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A. DUCROCQ  
KEYBOARD MACHINE

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2 Sheets-Sheet 2

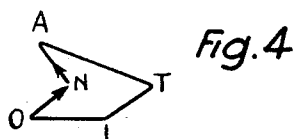


Fig. 4

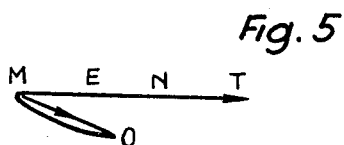


Fig. 5

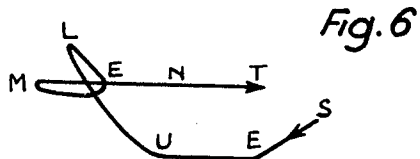


Fig. 6



Fig. 7

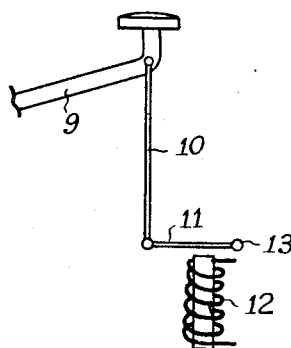


Fig. 8

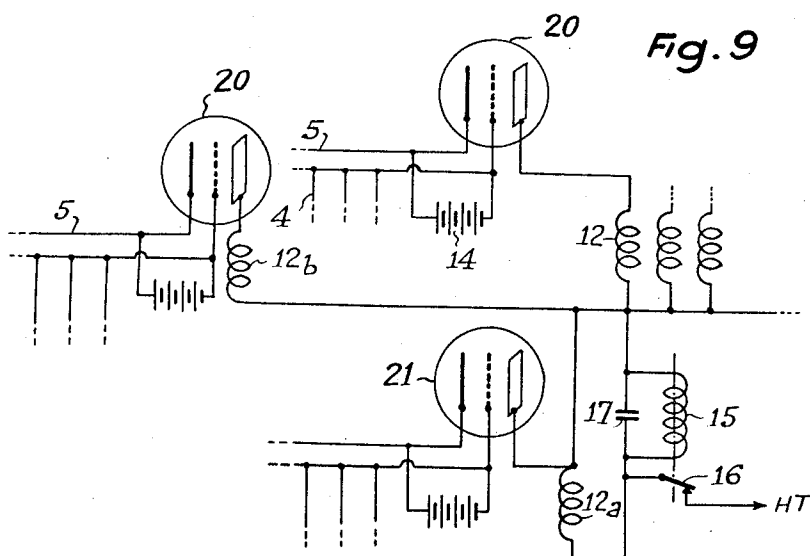


Fig. 9

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2,919,782

## KEYBOARD MACHINE

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9 Claims. (Cl. 197—19)

This invention relates to writing machines, which expression is herein used in a broad sense to designate any class of apparatus including a set of elements (herein termed keys) corresponding to a predetermined set of symbols, such as the letters of the alphabet, and selectively actuatable to produce a record of desired information as represented by the said symbols. Depending on the particular class of apparatus contemplated, the actuation of a key may cause any of various actions, such as the rocking of a type lever as in ordinary typewriters, the transmission of an electrical pulse or pulse train over a transmission line as in digital transmitters e.g. of the Telex type, the setting of type in a composition as in Linotype and similar type-setting machines, and so forth. While ordinary desk typewriters will be more specifically referred to hereinafter for purposes of clarity, it is to be expressly understood that the invention is not limited to this particular class of machine.

In conventional writing machines the keyboard generally includes one key per character (or other symbol) to be represented. This often obliges the operator to actuate in succession keys positioned at widely-spaced locations on the keyboard, correspondingly reducing typing-speed.

According to an essential feature of this invention, the keys are provided in a number greater than that of the characters (or other symbols) to be represented, with more than one key corresponding to a given character, whereby keys corresponding to those groups of letters (or other signs) that are more frequently encountered in association with one another in the particular language for which the machine is to be used, may be positioned at closely adjacent locations on the keyboard. The groups of letters involved may comprise two letters (i.e. digraphs) or three letters (trigraphs), or more.

In the ensuing description more particular reference will be made to the French language, but the statements made hereinafter will be readily transposable to the English language by those familiar with linguistics and information theory after having acquired a proper understanding of the present invention.

The most frequently occurring digraphs in French are ES, EN, LE, and DE. Accordingly, an "E" key will be provided adjacent the keys "S," "N," "L" and "D." Since the digraph combination PE likewise occurs quite frequently, another "E" key may be provided adjacent the "P" key.

The letter Q is practically always followed by U and the resulting digraph QU is generally followed in French by either an I or an E. Hence the corresponding "Q," "U," "I," and "E" keys are provided close to one another.

Similarly the letter H in French is usually preceded by either C or P. The letter G is often followed by N. The corresponding digraphs are provided for by the provision of suitably positioned keys.

Further frequently recurrent letter groups in French are EMENT and TION, found as terminal groups in

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many words. Key clusters corresponding to each of these letter groups are therefore provided, with, furthermore, a "Space" key being provided adjacent to both the "T" and "N" keys.

To facilitate operation of the machine, the keys may be divided into groups, with one group including the keys corresponding to the most frequently occurring letters or letter sequences; e.g. those having a normal occurrence frequency of 20% and more, another group comprising the keys corresponding to less frequently occurring letters, and a further set comprising keys corresponding to infrequent letters, such as (in French) the letters W and Y.

According to another feature or aspect of the invention, applicable in conjunction with or independently from the first above feature, the keys rather than being provided of the type that are depressible by finger action, are preferably provided in the form of stationary electrically conductive contact elements inserted in an insulating board or panel, and adapted to be touched with the end of a conductive stylus held in the operator's fingers so as to establish suitable electrical circuits controlling the typing operations.

When this feature of the invention is utilized in conjunction with the first above described feature involving the arrangement of keys in clusters or groups, wherein frequently occurring letter sequences are represented by adjacently positioned keys, it can readily be understood that in many cases involving entire letter sequences, it will be unnecessary to lift the stylus off the board in order to pass from one to another of the successive contact keys, but the stylus may be moved continuously over the board in sweeping strokes which will enable a suitably trained operator vastly to increase the typing speed. Thus, in the case of a keyboard of this type wherein the keys are spaced from one another by distances not exceeding one centimeter or so, a moderately skilful operator can achieve a typing rate of about ten signs per second, which is amply sufficient to follow ordinary speech. At the same time, it is important to note that the resulting typed record is no rough copy involving more or less phonetic spelling and therefore requiring to be retyped on an ordinary typewriter as is the case with conventional shorthand typing or stenotype machines, but may constitute a clean copy of the desired text without any spelling errors.

While the panel of the improved keyboard may be flat, according to another feature of the invention a warped panel may advantageously be used, formed with suitably contoured troughs or valleys tending to guide the stylus along the paths involved in the more frequently recurring letter sequences.

In some cases a given contact key of the keyboard of the invention may serve to command two different characters, e.g. "period" and "comma," as in conventional typewriter keyboards, with a special switch key being provided, adapted to be contacted before contacting such a common key in order to select between the two possible actions thereof. Preferably however, every, or almost every key of the improved keyboard is made to correspond to a single character whereby operating speed is further enhanced.

My improved keyboard includes a number of control keys such as "Upper-case," "Space," "Paragraph" and the like, and according to the invention such keys are preferably also arranged in clusters in accordance with frequently recurring sequences found in usual letterpress. Thus, the above-mentioned "Period," "Space," "Paragraph" and "Upper-case" keys are preferably positioned substantially in the order just indicated so that a quick sweep of the stylus past part or all of these keys will achieve any of the more frequently occurring composition

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sequences such as: Period, space and upper-case; or period, space, paragraph and upper-case; or space, question mark, space, paragraph and upper-case.

If desired, my improved machine may further be provided with any number of memory devices of any suitable type, operated by means of auxiliary contact keys of the keyboard, and which on actuation of the related keys will automatically trigger the typing of certain complete words, sentences or paragraphs.

While the mechanism through which the engagement of a contact key with the stylus causes the desired typing action or actions to be performed may assume any of various forms, one desirable form of mechanism may include a control circuit having a gas discharge tube with a negatively biased control grid, and having connected in the plate circuit of it an operating electromagnet and a delayed-action cut-off; the grid circuit being moreover shunted by a switch constituted by the contact key and stylus, so that engagement of the key with the stylus will remove the grid bias and operate the electromagnet to effect a typing operation. Since the firing time of a gas discharge tube of the thyratron type is of the order of one millionth of one second, and the time constant of an electromagnetic relay is likewise very short, it will be seen that these constants do not introduce a practical limitation into the speed achievable with the machine.

An exemplary embodiment of the invention will now be described for purposes of illustration but not of limitation with reference to the accompanying diagrammatic drawings, wherein:

Fig. 1 is a fragmentary sectional view of an improved keyboard, showing the stylus contacting a key;

Fig. 2 is a schematic front view of the keyboard;

Fig. 3 is a smaller-scale view of the keyboard illustrating the manner in which the keys are divided into groups or clusters;

Figs. 4 to 7 illustrate the manner in which four different words, selected by way of example, may be written with a single stroke of the stylus over the improved keyboard;

Fig. 8 diagrammatically illustrates the mechanism for actuating a type lever;

Fig. 9 is an electric circuit diagram of a form of circuit for controlling a type actuating electromagnet.

As shown in Fig. 1, in the preferred form of my invention a keyboard is provided which comprises a panel 1 of insulating material having a number of stationary conductive contact elements 2 inserted therein each corresponding to a character or sign. Even though the contact elements 2 are stationary their function corresponds to that of the keys of a conventional keyboard and they will consequently be designated "keys" herein. Each contact key 2 has a conductor 4 extending therefrom on the under side of the panel 1 for connection with a terminal of an electric circuit. A stylus member 3 of conductive material and preferably having a sharp tip as shown, is adapted to be conveniently grasped between the operator's fingers in the manner of a pencil, and is connected by way of a flexible conductor 5 of appropriate length to another terminal of the circuit, in such a manner that on engagement of the tip of the stylus 3 with a selected one of the keys 2, a control circuit is completed within the machine which will actuate the corresponding type character, in a manner to appear later. Some keys further correspond to control functions such as space, upper-case, paragraph, etc.

As indicated before, more than one key is generally provided for each character (or control function) so that a key corresponding to a desired character or function will generally be found not very far from any particular position of the board where it may be required. More specifically, the keys are so located that those corresponding to the groups of letters or signs most frequently associated in the particular language used, particularly digraphs or trigraphs are found adjacent to each other.

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The keys are arranged in groups, with dividing lines such as 6 between the groups. Other lines, such as 7, are preferably marked out on the keyboard along pathways corresponding to the letter sequences that recur most frequently in the language being used.

Referring to Figs. 2 and 3 in which keys are indicated by crosses, a first group of keys designated I, and located substantially centrally of the board, includes keys corresponding to digraphs having a particularly high rate of recurrence. It will be seen that in the embodiment here shown, which was designed for use in French, this central group includes the letter E twice, once adjacent to the letters L, M, N, D and another time near the letters S, T and L; note that each of the letters S and L also occurs twice within group I. The disposition shown was selected in order to permit a very rapid and effortless typing of the most frequently occurring digraphs, trigraphs and tetragraphs (i.e. 2, 3 and 4-letter sequences) of the French language. Thus with reference to the 4-letter sequence MENT (which forms the terminal group in a large number of French nouns and adverbs), it will be noted that the corresponding four keys are horizontally aligned in group I, so that the sequence can be written almost instantaneously with single stroke of the stylus. The same applies to the 3-letter sequence QUE, while the slightly less frequent though still much-used sequence QUI is nearly as easy to type, since it merely requires a short upward deviation of the stylus as will be immediately apparent. Also included in group I is a "Period" key and a "Space" key, the latter being designated in the drawing by a circle surrounding the cross which indicates key. The "Period" key is positioned adjacent to the L key, since in French a majority of sentences begins with a definite article, having the initial letter L. In Fig. 2 the sign ~ designates a comma.

Group II, as already mentioned, generally comprises the keys corresponding to letter sequences having a recurrence frequency somewhat lower, it being noted that in this group as in group I some of the letters occur more than once, and moreover some of the letters in group I likewise appear in group II. Group II further includes a "Carriage-return" key, a two-dot key, and a circumflex accent key. It will be noted that in this group the letters P and L are juxtaposed to take care of the digraph PL.

Groups III and IV are, generally, assigned to the less frequent letters and letter sequences in the French language, though it will be understood that each of these groups also contains, in accordance with the general teachings of the invention, keys corresponding to more frequent letters also appearing in the preceding groups. Group IV includes the relatively infrequent letters (in French) W, K and Z. Since H is more often not preceded in French by a C, the corresponding two keys are suitably positioned next to each other as shown.

Group V includes the three letters J, E and U, to provide for the most frequent combinations including the letter J, and "Period," "Space," "Upper-case" and "Brackets" keys. It will be noted that the first three keys just mentioned are provided in alignment for the purpose previously indicated.

Groups VI and VIII provide various punctuation marks, together with space keys, carriage return and upper-case keys in various convenient combinations. Group VII is devoted to numerals and arithmetical signs.

There has been indicated hereinafter the frequency of the digraphs and trigraphs which are the most frequently encountered in the French language, this frequency being represented by the number of occurrences of the particular digraph considered on an average, among 10,000 digraphs.

It will be observed that all these digraphs are formed by use of keys of group I, except for the digraphs AI, EP, and PA which are obtained with keys of the group II. The keys used for forming these trigraphs are included

Table I (digraphs)

|         |     |         |     |         |     |         |     |         |    |         |    |
|---------|-----|---------|-----|---------|-----|---------|-----|---------|----|---------|----|
| ES..... | 305 | TE..... | 163 | OU..... | 118 | EC..... | 100 | EU..... | 89 | EP..... | 82 |
| LE..... | 246 | SE..... | 155 | AI..... | 117 | TI..... | 98  | UR..... | 88 | ND..... | 80 |
| EN..... | 242 | ET..... | 143 | EM..... | 113 | CE..... | 98  | CO..... | 87 | NS..... | 79 |
| DE..... | 215 | EL..... | 141 | IT..... | 112 | ED..... | 96  | AR..... | 86 | PA..... | 78 |
| RE..... | 209 | QU..... | 134 | ME..... | 104 | IE..... | 94  | TR..... | 86 | US..... | 76 |
| NT..... | 197 | AN..... | 130 | IS..... | 103 | RA..... | 92  | UE..... | 85 | SA..... | 75 |
| ON..... | 164 | NE..... | 124 | LA..... | 101 | IN..... | 90  | TA..... | 86 | SS..... | 73 |
| ER..... | 163 |         |     |         |     |         |     |         |    |         |    |

in group I with the exception of the keys used for producing the trigraph DES (group II) and the trigraph AIT (group III).

ditions by the time the switch 16 has been restored to its normally closed position the stylus has already disengaged the key so that the thyatron is again in blocked

Table II (trigraphs)

|          |     |          |    |          |    |          |    |          |    |          |    |          |    |          |    |          |    |
|----------|-----|----------|----|----------|----|----------|----|----------|----|----------|----|----------|----|----------|----|----------|----|
| ENT..... | 118 | QUE..... | 72 | MEN..... | 54 | DES..... | 50 | ELE..... | 47 | NDE..... | 46 | ION..... | 42 | RES..... | 42 | SQU..... | 40 |
| LES..... | 77  | EDE..... | 58 | LLE..... | 53 | TRE..... | 49 | EME..... | 47 | AIT..... | 43 | NTE..... | 42 | EST..... | 40 |          |    |

Figs. 4 to 7 illustrate by way of example, some "stenograms" or continuous strokes of the stylus which, as previously explained, can be used to trace out whole letter groups or words without lifting the stylus off the keyboard owing to the particular distribution of the keys described. Figs. 4 to 7 illustrate this in connection with the four French words "NATION," "MOMENT," "SEULEMENT," and "LEQUEL" respectively. It will be understood that such stenograms in turn may be interconnected by continuous strokes of the stylus over the board, so directed as to avoid contact with any intermediate keys.

Mechanism will now be described, according to one form of embodiment of the invention, for effecting the typing actions on contacting a key with the stylus. Referring to Fig. 8, there is shown a typing key lever 9 of a conventional typewriter. Pivoted to each such lever 9 is the upper end of a link 10 the lower end of which is pivoted to the free end of a pivoted magnetic armature 11 having its other end 13 pivoted at a fixed point. Armature 11 is associated with an electro-magnet 12, and the winding of each electromagnet such as 12 is connected in the plate circuit of a corresponding gas-discharge tube or thyatron 20, as shown in Fig. 9. The grid of each thyatron is normally held at a high negative bias by a D.-C. source 14 to prevent the tube from normally firing. However, the grid is further connected, by way of the conductors 4 in parallel, to the corresponding contact key 2 of the keyboard, as indicated in Fig. 1. The cathode of the discharge tube 20 is connected by way of flexible conductor 5 to the stylus 3 as also indicated in Fig. 1.

Connected with all of the relay windings 12 in parallel is the winding of a cut-off relay 15 shunted by a delay condenser 17. Relay 15 when energized opens an associated cut-off switch 16 which is normally closed to complete the plate circuit of all the thyatrons such as 20 to the plate-voltage source indicated at HT. Thus it is seen that, on engagement of the tip of stylus 3 with a contact key 2 of the keyboard, a firing potential is applied to the grid of the related thyatron 20. The thyatron discharges, producing a flow of plate current through the related relay winding 12, whereupon armature 11 is attracted and the corresponding character is typed through the linkage described above in connection with Fig. 8. After a short time delay determined by the capacity of condenser 17, common cut-off relay winding 15 becomes energized, opening the cut-off switch 16 to disconnect the thyatrons 20 from the plate supply.

The arrangement just described provides an advantageous way of typing double letters. Normally, when it is desired to type a single character the operator need only contact the desired key 2 with the stylus for an extremely short time, brushing lightly past the surface of the key. Matters are so arranged that in such con-

condition and does not fire again. However, assuming it is desired to type a double letter, it is simply necessary to hold the stylus to the desired key for a slightly longer period, e.g. of the order of  $\frac{1}{10}$  of one second; thus, as the switch 16 is restored to its closed position after the character has been printed once, the thyatron 20 fires again and the same character is printed a second time.

As regards the "Upper-case" key, the corresponding electro-magnet winding shown at 12a controlled by thyatron 21 is seen to be connected directly to the cut-off switch 16 rather than being connected thereto through cut-off relay 15. Hence, energization of the "Upper-case" key with the stylus is seen to cause a permanent energization of the winding 12a, so that the typewriter carriage remains in its upper-case position, until such time as a letter key has been energized. When this is done, the letter is printed in the upper-case position and immediately thereafter both the thyatron 20 corresponding to the letter just typed and the thyatron 21 corresponding to the upper-case key, are simultaneously inactivated through the operation of cut-off relay 15—16 as previously described. The typewriter is thus restored to its normal lower-case position.

The keys corresponding to a sign for which the carriage of the writing machine must be in upper case position, such as a period or a numeral, are connected not only to the cathode of thyatron 20 associated with this sign, but also to the cathode of thyatron 21. Hence, on excitation of a contact key corresponding to any character of this class, the winding 12a controlled by thyatron 21 and the winding 12b controlled by the corresponding thyatron 20 are simultaneously energized. It will further be seen from the circuit connections in Fig. 9 that the cut-off relay winding 15 is likewise energized shortly after energization of windings 12a and 12b, so that after the desired character has been typed in the upper-case position, the corresponding two thyatrons are deactivated, the machine then returning to the lower-case position.

Reverting to Fig. 2, a plurality of additional keys 18 are shown as provided on the left-hand side of the keyboard. Each of these keys may serve to activate a related memory or storage device, preset so that excitation of the related key 18 with the stylus 3 will initiate a sequential typing process whereby a predetermined sequence of characters will be rapidly and automatically operated in succession, to type a corresponding word, sentence or paragraph, e.g. a stereotyped commercial phrase, an address, or the like. The memories associated with the respective keys such as 17 may have different capacities. One convenient form of memory device which has been satisfactorily used for the purpose of the invention, is a conventional telephone selector switch, of the type having from 10 to 50 (or more) switch positions. As described

in connection with the remaining keys, a thyatron may be provided for initiating the stepping operation of each selector memory device on energization of the related key 18. Since memory devices of this character are well-known and the control means therefor may be generally similar to the control means described with reference to Fig. 9 for the normal keys, it has appeared superfluous to illustrate the related circuits.

The apparatus of the invention as disclosed above may be provided in the form of a desk unit containing the control circuits, including the thyatrons and electromagnet relay means therein, and with the keyboard 1 forming the top of the unit. The keyboard may either be provided flat, in a horizontal plane or inclined, or it may, according to a further feature of the invention, be provided with a warped surface, in which shallow, rounded grooves or channels may be defined so as to guide the stylus along a number of different pathways corresponding to the most frequently recurring letter sequences.

Leading out of the unit is a bundle of conductors, about sixty in number in one form of the invention, each carrying a maximum current of the order of ten milliamperes, e.g. at about 20 volts. Thus the actual typewriter, which may be of any conventional type suitable for electrical operation, may be conveniently positioned at some distance from the unit.

It will be understood that various departures from and modifications in the form of embodiment described and illustrated herein may be made without exceeding the scope of the present invention.

What is claimed is:

1. A writing machine comprising a keyboard having electrically conducting key-members mounted thereon and insulated from each other, means on which characters-to-be-written are mounted, said key-members being greater in number than the characters to be written, certain of the characters which occur in normal usage more frequently than others being represented by more than one key-member, each of said plurally-representing key-members being placed in neighboring positions with other characters in connection with which they are most commonly used, a stylus manually movable over and in contact with said key-members, and means to actuate said character-mounting means including electro-magnetic means energized by engagement of said stylus with said key-members to selectively operate said actuating means.

2. A writing machine as claimed in claim 1 wherein the key-members are arranged in several groups on the keyboard consisting of characters recurring in usage in greater or lesser frequency or infrequently, said plurally-representing key-members being located in several of said groups and being located within each group in a position adjacent the key-members for characters with which the plurally-representing characters are most commonly used.

3. A writing machine as claimed in claim 2 in which

sequences of two or more characters which recur in usage most frequently have their key-members connected by channels for guiding said stylus.

4. A writing machine as claimed in claim 2 in which there is only one character-mounting means and actuating means for each separate character and in which each of the several key-members for a plurally-representing character is electrically connected to said one character-mounting means and actuating means for that character.

5. A writing machine as claimed in claim 4 in which each character control circuit comprises a thyatron having a negatively biased grid and having interposed in the plate circuit thereof a control electromagnet and a delayed cut-off switch, the switch formed by the corresponding contact and the stylus being disposed in parallel with the bias potential in the grid circuit.

6. A writing machine as claimed in claim 1 in which each character control circuit comprises a thyatron having a negatively biased grid and having interposed in the plate circuit thereof a control electromagnet and a delayed cut-off switch, the switch formed by the corresponding contact and the stylus being disposed in parallel with the bias potential in the grid circuit.

7. A writing machine having a keyboard having key-members thereon greater in number than the characters to be written, certain of the characters which occur in normal usage more frequently than others being represented by more than one key-member, each of said plurally-representing key-members being placed in neighboring positions with other characters in connection with which they are most commonly used, means on which characters-to-be-written are mounted, means to actuate said character-mounting means, and means manually movable over said keyboard to selectively operate said actuating means.

8. A writing machine as claimed in claim 7 wherein the key-members are arranged in several groups on the keyboard consisting of characters recurring in usage in greater or lesser frequency or infrequently, said plurally-representing key-members being located in several of said groups and being located within each group in a position adjacent the key-members for characters with which the plurally-representing characters are most commonly used.

9. A writing machine as claimed in claim 8 in which the manually-movable selective operating means includes a stylus and in which sequences of two or more characters which recur in usage most frequently have their key-members connected by channels for guiding said stylus.

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