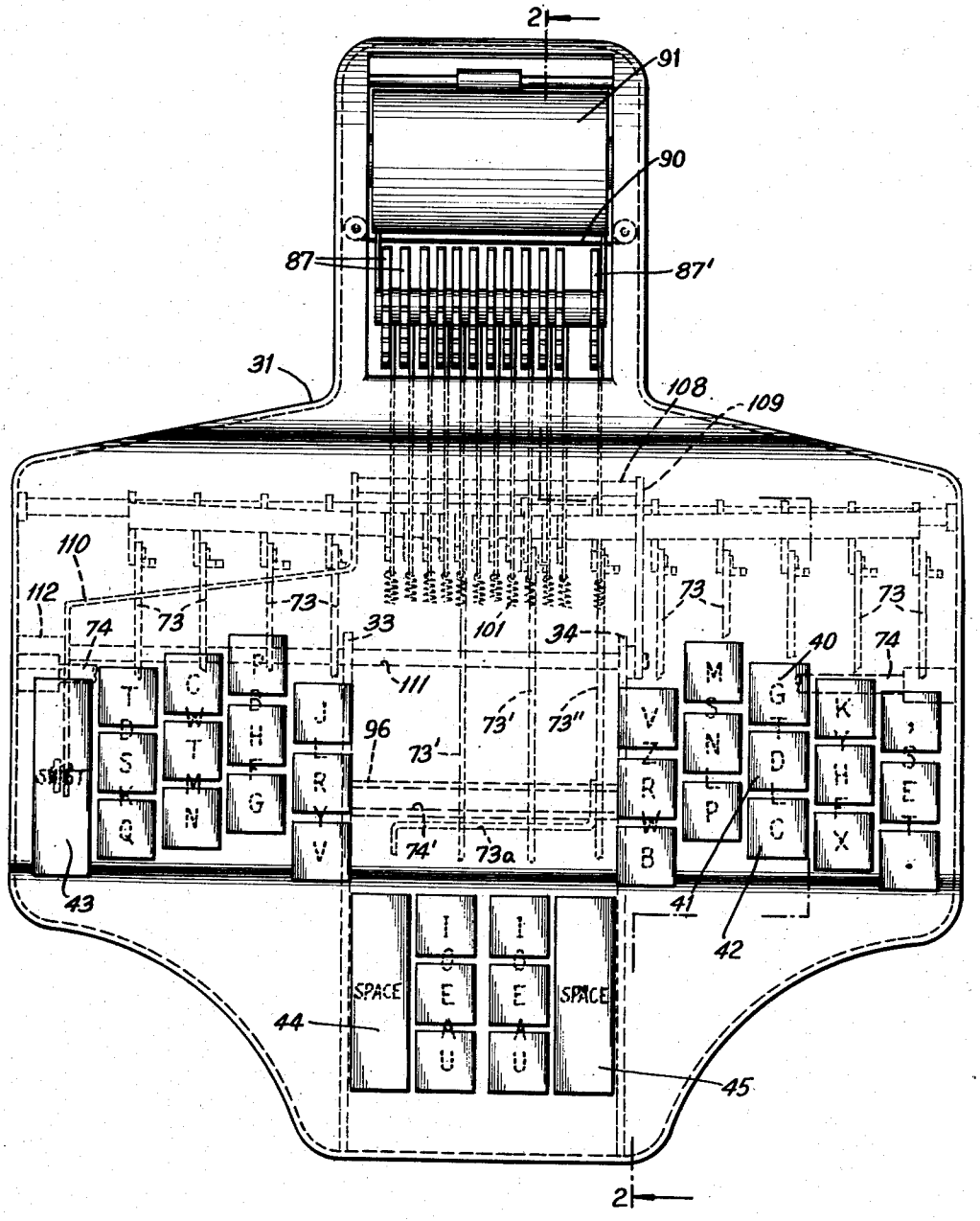
Dec. 4, 1945. W. A. AYRES ET AL 2,390,414

STENOGRAPHIC MACHINE

Filed July 29, 1943 6 Sheets-Sheet 1

FIG. 1.




INVENTORS
Waldemar A. Ayres
BY Ralph E. Page
W. M. Nelson
ATTORNEY

Dec. 4, 1945. W. A. AYRES ET AL 2,390,414

STENOGRAPHIC MACHINE

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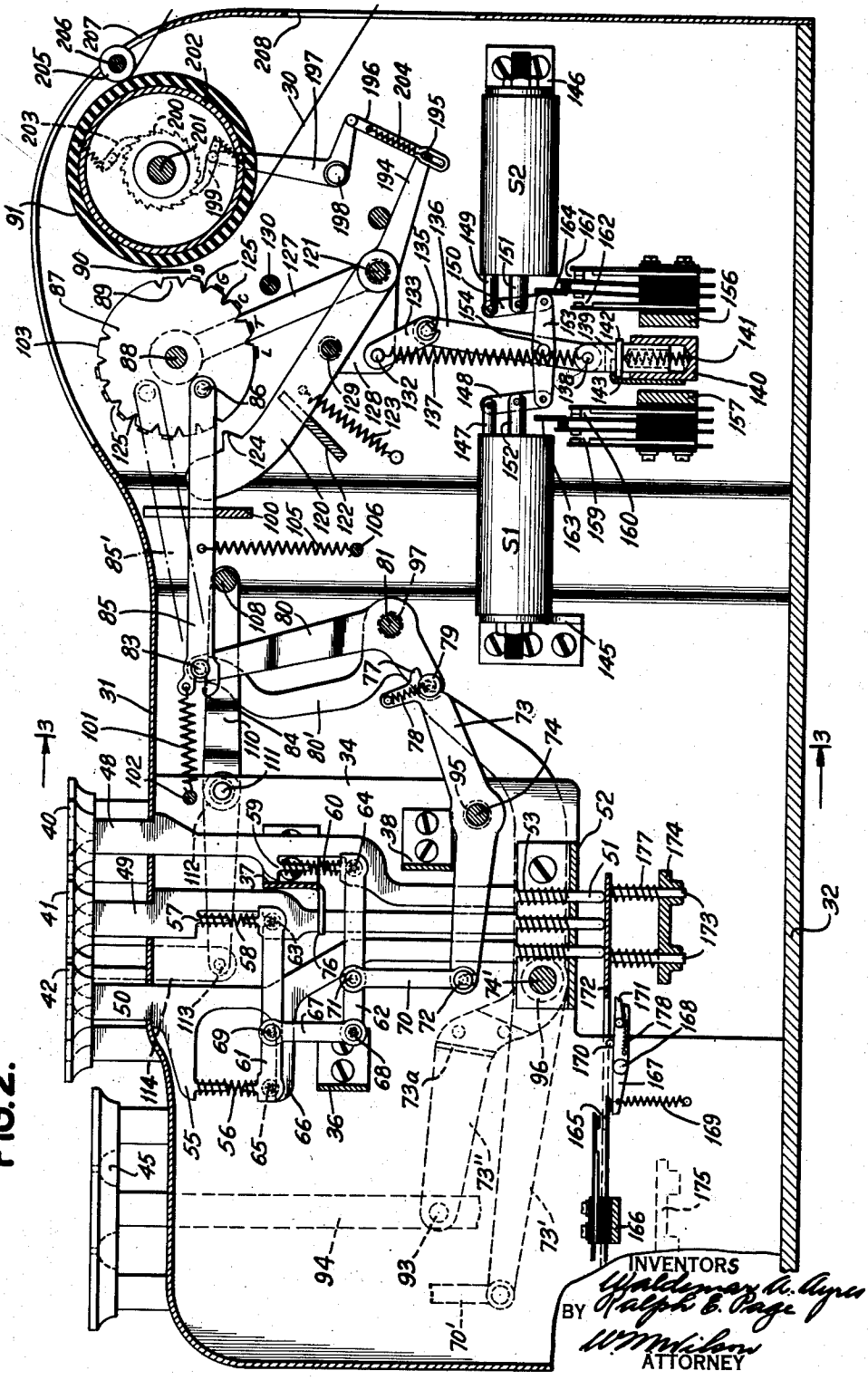


FIG. 2.

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FIG.3.

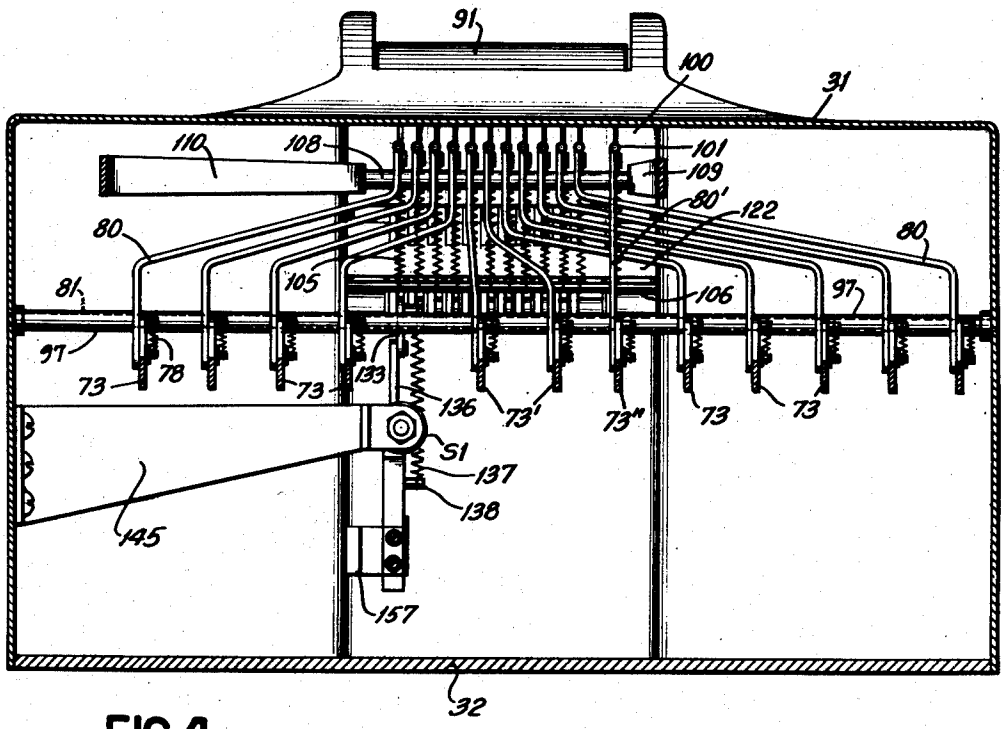



FIG.4.

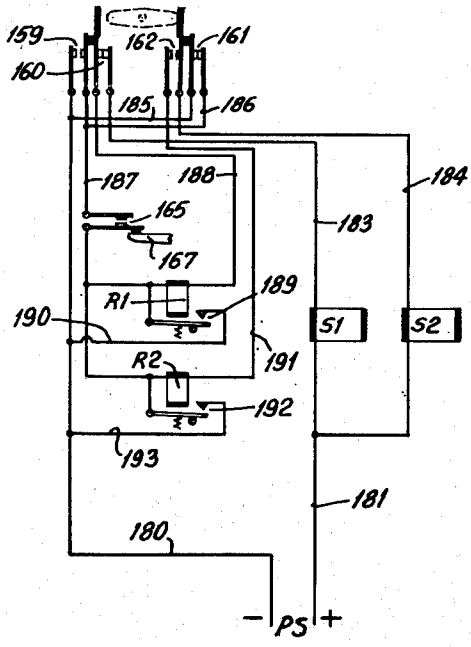
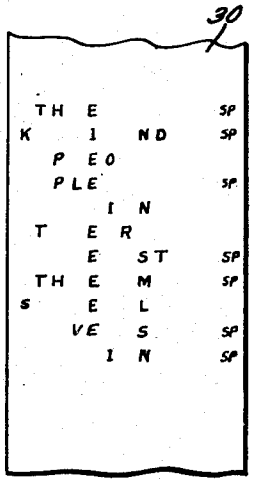



FIG.5.




INVENTORS
Waldemar A. Ayres
Ralph E. Page
BY W. M. Wilson
ATTORNEY

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STENOGRAPHIC MACHINE

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FIG. 6.

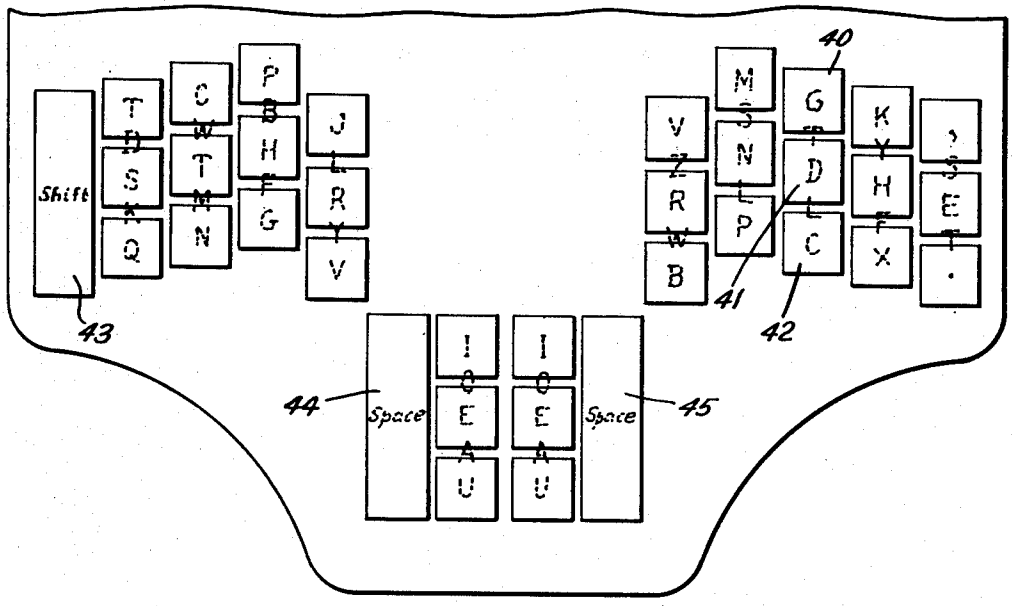
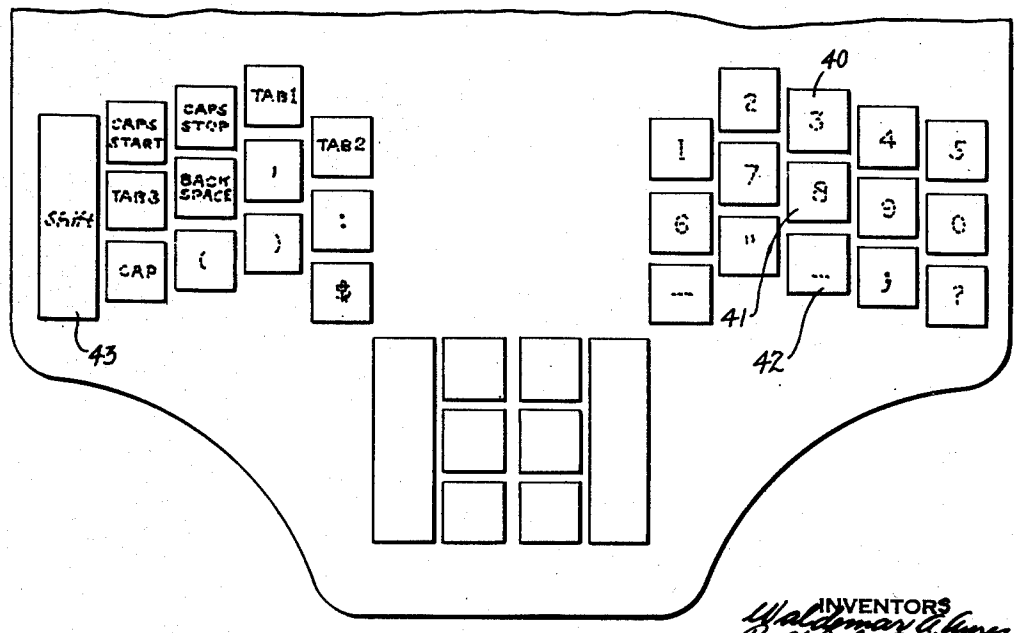



FIG. 7.




INVENTORS
Waldemar A. Ayres
Ralph E. Page
BY
W. M. Wilson
ATTORNEY

Dec. 4, 1945. W. A. AYRES ET AL 2,390,414

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FIG. 6.

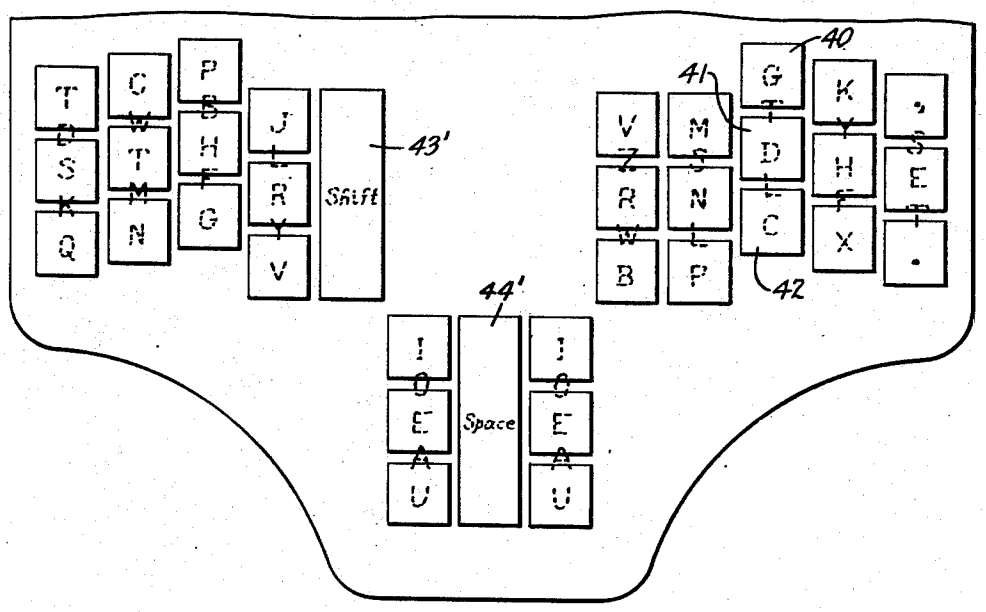
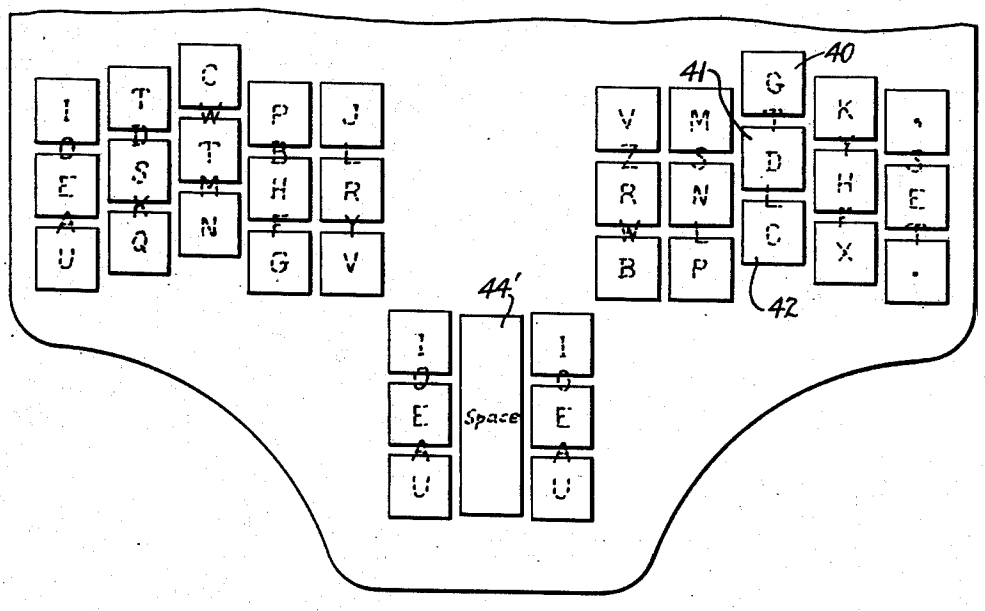



FIG. 9.




INVENTORS
Waldemar A. Ayres
Ralph B. Page
BY
W. M. Wilson
ATTORNEY

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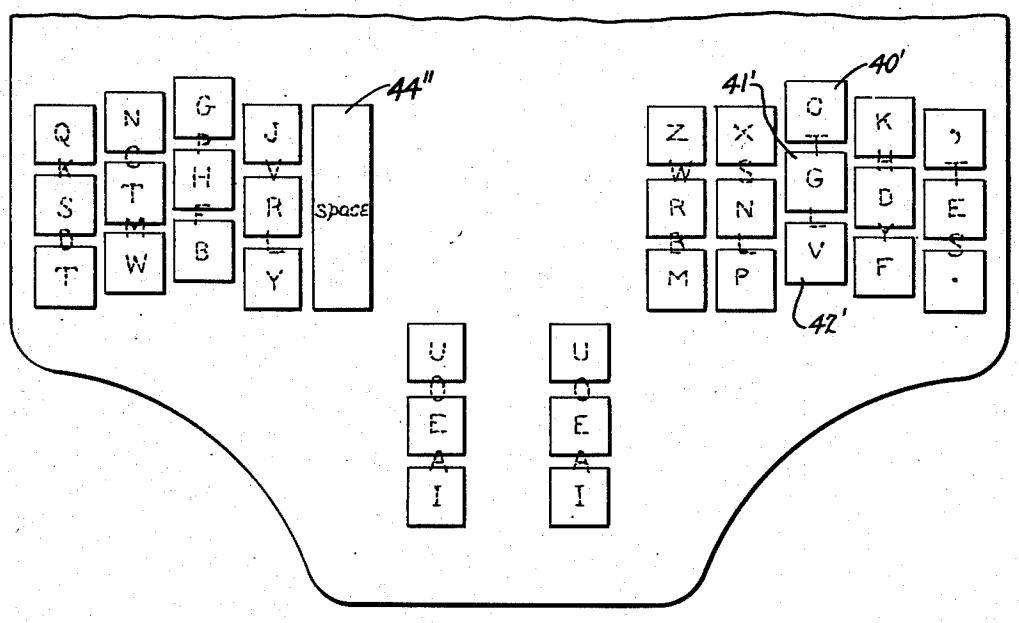
FIG. 10.




INVENTORS
Waldemar A. Ayres
Ralph E. Page
BY
W. M. Wilson
ATTORNEY

Patented Dec. 4, 1945 2,390,414

# UNITED STATES PATENT OFFICE

2,390,414

## STENOGRAPHIC MACHINE

Waldemar A. Ayres, Kew Gardens, N. Y., and Ralph E. Page, West Orange, N. J., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application July 29, 1943, Serial No. 496,606

9 Claims. (Cl. 197—9)

This invention relates in general to improvements in printing machines and more specifically to an improved form of stenographic recorder.

An object of the invention is to provide an improved key arrangement making it possible to write most short words with a single stroke of the fingers of both hands. The keys are arranged in consonant and vowel groups, there being an initial consonant group at the left to be operated by the fingers of the left hand, an intermediate vowel group occupying a central position beneath the thumbs of both hands, and final consonant group keys at the right of the machine under the fingers of the right hand. The keys are not only arranged as to consonant and vowel distinction in a left or right order, but the characters represented by the keys are arranged scientifically as a result of a study of letter sequence occurrence and relative frequency of speech sounds. The keys not only represent a complete series of alphabetic characters but they also represent repetitions of such characters placed to derive the greatest benefit. A common occurrence in the English language is the double TT and double LL arrangements as well as TH, CH, etc. It is an object not only to provide such sequences but to place them with respect to other letters on the keyboard, so that they fall within patterns of common usage and are recorded by a single stroke of the hands.

Another object of the invention is to provide a simple and yet effective differential mechanism for selecting a third character when two keys are operated together. The keys are arranged in a plurality of longitudinal rows, each row containing three keys for direct selection of the three most frequent letters, and they are used in combination to select two other letters through the joint operation of two of the three keys.

A still further object of the invention is to provide an automatic print operating device which is effective for aligning at the same time as it effects the printing impression. The type are arranged on wheels rocked under control of the key operated differential mechanism, and alignment is perfected by a wedge formed on the printing hammer coinciding with V-shaped notches arranged at regular intervals around the printing wheels.

A further object of the invention is the provision of a shift control for utilizing the keyboard to select a second set of printing characters including special marks, numbers, and punctuation characters. Each printing wheel carries a double set of type faces, one set of five faces relating to the normal alphabet selections and the second set of type faces formed with numerals and special characters. Each wheel is positioned through a link pivoted thereon to be directed for type selection operations by motions on either side of the fulcrum of the printing wheel. The link is operated by the shift mechanism to swing the character wheel for selection of either set of type faces prior to the selection of a particular type face.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a plan view of the machine.

Fig. 2 is a sectional elevation view taken along lines 2—2 in Fig. 1.

Fig. 3 is a sectional elevation view taken along lines 3—3 in Fig. 2.

Fig. 4 is a wiring diagram showing the electrical connections for controlling the print operating solenoids.

Fig. 5 shows an example of the printed strip.

Fig. 6 is a plan view of the keyboard.

Fig. 7 shows the shift characters selected by the keyboard of Fig. 6, when the shift selection mechanism is operated.

Figs. 8, 9 and 10 show alternative arrangements of the keys involving the rearrangement of the character keys and the shift and space selection bars. Fig. 8 shows the shift bar positioned for index finger control. Fig. 9 is an arrangement without shift control but including a set of initial vowel keys to the left of all initial consonant keys. In the keyboard of Fig. 10, a few letters are rearranged and the space bar is located for operation by the left index finger.

The framework of the machine comprises a casing 31 (Fig. 3) mounted on a base plate 32. The sides of the casing 31 are used as side plates and they carry hubs for supporting a number of transverse shafts. Near the forward end of the machine (Fig. 1) there is provided a pair of intermediate side plates 33 and 34 providing supports for the vowel keys and acting as an anchorage for a series of cross bars, such as bars 36, 37 and 38 (Fig. 2) fastened between the intermediate plate 34 and the right side wall of the casing. These bars act as stopping means for the linkages of the differential mechanism operated by the keys. Before describing the mechanism operated by the keys, it is believed well to

point out the arrangement of the keys and the reasons for such arrangement.

Referring to Fig. 6, it is seen that the keys are divided into three main groups, the group at the left including a shift bar and four longitudinal rows of keys with three keys in each row. The keys are not aligned in the transverse direction but are arranged to conform with the normal positions of the finger tips of the fingers on the left hand. It is intended that the fingers occupy a normal position on the center keys of the rows. In other words, the index finger tip will rest on the R key, the middle finger on the H key, the ring finger on the T key, and the little finger on the S key.

In order to form desired letter selections, one or more of the fingers are moved forward into cooperation with the top set of keys or retracted to engage one of the four lower keys. The letter selected by depression of each key is designated by the letter shown on the center of the key. Other letters are selected by joint operation of pairs of keys, the pairs belonging to keys in the same row, for example, in the first row at the left, a D is selected by operation of the small finger overlying the T and S keys. In this same row, a fifth character K is selected when the small finger depresses both the S and the Q keys. In a similar fashion it is possible for the three keys in each longitudinal row to select one of five characters.

From the foregoing it is apparent that the first three consonants of words, such as "school" and "stroll," are represented by a single depression of the fingers of the left hand in cooperation with the consonant keys in the left group. The center group of keys is seen to include two rows of vowel keys flanked by a pair of space-control bars. One of these bars is depressed when a complete word is printed or when the part of the word selected is the last part of the word. For example, in Fig. 5 the printed slip shows that the first two words were selected by a single movement of the hands, but the third word required a double movement and, therefore, the space sign is printed along with the second part of the word.

Referring back to Fig. 6, it is noted that the E keys occupy a central position in the two rows of vowel keys. The positions on the E keys are the ones occupied normally by the ends of the two thumbs. From these central positions the thumbs are moved back or forth to select and depress the I and U keys. The O and A vowels are selected by depression of combinations of two vowel keys.

The double set of vowel keys makes it possible to select many combinations involving double vowel sounds, such as OO, EE, as well as the combined sounds OU and IE, and so on.

The group of keys at the right represent the consonants usually required to represent word endings. They are arranged in the positions normally occupied by the finger tips of the right hand and include five rows of keys, one more than the initial consonant group. The fingers are to be placed so that the tip of the index finger of the right hand is over the R key, the middle finger over the N key, the ring finger on D key and the small finger on the H key. When selections are to be made in the column of the keys at the extreme right, the small finger is shifted over to cooperate with the comma key, the E key or the period key. The keys of these rows of final consonant keys are operated singly or in combinations, as already described in connection with the initial consonant keys, to select one of the five characters represented in each row. The characters represented at the center of each key is the one selected by operation of the key alone, the characters represented at the intersections or spaces between the keys is the character selected by combined operation of the two keys adjoining the representation. The extreme right row of keys includes the final vowel E which is found useful in many word endings. An example of the use of the group of keys at the right is in the formation of word endings such as the ending of the word "brought."

The selection of the numbers, punctuation marks and special characters shown on the keyboard in Fig. 7 is accomplished in the same manner as described in connection with the keys of the arrangement of Fig. 6. The only difference is that the shift bar **43** is operated along with the consonant keys to select the special set of type.

The operation of the keyboard of Fig. 8 is controlled for letter selection as described hereinbefore, one difference being that the shift bar **43'** is operated by the index finger rather than the small finger as in Figs. 6 and 7. There is another difference in operation called for by the arrangement of Fig. 8, in that the space bar **44'** is centralized for operation by the tip of either thumb. This differs from the kind of operation called for by the arrangement involving two space bars **44** and **45** (Fig. 6) located for operation by the middle part of the thumb of either hand. In Fig. 8 the index finger of the right hand is also called upon to make a greater number of key selections, and in doing so relieves the little finger which in Fig. 6 has the normal position over the H key, but in Fig. 8 has a home position on the E key. Figs. 9 and **10** relate to arrangements also calling for further use of the agile index fingers.

The key arrangement of Fig. 9 is in some ways the same as that of Figs. 6, 7 and 8. The three keys of each row are operated singly or in combination to make one of five type selections, as already described. One difference is in the omission of the shift control which is optional and for machines providing larger selection capacity. The main difference is in the provision of a set of vowel keys placed at the extreme left and before the entire set of initial consonant keys. Since many words are started with vowal letters, the arrangement of Fig. 9 is desirable in this respect.

Fig. 10 shows a key arrangement involving a reversal of position of keys in some rows, and the rearrangement of the X, M, V and F keys in the final consonant group. The space bar **44''** is located for left index finger operation and the two sets of vowel keys are isolated for unencumbered thumb control.

Since the section line **2—2** in Fig. 1 passes alongside the keys **40**, **41**, **42**, it is in connection with these G, D and C keys that an example of the differential mechanism is shown in Fig. 2. In Fig. 2 it is seen that the three stems attached to key tops **40**, **41** and **42** are formed differently to provide pivot points and operating abutments for a connected linkage of differential mechanism. The three key stems **48**, **49** and **50** pass through and are guided by rectangular slots cut into the top of the casing **31**. The stems are formed with shoulders cooperating with the underside of the casing to act as limiting stops for the upward movement of the keys. The lower

ends of the keys 51 are of a narrow elongated shape passing through guide openings in a cross bar 52 secured between the intermediate plates and the sides of the casing. Assembled on these lower ends are compression springs 53 pressing between bar 52 and shoulders on the key stems for restoring the keys after each operation.

The key stems 48, 49 and 50 have a common characteristic in that each one is provided with a spring holding projection, stem 50 having a projection 55 for guiding a spring 56, stem 49 having a projection 57 for a spring 58 and stem 48 having a projection 59 for a spring 60. These three springs 56, 58 and 60 are supported at their lower ends on the ends of a pair of horizontal operating links 61 and 62. Link 61 is pivoted at 63 on its right end in a notch cut into a shoulder on the key stem 49. A similar pivot is provided for link 62 by a notch cut into stem 48 to receive the pivot 64 on this lower link. The left end of the upper link 61 carries a pin 65, which rests on an extension 66 formed as part of key stem 50.

The two horizontal links are tied together by a short vertical link 67 which is articulated at 68 with link 62 and has a pivotal connection 69 located at a point about one-third the distance between centers 65 and 63 of link 61. A second vertical link 70 is pivoted between a center 71 on the lower horizontal link 62 and a pivotal mounting 72 on the end of an operating lever 73 fulcrumed on a shaft 74 extending across the machine.

The object of the differential linkage described is to produce five different degrees of downward movement of link 70 and lever 73 under control of the three keys 40, 41 and 42. It is possible to attain such different degrees of movement because of the ratio of operating movement produced by the placement of the various operating centers of the four operating links. Considering these operating movements in the order of their degree, taking the smallest degree of operation first, it is noted that when the key 41 is depressed, spring 58 presses down on the right end of link 61 until the end of the link abuts against the top of an offset portion 76 formed on the cross bar 37. As the right end of link 61 is depressed, the left center 65 thereof maintains its position but the center 69 is lowered to push down on link 67 an amount which is about one-third the movement of the key stem. The movement of link 67 is transmitted through horizontal link 62 when the latter is swung in a counterclockwise direction about pivot 64. There is a further reduction in the degree of movement because the center 71 of the link 70, to which the movement is imparted, is located nearer the point of rotation 64 than the point 68 of application. The resultant movement is communicated to lever 73 and rocks this lever a slight amount in a counterclockwise direction. At the right end of lever 73 is a shoulder 77 with a spring mounting for a spring 78 which is attached to a stud 79 on a bell crank lever 80 pivoted on a shaft 81. The upper end of print control lever 80 carries a stud 83 engaging in a slot 84 formed in the left end of a pitman 85 pivoted at 86 on a type wheel 87.

The type wheel is freely mounted on a shaft 88 and is normally positioned to present a blank type face 89 opposite a ribbon 90 situated between the type wheel and the platen 91. Directly below the blank face 89 on the type wheel 87 is a type face extension bearing the letter D. This is the first of a series of five type faces arranged around the periphery of the print wheel 87. It is seen that the first degree or portion of differential movement of the center 86 toward the right will carry type face D upward into the printing position opposite ribbon 90. The parts are proportioned so that depression of key 41 rocks links 61 and 62 to depress link 70 and rock lever 73 in a counterclockwise direction, carrying print lever 80 along therewith in a clockwise direction as urged by spring 78 and moving pitman 85 to the right and shifting the eccentric mounting 86 thereof to rock the print wheel 87 in a counterclockwise direction and position type face D for effecting a printing impression.

The second degree of movement is caused by operation of the G key member 40 shown in Fig. 2. Depression of the key and key stem 48 causes a rocking movement of the lower link with center 68 acting as a fixed pivot. The link is moved until the right end strikes the top of cross bar 38. About one-third of the swinging movement of link 62 is communicated to vertical link 70, and this is a movement about double the amount imparted by operation of the other key stem 49 as already described. The movement for selection of the G type is communicated through both levers 73 and 80 and through pitman 85 to rock center 86 counterclockwise far enough to lift the second type face G opposite the printing ribbon 90.

A third step of movement is produced by operation of the C key member 42. The attached key stem 50, when depressed, pushes down on the left end of horizontal link 61, through spring 56. Then, pivot 63 is stationary and link 61 swings about it. About two-thirds of the key stem movement is imparted to link 67, and this movement is further shortened by the arrangement of centers on horizontal link 62 through which the movement is carried. Pivot 64 acts as a fixed center and, as link 62 rocks downward, the vertical link 70 is carried down through three degrees or extents of movement which is communicated in the usual way to the type wheel 87, which is then rocked counterclockwise to bring the third or C type face opposite the ribbon 90.

The fourth type face on the printing wheel is moved into printing position by combined operation of the D and G keys. Such operation causes both key stems 48 and 49 to be depressed. Then pivot point 65 acts as a stationary center for the rocking movement of link 61 caused by depression of key stem 49. This lowering movement serves to place center 68 below its usual position and augment the movement imparted to vertical link 70 by the rocking movement of link 62 caused by depression of key stem 48. In other words, horizontal link 62 is pushed down on both ends by both key stems, and the resultant motion imparted to lever 73 is four extents or portions of movement, serving to carry the fourth type face T up into printing position.

The fifth and greatest degree of movement is the one caused by joint operation of the C and D keys for selection of the L type face. When key stems 49 and 50 are depressed at the same time, link 61 is lowered a full depression stroke with the left end of link 61 abutting against the top of cross bar 36 and the right end of the link striking against offset portion 76. Vertical link 67 communicates the complete depression movement to the left end of link 62, while the right end is held stationary around pivot 64. About two-thirds of the full movement is imparted as a

depressing action of vertical link 70, and through pivot 72 the largest degree of movement is communicated through the levers and pitman to the print wheel which is rocked in a counterlockwise direction far enough to bring the fifth position, carrying the L type, up opposite the printing ribbon 90.

Although the differential mechanism is described in connection with a single row or set of three character keys, it is apparent that each of the other ten rows of keys is provided with a similar mechanism for adjusting a printing wheel to represent desired selection of letters to form words and word parts.

Referring to Figs. 1 and 3, it is noted that the operating levers 73 are without offsets and have a plane of operation parallel with the sides of the machine. There are five such levers near the right side of the machine and four such levers at the left side of the machine. Near the center of the machine are two other such levers 73' also without offsets but of a greater length than the ordinary levers 73. These two special operating levers 73' (Fig. 2) are provided for the vowel keys which occupy a location near the front of the machine. These two vowel levers are pivoted on a shaft 74' extending between the two intermediate supporting plates 33 and 34. The front ends of levers 73' extend forward into cooperation with the lower ends of a pair of vertical links 70' similar in control as the operating links 70 already described. The rear ends of levers 73' are formed to avoid interference with shaft 74 and at the very end have a formation similar to the spring holding shoulder 77 already described with reference to levers 73.

A twelfth operating lever 73'' is provided to operate a printing wheel under control of either of the two space bars 44 and 45 (Fig. 1). This lever 73'' is positioned to lie directly beneath the right space bar 45 and is connected thereto by a pivot pin connection 93 (Fig. 2). Attached to lever 73'' is an L-shaped offset bar 73a which also has a pivot pin connection with the key stem depending from the left space bar 44. In Fig. 2 it is seen that the space operating lever 73'' is also pivoted on shaft 74' along with the two vowel levers 73'. Although the forward part of the space lever is of a special formation, the rear portion coincides with the contour of the levers 73' and also carries a spring shoulder 77 for operating one of the print levers 80.

The sectional elevation view in Fig. 3 shows that, although the twelve operating levers 73, 73' and 73'' are without offset formations, that is not true of the print operating levers 80 which have converging formations above the supporting shaft 81. The two vowel control levers 80 are centrally located and, therefore, have the smallest degree of converging formation. The other character selecting levers have progressively longer offsets as they are further removed from the center of the machine. An exception is the print control lever 80' cooperating with the space lever 73''. This lever is so situated that it is possible for it to operate directly in connection with the pitman for rotating the print wheel carrying the space type SP (note the space marks along the right margin of the sample strip in Fig. 5).

The levers 73 (Fig. 2) are spaced on shaft 74 by hubs or collars 95 freely mounted on the shaft. In a similar fashion, the levers 73' and 73'' (Fig. 1) are spaced and supported by hubs and collars 96 on shaft 74' between the intermediate support plates 33 and 34. Referring to Fig. 3, it is seen that other collars and hubs 97 are assembled on shaft 81 to confine and support the print levers 80.

It is noted that the differential mechanism involves many open pivot points such as points 63, 64, 65, 72, 79 and 83 which make it easy to assemble the parts as well as easy to take the machine apart for repairs.

A comb 100 (Figs. 2 and 3) is provided to guide the twelve pitman links 85 as they reciprocate to operate and restore the print wheels. Attached to the front end of each pitman 85 is a spring 101 also secured to a rod 102 between the intermediate frames. Springs 101 restore the pitman links and print wheels, but are not strong enough to pull the linkage beyond the home position in which it is held against shoulder 77 by spring 78 and balanced by the combined normal pressure of the key stem springs 56, 58 and 60.

A shift control is provided to make it possible for the keyboard to select a second set of type such as the special characters shown in Fig. 7. In Fig. 2 it is seen that each type wheel 87 not only bears the five character type faces already mentioned, but it also carries a second set of five faces led by the blank space 103 at the top of the wheel. The twelve pitmen 85 are normally held down in the character selecting position by individual springs 105 attached to a rod 106. However, it is possible to lift the pitmen about center 83 to the dotted position 85' for the selection of special type. When this is done, the printer wheels 87 are rocked almost a quarter of a turn in a clockwise direction and a position is reached wherein the shift blank face 103 is opposite the ribbon 90.

For the purpose of lifting pitmen 85 for shift selection, a shift bale is provided with a horizontal rod 108 underlying all pitmen. Reference to Fig. 1 shows that the shift bale is composed of a short straight arm 109 at the right and a long converging lever 110 at the left, a pivoting shaft 111 between the arm and lever, and the rod 108 on the rear ends of the arm and lever. Shaft 111 is supported at the left by a bearing 112 fixed to the left side of the casing. The shaft has further support by bearings in the intermediate frames 33 and 34.

In Fig. 2 it is seen that the forward end of shift lever 110 is articulated at 113 on the lower end of the stem 114 extending down from the shift bar 43 (Fig. 1). Depression of bar 43 causes a counterclockwise movement of the shift bale about center 111 (Fig. 2). This serves to raise rod 108 and carry all pitmen 85 up to the dotted position 85'. Then the effective ends of the pitmen are above the printer wheel center 88 rather than below it as normally used. The effect is that accompanying a shift all key selections cause the printer wheels to be rocked to one of five different extents in a clockwise direction and opposite to the normal direction of selection used with the pitmen in the normal lowered position. The selection of five special characters by operation of three keys is brought about in the same manner as explained in connection with selection of the type faces of the letters D, G, C, T and L. As shown in Fig. 7, there are only three shift characters 3, 8 and – on the keys corresponding to the G, D and C keys of Fig. 6. It is obvious that two other special marks as * and @ are selectable by combined operation of pairs of such keys with the shift.

When the shift bar is released, springs 105 pull the pitmen 85 to the bottom of comb 100 and rod 108 is carried along therewith to restore

the bale. For the sake of uniformity, the space sign print wheel 87' is provided with a pair of type faces and is rocked for a shift operation along with the character wheels.

Printing is effected by a set of twelve print hammers 120 pivoted on a shaft 121 and guided by a comb 122. All hammers are held in a normally retracted position by springs 123. The striking end of each hammer is formed with a pointed projection 124 for cooperation with locating V notches 125 cut in the printer wheel 87 between the type faces. Thus, by means of cooperation between the points and notches the hammers are not only adapted to throw the type wheels against the platen, but also align them on the way.

Shaft 88, upon which the type wheels 87 are mounted, is supported on the upper ends of a pair of arms 127 pivotally mounted on the shaft 121 along with the hammers. However, the hammers are held in a rocking frame comprising side plates 128 and a tie rod 129 passing through all the hammers. A rod 130 acts as a stop for the operating movement of the impression arms 127.

Pivotally attached at 132 to the left printer side plate 128 is the top of a link 133 forming part of a toggle linkage for operating the printing mechanism. The lower end of link 133 is slotted to receive a pin 135 on the upper end of a long toggle link 136. The two toggle links are held together by an over center spring 137 attached to center 132 and on the end of a stud 138 forming the pivot at the lower end of link 136. Also pivotally attached to stud 138 is a spring plunger 139 encased in a stationary holder 140 secured to the sides of casing 31. Fitted within a circular opening in holder 140 is a compression spring 141, a portion of which is contained in a hollowed out sleeve formed as the lower part of plunger 139. Spring 141 presses upward to force a shoulder 142 on the plunger against a locating stop in the form of a hook 143 fastened to the side of the holder. The action of spring 141 supplements the tension of spring 137 to force the toggle linkage into one of the two home positions, one of which is shown in Fig. 2. The toggle linkage is thrown from right to left and back again alternately, each throw of the linkage being effective to cause a printing operation. The impression occurs as center 135 passes through the dead center position wherein the linkages straighten out to move the frame 128 in a clockwise direction.

Of course, as the frame 128 is lifted about shaft 121, the hammers 120 are carried along therewith and strike against the print wheels 87 carrying them over toward the right and pressing them against the ribbon 90, a recording strip 30, and the platen 91. The timing of the hammer action is arranged to occur after the print wheels have assumed selected positions under control of the keys. The hammers not only throw the type wheels against the platen but they also align the wheels as they are moving toward the platen. This is possible because the pointed extensions 124 thereon engage the sides of the V notches 125 and rock the print wheels small amounts to bring them in accurate registry, so that all type faces form a parallel line of characters on the record strip 30.

Printing operation is controlled by a pair of solenoids S1 and S2. These solenoids are connected to the toggle mechanism to swing it alternately back and forth to cause a printing impression for each vibration. A bracket 145 is attached to the left side of the casing and carries fastened thereto the solenoid S1. Aligned therewith and further to the rear is the other solenoid S2 supported by a bracket 146 also secured to the left side of the casing. Extending from the side of solenoid S1 is the standard 147 for providing a pivot on which swings an operating lever 148. A similar standard 149 is extended from the other solenoid S2. Pivoted on this second standard is another operating lever 150 to which is articulated the plunger 151 of solenoid S2. The solenoid S1 has a plunger 152 which is connected in a similar fashion to the lever 148. The lower ends of levers 148 and 150 are joined by a link 153, the center of which is pivotally connected at 154 to the link 136 of the toggle. The parts are shown in the position assumed when the solenoid S2 has been energized. Then the plunger 151 is retracted and lever 150 is rocked in a counterclockwise direction to pull the link 153 towards the right, and through center 154 the toggle linkage is pulled over to the right to assume the position shown. Springs 123, 137 and 141 all tend to collapse the toggle linkage, but it is prevented from further movement by the obstruction provided by hook 143.

When another print operating cycle is desired, solenoid S1 is energized and it retracts the plunger 152 to rock the lever 148 in a clockwise direction. This serves to pull the link 153 towards the left, carrying toggle link 136 along therewith past the dead center position, which is the impression position, and allowing the toggle linkage to collapse a slight amount as limited by the hook 143.

The alternation of operation of solenoid S1, S2 is controlled by contacts opened and closed by the levers 148 and 150 which oscillate as the solenoids operate. Located beneath the toggle linkage is a pair of transverse bars 156, 157 each carrying a series of four contact blades insulated from the pair and from each other. These eight contact blades provide four pairs of contacts, two of which are associated with solenoid S1 and the other two operated by solenoid S2. Contacts 159 and 160 are associated with solenoid S1 and contacts 161 and 162 are associated with solenoid S2. The center blades of each related pair of contacts are connected by a block of insulation with another extending finger of insulation 163 and 164 placed in the path of the ends of link 153. The inner pairs of contacts 160 and 162 are of the normally closed construction while the outer pairs of contacts are normally open. The positions of the contacts are reversed when the related solenoid is energized, for example, as shown in Fig. 2, with solenoid S2 energized, link 153 is shifted into cooperation with insulation finger 164, and movement of the finger towards the right carries the center insulation blades along therewith and operates to close contacts 161 and open contacts 162.

When the other solenoid S1 is operated, the positions of associated contacts 159 and 160 are reversed from the position shown, because then the finger 163 is operated to close contacts 159 and open contacts 160. At the same time, the other two contacts 161 and 162 are released, so that their condition is reversed to open contacts 161 and close contacts 162. The controls effected by operation of the four contacts are more clearly understood with reference to the wiring diagram, which is described hereinafter.

The impulses for initiating operation of solenoids S1 and S2 to cause printing operation are

derived from contacts operated by the keyboard late in each character selecting operation. Each impulse is initiated by the closure of a pair of contacts 165 (Fig. 2) supported on insulation blocks and a bar 166 secured between the intermediate frame 34 and the right side of the casing. Cooperating with the lower blade of contacts 165 is the end of a lever 167 pivoted at 168 on the side of frame plate 34. A spring 169 tends to hold the lever rocked in a normally counterclockwise direction against a stop 170 also extending from the intermediate plate. Carried on the rear end of lever 67 is a flipper 171 located underneath a horizontal plate 172 and in the path of a shoulder on the plate. This plate 172 extends across the entire machine and is located underneath the guiding ends 51 extending from the lower part of the many key stems. The plate carries a series of plungers such as plungers 173 extending vertically downward through a casting 174 fastened in a horizontal position across the machine between the sides of the casing. A similar casting 175 is provided between the intermediate plates to provide guide openings for the plungers on the plate underneath the vowel key positions.

Assembled on each plunger is a compression spring 177 which tends to hold the horizontal plate 172 in an elevated position against the lower ends of the key stems. Upon depression of any one of the keys, the plate is lowered and in doing so cooperates with the flipper 171 and rocks the lever 167 to close contacts 165 near the end of the depression movement. As lever 167 rocks further in a clockwise direction, the end of flipper 171 escapes past the shoulder on the plate while the plate continues slightly in its downward course. Then spring 169 rocks the lever in a counterclockwise direction back to the normal position, wherein the contacts 165 are again opened. Later in the same cycle, the depressed key is released and plate 172 follows it upward and, in so doing, engages the end of flipper 171, but it is not obstructed because the flipper is pivotally mounted and flexible with respect to motion when imparted from the underside of the extending end. A small spring 178 is attached to the flipper to hold it in a clockwise direction against an abutment on the end of lever 167.

The temporary closure of contacts 165 sets up a circuit which is sustained by a relay for insuring that the proper solenoid is energized long enough to shift the toggle mechanism. Referring to the wiring diagram (Fig. 4), it is seen that extending from the power source PS is a pair of main lead lines 180 and 181. The positive line 181 branches out to pass through the two solenoids S1 and S2 by means of wires 183 and 184. Wire 183 is connected to the closed contact 160 and wire 184 is connected to the open contact 162. Assuming that the solenoid S2 was the one last energized, then the contacts are positioned as shown so that, when operating contacts 165 are closed, a circuit is set up through the other solenoid S1 and held momentarily through contacts closed by a relay R1. The circuit includes line 180, wire 185, contacts 161, wire 186, wire 187, contacts 165, relay R1, wire 188, contacts 160, wire 183, solenoid S1, and line 181. The energized relay R1 then operates its armature to close associated contacts 189 and the contacts 165 are shunted thereby, because in series with contacts 189 is a wire 190 connected to the line 180. The momentary holding circuit includes line 180, wire 190, contacts 189, relay R1, wire 188, contacts 160, wire 183, solenoid S1 and line 181.

When the solenoid is fully effective, it shifts the contacts as explained hereinbefore so that the circuit through solenoid S1 is open at contacts 160 and both the solenoid and associated relay R1 are deenergized at the same time that preparatory circuits are set up in readiness for energization of solenoid S2, whenever operating contacts 165 are again closed. The circuit for energization of solenoid S2 includes line 180, contacts 159, wire 187, contacts 165, relay R2, wire 191, contacts 162, wire 184, solenoid S2, and line 181. Energization of relay R2 serves to close the associated contacts 192 and arrange a shunt connection around contacts 165 including a wire 193 connected to the line 180.

It is understood that it is possible to depress the keys of a plurality of rows at the same time and that a printing impression is effected to record a complete word or a part of a word for each stroke of the hands. Each line on the strip in Fig. 5 is a product of a single operating stroke.

Means is provided for advancing the record strip 30 after each printing impression. Referring to Fig. 2, it is seen that the printer frame 128 is formed with an operating arm 194 extending toward the rear. Carried on the end of this arm is a pin 195 cooperating with a link 196 pivoted on one end of a paper feeding lever 197. The lever is pivoted at 198 and carries a pawl 199 cooperating with a ratchet wheel 200 assembled on the shaft 201 to which is secured the cylindrical tube 202 carrying the platen roller 91. Also cooperating with the ratchet wheel 200 is a retaining pawl 203 for holding it in the adjusted position.

When the printing frame is rocked in a clockwise direction, the pin 195 stretches a spring 204 attached to link 196 and rocks the lever 197 back in a clockwise direction. Then as the printer frame is restored, the lever 197 is pushed counterclockwise in a positive way to drive the pawl 199 in cooperation with the ratchet teeth on the gear 200. This serves to advance the record strip 30 which is caught between the surface of the platen and a pressure roller 205 freely mounted on shaft 206 mounted between the casing sides. A pair of openings 207 and 208 are cut in the casing to provide access for assembling the record strip around the platen.

While there have 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 and 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.

The keyboards and key arrangements disclosed are not claimed herein but are claimed in a divisional application filed March 17, 1945, Serial No. 583,250.

What is claimed is:

1. In a printing machine, a printing member carrying five character type, a platen, means for impressing the type against the platen, a set of three manipulative keys adapted for operation singly or in pairs by the same finger, a differential mechanism between said keys and said printing member for selectively adjusting said member to one of the five printing positions, said differential mechanism comprising a first horizontal link, one end of which is depressed by one key while the other end is depressed by the adjacent center

key of the three, a first vertical link, the upper end of which is connected at an offset position to said horizontal link, a second horizontal link, one end of which is connected to the lower end of said vertical link while the opposite end is connected for operation by the third key, and a second vertical link, one end of which is connected at an offset position to said second horizontal link and the opposite end of which is connected to a linkage for operating said printing member.

2. In a printing machine, a set of three manipulative keys arranged in a longitudinal row and disposed in a compact formation for operation singly or in combination by a single finger, a differential mechanism operated under control of said keys and selectively positioned to a greater number of control positions than the number of keys, printing devices adjusted under control of said differential mechanism, means for operating said printing devices to effect a recording impression on a record strip, electrical means under control of an operated key for timing the operation of said impression means, said impression means including a hammer mechanism connected to a toggle mechanism operated by a pair of solenoids, said hammer mechanism effecting an impression when the toggle mechanism is operated in either of two directions, said solenoids being connected on opposite sides of said toggle mechanism to operate it alternately, said solenoids having circuit connections for making them alternately effective under control of the operating keys.

3. In a printing machine, a set of three manipulative keys arranged in a longitudinal row and disposed in a compact formation for operation singly or in combination by a single finger, a differential mechanism operated under control of said keys and selectively positioned to a greater number of control positions than the number of keys, printing devices adjusted under control of said differential mechanism, means for operating said printing devices to effect a recording impression on a record strip, electrical means under control of an operated key for timing the operation of said impression means, said impression means including a hammer mechanism connected to a toggle mechanism operated by a pair of solenoids, said hammer mechanism effecting an impression when the toggle mechanism is operated in either of two directions, said solenoids being connected on opposite sides of said toggle mechanism to operate it alternately, and holding means under control of said electrical means for sustaining the operation of said solenoids, whereby the operation of said toggle mechansim is made independent of the duration of key operation.

4. In a printing machine, a plurality of keys, a differential mechanism adjusted by said keys, printing devices adjusted by said differential mechanism, a platen, a hammer mechanism for impressing the printing devices against the platen, electromagnetic means for operating said hammer mechanism, a platform mounted under all of said keys and operable thereby, a pair of contacts adjacent said platform, means under control of said platform for closing said contacts, and electrical connections between said contacts and said electromagnetic means for operating the magnetic means at a time governed by the depression of any one or more of said keys.

5. In a printing machine, a printing wheel bearing two sets of type characters, a platen, means for impressing the wheel against the platen, a set of type selection keys, a differential mechanism between said keys and said type wheel for adjusting said wheel to position a selected type for printing according to the setting of said keys, said differential mechanism including a link pivotally connected on the side of said wheel, a shift mechanism including a shift key and connections therefrom to said link for operating it to rock said printing wheel to select the second of said two sets of type on said printing wheel.

6. In a multiple impression typewriter, the combination of a plurality of type wheels each having two sets of five type faces and rockable to select the set other than a normal set and further rocked to one of five extents to select a type in the selected set, a plurality of sets of keys with three keys in each set, a differential mechanism between each type wheel and a related set of keys and adjusted thereby to one of five extents by the keys operated singly or in pairs, a shift key, and means under control of said shift key for rocking said wheels to select the set of type other than the normally selected set.

7. In a multiple impression typewriter, the combination of a type wheel having two sets of type faces separated by two blank type faces, one of said blank faces normally aligned with the printing point, a set of keys, means under control of said keys for rocking said wheel to place a selected type face of one set in effective position at the printing point, a shift control, and means under control of said shift control in cooperation with said rocking means for rocking said wheel to place a selected type face of the other set in effective printing position.

8. In a printing device, a printing wheel, a rocking frame upon which said wheel is mounted, a toggle mechanism operable in either of two directions to be extended for shifting said frame to effect printing impressions, a pair of solenoids connected to opposite sides of the toggle mechanism for operating said mechanism, and electrical controls for selecting alternate operation of said solenoids.

9. In a stenographic printing machine, a set of twelve printing wheels, each wheel bearing ten characters, five of which are effective for normal printing and the other five for selection of shift operations, a wheel operating means including a differential positioning mechanism for each wheel, a set of three keys operable singly or in combination for adjusting said differential mechanism to one of five different extents, and a shift mechanism cooperating with said wheel operating means to operate the wheel beyond the normal position to select the shift characters.

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