block out several lines of a printed form, as a contract or power of attorney, with a row of X's. These operations can be done at maximum speed and with a minimum of effort by a machine embodying the above novel features of the present invention.

The automatic repeat printing is very undesirable in ordinary writing operations when words or numbers are being printed or sentences typewritten, as the failure of the operator to release an operated key promptly may cause a double or triple imprint of a character thus spoiling the work and requiring an erasure. Such repeated printing is prevented by the non-repeat contacts NRC and the printing relay PR which operate to prevent a second imprint from the type wheel when the operator inadvertently holds a key depressed or fails to remove a finger from a key quickly enough. The contacts NRC (Figs. 2 and 9) remain closed as long as any character key is in depressed position. Ordinarily no circuit can extend through contacts NRC and PR since normally they are in a series circuit including contacts **222** operated by release magnet RM. When magnets PM and RM are energized in the course of a printing operation, contacts **222** close momentarily and a circuit is established from line wire **214**, contacts NRC, switch NRS, winding of print relay PR, and contacts **222**, to line wire **218**. The circuit through the release magnet RM will be held through the active bar **209** and brush **211** until the brush **211** breaks contact with said bar. Thus, the release magnet will be kept energized long enough to ensure that the depressed key will be fully released. Energization of print relay PR closes contacts **223** and opens contacts **217** so that the circuit for magnet PM is broken immediately after the energization of said magnet and at the same time a holding circuit for print relay PR is established through contacts NRC and **223**.

It is clear that, as long as contacts NRC are kept closed as by the operator holding a character key depressed, the relay PR will remain energized and prevent another operation of magnet PM. When a character key is held down too long, the

relay PR will function as above with the result that magnet RM will be energized each time the active bar **209** passes beneath brush **211**, but the magnet PM can not receive an impulse. It is plain, therefore, that repeated printing is impossible as long as any key is held down since magnet PM can receive a single impulse for each depression of a key. When the operator removes his finger from the depressed key, the magnet RM will receive one more impulse (since the depressed key is still held down by its lug **39** and bar **40**) which will effect release of the depressed key and permit contacts NRC to open and interrupt the circuit to magnet PR. It is preferred that contacts NRC be adjusted to remain closed at least until after the character key controlled contacts like *Kb* have opened on the upward stroke of the depressed key in order to avoid the possibility of contacts **217** closing before contacts like *Kb* have opened.

The space bar **23** is mounted on the free ends of key levers **30***a* (Fig. 2) like the key levers **30**, except for the omission of lugs **39** and **43**, and the levers **30***a* do not overlie bail **51**, **52**. The lugs **35** on the key levers **30***a* operate to close contacts SK (Fig. 9) which are in parallel. The contacts SK are also in parallel with contacts SC which it will be recalled control the magnet SM. It is quite apparent that closure of contacts SK by depression of space bar **23** will have the same effect as closure of contacts SC.

The back spacing key **26** controls contacts BSK and when depressed energizes back spacing relay BSR and the back spacing magnet BSM over a circuit as follows: Left-hand line wire **214**, contacts BSK, winding of relay BSR, contacts **224**, of relay BSR, return stop contacts RSC (normally closed) bar **107** and brush **108**, magnet BSM, the lowest brush **108** and its bar **107**, to right-hand line wire **218**. Energization of magnet BSM causes the back spacing clutch (Fig. 4) to be engaged to cause the printing unit to move one letter space distance to the left (Fig. 1). Energization of relay BSR causes its contacts **225** to close before contacts **224** open and the contacts **225** establish a momentary holding circuit for relay BSR to line wire **218** exactly as in the case with relay SR previously described. Thus a single impulse of current is imparted to magnet BSM.

Tabulating and returning printing unit

The mechanism illustrated in Figs. 4 and 5, controlled by magnets SM and BSM, are also jointly controlled in a novel fashion by three keys and a single stop bar to cause tabulating movement of the printing unit, returning the printing unit to starting position to begin a new line, and line spacing movement of the platen. All these movements are automatically controlled by only three contacts operated by the single stop bar. This mechanism is best understood by reference to Figs. 6 to 9. Secured to the shaft **31**, on which are pivoted key levers **30**, are two arms **226** (Figs. 6 and 7) which extend vertically into the space in front of frame **18** adjacent frames **10**, **11** (see Fig. 2 also). Springs **227** normally hold the arms **226** against fixed pins **228** carried by frames **10**, **11**. A stop bar **229** is slidably mounted in rectangular holes **230** in the free ends of arms **226**. The stop bar is provided with notches **231** spaced at intervals of one letter space distance which notches are adapted to retain stops like **232**, **233**, **234** (see Fig. 8) of which **232** and **234** are the left-hand and right-hand marginal stops, respectively, while **233** is a tabulating stop. These stops extend forwardly of the bar **229** (or to the right, Fig. 2) into the path of a cam lug **235** on a block **236** secured to the rear of the printing unit.

The right-hand end (Fig. 6) of bar **229** is provided with a pin **237** which, through movements of bar **229**, controls three sets of contacts ARC, RSC, and TSC which are mounted on insulating blocks carried by a frame **238** secured to frame **11**. The above contacts may be termed the automatic return contacts, return stop contacts, and tabulating stop contacts, respectively. The contacts TSC are directly operated by pin **237** and are opened whenever bar **229**, and arms **226** are rocked rearwardly or clockwise (Fig. 7). The contacts ARC and RSC are operated by two levers **240**, **241** which extend on opposite sides of pin **237** and are both pivoted on a screw stud **242** carried by frame **238**.

A strong coil spring **243** normally holds both levers **240**, **241** firmly against a fixed stop **244** fixed to frame **238** and said stop is just wide enough to permit pin **237** to move freely laterally of the axis of the bar **229** but prevents longitudinal movement of bar **229** unless by a force sufficient to overcome the tension of spring **243**. When the bar **229** is moved to the right (Fig. 6) normally open contacts ARC will be closed by movement of lever **241**. On the other hand, normally closed contacts RSC will be opened by lever **240** whenever bar **229** is moved to the left. The three movements of bar **229** to control the three sets of contacts are controlled by the three types of stops shown in Fig. 8. Their operation in conjunction with the keys **27**, **29** will now be explained in detail.

As many stops as may be necessary will be set in the usual fashion to correspond with the various columns of the sheet on which typewritten data is to appear in columnar form, bar **229** being provided with the usual scale for convenience in locating the stops **233** the proper number of letter spaces distance from the left-hand limit of movement of the printing unit. Assuming that the operator wishes to typewrite data in one of the columns having a stop **233**, he will depress tabulating key **29**, thus closing contacts TK and energizing tabulating relay TR over a circuit as follows: Left hand line wire **214**, contacts TK, winding of relay TR, tabulating stop contacts TSC, a bar **107** and its brush **108**, magnet SM, the lowest brush **108** and its bar **107**, to line wire **218**. Relay TR closes its contacts **245** to establish a holding circuit for itself around contacts TK, permitting key **29** to be released, and opens contacts **215**, in series with magnet PM, to prevent a printing operation from taking place.

The energization of magnet SM causes the letter spacing clutch to be engaged and the printing unit will commence to move to the right (Fig. 1). Since magnet SM is kept energized by the holding circuit through contacts **245**, the letter spacing clutch will not become disengaged after the first revolution of shaft **176** but will remain engaged.

The printing unit will continue its movement to the right until cam lug **235** strikes the bevelled edge of one of the stops **233**, thus forcing bar **229** rearwardly (to the right Fig. 7) and opening contacts TSC. As a result the relay TR and magnet SM will be deenergized and the letter spacing clutch will become disengaged preventing further movement of the printing unit until a key is again depressed.

The stops **232**, **234** are inserted at the left-hand and right-hand ends of bar **229** to correspond with the desired margins. These stops are long enough

to be struck by the flat side of the cam lug **235** so as to slide the bar **229** whenever the printing unit in its movements reaches the limits of movement determined by said stops.

Assume that in the course of writing a line of typewritten matter the cam lug **235** strikes stop **234** thus forcing bar **229** to the right (Fig. 6) and causing lever **241** to close automatic return contacts ARC. This causes a circuit to be established as follows: Left hand line wire **214**, contacts ARC, winding of return relay RR, return stop contacts RSC, a bar **107** and its brush **108**, back spacing magnet BSM, and the lowest brush **108** and its bar **107**, to line wire **218**. Relay RR closes contacts **246** to establish a holding circuit for itself to line wire **214** and also closes contacts **247**. The result is that the back spacing clutch is engaged and the printing unit commences to move to the left (Fig. 1). Eventually the cam lug **235** will strike the left-hand marginal stop **232** and, as a result, bar **229** will be moved to the left causing contacts RSC to be opened. Further movement of the printing unit will now cease.

Automatic line spacing

Relay RR also closes contacts **247** which, in collaboration with contacts **246** establish a circuit as follows: Line **214**, contacts **246**, **247**, winding of line space relay LSR, contacts **248** of relay LSR, and the line spacing solenoid LSS, to line wire **218**. Relay LSR closes its contacts **249** to establish a holding circuit for itself to line wire **218** and opens to contacts **248** to break the circuit through the solenoid LSS so that the latter receives a single impulse. Relay LSR is preferably a slow acting relay and its contacts **249** close before contacts **248** open in order to insure that solenoid LSS will receive a single impulse of duration sufficient to cause a complete operation of the line spacing mechanism. Relay LSR becomes de-energized as soon as contacts RSC open. Contacts LSK, controlled by the line spacing key LSK, have the same effect as contacts **246**, **247**, while contacts RK, controlled by the return key **27** have the same effect as contacts ARC. Thus the operator can line space the platen at any time by merely depressing key **28** or can both line space the platen and return the printing unit by depressing key **27**.

The printing unit **65** is provided with a suitable index finger or pointer **250** secured to the front plate **104** which pointer coacts with a scale **251** on the upper edge of the front plate **17** to indicate the exact position of the printing unit at all times.

Automatic operation

It may happen that the operator may have to repeat a character from a point in one line to a point in another line, involving the operation of returning the printing unit to a position to begin a new line before the desired number of imprints have been made. Such would be the case if it were necessary to underline several lines of writing or block out several lines of a printed form like a standard legal document. The machine is capable of printing a row of characters to the end of a line, returning the printing unit to begin a new line, and resuming the printing of the desired character on the new line, all automatically performed and initiated by depression of a single key.

Assume it is desired to block out four lines of a printed form with a row of X's. Automatic repeat switch ARS is thrown to "on" or open position and the "X" key depressed. The machine will now automatically print a row of X's until eventually lug **235** strikes stop **234** thus closing contacts ARC to initiate return of the printing unit to starting position as described. Contacts **216** of relay RR will open preventing the printing magnet PM from operating at the end of the line and while the printing unit is being returned. The magnet RM, not having been energized to release the depressed "X" key, the latter will still be locked in depressed position by bar **40** and contacts Kx will be closed when eventually the printing unit arrives at its starting position in readiness to begin a new line at which point contacts RSC open to deenergize relay RR and magnet BSM. Reclosure of contacts **216**, by the deenergization of relay RR will complete a circuit to magnet PM through contacts Kx and the machine will resume automatic printing of the X's. The above action will continue as long as switch ARS is open. When the fourth line is almost completed the switch ARS is closed by the operator causing magnet RM to be energized to release the depressed key.

Since the machine is capable of printing more rapidly than the operator can operate the keys a considerable amount of time is saved besides saving the operator's energy for work requiring closer manual supervision by the operator.

Relays TR, and RR, through their contacts **215**, **216** positively prevent operation of the printing mechanism during tabulating and return movements of the printing unit.

The machine described herein is much simpler than prior power driven typewriters because the printing mechanism comprises a single type wheel which is controlled by contacts actuated by the keys rather than by linkages operated by the keys. The elimination of the usual pivoted type bars with their individual operating cams or actuators, common in prior power driven typewriters, permits a considerable saving in the cost of the machine.

The fact that the present machine is wholly controlled by contacts actuated by the keys admirably adapts it for use in printing telegraph systems and automatic letter writers controlled by perforated tapes. In the one case the brushes **210** can be directly connected to a suitable coding or decoding device in the telegraph system while in the other case the brushes **210** can be directly connected to the analyzer sensing the holes in the tape. In either of the above cases the necessary connections need not interfere to the smallest degree with manual control of the machine through the keyboard.

The printing mechanism described herein has been found by actual experiment to produce a clear impression even with the type wheel moving relative to the paper. It is quite possible, therefore, to adjust contacts SC to close and initiate operation of the spacing clutch before the printing hammer strikes the selected type element so that printing and letter spacing take place together thus producing a faster operation than will be realized when the letter spacing operation must not take place until after the impression of the type has been made. It is also possible to energize magnets PM and SM simultaneously or even energize magnet SM first since the initial movement of the plate **193** and shaft **194** is slow whereas the printing hammer **131** operates at high speed.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it

will be understood that various omissions and substitutions and changes in the form and details of the device illustrated in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is as follows:

1. In combination, recording mechanism, a power drive adapted to operate the recording mechanism, including an electric propulsion unit, a series of circuit closing devices selectively operable to control recording operations of the recording mechanism by the power drive, means operative to prevent operation of the circuit closing devices, and an electro-magnetic current responsive device for rendering the preventing means inactive when current is supplied to the propulsion unit.

2. A typewriting machine comprising printing mechanism, a power drive for said mechanism including a driving motor, a series of selectively operable devices for controlling the operation of the printing mechanism by the power drive, and electro-magnetic means controlled directly by the current supply to the motor for preventing operation of said devices when the flow of current to the motor ceases.

3. In combination with a main frame and a work sheet support mounted on the frame; of a self-contained printing unit movably mounted on said frame whereby the printing unit is adapted to traverse a work sheet on said support, said printing unit comprising a printing element with power means for selectively actuating the printing element to print upon the work sheet and power means for moving the printing unit step-by-step relative to the work sheet whereby the printed characters are spaced on the work sheet; and means independent of the printing unit for controlling the selective actuating means and moving means.

4. In combination, recording mechanism, a power drive for operating the recording mechanism, means for selectively controlling the operation of the recording mechanism by the power drive including a plurality of selectively operable circuit closing devices and a printing magnet, means for preventing more than one operation of said magnet for each operation of a circuit closing device to prevent repeated recording operations when a circuit closing device is kept in operated condition too long, and means for disabling the preventing means to permit repeated operations of the magnet when a selected circuit closing device is held in operated position.

5. In a typewriting machine, a stationary work sheet support, a printing unit adapted to traverse a work sheet on the support, said printing unit having a sliding driving connection to the motor and comprising means for printing on the work sheet including a type wheel having two rows of characters, means for moving the printing unit from one side of the sheet to the other to print characters in succession, means for shifting the type wheel to select one of said rows of characters for a subsequent character selecting operation, and power means for selecting from the selected row the character which is to be effective to print; said type wheel, moving means, and selecting means all being operated through the sliding connection.

6. A typewriting machine comprising a power drive, printing means adapted to be operated by the power drive, a series of manually operable keys for selectively controlling operation of the printing means by the power drive, means common to all the keys to prevent repeat operation of the printing means when a key is kept in operated position for too long a period, means releasable by an operation of the printing means for locking any selected key in operated position, and auxiliary means also common to all the keys for rendering the first named means ineffective whereby to permit repeat printing under control of any active key.

7. In a typewriting machine, a propulsion unit, a power shaft driven by said unit, a stationary support for a work sheet, a self-contained printing unit movable from one side of the work sheet to the other to print a line of characters in succession, said unit comprising a constantly rotating power-driven type wheel having two rows of characters, means for actuating the type wheel to effect selection of a row of characters, means cooperating with the type wheel to effect selection of a character in the selected row, and means operable to move the printing unit from any point in a line to another point in the same line, said type wheel, operating means, and moving means being all mounted in said unit and having a sliding connection to the power shaft to permit the printing unit to move from one side of the work sheet to the other to print a line of characters; and means external to said unit and independent of its movement for controlling the actuating means and moving means.

8. In a typewriting machine, a support for a record sheet, and a self-contained printing unit movable parallel with said support to print a line of characters; said unit comprising a constantly rotating type wheel, power means cooperating with the type wheel to select a type and make an impression on the record sheet while the type wheel is in motion, and means for moving the printing unit from one point in a line to another including a differential gear device and selective clutch means for controlling said device to determine the direction of movement of the printing unit; a propulsion unit, a shaft constantly driven by said propulsion unit, said shaft extending parallel with the line of travel of the printing unit and having sliding driving connection to the type-wheel and associated means included in the printing unit.

9. A typewriting machine comprising printing mechanism, a power drive for the printing mechanism, character keys operable to connect the printing mechanism to the power drive to print characters corresponding to the keys, means for preventing a second printing operation when any key is held in operated position until after a single character has been printed, means for retaining an operated key in operated position, means effective during a printing operation to release the retaining means, and a device for rendering inactive both the preventing means and the releasing means.

10. In a typewriting machine, a stationary support for a work sheet; a self-contained movable printing unit adapted to traverse the work sheet and its support to print a line of writing, said printing unit comprising a constantly moving type element, power means operable to select a type for an impression while the type element is moving, a magnet for controlling the power means, means moving the printing unit including differential gears, and an element controlled by the first-named means for rendering the differential gears effective to move the printing unit as

an incident to a type selecting operation; and devices external to the printing unit and independent of its movement for controlling the magnet.

11. A typewriting machine comprising a power drive, printing means adapted to be operated by the power drive; a series of manually operable elements, each element representing a character and adapted to be selectively operated to control operation of the printing means by the power drive to print the character said element represents; means for locking said elements in operated position, means operable as an incident to each printing operation to disable the locking means to permit return of the operated elements to normal position, and a manually operable device for disabling the last named means to permit a second operation of the printing means.

12. In a typewriting machine, a printing instrumentality, a power drive therefor, and means operated by the power drive for moving the printing instrumentality in two directions comprising differential gearing, a pair of irreversible Geneva gear connections each operating the differential gearing in a different direction, a pair of clutches, each adapted to couple one of said gear connections to the power drive, and selecting means for controlling the operation of the clutches.

13. In a typewriting machine, a power drive, a work sheet support, and a movable printing unit adapted to traverse a work sheet on said support; said printing unit comprising a type wheel constantly rotated by the power drive, means operated by the power drive for taking an impression from the type wheel while it is in motion and without interrupting its motion, and means for moving the printing unit after each impression to traverse the work sheet.

14. In a typewriting machine, a power drive, a work sheet support, a series of keys, and a movable printing unit adapted to traverse the work sheet; said printing unit comprising a constantly rotating type wheel, a printing hammer, a driving ratchet constantly operated by the power drive, an inter-ponent connected to the printing hammer and adapted to engage the teeth of the driving ratchet, a latch holding the inter-ponent in idle position, an electromagnet controlled by said keys and adapted to release said latch to cause an impression, and means operated by the power drive for advancing the printing unit after each impression.

15. In a typewriting machine, a work sheet support, a printing unit movable to traverse a work sheet on the support, means for moving the printing unit in either direction to traverse the work sheet; a control element operable in response to movement of the printing unit, said element extending parallel with the path of movement of the printing unit and movable in three different directions, and a control unit operated by the movements of said element for controlling movement of the printing unit in both directions.

16. In a typewriting machine, a movable printing unit, and means for moving said unit in opposite directions comprising a fixed rack, a differential gear device engaging said rack and mounted in said unit, a power drive, a pair of clutches for connecting said power drive to said differential gear device to operate the latter in two different directions, a stop bar extending parallel with the path of movement of the printing unit and movable in three directions by movement of the printing unit, and means controlled by the movements of said stop bar for selectively operating said clutches.

17. A typewriting machine comprising a printing instrumentality, a work sheet support, the latter and said printing instrumentality being movable relative to each other to print a line of characters on a work sheet on the support; means for causing said movement including a rack, a device geared to the rack for moving the printing instrumentality and support relative to each other in two directions, a power drive and a pair of clutches selectively operable to connect the power drive to the reversible device to operate the latter in two directions; a stop bar movable in three directions in response to movements of the printing instrumentality and support relative to each other, and a pair of electric control circuits, one for each clutch, for selectively operating the clutches in accordance with the movements of the stop bar.

18. An electric typewriter comprising a main frame, a work sheet support mounted in the main frame, guides mounted in the frame and extending parallel with the work sheet support, an electric motor; a drive shaft rotatably mounted in the frame and extending parallel with the guides, said shaft being continuously driven by the motor; a carriage mounted on said guides to traverse a work sheet on the support, a hollow drive shaft mounted in the carriage and having a sliding driving connection to the first drive shaft, a type wheel driven by the hollow shaft and mounted in the carriage, a printing hammer coacting with the type wheel and operating means therefor operable by the hollow drive shaft, electromagnetic means on the carriage for controlling the operation of the printing hammer, means operable by the hollow drive shaft for moving the carriage after each impression, electromagnetic means controlled by movement of the printing hammer for controlling the operation of the carriage moving means by the hollow drive shaft, a series of contact rails mounted in the main frame and extending parallel with the guides; contact elements mounted on the carriage and coacting with the contact rails, said contact elements being connected to the electromagnetic means on the carriage; a series of manually operable control keys mounted in the main frame, circuit controlling devices operated by the keys, and control circuits connecting said devices to the contact rails.

19. A printing machine comprising a main frame, a work sheet support mounted in said frame, a carriage slidably mounted in said frame for traversing a work sheet on said support; power operated printing means, character selecting means, and carriage traversing means all mounted in said carriage; an electric propulsion unit mounted in the main frame, a single operating shaft continuously operated by said unit and extending parallel with the movement of the carriage; a sliding connection in the carriage between said shaft and power operated means on the carriage, electromagnet control devices on the carriage for controlling the operation of the power operated means, contact rails mounted on the frame and parallel with the work sheet support, contact elements mounted on the carriage and connected to the electromagnetic means, said contact elements cooperating at all times with said contact rails, and electrical control means independent of the carriage and connected to said contact rails.

20. In a typewriting machine, a main frame,

a work sheet support mounted in said frame, a printing unit mounted in said frame for movement to traverse a work sheet on said support, an electric propulsion unit, a shaft continuously driven by said unit and extending parallel with the work sheet support, a rack mounted in said frame and parallel with said support; a differential gear device meshing with said rack and mounted in the carriage, said gear device including a pair of normally disengaged one revolution clutches connecting said differential gear device with the continuously driven shaft, one of said clutches when engaged, causing the differential gear to be rotated in a direction to move the carriage toward the right for letter spacing or tabulating movement and the other clutch when engaged causing the carriage to move to the left for back spacing or carriage return movement; and electromagnetic means associated with said clutches for selectively engaging them.

21. In a typewriting machine, a work sheet support, a printing unit movable to traverse the work sheet support, a rack parallel with the line of travel of the printing unit, and means mounted in the printing unit for moving the printing unit comprising a gear meshing with the rack, a pair of bevel gears rotatably mounted in the printing unit on each side of the first named gear, idler gears on the first named gear and connecting said bevel gears, a continuously operated drive shaft mounted in the printing unit; a pair of irreversible Geneva drive units, each connected to one of said bevel gears whereby rotation of the first named gear and hence the printing unit is normally prevented; a pair of one revolution clutches, each adapted when engaged to connect one of the Geneva drive units to the power drive shaft, and a pair of electromechanical devices, each associated with a clutch for selectively engaging the clutches.

22. In a typewriting machine, a power drive, a work sheet support, and a movable printing unit adapted to traverse a work sheet on said support, said printing unit comprising a type wheel constantly rotated by the power drive, power means operated by the power drive for taking an impression from the type wheel while it is in motion and without interrupting its motion, means operated by the power drive for moving the printing unit a letter space distance for each impression and means operated by the impression taking means for initiating an operation of the moving means.

23. In a typewriting machine, recording mechanism, power means for operating the recording mechanism including an electric propulsion unit, keys for controlling the operation of the recording mechanism by the power means, a locking bar common to all the keys and movable to a position to lock all the keys against operation, and electromagnetic means controlled directly by the current supplied to the propulsion unit for operating the locking bar.

24. In a typewriting machine, a traveling carriage, a stop bar extending parallel with the line of travel of the carriage and adapted for movement in two directions along its longitudinal axis and also movement transverse of its longitudinal axis, marginal stops settable on the carriage and engageable thereby to cause longitudinal movement of the stop bar in the direction of movement of the carriage, a tabular stop engageable by the carriage to cause transverse movement of the stop bar, and carriage moving means selectively controlled by the movements of the stop bar caused by said stops.

25. In a typewriting machine, a traveling carriage, a fixed rack along which the carriage moves; a constantly rotating power shaft parallel with the rack, a carriage moving device mounted in the carriage including a differential gear device meshing with said rack and adapted to drive the carriage in either direction along said rack, and including a pair of selectively actuable clutches connecting the gear device to the power shaft for driving purposes; a stop bar movable in two directions longitudinally of its axis and also movable transversely of its axis, said stop bar being adapted by such movements to selectively control the clutches; and stops settable on the stop bar and responsive to movement of the carriage, each stop being adapted to cause movement of the bar in one of said directions.

26. In a typewriting machine, printing mechanism, a series of character keys for controlling said mechanism, means for locking the keys in operated position, means controlled by the printing mechanism for releasing said lock, and means controlled by the releasing means for preventing a second operation of the printing mechanism before a subsequent key operation.

27. In a typewriting machine, printing mechanism, a series of character keys for controlling said mechanism, means for locking the keys in operated position, means controlled by the printing mechanism for releasing said lock, means controlled by the releasing means for preventing a second operation of the printing mechanism before a subsequent key operation, and manually operable means for disabling both the releasing means and the preventing means to enable repeated printing in response to operation of any selected key.

28. An electric typewriter comprising a printing circuit, a series of keys and selecting means controlled by said keys for controlling said circuit, a traveling carriage, means for returning the carriage, a carriage return key for controlling the carriage return means, and means controlled by the carriage return key for interrupting the printing circuit while the carriage is being returned.

29. In a typewriting machine, power operated printing mechanism including a printing circuit and a selectively controllable printing magnet; a traveling carriage, means for moving said carriage to space characters printed by the printing mechanism, a magnet controlled by operation of the printing mechanism for initiating an operation of the moving means, a tabular key, means controlled by the tabular key for controlling the second magnet, and means also controlled by the tabular key for interrupting the printing circuit to prevent operation of the printing magnet during tabulating operations.

30. A recording machine comprising a power drive, recording mechanism operable by the power drive, selecting members for selectively controlling the operation of the recording mechanism by the power drive, means associated with the selecting members for preventing more than one operation of the recording mechanism at a time when any selecting member is operated, means automatically released during each operation of the recording mechanism for holding the selecting members in operated position, and a device for rendering ineffective both the holding means and preventing means whereby to permit automatic repeated operation of the recording

mechanism under control of an operated selecting member.

31. In combination, recording mechanism, power means to operate the recording mechanism, a series of control devices selectively operable to control operation of the recording mechanism by the power drive, means for preventing more than one operation of the recording mechanism when any selected control device is operated, means to hold the selected control device in operated position, means automatically operative during each recording operation for releasing the holding means, and a device settable to render ineffective both the holding means and releasing means.

32. In a recording machine, a main frame, a propulsion unit mounted in the frame, a carriage movable in said frame; power means on the carriage and adapted for moving the carriage forwardly to letter space and tabulate the carriage and also adapted for moving the carriage backwardly to back-space and return the carriage; means for connecting the power means to the propulsion unit and adapted to permit the carriage to move freely on the frame, control devices on the carriage for determining the direction of movement imparted to the carriage by the power moving means, and selective devices mounted on the frame for controlling the control devices.

33. In a recording machine, a main frame, a propulsion unit mounted in the frame, a carriage movable in said frame; power means on the carriage and adapted for moving the carriage forwardly to letter space and tabulate backwardly to backspacing and return the carriage; means for connecting the power means to the propulsion unit and adapted to permit the carriage to move freely on the frame, control devices on the carriage for determining the direction of movement imparted to the carriage by the moving means, and means for selectively controlling the control devices including a stop bar having marginal stops for controlling the limits of travel of the carriage, and a stop for limiting tabulating movement and including keys for controlling the movements of the carriage.

34. In a typewriting machine, a main frame, a work sheet support on said frame; a travelling carriage comprising a type wheel adapted to print on the work sheet and continuously power driven, power means for selecting the character printed by said type wheel, a single magnet for controlling the power selecting means; and means external to the carriage for controlling said magnet comprising a selecting commutator and a series of circuit closing devices each associated with one of the characters on the type wheel.

35. In a typewriting machine, a main frame, a work sheet support on said frame; a travelling carriage comprising a printing element constantly in motion and adapted to print on the work sheet, power means selecting the character printed by said printing element, and an element for controlling the power selecting means; a series of character keys mounted in the frame and independent of the carriage, and means mounted in the frame and independent of the carriage for operating the controlling element in accordance with any selected key.

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