Nov. 11, 1941. A. F. COLTON 2,261,965

VARIABLE TYPE PRINTING MACHINE

Filed Sept. 19, 1938 7 Sheets-Sheet 1

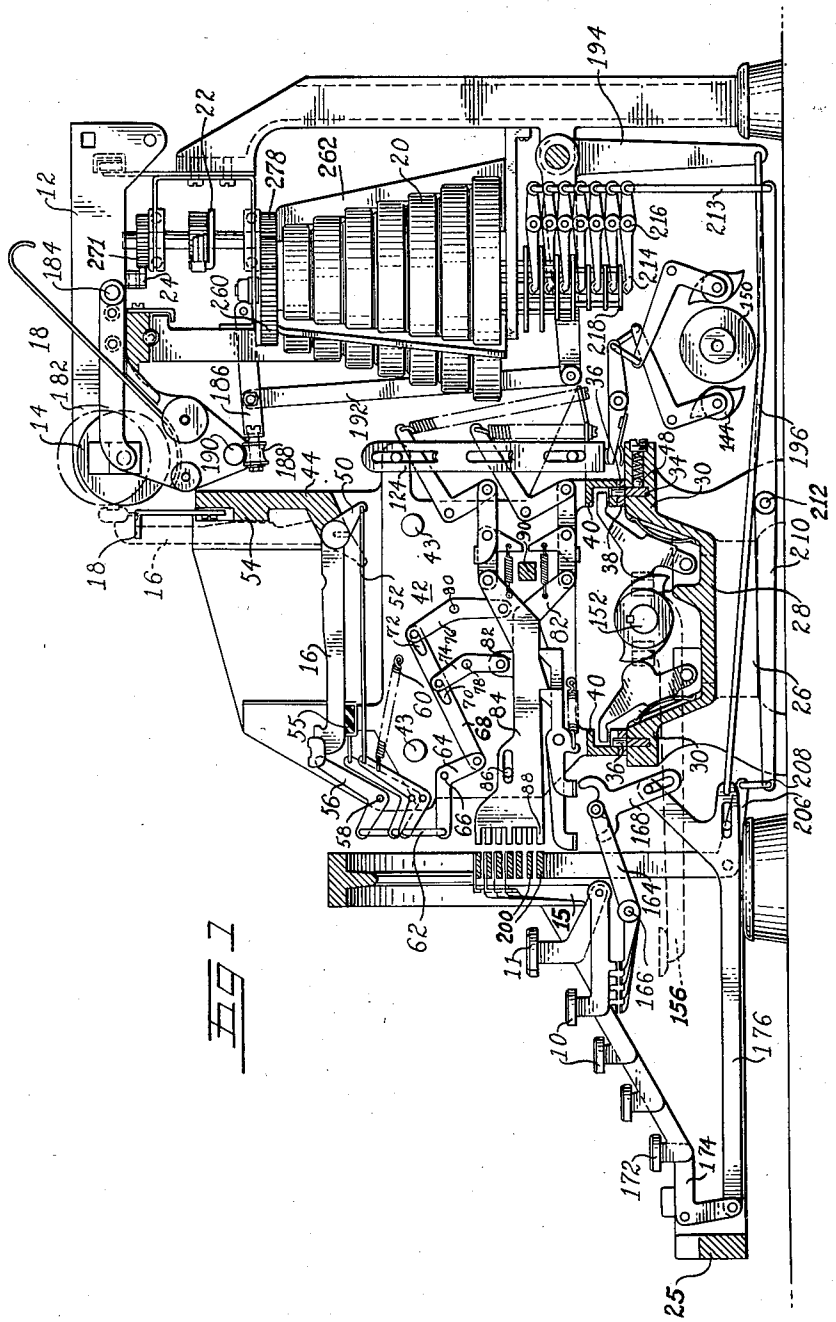

FIG. 1

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VARIABLE TYPE PRINTING MACHINE

Filed Sept. 19, 1938 7 Sheets-Sheet 2

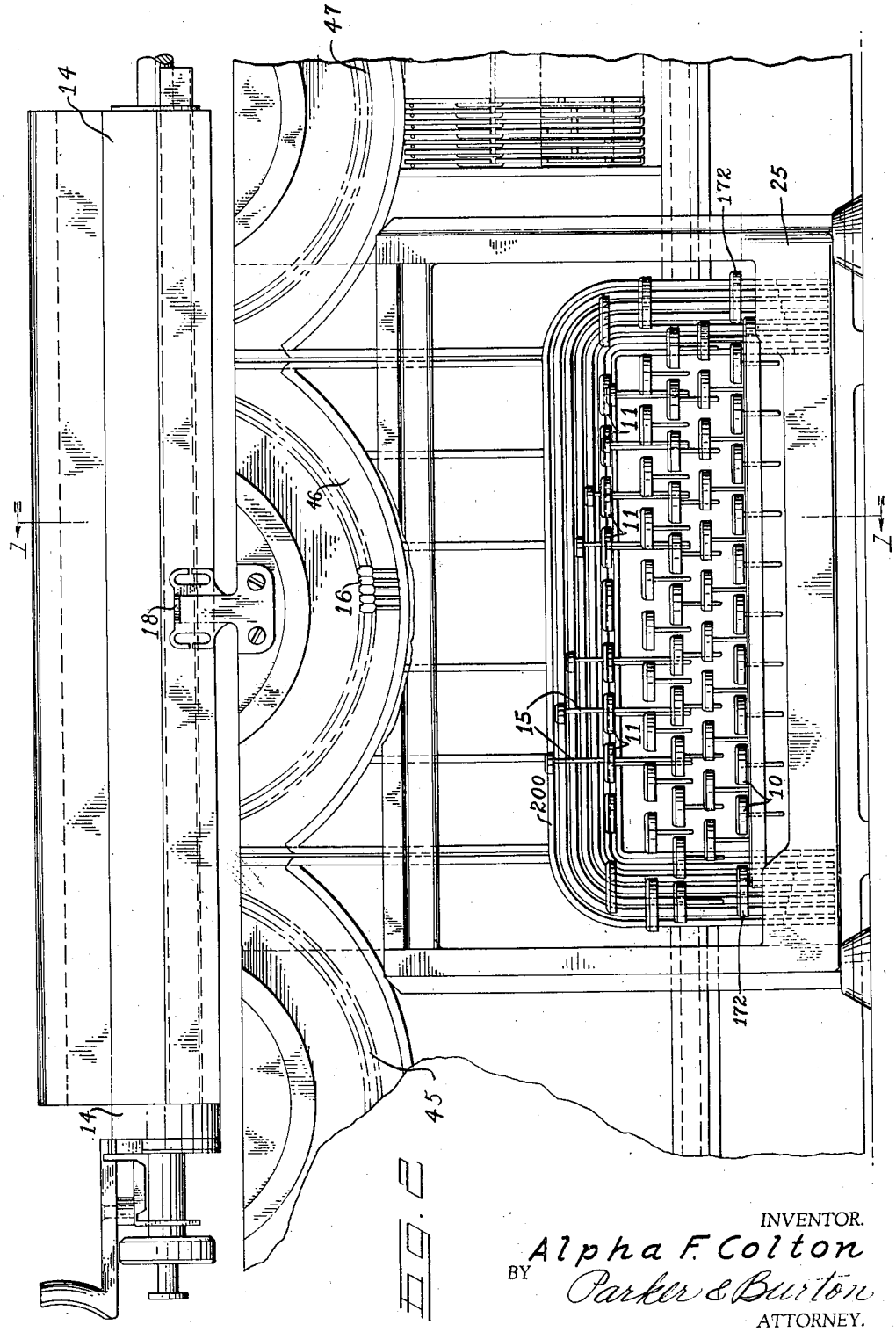

FIG. 2

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VARIABLE TYPE PRINTING MACHINE

Filed Sept. 19, 1938 7 Sheets-Sheet 3

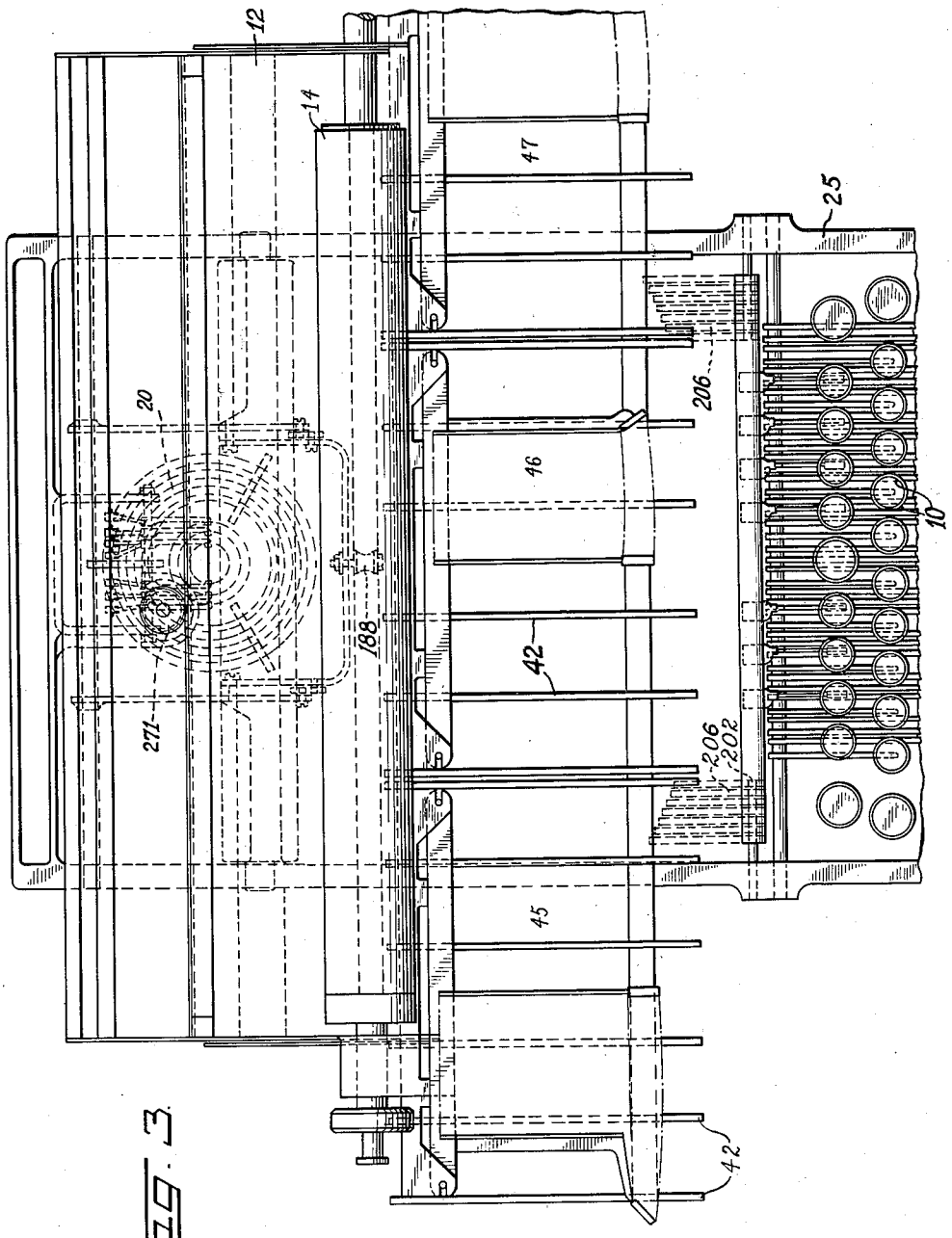

Fig. 3

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VARIABLE TYPE PRINTING MACHINE

Filed Sept. 19, 1938 7 Sheets-Sheet 4

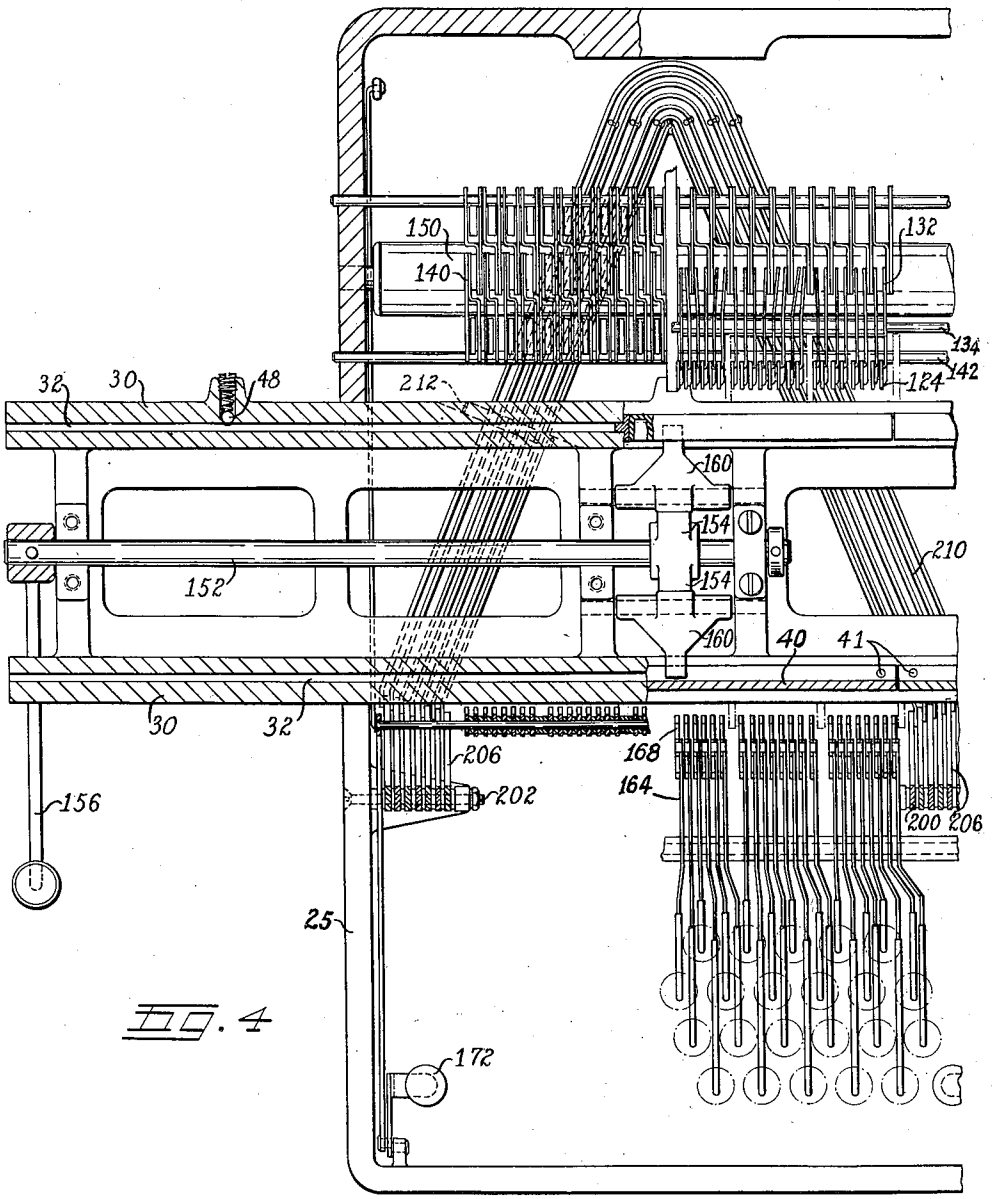

FIG. 4

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VARIABLE TYPE PRINTING MACHINE

Filed Sept. 19, 1938 7 Sheets-Sheet 5

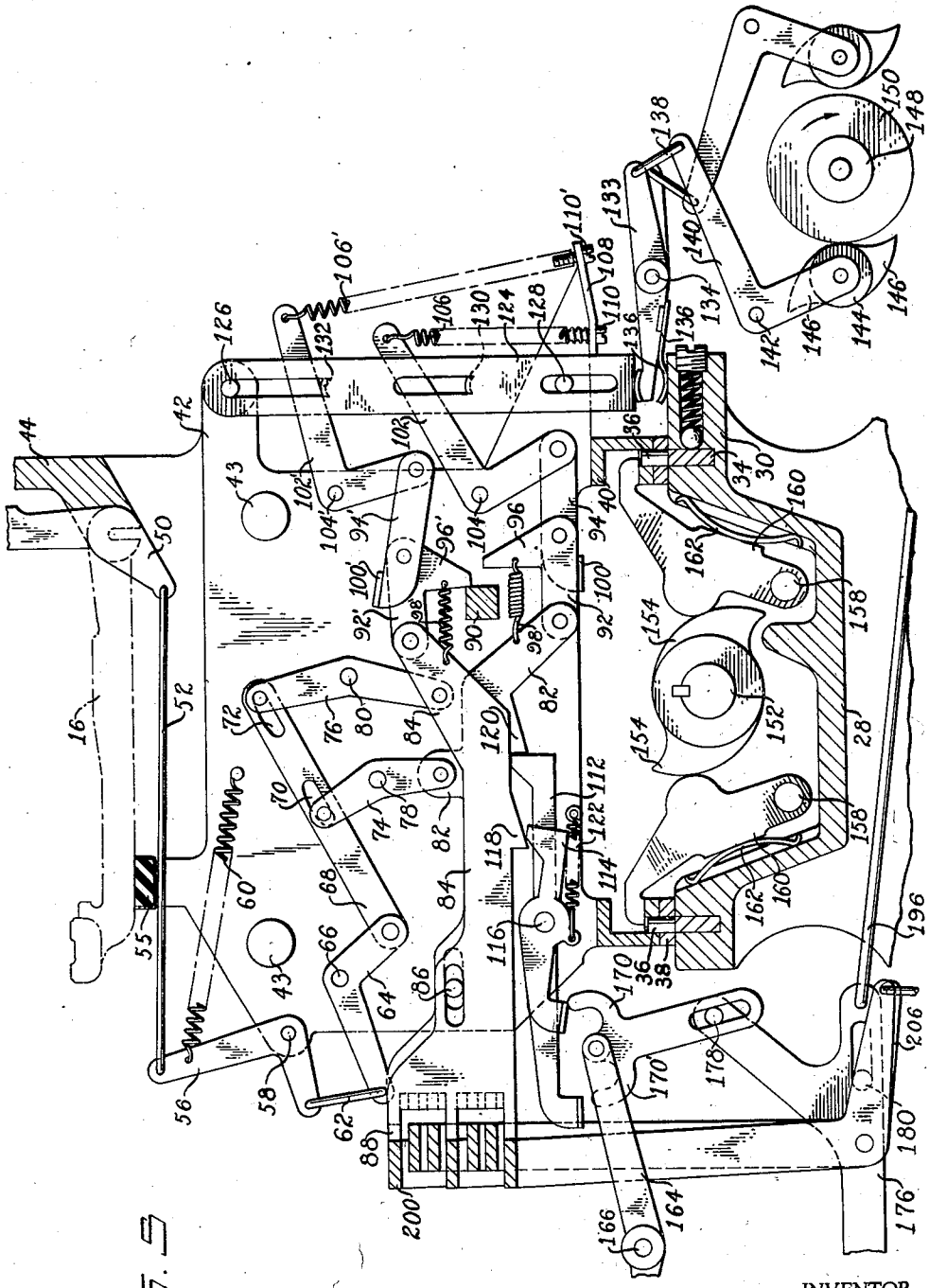

FIG. 5

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VARIABLE TYPE PRINTING MACHINE

Filed Sept. 19, 1938 7 Sheets-Sheet 6

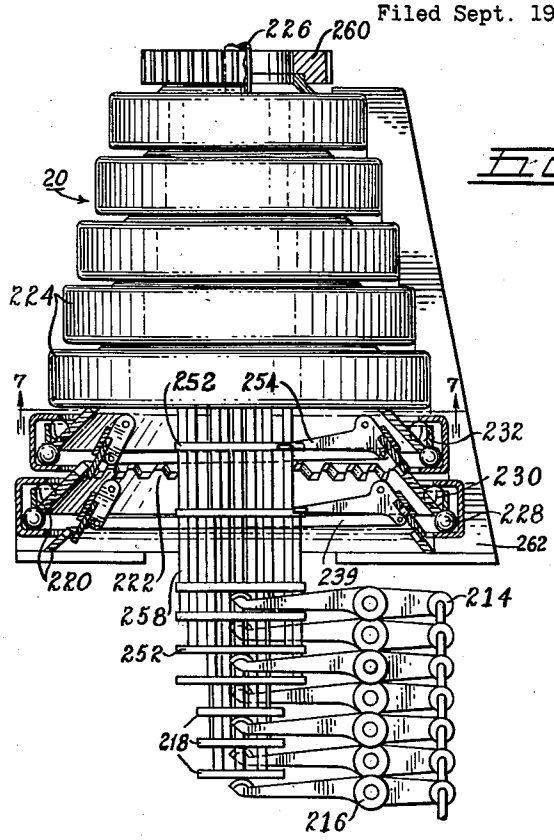


Fig. 6

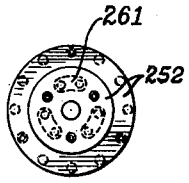


Fig. 8

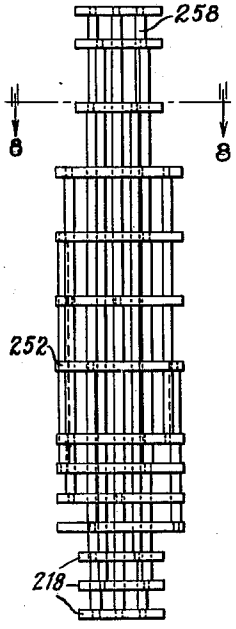
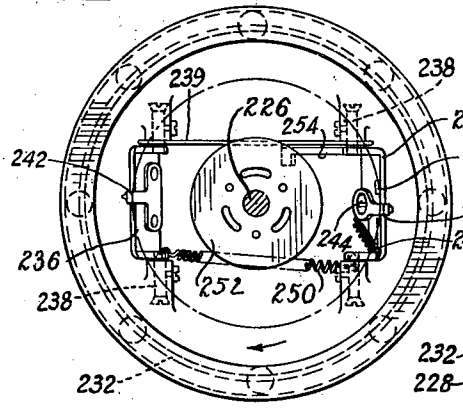


Fig. 9

Fig. 7



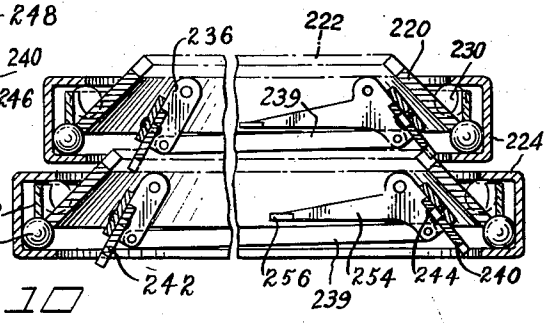


Fig. 10

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VARIABLE TYPE PRINTING MACHINE

Filed Sept. 19, 1938 7 Sheets-Sheet 7

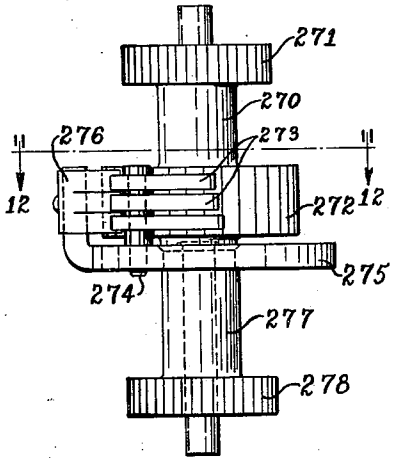

Fig. 11

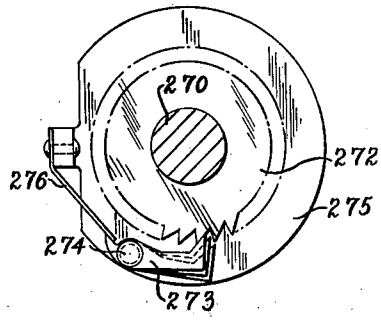

Fig. 12

Fig. 13

Variable Width

28 19 17 12 27 27 12 18 45 10 20 9 23

Roman

Italic

2 9 15 9 9 12

Boldface

15 20 11 17

aaaa

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Patented Nov. 11, 1941

2,261,965

UNITED STATES PATENT OFFICE

2,261,965

VARIABLE TYPE PRINTING MACHINE

Alpha F. Colton, Detroit, Mich.

Application September 19, 1938, Serial No. 231,307

10 Claims. (Cl. 197—17)

This invention relates to printing machines and particularly to an improved typewriting machine capable of printing a variety of printing fonts and of providing a practically unlimited number of widths for each printing character.

An important object of this invention is to provide a machine of compact proportions approximating the size of a typewriter adapted to print various types or fonts of characters and to give an individual spacing to the characters. It is desirable that an automatic line justifying mechanism of the type illustrated in my copending application, Serial No. 42,796, filed September 30, 1935, now Patent No. 2,133,973, be incorporated in the machine. As a result, a machine constructed in accordance with this invention and including the automatic justifier of my copending application is able to produce a typed original that is equal to a proof from printer's type. Photographic reproductions of this printed material can be used to form type plates for printing purposes. If desired, the automatic justification and indention control described in my copending application Serial No. 230,733, filed Sept. 19, 1938, could be incorporated in this machine.

Other important objects of this invention are to provide a machine of small proportions, which will rapidly substitute any one of several type faces and automatically space the characters on the printed surface in the most pleasing letter widths. In accomplishing the objects of this invention, the machine is of such a design that a whole set of type bars and associated parts is readily insertible into and removable from the machine. Each set of type bars thus inserted is provided with a particular kind of font such as roman, italic, or bold face type. The machine is preferably provided with a novel track construction extending operatively between a bank of keys and the print receiving surface. Mounted on this track is a body or unit carrying a plurality of sets of type bars and associated parts. One such unit at a time is capable of being moved along the track into operating position before the print receiving surface. The machine is so constructed that there is no need to connect any parts together as each unit is shifted into operating position. The machine is thus capable of utilizing several different kinds of type without any extra effort on the part of the operator other than to bodily shift the desired set of type bars along the track into operating position.

The machine constructed in accordance with this invention is provided with novel mechanism for individually varying the spacing of the characters or letters as they are printed. It is well understood in the printing art that printed letters vary in width, and heretofore in the use of type setting or composing machines the spacing of the letters was accomplished by casting the metal slugs containing the letters in various widths. The present machine provides a novel escapement mechanism for shifting one part of the machine, such as the print receiving surface, in step by step fashion as character impressions are made which is capable of providing a practically unlimited variation of letter widths. As a result any design or proportion of faces may be typed on the print receiving surface without shifting or adjusting any part of the machine. The escapement mechanism accomplishing this result is composed of a plurality of escapement devices mutually interrelated and so arranged that two or more of these devices may be operated simultaneously to obtain the desired character spacing. The several devices of the escapement mechanism are associated together so that they act cumulatively or additively together in one direction therethrough to cause shifting movement of the body or platen upon which the print receiving surface is mounted. Novel operating elements are provided for actuating any one or several or all of the escapement devices as a key is operated to swing a type bar against the print receiving surface. These elements are preferably permanently installed in the machine and are disposed in positions where they are readily operated upon by any one of the displaceable units of type bar sets insertable in the machine. By varying the construction of the individual operating parts of the machine it is possible not only to provide a different width for different characters but also to provide a different width for the same letter as it appears in the different printing fonts.

An important feature of this invention is the provision of novel mechanism for positively preventing binding or locking of parts if there is any overlapping action particularly as regards printing of capital and small letters. The machine as in typewriters in general is provided with a shift mechanism for typing capital letters when the keys are struck. In the present invention two connections are provided between each key and its type bar, one for operating the type bar to strike a small letter and the other for operating the type bar to strike a capital letter. Novel means is provided which, when the shift

mechanism is operated for printing capital letters, instantly and automatically renders the connection for typing small letters inoperative. When the connection for typing small letters is resumed the connection for operating the type bars to print capital letters is instantly and automatically removed from operation.

Another important feature of this invention is the provision of novel power operated means for operating the type bars. The stored energy of springs is employed for individually operating the type bars. These springs are adjustable in a novel manner to vary the individual typing strokes. Novel means is operable after each type bar has been used to instantly self cock the type bar against the tension of the springs for succeeding type actions. The parts are so operatively associated together that the typing may be performed by the operator as rapidly as on the ordinary typewriter. There is no necessity for waiting until each type bar falls back into its initial operating position. On the contrary the machine may be operated so quickly that one type bar may be making an impression on the print receiving surface while another type bar may be settling back and a third type bar rising to make the next succeeding impression.

Various other objects, advantages, and meritorious features will become more fully apparent from the following specification, appended claims, and accompanying drawings, wherein:

Figure 1 is a cross sectional view through a machine embodying the invention from front to rear and taken along line 1—1 of Fig. 2,

Fig. 2 is a front view of the central portion of the machine shown in Fig. 1 partially broken away for clarity,

Fig. 3 is a top view of the central portion of the machine and indicating in dotted outline the position of certain parts in the interior of the machine,

Fig. 4 is a horizontal cross-sectional view through the base portion of the frame,

Fig. 5 is an enlarged detail of one of the mechanisms for operating a type bar showing one position of its movement,

Fig. 6 is an enlarged detail view of the escapement mechanism partially broken to show the interior construction,

Fig. 7 is a cross sectional view through the escapement mechanism along line 7—7 of Fig. 6 and shows the underside of one of the escapement devices in the mechanism,

Fig. 8 is a cross sectional view along line 8—8 in Fig. 9 and shows the formation of the discs utilized in the escapement mechanism,

Fig. 9 is a detail view of the operating rods and discs in the escapement mechanism,

Fig. 10 is an enlarged detail view of the elements employed in each escapement mechanism,

Fig. 11 is an enlarged plan view of the clutch employed between the escapement mechanism and the carriage,

Fig. 12 is a cross sectional view of the clutch in Fig. 11 along line 12—12 thereof, and

Fig. 13 is a view illustrating examples of printed material producible upon a machine of this invention showing particularly various kinds of fonts and the variable widths of the characters.

The purpose of the invention may be best explained by referring to Fig. 13 where several different kinds of type such as that used by printers are shown. These various fonts of type, roman, italic, bold face and others, are regularly produced by printers on Monotype, Linotype and other forms of printing machines. These machines space the letters from one another so that a line of such characters looks uniform to the eye, that is, the letters in the words do not appear to be spaced at one point and crowded at another point. It is the purpose of the present invention to produce the same kind of printing from a machine similar in size and principle to that of an ordinary typewriter. The machine may well have the usual features of a typewriter such as a keyboard, a movable carriage or platen, an escapement mechanism, an inked ribbon, and type bars which swing in an arc when a key on the keyboard is depressed and strike the platen through the inked ribbon. The machine described herein incorporates these parts. It is understood, however, that the principles of the invention are applicable to other forms of printing machines.

Referring to Fig. 1, the machine comprises, in general, a keyboard 10, each key of which is individually depressible, and a movable carriage 12 carrying a roller platen 14 against which a series of typebars 16 strike to make the printing impressions. As is customary in typewriter use, paper will be rolled about the platen and the faces of the type bars will strike the paper through an inked ribbon stretched through a ribbon support 18 shown in Fig. 2. The stored energy of a spring (not shown) or other form of power means acts upon the carriage 12 and yieldingly urges it in one direction of its travel. An escapement mechanism, generally indicated at 20, acts to impart a step by step motion to the carriage as printing impressions are made by the type bars. It is operatively coupled through a one way drive mechanism 22 to a rack bar 24 supported on the carriage.

Encircling the machine is a rectangular frame 25. At the back and sides of the machine walls are provided for partially enclosing the operating parts, the front and top being open as is customary to permit access to the keyboard and to the travelling carriage. Extending transversely of the frame 24 and operatively between the platen roller and the keyboard is a sub-frame 26. This sub-frame is shaped with a depressed central portion 28 and raised marginal portions 30. The latter form a pair of tracks or ways upon which moves a plurality of sets of type bars and operating means therefor. As shown in Fig. 4 the sub-frame 26 including the track portions 30 projects from opposite sides of the machine. The tracks are each grooved longitudinally as shown at 32 in Fig. 4. These grooves receive vertical slide bars 34 which lie flush with the edges of the grooves and provide a sliding support for the several sets of type bars and operating means therefor. At spaced intervals, dowel pins 36 project from the top edges of the slide bars. Overlying the top edges of the slide bars and bearing upon the top of the tracks 30 are horizontal slide bars 38. These last bars are provided with holes through which the dowel pins project as shown. Each pair of horizontal and vertical slide bars form a T-shape sliding support for a plurality of units containing certain operating parts of the machine.

The units above referred to each include in this particular embodiment of the invention a set of type bars, operating mechanism therefor, and control means for determining the length of carriage travel as each typing operation is performed. The supporting framework of each unit

comprises spaced parallel supporting members 40 fixed to and arranged so that they bear upon the strips 38. The supporting members 40 are of a length approximating the side dimensions of a set of type bars. Holes are provided in the members 40 as indicated in Fig. 4 at 41 for receiving the projecting ends of the dowel pins. Bridging the supporting members 34 at spaced intervals are parallel upright supporting plates 42. Between these plates are assembled the parts for operating the type bars of that particular set. Rods 43 passing through the plates act to hold the same in place. Extending transversely of the plates at the top is a type bar segment 44 of customary construction. It is slotted along its bottom edge to receive the pivoted ends of the type bars 16. A wire extending through the slotted edge of the segment acts as a bearing point about which the type bars swing. The above assemblage forms a complete unit removable from the machine by merely lifting the unit bodily from the track.

The track in the present embodiment of the invention is long enough to receive three such units as that described above. When three units are properly connected to the slide bars 34 and 38 by fitting the dowel pins into holes provided therefor in the members 40, the three units are shiftable left and right through the machine. The type bar sets of each unit are designated by the reference numerals 45, 46 and 47. Each set may have a different kind of character design, the left set 45 may have italic font, the center set 46 may have roman font, and the right set 47 may have bold face font.

To dispose each unit in operating position before the platen roller, concave depressions are formed in the sides of the vertical slide bars 34 into which spring pressed balls 48 are pressed when a unit is disposed in operating position on the track. The operator can tell by the sudden check imposed on the travel movement of the units by the spring pressed balls when they enter a depression that one of the units is in position for typing. The balls, however, will yield to extra force being exerted to shift the units.

Each type bar in each unit is provided with its own operating mechanism. These operating mechanisms are similar and a description of one will suffice for the others. Referring in particular to Figs. 1 and 5, each type bar 16 is provided with an arm 50 extending angularly below the segment 44. The usual pull wire 52 acts on the arm 50 to swing the type bar upwardly against the platen roller. A bumping ring 54 is provided on each segment to limit the severity of the type bar stroke. After the typing stroke the type bar will fall back on a cushioning ring 55 customarily employed.

The opposite or forward end of the pull wire 52 is connected to one end of a crank arm 56 pivoted at 58. The usual return spring 60 acts on the crank arm to return the type bar to its initial operating position. The free end of the crank arm is connected by a vertical wire 62 to one end of a transfer lever 64 disposed therebelow. This last lever is pivoted about a wire 66 common to all the type bars in the set. In order to allow the arrangement of the type bars of each set in an arcuate formation the connecting wires 62 are of varying lengths as indicated in Fig. 1.

One end of a link 68 is pivotally connected to the opposite end of the transfer lever 64. Link 68 is free for bodily movement and is provided with two slightly arcuate slots 70 and 72. Pins secured to the ends of actuating levers 74 and 76 ride in these slots. These levers are pivoted intermediate their ends on horizontal rods 78 and 80, respectively, extending parallel to the sub-frame 26. The opposite or lower ends of the levers 74 and 76 are pivotally attached respectively to reciprocating members or plates 82 and 84. Two such plates and two such levers 74 and 76 are provided for each type bar. The plates are disposed side by side, plate 82 being partially concealed from view in Figs. 1 and 5. Rod 86 extending parallel to the sub-frame supports the plates 82 and 84 for fore and aft movement, the plates being slotted horizontally where rod 86 passes therethrough as shown to permit this movement. The forward end of each plate is provided with one or more projections or teeth 88. In the present embodiment of the invention three teeth is the maximum each plate may have. These teeth vary in position on each plate, and as will be pointed out hereinafter the number, as well as the position of the teeth, will determine the distance of carriage movement as each typing stroke is made.

The rear ends of the plates 82 and 84 for each type bar are directed angularly in opposite directions as shown. In normal inoperative position, the plates are disposed in their rearward position. To drive each plate forward, a toggle mechanism which can be broken as hereinafter described is provided. Each toggle mechanism comprises a pair of links and a projecting dog on one link which is tripped by the fixed horizontal bar 90 extending parallel to the sub-frame. The two links for plate 82 are shown at 92 and 94, link 92 having the projecting dog 96 which is tripped by bar 90. The two links for plate 84 are disposed on the other side of the bar 90 and are referred to by numbers 92' and 94', the dog of link 92' being represented by number 96'. Each toggle mechanism is provided with a spring 98 or 98' which is tensioned between the plate with which it is associated and the dog of the toggle mechanism and acts to swing the links inwardly toward stop bar 90. Stops 100 and 100' are provided on links 94 and 94', respectively, to limit the inward movement of the links when the links of each toggle are disposed in alignment as shown in Fig. 1.

Power means acts through the toggle mechanism to drive the plates 82 and 84 forwardly in the machine. To accomplish this, the rear links 94 and 94' of each toggle mechanism are each connected to one end of the crank arms 102 and 102' respectively. The crank arms are pivoted about rods 104 and 104' respectively as shown. The opposite ends of the crank arms project upwardly and rearwardly. Coil springs 106 and 106' are tensioned between a support 108 on track 30 of plates 42 and the upwardly inclined ends of the crank arms 102 and 102' respectively. Screws 110 and 110' adjustably secure the springs 106 and 106' respectively to the support 108 and are capable of varying the tension of the springs. Individual adjustment of the coil springs is particularly desirable because it permits careful regulation of the type bar strokes and obtains a uniform printing impression irrespective of the size or design of the typing faces.

Each plate 82 and 84 is releasably locked in rearward position against the tension of its respective spring 106 and 106' by dogging mechanism operable from the keys on the keyboard.

Disposed below each pair of plates are a pair of dogs or pawls 112 and 114 rockably supported on a horizontal rod 116. Each dog is tensioned by a spring to rock counterclockwise into engagement with a depending tooth or lug on the plate with which it is associated and lock the plate against forward movement. Dog 112 is associated with plate 82 and acts as a stop against which the lug 118 strikes. Dog 114 is associated with plate 84 and is a stop against which the lug 120 strikes. Spring 122 is associated with dog 114 and as previously described acts to swing the dog into position to engage lug 118. A smilar spring (not shown) is provided for dog 112. When a dog is rocked clockwise and is released from engagement with the lug on the plate with which it is associated, the plate will be impelled forwardly by the tensioned spring acting on the toggle mechanism. Fig. 5 shows this action with respect to plate 84. The impelling action of the spring 106' which is urging the plate forwardly is broken when the depending dog 96 of the toggle mechanism is tripped by bar 90. Fig. 5 shows the toggle links in the prccess of being broken by the bar 90.

Associated with each pair of plates 82 and 84 is a device for returning both plates to initial inoperative position against the tension of the power springs 106 and 106'. This device is operated automatically from a continuously rotating member extending transversely throughout the machine. Referring to Fig. 5, the device for each pair of plates comprises a member 124 supported for vertical movement by spaced rods 126 and 128. The member is slotted to provide this vertical movement as shown. Intermediate the extremities of this member, tabs 130 and 132 are struck out. These tabs engage the bottom edges of the crank arms 102 and 102' and when the member 124 is moved upwardly it acts to swing these crank arms counterclockwise against the tension of the springs. If the upward movement imparted by member 124 to the crank arms carries the plates 82 and 84 rearwardly far enough the dogs 112 and 114 will engage the plates and hold them against the tension of the springs and thereby relieve member 124 of the support of the crank arms.

Acting upon the bottom end of the member 124 is a cocking lever 133 pivoted intermediate its ends at 134. The end of the cocking lever acting upon the member 124 is provided with a light flat spring member 136 which, as shown in Fig. 5, yieldingly spaces the end of the lever from the rear rail 30. This spring, however, will yield to allow the lever 133 to rock counterclockwise when member 124 is pressed downwardly by the action of the springs 106 or 106' on their respective crank arms. The opposite end of the lever 133 is connected by a link 138 to one end of a crank arm 140 pivoted at 142. The opposite end of the crank arm carries a half cycle cam 144. Extending transversely of the machine there is a continuously operated shaft 148 carrying a roller 150 against which the half cycle cam 144 is adapted to be pressed. It is obvious from an examination of Fig. 5 that if the lever 133 is rocked counterclockwise it will carry the rotatable member 144 and its cam faces into contact with the periphery of the roller 150. This shaft is continuously rotated in the direction of the arrow by power means not shown, and when the contact is made between the cam 144 and the roller, the cam rolls over on one of its high sides and laterally displaces the lower end of the crank arm 140 from the roller. This movement, as is apparent, swings the lever 133 in the opposite direction to that in which it is urged by the member 124 when the latter is depressed. Accordingly it acts to raise the member 124 and either one of the crank arms 102 or 102' which at that time may be bearing upon the tab 130 or 132. This upward movement of member 124 as previously described will raise this crank arm and retract the plate 82 or 84 associated therewith through the toggle link mechanism. After one of the high sides of the cam faces 144 has escaped past the periphery of the roller 150 the crank arm 140 will swing counterclockwise to its initial operating position. A contact of the rotating member 144 with the periphery of the roller 150 is prevented at this point by the flat spring 136 which is strong enough to keep away the cam from contact. Thus it is only when member 124 is depressed by the action of one of the crank arms 102 or 102' that the rotatable member 144 is forced into contact with the roller. As shown in Fig. 5, the half cycle cam assemblies may be arranged alternately on opposite sides of the roller 150 to conserve space.

The type bars 16 and their associated operating mechanism and recocking mechanisms are all located upon a body which travels upon the rails 30 of the sub-frame. To positively lock this body with one of the sets of type bars in operating position, there is provided in the depressed portion 28 of the sub-frame a clamping mechanism which is manually controlled from the outside of the machine. As is clearly shown in Fig. 5, this mechanism comprises a shaft 152 to which is secured a cam element having two diametrically opposite cam faces 154. This shaft extends longitudinally through the depressed portion of the sub-frame and projects from one end thereof as is shown in Fig. 4. Journals are provided at spaced points along the sub-frame for permitting rocking movement of the shaft. To the projecting end of the shaft there is fixed a handle 156 which, when swung downwardly, will cause the shaft and the cam members associated therewith to rotate in a counterclockwise direction as viewed in Fig. 5. Pivotally supported upon rods 158 are clamping members 160 having turned over ends which are adapted to bear upon the supporting members 38 of the travelling body. Fitted to the sides of the sub-frame in the depressed portion 28 are flat spring members 162 which act, as is clearly apparent in Fig. 1, to swing the clamping members out of engagement with the supporting members 38. However, it is apparent that when shaft 152 is rotated counterclockwise it will carry the high sides of the cam faces 154 into engagement with the backs of the clamping members 160 and force them down into tight engagement with the supporting members 38. Thus, after one set of type bars has been disposed in operating position in the machine, the travelling member may be positively locked against any movement during the operation of the machine.

The keys on the keyboard are separately associated with each pair of plates 82 and 84. Novel operating means is provided for tripping one of the dogs 112 and 114 and positively preventing the other from being acted upon when the key 10 associated therewith is depressed. Considering the operating mechanism for one key 10, a lever 164 is rockably supported intermediate its ends about a rod 166. The forward

end of the lever is shaped to be engaged by the key when the latter is depressed. As is clearly apparent in Fig. 1, this will cause lever 164 to swing in a counterclockwise direction and carry its opposite rear end upwardly toward the front ends of the dogs 112 and 114 disposed thereabove. Pivotally carried on the rear end of the lever 164 is a trip lever 168 having ears 170 and 170' on opposite sides thereof which are adapted, when member 168 is swung to an inclined position, to engage the forward end of one of the dogs. Thus, when a key 10 is depressed it will cause the member 168 associated therewith to rise and trip one of the dogs and thus cause one of the plates 82 or 84 to shift forwardly its limited distance of travel. If, as shown in Fig. 5, the ear 170 engages and raises the forward end of dog 114 the plate 84 associated therewith will be forced forward by the action of its spring 106'. Conversely, however, if member 168 is swung to an inclined position substantially opposite to that shown in the drawings the forward ear 170' will be in position for engaging the forward end of the dog 112 and tripping the same so as to cause forward advancement of plate 82.

The two-positional character of member 168 is for the purpose of operating the type bar to print either a capital letter or a small letter. When it is in the position shown in the drawings it is adapted to cause the printing of a small letter. When it is shifted to an inclined position opposite to that shown in the drawings it is ready to cause the printing of a capital letter or other printed symbol.

For manually controlling the position of member 168, the usual shift key on the keyboard is provided with mechanism which swings the member 168 to its inclined position opposite to that shown in the drawings. The shift key is represented at 172 on the keyboard. When depressed it will swing a crank arm 174 in clockwise direction in Fig. 1 and pull link 176 forwardly. Since this link as shown in Figs. 1 and 5 is attached to member 168 through a slotted connection 178, the member will be swung around its pivotal support on lever 164 to an inclined position equal to but opposite that illustrated in the drawings. A stud 180 supports the link 176 for reciprocal movement.

When the shift key 172 is depressed it also causes the platen roller to rise so that the type faces carrying the capital letters may be in position to strike the platen. This is accomplished in any suitable way well known in the art. For example, the opposite ends of the platen roller may be carried upon arms 182 which are pivoted to the carriage at 184. To produce the upward movement of the platen roller at any point in the travel of the carriage an arm 186 having a grooved wheel 188 is provided for engaging a circular rod 190 extending across the bottom of the carriage frame. This arm is connected by suitable linkage 192, 194, and 196 to the rear end of the shift link 176.

When material is typed upon a machine of this character, the carriage must be advanced in step by step manner to present succeeding spaces on the paper for the type bars to strike thereagainst. It is the purpose of this invention as previously described to arrange the spacing of the characters on any printing surface inserted in the machine in a way most pleasing to the eye. To accomplish this each character typed is given an individual spacing on the print receiving surface. Letters of large or small widths can therefore be printed in a way which is equal to a proof from printers' type. The individual spacing of the characters is provided by novel escapement mechanism which varies the distance of travel of the carriage in accordance with the particular character typed. This novel mechanism 20 is disposed in the rear of the machine below the path of travel of the carriage. In general, this escapement mechanism comprises a plurality of escapement devices arranged to act cumulatively upon one another and transmit the resulting action to the carriage.

In the present embodiment of my invention, seven such escapement devices are provided in the escapement mechanism generally indicated at 20. These devices are mounted as shown in a vertical stack, each device being of slightly less diameter than the device therebelow so that the mechanism has a conical appearance when viewed as a whole. Each device in the mechanism is individually operated by linkage extending to the front of the machine. Seven of such links corresponding in number to the escapement devices employed are shown in the illustrated embodiment of the invention herein. As previously mentioned the plates 82 or 84 are provided with teeth 88 which are positioned in different positions on the plates of each set of type bars for the purpose of determining the amount of carriage movement as each typing operation is performed. The linkages connecting the escapement mechanism with the front of the machine are so disposed opposite these teeth so as to be affected thereby when either the plate 82 or 84 is impelled forwardly when released by the dogs controlled from the keyboard.

Disposed in the path of movement of the teeth 88 on the plates 82 and 84 are a series of escapement operating elements corresponding in number to that of the escapement devices in the mechanism generally indicated at 200. Referring to Figs. 1 and 2, these elements are indicated at 200 and are arranged in a vertical plane just rearwardly of the keyboard but forwardly of the way through which the type bar segments travel so as not to interfere with their movement. These elements 200 are in the form of thin flat bars of inverted U-shaped formation. They extend the length of the keyboard as shown in Fig. 2 and the opposite ends depend downwardly below the keyboard. As Fig. 4 clearly shows, studs 202 extending inwardly from opposite sides of the rectangular base frame 24 form pivotal supports for the ends of the elements. The elements are independently swingable about these studs.

Each element has a rearwardly extending arm 206 fixed thereto. Depending from the end of the arms 206 are links 208 which separately connect each element to an escapement operating member 210 extending rearwardly along the bottom of the machine to a point below the escapement device 20. Each escapement operating member is of V-shape formation as shown in Fig. 4, the opposite ends of which are pivoted to the links 208 while the base of its V-shape is below the stack of escapement devices 20. Rods 212 which extend angularly to the machine as shown in Fig. 4 form pivots about which the escapement operating members 210 rock. The rear end of each rocking member 210 is connected by a vertical link 213 to one end of an escapement operating lever 214 swingable about a rod 216. The opposite end of each lever 214 acts upon the underside of a circular plate or disc 218

which has connections entering the stack of escapement devices **20**. As shown in Fig. 1, the levers **214** are mounted in spaced vertical relationship in order to allow each lever to act upon a separate disc **218**.

A comparison of Fig. 1 with Fig. 5 will show that when either one of the plates **82** or **84** is impelled forwardly, the teeth **88** provided on the front end thereof will strike one or more elements **200** depending on the number of teeth and rock the elements back as shown in Fig. 5. Three spaced teeth are provided on plate **84** shown in Fig. 5. These teeth therefore rock three escapement operating elements **200** out of line as is clearly apparent. The rocking motions of the elements **200** are transmitted to the V-shaped operating members **210** and rock the latter about their pivot points. This rocking motion in turn is transmitted to the escapement operating levers **214** and acts to raise the discs **218** thus affected.

The novel escapement mechanism **20** as previously mentioned comprises a series of intercooperating escapement devices acting when two or more are operated simultaneously. Each escapement device consists of a tapered ring **220** around the top edge of which cut teeth **222** are provided. The ring **220** of each escapement device except the bottom of the seven shown herein is rotatively supported in a ball bearing race **224**. The ball races and the rings **220** of the escapement mechanism vary progressively in size from the largest diameter at the bottom of the stack to the smallest diameter at the top of the stack. They are arranged concentric to a shaft **226** which projects from opposite ends of the stack. As shown, the lower edge of each ring **220** rides on one set of ball bearings **228**. A second set of ball bearings **230** is carried above the bottom edge of each ring and acts to keep each ring from axial movement relative to the races. A ball bearing spacer ring **232** is provided for keeping the bearings in equally spaced apart condition.

Within each ring **220** is a pair of escapement dogs which act together upon the teeth **222** of the next lowermost ring **220**. As shown in Figs. 7 and 10, the escapement device proper in each ring comprises a rocking frame **234** and a second rocking frame **236** arranged diametrically on opposite sides of shaft **226** and pivoted about spaced parallel axes formed by the pivot pins **238**. A link **239** pivotally attached to the frames at points spaced from the pivot pins functions to connect the frames together for joint rocking movement. On frame **234** a loose escapement dog **240** is mounted, on the other frame a tight or fixed escapement dog **242** is provided. The loose dog **240** is pivoted by screw **244** to the frame **234** for rocking movement parallel to the frame. A small coiled spring **246** is tensioned between the frame **234** and the loose dog and yieldingly acts to swing the dog in the opposite direction from the spring. A stop **248** is provided on the frame for limiting the swinging movement of this dog.

Extending between a fixed part on the ring and the frame **236** is a coiled spring **250** which yield- that when the frames are in this extreme position of their rocking movement. The dogs **240** and **242** are so mounted on their respective frames that when the frames are in this extreme position of their movement urged by spring **250** only the loose dog **240** engages with the teeth on the next lower ring but when the frames are rocked to the opposite extreme position of their movement the tight or fixed dog **242** meshes with the teeth of the lower ring while the loose dog is drawn inwardly out of engagement with the ring. If a force continuously urges the stack rings **220** to rotate in one direction the act of rocking the frames in one of the rings will click the dogs **240** and **242** in and out of mesh with the teeth of the ring below and all the rings thereabove will rotate intermittently so long as the rocking motions continue. In the present instance, the pull exerted on the carriage of the machine is transmitted to the top of the stack of escapement devices and tends to rotate the rings **220** in the direction indicated by the arrow in Fig. 7. When the frames **234** and **236** in one ring are rocked this ring and all rings thereabove will rotate the distance of one tooth on the next lowermost ring.

To rock the frames **234** and **236** of each escapement device from operating levers **214**, each ring has associated therewith a circular plate or disc **252**. This disc is provided with a central hole slidingly fitting the shaft **226**. Formed integral on rocking frame **234** of each escapement device is an arm **254** which projects inwardly toward the rim of the nearest disc **252** and is provided with a part **256** which rests thereon. It is obvious that when a disc **252** is raised it will raise the arm **254** and rock both frames **234** and **236** against the tension of spring **250**. The ring within which these frames are mounted will then be rotated the distance of one tooth on the ring next therebelow.

Each disc **252** is connected to one of the discs **218** upon which the escapement operating levers act. The form of connection is by struts or rods **258** which pass through any discs intermediate the two discs which are connected together. Certain of the discs **218** and **252** are a little larger than the others in order to allow passage of their connecting rods past the edges of the smaller discs. Three connecting rods are provided for each set of discs **218** and **252**. The rods are spaced equidistantly around the shaft **226**. The smaller discs except those at the extreme ends of the stack are each provided with three equidistantly spaced arcuate slots **261** as shown in Fig. 8. Through these slots pass rods for operating other discs in the escapement mechanism. The smaller connected sets of discs **218** and **252** are arranged in corresponding positions, the bottom disc **218** connecting by rods with the upper disc **252**, the next lowermost disc **218** with the next higher- most disc **252**, and the third disc **218** from the bottom with the third disc **252** from the top. With respect to the larger discs the order is reversed. The fourth from the bottom disc **218** is connected by the rods to the disc **252** which is seventh from the top, and the fifth disc **218** from the bottom is connected to the sixth disc **252** from the top. The sixth disc **218** from the bottom is connected by rods to the fifth disc **252** from the top, and the seventh disc **218** from the bottom is connected to the fourth disc **252** from the top.

Beginning at the bottom of the superimposed stack of escapement devices, the first ring is fixed in the braces **262** which support the bearing races. The second ring **220** is free to revolve in the ball race in which it is mounted but is retrained by its loose dog **240** which engages one of the teeth of the first ring. The third ring from the bottom is free to rotate but is restrained by the engagement of its loose dog with the teeth of the second ring, et cetera. At the top the eighth or top ring has affixed thereto a spur gear **260** which is

geared through the one-way clutch mechanism generally indicated at **22** to the carriage rack **24**.

The action of the escapement mechanism is as follows: The force acting on the carriage to shift it to one extreme position of its travel is transferred through the clutch device **22** to the spur gear **260** and the top ring **220** and thence through the stack of rings **220** to the fixed bottom ring. Obviously, upon the rocking of any one of the frames **234** and **236**, the dogs carried thereby will permit escapement of the ring the distance of one tooth on the next lower ring. Assuming that the escapement device in the top is actuated, then only the top ring rotates the angular distance represented by the pitch or distance from one tooth to the next tooth on the second ring from the top. If, however, the escapement device associated with the ring **220** second from the bottom is operated, the whole stack of rotating rings escape a distance represented by one tooth on the bottom fixed ring. Any intermediate ring in the stack will, if its escapement is operated, cause itself and all rings thereabove to rotate a distance represented by a tooth on the next lower ring.

If two or more escapement devices in the stack should be operated simultaneously, the effect is cumulative. The action of one is added to the action of the other and the sum total is transmitted to the carriage. Since the carriage is continuously tending to rotate the stack of rings in one direction, the resultant action of two or more escapement operations is instantly transferred to the carriage and the carriage travels a distance until all the loose dogs are restrained from further rotation by the teeth on the cooperating ring.

By setting an arbitrary measure for widths of characters it is possible by varying the diameter of the rings **220** and by using different pitch teeth to get large numbers of character widths from a few escapement devices of the kind described. In the present embodiment of the invention, the diameters of the rings **220** and the pitch of the teeth have been selected so as to provide 43 uniform variations of letter spacing, that is to say, it is possible from the stack of seven escapement devices illustrated herein to advance the carriage anywhere from one increment of space to 43 like increments of space without omitting any increment of space between these figures. Thus, if the largest character typed is given a width or space of 43 increments, it is possible by the apparatus described herein to divide the maximum width into 43 smaller widths all differing from one another by equal spacing increments. There is therefore a variety of 43 widths to choose from for the characters printed by this machine.

The arbitrary figure of 43 is selected herein as the maximum width because it is possible by fixing the escapement devices in values of 1, 2, 3, 6, 10, 20 and 30 to obtain by single or simultaneous operation of not more than three escapement devices all values from 1 to 43. Thus the maximum space selected by this measure may be divided into 43 equal divisions. It is desirable, if possible, to minimize the number of simultaneous escapement operations. The fewer escapement operations that need be performed the longer will the parts last. Furthermore, there will be less load on the coil springs **106** and **106'** since these springs operate the escapement devices in addition to imparting the typing strokes to the type bars.

Naturally the full range of widths of units between 1 and 43 is more than ample to take care of any one font or design of typing face. It is possible to provide a very reduced range from 1 to 15 units, a moderate or average range from 5 to 30 units, while an extended range would utilize the units from 8 to 43. All these different ranges can be obtained without shifting or adding elements or gearing to the machine. The escapement device described herein is capable of accommodating the extremes that might be desired for typeprinting.

Fig. 13 illustrates samples of printing (exaggerated for clarity) which are capable of being produced by the present invention. In the first place by shifting the segment units back and forth on the rails **30** it is possible to print three kinds of fonts, such as roman, italic and bold face. At any time one of these units might be removed without disturbing the other and a unit substituted therefor containing a different font or design of type. In addition, the letters are given an individual spacing which sets them out on a print receiving surface in the most pleasing spatial arrangements. The sample "variable width" illustrates the use of a divisible range of 43 units. The letter of largest width, W, occupies 43 units. The remaining letters are of various lesser widths as indicated by the numerals below each letter, the letters *t* and *i* being the smallest in width. The division of the "italic" into units shows how the letters of a different font may be given various widths to space them in the most pleasing way to the eye. The grouping of "a"s illustrates the different width that may be required because of difference in design of alphabets.

The operation of the machine is similar to that of a typewriter and may be briefly summarized. Selection of the kind of printing font is obtained by shifting the segment units back and forth along the track until the spring pressed balls releasably lock the desired unit in operating position when the parts in the unit and main frame are disposed in operating relationship. A depression of a type bar key will act as trigger upon the type bar mechanism and the stored energy of the coil spring acting on plate **82** (or **84** if upper case letters are being typed) corresponding to this type bar will drive the same forward and impart a typing stroke to the type bar selected. At the same time the plate rocks one or more escapement operating elements and causes the operation of the escapement mechanism **20**. The position and number of the teeth **88** on the plate control the operation of the escapement. The driving force exerted by the coil spring on the plate which is released will terminate when the toggle links are tripped and broken by the bar **90**. This will occur before the type bar has made a printing impression so that its momentum alone provides the typing action. At the same time the plate is impelled forwardly, the cocking member **124** associated therewith is depressed and the two cycle cam **146** is pressed against the continuously operating roller where it receives a driving force sufficient to raise the cocking member and tension the released spring. In the meantime the released plate is returned by the tension of the return springs on the type bar and toggle mechanism and is releasably locked against the tension of the driving spring by the key operated dog which previously had released it.

In order that the operator may have manual

variable control of the spacing of the platen independent of the control produced by character key actuation, I have provided seven separate control keys 11 each having an arm 15, one arm for each inverted U-bar 200. Such arm is hooked over its U-bar 200 as shown in Fig. 1. When one or more of said control keys 11 is depressed it pulls its controlled U-bar 200 forwardly in the same manner as if said bar had been actuated by either of the plates 82 or 84 and thereby controls the selective functioning of the escapement. This mechanism might be utilized by the operator for making corrections or for lining up as desired.

The clutch device generally indicated at 22 provides a positive connection between the escapement mechanism 20 and the carriage when the latter is travelling in the direction it is tensioned but disconnects the drive between the escapement mechanism and the carriage when the carriage is returned for the typing of another line.

This clutch device is constructed in a novel manner to exactly hold the carriage in any adjusted position. It comprises a number of operating elements as follows: Fixed at the top of a spindle (shaft) 270 is a gear 271 which meshes with the carriage rack bar 24. Fixed midway of said shaft is a ratchet gear 272 with angular slanted teeth of fine pitch. Three pawls 273 are spaced apart by washers and pivoted on pin 274 fixed at its lower end in plate 275. Secured to an upwardly extending arm of plate 275 is a flat spring 276 which is slit into three separate sections at its free end and pressed outward on the tails of pawls 273 engaging the pawls with ratchet gear 272. Fixed in plate 275 is a sleeve 276 and fixed at the lower end of the sleeve is gear 278 which meshes with gear 260.

Three slightly different lengths of pawls are used so that each tooth of gear 272 may be held in three different positions. If the teeth are 3/64 inch apart at the pitch diameter then the holding positions are varied by 1/64 and since the gear meshed with the carriage rack is 2/3 the diameter of the ratchet gear the distance between possible stopping places is 1/96 inch. In typing with variable width escapements in a typewriter the end of a line might be any multiple of the difference between any two different carriage feeds and in returning the carriage to the initial typing point the ratchet must be of very fine division to hold the carriage at the correct starting point.

What I claim:

1. A typewriting machine comprising, in combination, a print receiving surface, a bank of keys disposed in front of said print receiving surface in spaced relation thereto, mechanism for imparting step-by-step movement to said print receiving surface formed of a plurality of escapement devices being in number substantially less than the total number of keys in said bank of keys and each adapted to impart a different step-by-step movement to the print receiving surface, said escapement devices operatively associated together so that two or more of the devices can be operated simultaneously and cause the print receiving surface to advance an amount equivalent to the sum of the separate steps imparted by the escapement devices thus operated, a track extending transversely through the machine from one side to the other between the bank of keys and the print receiving surface, a unit capable of movement along said track carrying a set of type bars for striking the print receiving surface, type bar operating mechanisms, means controllable from the bank of keys for causing the operation of said type bar operating mechanisms selectively when the unit is disposed in predetermined position between the bank of keys and the print receiving surface, escapement operating elements arranged side-by-side substantially parallel to the track but slightly spaced from the path of movement of said unit, said elements corresponding in number to the escapement devices and having connections each to a different escapement device for operating the same, and a member in each type bar operating mechanism carried by the unit adapted when the unit is disposed in said predetermined position and upon operation of the type bar to project from the unit in which it is carried, said member being shaped to engage one or more escapement operating elements when thus projected and cause the operation of one or more escapement devices.

2. A type printing machine comprising, in combination, a print receiving surface, a set of type bars operable to strike said surface and make printing impressions thereon of varying widths, a bank of keys, operating mechanism between each key in said bank of keys and a type bar in said set of type bars and adapted upon movement of the key to cause the type bar to strike the print receiving surface, an escapement mechanism for shifting said print receiving surface in step-by-step manner as said keys are struck, said escapement mechanism including a train of escapement devices operatively associated together and acting cumulatively in one direction from one end of the train to the other, each escapement device operating through succeeding devices in the train to cause a different step-by-step movement of the print receiving surface, a plurality of movable escapement operating elements corresponding in number to the number of escapement devices in said escapement mechanism and each individually associated with one of the devices to operate the same, said elements arranged together in proximity to all the type bar operating mechanisms, an element in each type bar operating mechanism operable upon striking movement of the type bar to engage and shift certain escapement operating elements and thus cause the print receiving surface to move a variable amount depending on the escapement operating element or elements moved, a separate set of keys corresponding in number to said escapement operating elements, and operating connections extending from said set of keys to said escapement operating elements for actuating the latter independently of the operating mechanism for said set of type bars.

3. In a typewriting machine, escapement mechanism for advancing a carriage variable distances of movement as typing operations are performed comprising, in combination, a series of ring-shaped members arranged co-axially in side-by-side relationship, said members provided with inwardly facing teeth around their common axis, all of said ring-shaped members with the exception of one immovable member on one end of the series being mounted for rotation about the axis, escapement devices carried by each rotatable member within the hole thereof and operatively engageable with the teeth of the next succeeding member in the series, operating means for independently actuating the escapement devices of each member extending longi-

tudinally through the holes in the members to their respective escapement devices, the arrangement of the teeth being different on each member so that each single escapement operation or combination of escapement operations imparts a distinct movement to the carriage.

4. In a typewriting machine, escapement mechanism for advancing a carriage variable distances of movement as typing keys are operated comprising, in combination, a series of rotatable ring members arranged co-axially in side-by-side relationship, and provided with inwardly facing teeth around their axis of rotation, the pitch diameter of the teeth on the ring members varying progressively from one end of the series to the other, a fixed member adjacent one end of said series provided with teeth arranged in a circle concentric with said rotatable members, tooth escapement means located within each ring member and attached thereto for joint rotation therewith, each escapement means of one ring member operating upon the teeth of the next succeeding ring member and adapted to allow the ring member to which it is attached to escape one tooth at a time on the next succeeding ring member, the escapement means in the last rotatable member adjacent said fixed member operating upon the teeth of the latter, and means for independently operating the escapement means of each ring member extending longitudinally through the holes in the ring members.

5. In a typewriting machine, a carriage, type bars and operating means therefor, and an escapement for shifting the carriage variable distances as the typing operations are performed comprising a series of ring-shaped members provided with inwardly facing teeth and arranged coaxially in side-by-side relationship, all the members with the exception of one fixed member on one end of the series being rotatably mounted, operative connections between the carriage and the member on the end of the series opposite to the fixed member tending to rotate the member, an escapement device carried within each rotatable member engageable with the teeth of the next succeeding member on the side nearest to the fixed end member and when operated adapted to allow the member within which it is carried and all other members on the other side to escape one tooth at a time, the teeth on said members being arranged differently from one another so that each escapement operation or combination of escapement operations imparts a distinct movement to the carriage, a separate operating means for each escapement device extending longitudinally through the members to its respective escapement device, and means operatively associating said last means with the type bar operating means and rendering the same responsive thereto.

6. In a typewriter, mechanism for imparting step-by-step movement to a carriage as typing operations are performed comprising a series of ring-shaped members co-axially arranged and each mounted for rotation relative to the others, said members each provided with a series of teeth around their axis of rotation having a different pitch diameter, a fixed member adjacent one end of said series of rotatable ring members having teeth arranged in a circle co-axial with said rotatable members, a pair of rocking pawls carried by each rotatable ring member substantially at diametrically opposite points on the member, said pawls extending toward the teeth of the next adjacent member and adapted to engage the teeth to lock the two members together, means connecting said pawls for joint rocking movement in such a manner that the pawls when rocked alternately engage the teeth of the adjacent member and allow the member to which they are attached to escape one tooth at a time relative to the other member, operating rods extending longitudinally through the ring-shaped members, and means connecting one rod to each pair of pawls to rock the same independently of the others.

7. A typewriting machine comprising, in combination, a keyboard, a movable carriage having a platen upon which the typewriting operations are performed, escapement mechanism for imparting step by step movement to the carriage as typewriting operations are performed comprising a plurality of escapement devices each imparting a different movement to the carriage and so coupled together that two or more may be operated simultaneously and the summation of their action imparted to the carriage, a track extending between said keyboard and said escapement mechanism, a body movable along said track carrying a set of type bars adapted when positioned between the escapement mechanism and the keyboard to strike the platen on the carriage, means rendering each type bar operatively responsive to a key on the keyboard, when said body is positioned between the escapement mechanism and the keyboard, an operating connection for actuating each device in the escapement mechanism extending from the escapement mechanism under the track to the keyboard on the other side thereof, means responsive to the operation of each type bar for actuating one or more of said operating connections to thus operate one or more of said escapement devices, and special keys on the keyboard operatively coupled with said escapement operating connections and arranged to actuate the same without causing a type bar to strike the platen.

8. A typewriting machine comprising, in combination, a keyboard, a carriage having a platen upon which the printing impressions are made, means for guiding the carriage in a movement parallel to the keyboard and spaced therefrom, a track extending between the carriage guiding means and the keyboard, a body movable along said track carrying a set of type bars adapted when positioned between the keyboard and the carriage to strike the platen and make printing impressions thereon, means rendering the type bars operable from the keys on the keyboard when the body is properly positioned on the track between the keyboard and the carriage, escapement mechanism for imparting step by step movement to the carriage located on the carriage side of the track and comprising a plurality of escapement devices each imparting a different movement to the carriage so coupled together that two or more may be operated simultaneously and the summation of their action imparted to the carriage, means for selectively operating said escapement devices including a plurality of control elements mounted on the keyboard side of the track, means carried by said body responsive to the operation of each type bar and adapted when the body is properly positioned between the carriage and the keyboard to operate one or more of said escapement operating elements simultaneously with the operation of the type bar, and operating connections extending from said escapement operating ele-

ments under said track to said escapement mechanism and each one operatively connected with an escapement device therein.

9. The invention described in claim 8 characterized by the fact that special keys are provided on the keyboard for actuating said escapement operating elements without causing a type bar to strike the platen.

10. A typewriting machine comprising, in combination, a keyboard, a carriage having a platen upon which the printing impressions are made, means for guiding the carriage in a movement parallel to the keyboard and spaced therefrom, a track extending between the carriage guiding means and the keyboard, a body movable along said track carrying a set of type bars adapted when positioned between the keyboard and the carriage to strike the platen and make printing impressions thereon, type bar operating means carried by said body and controlled by the keyboard for causing said type bars to strike the platen when said body is properly positioned on the track between the keyboard and the carriage, escapement mechanism for imparting step by step movement to the carriage located on the carriage side of the track and comprising a plurality of escapement devices each imparting a different movement to the carriage so coupled together that two or more may be operated simultaneously and the summation of their action imparted to the carriage, a plurality of elements for operating said escapement devices corresponding in number thereto and mounted adjacent to the track on the keyboard side thereof, means mounting each of said elements for movement away from the track, the operating means for each type bar including a member adapted upon operation thereof and when said body is properly positioned on the track between the keyboard and the carriage to be projected toward said operating elements, each of said members being shaped for engaging one or more of said elements and causing those engaged to move away from the track, and operating connections extending under the track and connecting each of said elements with one of the escapement devices in said escapement mechanism and rendering the devices responsive to the movement of the elements caused by said projectible members.

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