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PATENT SPECIFICATION

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(54) KEYBOARD APPARATUS E.G. FOR TYPEWRITING, TYPESETTING, DATA HANDLING AND SIMILAR MACHINES

(71) I, VELAUTHAR KOPALA-PILLAI THILLAINAYAGAM, a British Subject of 74 Forlease Road, Maidenhead, Berkshire, SL6 1SD, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to keyboard apparatus, e.g. for machines used in typewriting, typesetting, data handling and the like. In this context, the term keyboard apparatus means an assemblage or plurality of keys which when operated either singly or in a combination or permutation activate mechanisms containing types or other mechanisms and/or produce coded or uncoded electrical impulses so that information could be transferred to material mediums directly or via interface mediums indirectly. Where a language contains large number of characters in spite of whether the characters are alphabetic, semi-alphabetic, syllabic or semisyllabic, in comparison with latin or roman alphabets, the keyboard becomes unmanageable in size. In order to reduce the number of keys on the prior art keyboards for such languages the characters are fragmented and assembled by overprinting by several methods, one of which is by the use of dead keys and/or half space keys. This hinders transfer or handling of information internally and internationally as conventional equipment could not be used. Production of specialised equipment is expensive as it caters for a small market and hence the need for simpler and cheaper keyboards to transfer and/or handle information internally and internationally using conventional and/or universally available equipment has been felt by many countries for a long time.

It is therefore desirable to provide a simplified keyboard for transferring and/or handling information internally and internationally, in any language that could be accommodated on the keyboard and

particularly in languages where characters are alphabetic, syllabic, semi-alphabetic or semi-syllabic and where the characters are numerically greater than the characters in roman or latin alphabets.

In the present age where natural resources are depleting rapidly, labour costs are rising sharply, production methods are improving constantly and international communications are growing heavily, it is also desirable to provide a suitable keyboard which can be used in conjunction with commonly known mechanisms for as many languages as possible. In this regard it may be desirable to accommodate characters of one language on a Qwerty type keyboard in a manner such as to create as many vacant character positions as possible to enable the keyboard to be used for either multi-lingual operation and/or multifount operation, thus enabling further savings on equipment to be effected.

It is also desirable to provide or evolve character codes (like American Standard Code for Information Interchange (ASCII) or United Kingdom Date Code, or International Telegraph Codes) using this keyboard so that international interchange of information is possible in conjunction with conventional equipment.

According to this invention there is provided keyboard apparatus for printing and/or producing electrical signals corresponding to compound character components that, in combination, form compound characters that are non-Roman characters of a language, the keyboard apparatus being characterised by a first set of keys each of which is operable to print and/or produce an electrical signal corresponding to a compound character component representative of a consonant, a second set of keys each of which is operable to print and/or produce an electrical signal corresponding to a compound character component representative of a vowel, and being characterised in that the sequential operation of one key of the first set and one

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key of the second set will print without overprinting and/or produce two sequential electrical signals corresponding to the two associated compound character components that together represent a compound character of the language in the form of the consonant followed by the vowel.

Preferably the keys of one set are dispersed between or among the keys of the other set so as not to be grouped together.

It will be appreciated that for this invention the compound characters of the language are divided, on a phonetic basis, into consonant-representing components and vowel-representing components.

For brevity of expression in the following description, the keyboard shall be called SAKTHI, the acronym, for "Simplified Alphanumeric Keyboard for Transferring and/or Handling Information", (the term "Alphanumeric" meaning: "alpha"—the characters of the language; "numeric"—syllables, punctuation marks, numerals, diacritical marks and the like), to distinguish it from the multitudes of keyboards available today. Whenever this keyboard is put to different use, the use shall follow the acronym, for example:

SAKTHI (Tamil) to mean that the keyboard is for use with Tamil language;

SAKTHI code (Tamil) to mean that the code outputted by the keyboard is for Tamil language;

SAKTHI (Tamil) code converter ROM to mean that the Read Only Memory is for use in keyboards for Tamil language to convert from one code to another; etc.

By way of example, embodiments of the invention will now be described with reference to the drawings accompanying the Provisional Specification and in which:

Fig. 1 shows the complete set of Tamil characters in its existing form, and arranged in a matrix;

Fig. 2 shows alphabets (not complete) from Burmese, Devanagari, Kashmir, Gurmukhi, Bengali, Gujarati, Singhalese and Tamil with their phonetic value in English;

Fig. 3 shows one of the many possible arrangements of Tamil characters in the re-organised form and arranged in a matrix;

Fig. 4 shows one of the many possible arrangements of Tamil characters in the regularised form and arranged in a matrix;

Fig. 5 shows one of the many possible basic arrangements of SAKTHI (Tamil) for typewriters;

Fig. 6 shows one of the many possible basic arrangements of SAKTHI (Tamil,

Kirantha and English) for multilingual typewriters;

Fig. 7 shows one of the many possible basic arrangements of SAKTHI (Tamil, Kirantha and English) for data handling, information interchange and the like;

Fig. 8 shows in block diagram the SAKTHI (Tamil, Kirantha and English) display device;

Fig. 9 shows one of the many possible basic arrangements of SAKTHI code (Tamil, Kirantha and English) used for the display device;

Fig. 10 shows one of the many possible arrangements of SAKTHI code (Tamil, Kirantha and English) used for typesetting and composing;

Fig. 11 shows in block diagram the method of obtaining existing unmodified characters by using the SAKTHI (Tamil, Kirantha and English) for either regularised and/or re-organised characters for the purpose of typesetting and composing.

Each of the keyboards described below is suitable for use with any language in which the characters are numerically greater than those of latin or roman characters and where the vowels and the basic characters form the two axes of the matrix and the elements of the matrix the combination characters formed by the axes. For example, if A_i is an element of the vowel axis and B_j is an element of the basic character axis, then the corresponding element in the matrix, $B_j A_i$ is the combination character. The element $B_j A_i$ is at present written in one or more of the following ways:

(1) by a unique character as shown ringed in Fig. 1 by way of example only;

(2) by overprinting certain symbol or symbols representing the vowel sound or sounds on a basic or a compound character or by using diacritical mark or marks as shown enclosed in box in Fig. 1 by way of example only;

(3) by writing symbol or symbols representing the vowel sound on one or both sides of the basic or the compound character or by writing diacritical mark or marks above and/or below the basic character or both.

In certain languages special characters are encountered which cannot be written as an element of the matrix. These characters are treated differently as such and are assigned a character position on the keyboard. For example, reference may be made to character marked x in Fig. 5.

Because of the unordered manner in which combination characters are formed, elaborate ways of reproducing these characters have been employed so far.

The methods employed in the embodiments of this invention described

below eliminate overprinting completely and one character or symbol is outputted for every stroke of the key (except for the space bar or other special keys which are not intended to output a character) as in the Qwerty type keyboard, by

(a) writing the vowel itself to the right of the basic character when a combination character is required. This system is called the alphabetic system since each letter has a single sound. For example, reference may be made to Fig. 3;

(b) writing the symbol or symbols representing the vowel sound on one or both sides of the basic character. This system is called the semi-alphabetic or semi-syllabic system. For example, reference may be made to Fig. 4.

For the purpose of this specification, method (a) is called re-organising and method (b) is called regularising.

If the characters are to be regularised, the symbol or symbols (syllable) used for majority of characters bearing the same vowel sound is noted. All characters are rewritten using the basic character and the symbol or symbols representing vowel sounds separately and in a certain order, that is, the symbol or symbols representing the vowel sound are written on one side or both sides of the basic character as the case may be. If no symbol or symbols are used for that particular vowel sound, then a new symbol (syllable) is created. The new matrix thus formed will be an identity matrix to the original matrix as shown in Fig. 4. When the characters are regularised, the character positions necessary on the keyboard will be the total of the number of elements in both axes plus the vowel symbols plus the special characters.

If the characters are to be re-organised, the number of character positions necessary are the total of the elements in both axes (alphabets) plus the special characters. For example, reference may be made to Fig. 3.

It may be noted that on a regularised keyboard, the re-organised characters could be outputted and not vice versa. When re-organised characters are used (alphabet system), the vowel symbols are used just as symbols like *, # etc. For example, references may be made to Fig. 3 and Fig. 4.

Arranging the character elements by these methods reduces the character positions necessary for the particular language, and the vacant positions on the keyboard could be used to accommodate special characters, numerals, diacritical marks, punctuation marks, mathematical symbols and characters of other language or languages and/or different type fonts in the same language. For example, reference may be made to Fig. 6 which is a Qwerty type keyboard for multilingual operation, viz: the

keyboard accommodates complete regularised or re-organised Tamil characters, special characters, numerals, punctuation marks, diacritical marks, mathematical symbols, Kirantha characters which are most commonly used in Tamil language and complete alphabet of English language in either upper case (or capital letters) or lower case (or small letters).

One of the applications of embodiment of this invention is to transfer or handle information or data. The equipment used for this purpose include teleprinters, teletypewriters, computer interfaces, data transmission equipment, etc. To transfer information or data via a physical medium or by direct electrical connections of various units or by means of transmission equipment, the information has to be first converted to electrical impulses or logically related codes. There exist codes for international information interchange for many languages but codes have not been developed for some languages. SAKTHI eliminates this deficiency by providing many more languages with international codes. Reference may be made to Fig. 7 in which a normal teleprinter type keyboard for Tamil characters, Kirantha characters commonly used in Tamil and English characters together with control keys and keys for other marks mentioned earlier are shown.

It may be noted at this juncture that the number of character positions available on a keyboard obeys the following mathematical relationship:

$$N=np^q$$

where

N is the number of character positions available on the keyboard;

n is the number of keys on the keyboard;

p is the number of positions the type carrying mechanism could be shifted; and

q is the number of modes the keys could be operated.

However, there are limitations to n, p and q depending on the size of the keyboard and usage. On a Qwerty type keyboard, p=2. SAKTHI code (Tamil, Kirantha and English) for the purposes discussed are generated by keeping the p the same as in the normal teleprinter or teletypewriter and varying q.

Since the code should be able to be transmitted, received and interpreted internationally, the SAKTHI code uses the basic 7 bit international code for interchange of information. With 7 bits, it is possible to accommodate $2^7=128$ characters. By adding another mode of

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operation, an additional bit, the 8th bit is introduced, thereby increasing the character capacity to $2^8=256$ characters. At present, the unused 8th bit is used for parity checking. When this bit is used as an information bit, this facility is lost, but because the parity bit checks errors and controls the machines, this could be done by any number of additional bits. A complete list of the SAKTHI code (Tamil, Kirantha and English) is shown in Fig. 10. It may be seen that the 8th bit thus divides the 256 character positions into two equal subsets of 128 character positions, each subset being selected when bit 8 is a logical one or logical zero and one of the subset contains the complete set of the International Information Interchange Code. There are two possible arrangements of the two subsets of 128 character positions in an 8 bit code and many possible arrangements within the subsets and the set itself.

The SAKTHI meets with the full requirements for transmission of any particular user or administrator is willing to compromise in the transmission of their respective language, it could be done so by suitably selecting a code with lesser number of bits, say, a 5 bit or 6 bit or 7 bit code. Consequently, the keyboard will also be suitably modified.

For Thiamil, Kirantha and English displays, certain elements of the subset contained in columns 2, 3, 4 and 5 and the complete 128 characters of the international Information Interchange Code are used, ignoring the Tamil characters in the subset contained in columns 14 and 15. Such a partial list is shown in Fig. 9.

For type setting and composing in the printing industry, where the need for existing unmodified characters arises, the whole set as given in Fig. 10 is used. The character positions are then electronically generated by processing the sequential signals corresponding to the character's components, and the compound characters formed (e.g. electronically and/or mechanically) by using either the regularised characters or the re-organised characters or both.

In this connection, reference may be made to Fig. 11. 3 is a Read Only Memory (ROM) of 512×8 bit capacity and is programmed to output the eight bit code pertaining to certain combination characters, when addressed appropriately. 6 and 7 are temporary data storage registers which, when strobed, output the contents. Outputs of 6 form the addresses for ROM 3. Outputs of ROM 3 and registers 7 are ORed to give eight bit codes at 5 which identify character positions in the complete list of the SAKTHI code (Tamil, Kirantha and English) shown in Fig. 10. 8 is a bistable

toggle which has two inputs 'M' and 'N'. Input 'M' is obtained from 11 which contains logic to detect key strokes. Input 'N' is the 8th bit (B8) outputted by the SAKTHI. When B8 is a logical one, operation of toggle 8 is inhibited. Output of 8 is normally at logical one. 9 is a monostable which operates on the leading positive edge of output of 8 and strobes registers 6. Outputs of 6 form the addresses of ROM 3. When B8 is a logical one, delay monostable 10 is operated and its output strobes registers 7. Outputs at 5 are fed into typesetting and composing machines directly or recorded in an interface medium for future use. When outputs at 5 are accepted by the equipments connected to these, a reset pulse 4 is sent back to clear registers 6 and 7. As mentioned earlier, B8 determines which half of the 256 character set is accessed. Thus when any character contained in this subset of 128 characters (except the Tamil characters contained in columns 14 and 15) are outputted by the SAKTHI, the codes for these characters are passed to the output at 5 via 7. To obtain the codes for any other characters which are accessed when bit eight (B8) is a logical zero, only the first six bits (B1 to B6) in 1 are used. Certain vowel symbols in the case of regularised characters and corresponding vowels in the case of re-organised characters in 2 are assigned binary codes equivalent to decimal figures one to seven. These three newly formed binary bits (B7, B8 and B9) are used to address ROM 3 via 6 in conjunction with B1 to B6. In either case (that is, regularised or re-organised characters), a special key (not shown) is used to output binary 000 when addresses for single alphabets or certain vowel symbols are generated.

Arrangement shown in Fig. 8 was used to test the feasibility of the keyboard. The display device receives tape inputs 1, keyboard inputs 2 and direct inputs 3 from computers or data handling machinery. Information bits one to seven 4 and control bit eight 5 are fed to a Random Access Memory 6. Timing and control functions are generated in 7. During write mode, all the eight bits are stored in the Random Access Memory 6. During read mode, bits one to seven are fed in parallel to an English Character Generator ROM 10 and a Tamil and Kirantha Character Generator ROM 11. Depending on whether bit eight is a logical one or logical zero, either of the Character Generators 10 or 11 are selected. The outputs from 10 and 11 are ORed and are converted from parallel to serial data in 12, and presented in the form of logical ones and logical zeroes to the video display 14, in conjunction with video circuitry contained in 13. Thus it is possible to display either Tamil and Kirantha characters or English

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characters in the upper and lower cases or an intermixed text.

WHAT I CLAIM IS:—

1. Keyboard apparatus for printing and/or producing electrical signals corresponding to compound character components that, in combination, form compound characters that are non-Roman characters of a language, the keyboard apparatus being characterised by a first set of keys each of which is operable to print and/or produce an electrical signal corresponding to a compound character component representative of a consonant, a second set of keys each of which is operable to print and/or produce an electrical signal corresponding to a compound character component representative of a vowel, and being characterised in that the sequential operation of one key of the first set and one key of the second set will print without overprinting and/or produce two sequential electrical signals corresponding to the two associated compound character components that together represent a compound character of the language in the form of the consonant followed by the vowel.

2. Keyboard apparatus according to Claim 1, characterised in that the sequential operation of a plurality of keys of the first set followed by one key of the second set will print in corresponding sequence without overprinting and/or produce correspondingly sequential signals corresponding to the compound character components that together represent a compound character of the language in the form of the plurality of consonants followed by the vowel.

3. Keyboard apparatus according to Claim 1 or Claim 2, characterised in that the sequential operation of one key of the second set and one key of the first set will print without overprinting and/or produce two sequential electrical signals corresponding to the two associated compound character components that together represent a compound character of the language in the form of the vowel followed by the consonant.

4. Keyboard apparatus according to any preceding Claim, wherein at least some of the compound character components associated with the first set of keys are generally identical to the consonant portions of the written compound

characters, but are re-organised for side-by-side printed disposition with respect to others of said compound character components.

5. Keyboard apparatus according to any preceding Claim, wherein at least some of the compound character components associated with the second set of keys are symbolic representations of the vowel portions of written compound characters.

6. Keyboard apparatus according to any preceding Claim, wherein the compound character components associated with the first and second sets of keys are, or are derived from the consonant and vowel portions of the compound characters of the written language when represented in the form of a matrix array having the consonant and vowel portions as its primary column and row respectively.

7. Keyboard apparatus according to any preceding Claim, wherein the said language is composed of characters that numerically exceed the characters of a language composed of Roman and/or Latin letters.

8. Keyboard apparatus according to any preceding Claim wherein operation of the said keys produces sequential electrical signals, characterised in that the signals are in binary form, each signal being discrete and distinctive of its associated compound character component.

9. Keyboard apparatus according to Claim 8, wherein said signals are discrete coded constituents of an n-bit binary code, where n depends on the number of characters in the language.

10. Keyboard apparatus according to Claim 9, wherein n=8.

11. Keyboard apparatus according to any preceding Claim, wherein at least some of the said keys are each operable in different modes, operation in one mode being as aforesaid and operation in at least one other mode being such as to produce an electrical signal for a different purpose (e.g. a signal corresponding to a character or character portion of a different language) and/or to print a character or character portion of a different language or in a different font size of the same language.

12. Keyboard apparatus according to Claim 11, wherein said different language is composed of Roman and/or Latin letters.

13. Keyboard apparatus according to any preceding Claim wherein operation of said keys produces sequential electrical signals, characterised in that said signals are

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characters in the upper and lower cases or an intermixed text.

WHAT I CLAIM IS:—

1. Keyboard apparatus for printing and/or producing electrical signals corresponding to compound character components that, in combination, form compound characters that are non-Roman characters of a language, the keyboard apparatus being characterised by a first set of keys each of which is operable to print and/or produce an electrical signal corresponding to a compound character component representative of a consonant, a second set of keys each of which is operable to print and/or produce an electrical signal corresponding to a compound character component representative of a vowel, and being characterised in that the sequential operation of one key of the first set and one key of the second set will print without overprinting and/or produce two sequential electrical signals corresponding to the two associated compound character components that together represent a compound character of the language in the form of the consonant followed by the vowel.

2. Keyboard apparatus according to Claim 1, characterised in that the sequential operation of a plurality of keys of the first set followed by one key of the second set will print in corresponding sequence without overprinting and/or produce correspondingly sequential signals corresponding to the compound character components that together represent a compound character of the language in the form of the plurality of consonants followed by the vowel.

3. Keyboard apparatus according to Claim 1 or Claim 2, characterised in that the sequential operation of one key of the second set and one key of the first set will print without overprinting and/or produce two sequential electrical signals corresponding to the two associated compound character components that together represent a compound character of the language in the form of the vowel followed by the consonant.

4. Keyboard apparatus according to any preceding Claim, wherein at least some of the compound character components associated with the first set of keys are generally identical to the consonant portions of the written compound

characters, but are re-organised for side-by-side printed disposition with respect to others of said compound character components.

5. Keyboard apparatus according to any preceding Claim, wherein at least some of the compound character components associated with the second set of keys are symbolic representations of the vowel portions of written compound characters.

6. Keyboard apparatus according to any preceding Claim, wherein the compound character components associated with the first and second sets of keys are, or are derived from the consonant and vowel portions of the compound characters of the written language when represented in the form of a matrix array having the consonant and vowel portions as its primary column and row respectively.

7. Keyboard apparatus according to any preceding Claim, wherein the said language is composed of characters that numerically exceed the characters of a language composed of Roman and/or Latin letters.

8. Keyboard apparatus according to any preceding Claim wherein operation of the said keys produces sequential electrical signals, characterised in that the signals are in binary form, each signal being discrete and distinctive of its associated compound character component.

9. Keyboard apparatus according to Claim 8, wherein said signals are discrete coded constituents of an n-bit binary code, where n depends on the number of characters in the language.

10. Keyboard apparatus according to Claim 9, wherein n=8.

11. Keyboard apparatus according to any preceding Claim, wherein at least some of the said keys are each operable in different modes, operation in one mode being as aforesaid and operation in at least one other mode being such as to produce an electrical signal for a different purpose (e.g. a signal corresponding to a character or character portion of a different language) and/or to print a character or character portion of a different language or in a different fount size of the same language.

12. Keyboard apparatus according to Claim 11, wherein said different language is composed of Roman and/or Latin letters.

13. Keyboard apparatus according to any preceding Claim wherein operation of said keys produces sequential electrical signals, characterised in that said signals are

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processed to re-create the original compound characters.

- 5 14. Keyboard apparatus substantially as herein described with reference to and/or as illustrated in any one of Figs. 5 to 11 of the drawings accompanying the Provisional Specification.

For the Applicant,
E. EDER,
Chartered Patent Agent,
Lonsdale Chambers,
27 Chancery Lane,
London WC2A 1NF.

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