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**PROVISIONAL APPLICATION FOR PATENT COVER SHEET**

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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| INVENTOR(S)                                                                                                                             |  |                               |  |                                                         |       |
|-----------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------|--|---------------------------------------------------------|-------|
| Given Name (first and middle [if any])                                                                                                  |  | Family Name or Surname        |  | Residence<br>(City and either State or Foreign Country) |       |
| Firooz                                                                                                                                  |  | Ghassabian                    |  | Great Neck, NY                                          |       |
| Additional inventors are being named on the _____ separately numbered sheets attached hereto                                            |  |                               |  |                                                         |       |
| TITLE OF THE INVENTION (500 characters max)                                                                                             |  |                               |  |                                                         |       |
| Method of Data Entry Combining Key Press and Speech                                                                                     |  |                               |  |                                                         |       |
| Direct all correspondence to: CORRESPONDENCE ADDRESS                                                                                    |  |                               |  |                                                         |       |
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|                                                                                                                                         |  | Telephone                     |  | 2126972800                                              | Fax   |
| ENCLOSED APPLICATION PARTS (check all that apply)                                                                                       |  |                               |  |                                                         |       |
| <input checked="" type="checkbox"/> Specification Number of Pages                                                                       |  | 82                            |  | <input type="checkbox"/> CD(s), Number                  |       |
| <input checked="" type="checkbox"/> Drawing(s) Number of Sheets                                                                         |  | 42                            |  | <input type="checkbox"/> Other (specify)                |       |
| <input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76                                                                        |  |                               |  |                                                         |       |
| METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT                                                            |  |                               |  |                                                         |       |
| <input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.                                              |  |                               |  | FILING FEE AMOUNT (\$)                                  |       |
| <input type="checkbox"/> A check or money order is enclosed to cover the filing fees.                                                   |  |                               |  | 80.00                                                   |       |
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| The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government. |  |                               |  |                                                         |       |
| <input checked="" type="checkbox"/> No.                                                                                                 |  |                               |  |                                                         |       |
| <input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are:                            |  |                               |  |                                                         |       |

(Page 1 of 2)

Respectfully submitted

SIGNATURE

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(If appropriate)

Docket Number:

34,345

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This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop Provisional Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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PATENT

Docket No. 676-025c6

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Ghassabian  
Serial No. : TBA  
Filed : May 5, 2003  
For : METHOD OF DATA ENTRY COMBINING KEY PRESS AND SPEECH

EXPRESS MAIL CERTIFICATE

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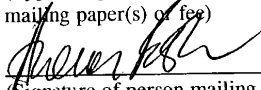
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5

**PROVISIONAL PATENT APPLICATION**

**FOR**

10 **METHOD OF DATA ENTRY COMBINING KEY PRESS & SPEECH**

15

20 **Inventors: Benjamin Firooz Ghassabian**

Title:

**A MICROPHONE FOR DATA ENTRY  
USING INTEGRATED KEYPAD SYSTEMS**

Specification:

5

The invention described hereafter relates to method of configuration of symbols such as characters, punctuation, functions, etc. (e.g. symbols of a computer keyboard) on a small keypad having a limited number of keys, for data entry in general, and for data and/or text entry method combining voice/speech of a user and key interactions (e.g. key presses) on a keypad, in particular. This method facilitates the use of such a keypad.

Fig. 1, shows an example of an integrated keypad 100 for a data entry method using key presses and voice/speech recognition systems. In this example, the keys of the keypad may respond to one or more type of interactions with them. Said interactions may be such as:

- pressing a key with a specific finger or a portion of a finger (using a finger recognition system)
- a single tap (e.g. press) on a key or a double tap (e.g. two consecutive presses with short time interval) on a key.
- a slight pressure (or a touch) on a key, or a heavy pressure on a key
- a short time interaction with a key (e.g. a short time pressing of a key) or a longer time pressing of a key etc...

To each of said interactions or to any combination of them with the keys of the keypad, a group of symbols on said keypad may be assigned. For example, the symbols shown on the top side of the keys of the keypad 100, may be assigned to a single pressure on the keys of the keypad. If a user, for example  
5 presses the key 101, the symbols "DEF3 ." may be selected. In the same example, the symbols configured on the bottom side of the keys of the keypad 100, may be assigned for example, to a double tap on said keys. If a user, for examples double taps on the key 101, then the symbols " { } ' " are selected.

Same selection may also be possible with other interactions such as those  
10 described before depending on the system implemented with the keys of the keypad. For example, a slight press (or a touch) on the key 101, could select the symbols configured on the top side of said key, and a heavier pressure on the same key, could select the symbols configured on the bottom side of said key.

As described, when a user interacts with a key, a recognition system  
15 candidates the symbols on said key which are assigned to said type of interaction. For example, if a user touches or slightly presses the key 102, the system candidates the symbols, "A", "B", "C", "2", and ",". To select one of said candidated symbols, said user may speak, for example, either said symbol or a position appellation of said symbol on said key. For this purpose a voice/speech  
20 recognition systems is used.

If the user does not speak, a predefined symbol among those candidated symbols, may be selected as default. In this example, the punctuation "," shown

in a box 103 is selected. To select one of the other candidate symbols, for example the letter "B", the user may speak said letter.

In the same example, if the user presses heavily the key 102, then the symbols "[", "]", and "" may be candidate. As described above, if the user does not speak, a predefined symbol among those selected by said pressing action, may be selected as default. In this example, the punctuation "" is selected. Also in this example, to select a desired symbol among the two other candidate symbols "[", or "]", the user may use different methods such as speaking said desired symbol, and/or speaking its position relating to the other symbols, and/or speaking its color (if each symbol has a different color), and/or any predefined appellation (e.g. a predefined voice or sound generated by a user) assigned to said symbol. For example, if the user says "left", then the character "[" is selected. If the user says "right", then the character "]" is selected.

Of course, instead of using a voice/speech, a behavior of a user combined with a key interaction may select a symbol. For example, a user may press the key 102 heavily and swipe his finger towards a desired symbol.

The above-mentioned method of data entry may also be applied to a keypad having keys responding to a single type of interaction with said keys (e.g. a standard telephone keypad having push-buttons). As shown in Fig. 2, a keypad 200 having keys responding to a single interaction with said keys. When a user presses a key all of the symbols on said key are candidate by the system. For example, if the user presses the key 202, then the symbols, "A", "B", "C", "2", ",", "[", " ", and "]" are candidate.

In this example, if the user does not speak, the system may select a predefined default symbol. In this example, punctuation “,” 203 is selected.

Still in the same example, to select a desired symbol among the said candidates, the user may either speak a desired symbol, or for example, speak a position appellation of said symbol, on said key or relating to other symbols on said key, or any other appellation as described before. For example, a symbol among those configured on the top of the key (e.g. “A”, “B”, “C”, or “2”), may be selected by speaking it. In other hand, for example, one of the symbols configured on the bottom side of the key, (e.g. “[“, “ “, or “J”) may be selected by speaking its position relative, for example, to the two other symbols on the bottom side of said key, by saying for example, “left”, “middle, or “right”. For example, to select “[” 204, the user may press the key 202 and say “left”.

As mentioned, the keys the keypad of fig.1, may respond to at least two predefined types of interactions with them. Each type of interaction with a key of said keypad may candidate a group of said characters on said key.

As described before, during a data entry such as writing a text, different interactions with the keys (e.g. one tap, double tap) and different user behavior (e.g. speaking, not speaking) combined with said key interactions, may be required. Although the data entry method of this invention is a quick and easy data entry, a good configuration of the symbols on the keys of the keypad of this invention, may result a still easier and quicker data entry system. This method will be described hereafter.

According to one embodiment, as shown in fig. 3, a number of symbols (e.g. symbols on a computer keyboard) are physically divided into at least two groups and arranged on a telephone keypad keys by their order of priority (e.g. frequency of use, familiarity of the user with existing arrangement of some symbols such as letters and digits on a standard telephone keypad, etc.), as follow:

**First group assigned to a first type of interaction with a keys**

10    **a) A first subgroup using voice/speech**

Digits 0 – 9, and letters A-Z may be placed on the keys of a keypad according to standard configuration and assigned to a first type of interaction (e.g. a first level of pressure) with said keys. A desired symbol among them may be selected by interacting (e.g. said first type of interaction) with a  
15    corresponding key and naturally speaking said symbol. In fig. 3 said symbols (e.g. 301) are configured on the top side of the keys.

Letters and digits may frequently be used during, for example, a text entry. They both, may naturally be spoken while, for example, tapping on  
20    corresponding keys. Therefor, for faster and easier data entry, they preferably may be assigned to a same type of interaction with the keys of a keypad.

**b) A second subgroup not using voice/speech**

At least part of the other symbols (e.g. punctuation, functions, etc.) which are frequently used during a data (e.g. text) entry may be placed on the keys (one symbol per key) of the keypad and be assigned to said first type of interaction (e.g. a single tap) with said keys. As default, a desired symbol may be selected by only said interaction with corresponding key without the use of speech/voice. In fig. 3 said symbols (e.g. 302) are configured in boxes on the top side of the keys.

Of course, said symbols may also be selected by speaking them while interacting with a corresponding key, but because speaking this kind of symbols (e.g. punctuation, functions) is not always a natural behavior, it is preferable to not to speak them.

**At least a second group assigned to at least a second type of interaction with at least one key**

At least part of the remaining symbols may be assigned to at least a second type of interaction with said keys of said keypad. They may be divided into two groups as follow:

**c) A third subgroup not using voice/speech**

A third subgroup comprising the remaining frequently used symbols and the ones which are difficult and/or not natural to pronounce, may be placed on said keys of said keypad (one symbol per key) and assigned to a second type

of interaction (e.g. double tap, heavier pressure level, two keys pressed simultaneously, a portion of a finger by which the key is touched, etc.) with said keys.

As default, a desired symbol may be selected by only said interaction with  
5 a corresponding key without the use of speech/voice. In fig. 3 said symbols (e.g. 303) are configured in boxes on the bottom side of the keys.

Of course, said symbols may also be selected by speaking them while interacting with a corresponding key, but because speaking this kind of symbols (e.g. punctuation, functions) is not always a natural behavior, it is preferable to  
10 not to speak them.

**d) At least a fourth subgroup using voice/speech**

A fourth subgroup comprising at least part of remaining symbols may also be assigned to said second type of interaction with the keys of said keypad and be  
15 combined with a user's behavior such as voice. In fig. 3 said symbols (e.g. 304) are configured on the bottom side of the keys. Said symbols may be selected by said second type of interaction with a corresponding key and use of voice/speech in different manners such as:

- 20
- the symbols being selected by naturally pronouncing their appellation
  - the symbols being selected by naturally speaking their position relative to each other on a key or their position while using them in a text (e.g. "<", ">" in this example, said symbols do not belong to said second type

of interaction, this is only an example), by saying for example, "left, right, open, close, etc."

- the symbols which are very rarely used (they are very few) and/or are difficult to pronounce (e.g. 304). For a fast and easy data entry method, said symbols may also be selected by speaking their position on a key, or relative to each other on said key. Of course they be selected by using other speech such a pronouncing them.

**e) Others**

If needed, other symbols such as "F1-F12", etc. may be provided on the keys of the keypad and assigned a type of interaction. For example, they may be assigned to said second type of interaction (with or without using speech), or be assigned to another kind of interaction such as pressing two keys simultaneously, triple tagging on corresponding key(s), using a switch to enter to another mode, etc.

**More considerations to enhance the keypad and the use of it**

Because Digits 0 – 9, and letters A-Z may be placed on the keys of a keypad according to standard configuration and be assigned to a first type of interaction (e.g. a first level of pressure, a single tap, etc.) with said keys combined with speech, some keys such as 311, 312, 313, and 314, may contain at most one symbol (e.g. digit 1 on the key 311, or digit 0 on the key 313) used in

said configuration. Thus for better use of said keys, some easy and natural to pronounce symbols 321-324 may be added on said keys and be assigned to said first type of interaction. for example, a user can select the character "(" by using a first type of interaction with key 311 and saying, for example, "left", or "open".

5 To select the character ")" the user may use the same first type of interaction with said key 311 and say for example, "right" or "close". This is a quick, and more importantly a natural speech for said symbols. Because the number of candidate symbols on said keys 311-314, assigned to said first type of interaction does not exceed the ones on the other keys, the voice recognition system may still have a  
10 similar degree of accuracy as for the other keys.

Also, some symbols may be used in both modes (interactions with the keys). Said symbols may be configured more than once on a keypad (e.g. either on a single key or on different keys) and be assigned to a first and/or to a second type of interaction with corresponding key(s).

15 Fig.3, illustrates a preferred embodiment of this invention for a computer data entry system. The keys of the keypad 300 respond to two or more different interaction (such as different levels of pressures, single or double tap, etc.) on them. As shown, a number of symbols, such as alphanumerical characters, punctuations, functions, and PC command are distributed among said keys as  
20 follow:

#### Mode 1

**First group-** Letters A-Z and digits 0-9 are the symbols which are very frequently used during a data entry such as writing a text. They may easily and most importantly, naturally, be pronounced while pressing corresponding keys. Therefor they are arranged together on the same side on the keys, belonging to a  
5 same type of interaction (e.g. a first mode) such as a single tap (e.g. single press) on a key, and are selected by speaking them.

**Second group-** Characters such as punctuations, and functions which are very frequently used during a data entry such as writing a text, may belong to a same type of interaction which is used for selecting said letters and digits (e.g.  
10 said first mode). This is to stay, as much as possible, with a same type of interaction with the keys while entering data. Each key may only have one of said characters of said second group. This group of symbols may be selected by only pressing a corresponding key, without using voice. For better distinction, they are shown in boxes on the top (e.g. same side as for the letters and the digits) of the  
15 keys.

## Mode 2

Other symbols of said number of symbols are shown on the bottom side of the keys of the keypad. They are assigned to a second type of interaction (e.g.  
20 double tap) with said keys.

**Third group-** The default symbols (e.g. those which require an interaction with a key and may not require use of voice) are shown in boxes. Said

symbols comprise characters, punctuations, functions, etc., which are less currently used by users.

**Fourth group-** Finally the symbols which are rarely used in a data entry, and are not spelled naturally, are in this example, located at the left side on the bottom side of the keys. They may be selected by corresponding interaction (e.g. double tapping) with corresponding key and either (e.g. almost simultaneously) pronouncing them, or calling them by speaking a predefined speech or voice assigned to said symbols (e.g. "left, right", or "blue, red" etc.).

By using a keypad having keys corresponding to different type of interaction with them (preferably two types, to not complicate the use of the keys) and having some symbols which do not require speech (e.g. defaults), when a key of said keypad is interacted, either a desired key is directly interacted (e.g. default), or the candidated symbols to be selected by a user behavior such as voice/speech are minimal. This augments the accuracy of voice recognition system.

For example, when a user slightly presses a key, the system selects the symbols on the top of said key among those symbols situated on said key. If the user simultaneously uses a voice, then the system selects those symbols requiring voice among said selected symbols. This procedure of reducing the number of candidates and requiring voice recognition technology to select one of them, is used to have a data entry with high accuracy through a keypad having a limited

number of keys. The reducing procedure is made by user natural behaviors, such as pressing a key and/or speaking.

As shown in fig.4, the keys 411, 412, 413, and 414, have up to one symbol (shown on the top side of said keys) requiring voice interaction and assigned to a first type of interaction with said keys. On the other hand, same keys on the bottom side contain two symbols which require a second type of interaction with said keys and also requires voice interaction. Said two symbols may be used more frequently (e.g. in an arithmetic data entry or when writing a software, etc.) than the other symbols belonging to same category. In this case and to still minimize the user errors while interacting with keys (e.g. pressing), said symbols may also been assigned to said first type of interaction with said keys. The total of the candidated symbol remains low. A user may press said key as he desires and speak.

Additional arrangements may be provided on above-mentioned keypad to facilitate its use by a user. For example, “-“ and “\_”, “”” and “””, or “,” and “:” may be configured as default symbols on a same key 411, or on two neighboring keys 415, 416. Also “Sp” and “ (e.g. Tab), may also be considered as default symbols and been configured on the same key 412, each responding to a different type of interaction (e.g. pressing level) with said key. For example, by pressing once the key 412, the character “Sp” is selected. By double tapping the same key, the “tab” function is selected.

While interacting with a key (e.g. pressing a key once or double tagging on it), by not releasing said key, a symbol corresponding to said interaction

(including speech if needed) may be selected and repeated until the key is released. For example, by double tapping on the key 415 and keeping the key pressed after the second tap and not speaking, the default symbol (e.g. "&") assigned to said interaction is selected and repeated until the user releases said key. To enter the letter "X" and repeating it, the user may for example, press the corresponding key 415 (without releasing it) and say "X". The letter "X" will be repeated until the user releases said key.

Also, for a more familiar look of the keypad, letters, digits, and characters such as "#" and "\*", may be placed on said keys according to a standard telephone keypad configuration.

Additional keys separately disposed from the keys of said keypad may be used to contain some of said symbols or additional symbols. In the example of Fig. 6, the cursor is navigated in different directions by at least one key separately disposed from the keys of the keypad 600. A single key 601, may be assigned to all directions 602. The user may, for example, press said key and say "up, down, left, or right to navigate the cursor in corresponding directions. The key 601, may also be a multi-directional key (e.g. similar to those used in video games, or in some cellular phones to navigate in the menu). The user may press on the top, right, bottom, or left side of the key 601, to navigate the cursor accordingly. Also a plurality of additional keys may be assigned, each to for example, to at least a symbol such as " " .

Said additional keys may be the existing keys on an electronic device. For example, in a cellular phone, in addition to the twelve keys of a standard

telephone keypad, additional function keys such as menu key, or on/of key etc.,  
are provided. at least some of those keys may be used as additional data entry  
keys, containing a number of symbols, while the system is, for example, in a text  
entry mode. This frees some spaces on the standard telephone keypad keys. The  
5 freed spaces may permit a better accuracy of voice recognition system and/or a  
more user friendly configuration of the symbols on the keys of the keypad.

The above-mentioned method of configuration and the examples shown  
before are only shown as examples. Of course many other configurations of the  
symbols and different assignment to different user interactions with the keys may  
10 be considered. For example, a key may not have a default symbol or on a key,  
there may be no symbols which are assigned to a voice/speech.

Also not all of the keys of the keypad may respond to a same kind of  
interaction. For example, a first key of a keypad may respond to two levels of  
pressure while another key of the same keypad may respond to a single or double  
15 tap on it.

Figs. 1-7 show different configurations of the symbols on the keys of  
keypads.

20 The above-mentioned data entry system permits a full data entry such as a  
full text data entry through a computer keypad. By inputting, one by one,  
characters such as letters, punctuation marks, functions, etc, words, and sentences  
may be inputted.

This will have a great impact on telecommunication market permitting to enhance many applications and methods already in use. Some of them are listed hereafter.

It is understood that any combination of the above-mentioned interactions may be  
5 used for inputting a desired symbol.

According to one embodiment of the invention, the user uses voice/speech to input a desired symbol such as a letter without other interaction such as pressing a key. The user may use the keys of the keypad (e.g. single press, double press, triple press, etc) to enter symbols such as punctuations without speaking  
10 them.

It is understood that the data entry method described in this application may be applied to all other languages such as Chinese, Koreans, Japanese, Etc.

#### Correction and Repeating of Symbols

15

Different methods may be used to correct an erroneously entered symbol. As mentioned, to enter a symbol, a user for example, may press a corresponding key and speak said desired symbol configured on said key. It may happen that the voice/speech recognition system misinterprets the user's speech and the system  
20 selects a non-desired symbol configured on said key.

For example, if the user:

a) recognizes an erroneously entered symbol before entering a next desired symbol (e.g. the cursor is positioned after said erroneous symbol, next to it), he then may proceed a correction procedure explained hereafter;

5

b) recognizes an erroneously entered symbol after entering at least a next symbol, he first may navigate in the text by corresponding means such as the key 101 (fig.1), or 202 (fig.2), having navigation functions, and positions the cursor after said erroneous symbol next to it. He, then, proceeds to a correction procedure explained hereafter;

10

After positioning the cursor after said erroneous symbol, next to it, the user may re-speak either said desired symbol or its position appellation without re-pressing said corresponding key. If the system again selects the same deleted symbol, it will automatically reject said selection and selects a symbol among remaining symbols configured on said key, wherein either its appellation or its position appellation corresponds to next highest probability corresponding to said user's speech. If still an erroneous symbol is selected by the system, the procedure of re-speaking the desired symbol by the user and the selection of the next symbol among the remaining symbols on said key with highest probability, may continue until said desired symbol is selected by the system.

15

20

It is understood that in a data entry system using a keypad having keys responding, for example, two levels of pressure, when correcting, the recognition

system may first proceed to select a symbol among those belonging to the same group of symbols belonging to the pressure level applied for selecting said erroneous symbol. If none of those symbols is accepted by the user, then the system may proceed to select a symbol among the symbols belonging to the other  
5 pressure level on said key.

Fig. 7B, shows a flowchart corresponding to an embodiment of a method of correction. If for any reason a user wants to correct an already entered symbol, he may enter this correction procedure.

Correction procedure starts at step 3000. If the replacing symbol is not  
10 situated on the same key as the to-be-replaced symbol 3010, then the user deletes the to-be-replaced symbol 3020, and enters the replacing symbol by pressing a corresponding key and if needed, with added speech 3030 and exits 3110.

If the replacing symbol is situated on the same key as the to-be-replaced symbol 3040, and the replacing symbol does not require speech 3050, then the  
15 system proceeds to steps 3020 and 3030, and acts accordingly as described before, and exits 3110.

If the replacing symbol is situated on the same key as the to-be-replaced symbol 3040, and the replacing symbol does require speech 3060, two possibilities are considered:

20

- a) the cursor is not situated after the to-be-replaced symbol 3070. In this case the user positions the cursor after the to-be-replaced symbol, next to it 3080, and proceeds to next step 3090;

b) the cursor is situated after the to-be-replaced symbol 3070 (e.g. the user recognizes an erroneously entered symbol, immediately). In this case the user proceeds to next step 3090;

5           At the step 3090, the user speaks the desired symbol without pressing a key. By not pressing a key and only speaking, the system understands that a symbol belonging to a key which is situated before the cursor must be replaced by another symbol belonging to the same key. The system then, will select a symbol among the rest of the symbols (e.g. excluding the symbols already  
10   selected) on said key with highest probability corresponding to said speech 3100. If the new selected symbol is yet a non-desired symbol 3110, the system (and the user) re-enters at the step 3090. If the selected symbol is the desired one the system exits the correction procedure 3120.

          Of course, instead of the above-mentioned method, a conventional  
15   method of correcting a symbol may also be provided. for example, to correct an already entered symbol, the user may simply, first delete said symbol and then re-enter a new symbol by pressing a corresponding key and if needed, with added speech.

          The text entry system, may also be applied to a word level (e.g. the user  
20   speaks a word and types it by using a keypad). A same text entry procedure may combine word level entry (e.g. for words contained in a data base) and character level entry. Therefore the correction procedure described above, may also be applied for a word level data entry.

For example, to enter a word a user may speak said word and press the corresponding keys. If for any reason such as disambiguity between two words having closed pronunciation and similar key presses, the recognition system selects a non-desired word, then the user may re-speak said desired word without re-pressing said corresponding keys. The system then, will select a word among the rest of candidates words corresponding to said key presses (e.g. excluding the words already selected) with highest probability corresponding to said speech. If the new selected word is yet not the desired one, the user may re-speak said word. this procedure may be repeated until either said desired word is selected by the system or there is no other candidate word. in this case, the user can enter said desired word by character by character entry system such as the one explained before.

It is understood that in word level, when correcting, the cursor should be positioned after said to-be-replaced word. For this purpose and for avoiding the ambiguity with character correction mode, when modifying a whole word (word correcting level), the user may position the cursor after said to-be-replaced word wherein at least one space character separates said word and said cursor. This is because for example, if a user wants to correct the last character of an already entered word, he should locate the cursor immediately after said character. By positioning the cursor after at least one space after the word (or at the beginning of the next line, if said word is the last word of the previous line), and speaking without pressing keys, the system recognizes that the user may desire to correct the last word before the cursor. For better result, it is understood that if the to-be-

replaced word contains a punctuation mark (e.g. “.” ”?” ”,” etc.), the cursor may be replaced after an space after the punctuation mark. This is because in some cases the user may desire to modify an erroneous punctuation mark which must be situated at the end of a word. For this purpose the user may position the cursor

5 next to said punctuation mark.

To avoid accidental corrections (e.g. the cursor is positioned somewhere in the text and someone speaks without intending a data entry), different methods may be applied. For example, a pause or non-text key may be used while a user desires for example, to rest during a text entry. Another solution is that after the

10 cursor is positioned in a location in a text, after a laps of time (for example two seconds) no correction of the last word or character before the cursor is accepted by the system. If a user desires to correct said word or said character he may, for example, navigate said cursor (at least one move to any direction) and bring it back to said desired position. After the cursor is repositioned in the desired

15 location, the time will be counted from the start and the user should start correcting said word or said character before said laps of time is expired.

#### **Repeating a symbol**

20 To repeat a desired symbol, the user, first presses the corresponding key and if required either speaks said symbol, or he speaks the position appellation of said symbol on its corresponding key or according to other symbols on said key. The system then selects the desired symbol. The user continues to press said key

without interruption. After a predefined laps of time, the system recognizes that the user indents to repeat said symbol. The system repeats said symbol until the user stops pressing said key.

It should be noted that the above described method of correction and  
5 repeating of key symbol can be used in conjunction with any method of entry including but not limited to single/double tap, pressure sensitive keys, keys pressed simultaneously, keys pressed on only a portion thereof etc.

#### Telephone directory

10 To make a phone call, instead of dialing a number, a user may enter a to-be-called destination by any information such as name (e.g. person, company, etc.) and if necessary enter more information such as the said to-be-called party address, etc. A central directory, may automatically direct said call to said  
15 destination. If there are more than one telephone lines assigned to a said destination (e.g. party), or there are more than one choice for said desired information entered by the user, a corresponding selection list (e.g. telephone numbers, or any other predefined assignments assigned to said telephone lines) may be transmitted to the caller's phone and displayed for example, on the  
20 display unit of his phone. Then the user may select a desired choice and make the phone call.

The above-mentioned method of calling (e.g. dialing), may permit to eliminate the need of calling a party (e.g., a person) by his/her telephone number.

Therefor may eliminate (or at list reduces) the need of remembering phone numbers, carrying telephone books, or using an operator's aid.

**Interactive directories using voice/speech**

5

Voice directories are more and more used by companies, institutions, etc.

This method of interaction with another party is a very time consuming and frustrating procedure for the users. Many people, by hearing a voice directory on the other side of the phone, disconnect the communication. Even when a person  
10 tries to interact with said system, it frequently happens that after spending plenty of time, the caller does not succeed to access a desired service or person. The main reason for this ambiguity is that when listening to a voice directory indication, many times a user must wait until all the options are announced. He (the user), many times does not remember all choices which were announced. He  
15 must re-listen to those choices.

Also many times the voice directory demands a data to be entered by a user. This data entry is limited in variation because of either the limited number of keys of a telephone keypad or the complexity of entering symbols through it.

The above-mentioned data entry method permits a fast visual interaction  
20 with a directory. The called party may transmit a visual interactive directory to the caller and the caller may see all choices almost instantly, and respond or ask questions using his telephone keypad (comprising the above-mentioned data entry system) easily and quickly.

### Voice mails

Voice mails may also be replaced by text mails. This method is already in  
5 use. The advantage of the method of data entry described above is evident when a  
user has to answer or to write a message to another party. The data entry method  
of the invention is also dramatically enhances the use of messaging systems  
through mobile electronic devices such as cellular phones. One of the most  
known use is in the SMS.

10 The number of electronic devices using a telephone-type keypad is  
immense. The data entry method of this invention permits a dramatically  
enhanced data entry through the keypads of said devices. Of course this method  
is not limited to a telephone-type keypad. It may be used for any keypad wherein  
at least a key of said keypad contains more than one symbol.

15

### Multi-sectioned keypad

The size of a keypad using the above-mentioned data entry method, may  
still be minimized by using a keypad having multiple sections. Said keypad may  
20 be minimal in size (e.g. as large as the largest section, for example as large as of  
the size of an adult user's fingertip or the size of a small keypad key) in a closed  
position, and maximized as desired when the keypad is in open position  
(depending on the number of sections used and/or opened).

Theoretically, in closed position, the keypad may even have the size of a key of said keypad.

Fig 8 shows one embodiment of said keypad 800 containing at least three sections 801, wherein each of said sections contains one column of the keys of a telephone keypad. When said keypad is in open position, a telephone-type keypad 800 is provided. In closed position 802 said keypad may have the width of one of said sections.

Another embodiment of said keypad is shown in fig. 9. Said keypad 900 contains at least two sections 901-902 wherein a first section 901 contains two columns 911-912 of the keys of a telephone-type keypad, and a second section 902 of said keypad contains at least the third column 913 of said telephone-type keypad. When said keypad is in open position, a telephone-type keypad is provided. Said keypad, may also have an additional column 914 of keys arranged on said second section. In closed position 920 said keypad may have the width of one of said sections.

As shown in fig. 10, another embodiment of said keypad 1000 contains at least four sections 1001-1004 wherein each of said sections contains one row of the keys of a telephone keypad. When said keypad is in open position, a telephone-type keypad is provided. In closed position 1005 the length of said keypad may the size of the width of one row of the keys of said keypad.

Fig. 11 shows another embodiment of said keypad 1100 containing at least two sections 1101-1102 wherein a first section contains two rows of the keys of a telephone-type keypad, and a second section of said keypad contains

the other two rows of said telephone-type keypad. When said keypad is in open position, a telephone-type keypad is provided. In closed position 1103, the length of the keypad may be as the size of the width of one row of the keys of said keypad.

5           The above-mentioned multi-sectioned keypad has already been described in patent applications already filed by the inventor.

By using the above-mentioned data entry method through a multi-sectioned keypad as described, a miniaturized easy to use full data entry keypad may be provided. Such keypad may be used in many device, specially those  
10   having a limited size.

Of course, the above-mentioned symbol configuration may be used on said multi-sectioned keypad.

Fig. 12 shows another embodiment of a multi-sectioned keypad 1200. The distance between the sections having keys 1201 may be increased by any means.  
15   For example, empty (e.g. not containing keys) sections 1202, may be provided between the sections containing keys. This will permit more enlarged the distance between the sections when said keypad is in open position. In other hand, it also permits to have a still thinner keypad in closed position 1203.

20   A data entry device having integrated keypad and mouse or point and click device

To enhance the data entry method through a keypad in general and through the keypad of this invention in particular, a point and click system, hereinafter a mouse, can be integrated in the back side of an electronic device having a keypad for data entry in its front side.

5           Fig. 13, shows an electronic device such a cellular phone 1300 wherein a user holds in palm of his hand 1301. Said user may use only one hand to hold said device 1300 in his hand and in the same time manipulate its keypad 1303 located in front, and a mouse or point and click device (not shown) located on the backside of said device. The thumb 1302 of said user may use the keypad 1303,  
10       while his index finger 1304 may manipulate said mouse (in the back). Three other fingers 1305 may help holding the device in the user's hand.

          The mouse or point and click device integrated in the back of said device may have similar functionality to that of a computer mouse. Also several keys (e.g. two keys) of either the telephone-type keypad or among the additional keys  
15       of said device may be assigned to the mouse click functions. for example, keys 1308 and 1318 may function with the integrated mouse of said device 1300 and have the similar functionality of the keys of a computer mouse. Said keys may have the same functionality as the keys of a computer mouse. For example, by manipulating the mouse, the user may navigate a Normal Select (pointer)  
20       indicator 1306 on the screen 1307 of said device and position it on a desired menu 1311. As for a computer mouse, said user then, for example, may tap (click) or double tap (double click) on a predefined key 1308 of said keypad

(which is assigned to the mouse) to for example, select or open said desired menu 1311 which is pointed by said Normal Select (pointer) indicator 1306.

Because the display of mobile devices such as cellular phones has a small size, a rotating button 1310 may be provided in said device to permit to a user to, for example rotate the menu lists. For example, after a desired menu 1311 appears on the screen 1307, a user may use the mouse to bring the Normal Select (pointer) indicator on said desired menu and select it by using a predefined key such as one of the keys 1313 of the telephone-type keypad 1303 or one of the additional keys 1308 on said device, etc.

As for a computer, then the user may press said key to open the related menu bar 1312. To select a function 1313 of said menu bar 1312, the user may maintain said key pressed and after bringing the Normal Select (pointer) indicator 1306 on said function, by releasing said key, said function may be selected.

Other functionalities similar to those of a computer may be provided by using said keypad and said mouse.

Also, instead of using said keys assigned to a mouse, a user may use a predefined voice/speech or other predefined behavior(s) to replace the functions of said keys. For example, after positioning the Normal Select (pointer) indicator 1306 on an icon, instead of pressing a key, the user may say "select" or "open" to select or open the application represented by said icon.

Fig. 14, shows an electronic device such as a mobile phone 1400. A plurality of different icons 1411-1414 representing different applications, are displayed on the screen 1402 of said device. To select and/or open one of the

applications, as for computers, by using a mouse, a user may bring the a Normal  
Select (pointer) indicator 1403, on a desired icon 1411. Then said user may select  
said icon by for example pressing once, a predefined key 1404 of said keypad. To  
open the application represented by said icon, the user, for example, may double  
5 tap on a predefined key 1404 of said keypad.

The mouse integrated in the backside of an electronic device may be of  
any type. For example, Fig.15 shows the backside of an electronic device 1500  
such as the ones shown in figs. 13-14. The mouse 1501, is similar to a  
conventional computer mouse. It may be manipulated, as described, with a user's  
10 finger. It may also be manipulated like a conventional computer mouse, by laying  
the device on a surface such as a desk and swiping said mouse on said surface.

Fig. 16, shows another conventional type of mouse (a sensitive pad)  
integrated on the backside of an electronic device 1500 such as the ones shown in  
figs. 13-14. The mouse 1601, is similar to a conventional computer mouse. It may  
15 be manipulated, as described, with a user's finger. in this example, preferably as  
described before, while holding the device in the palm of his hand, the user uses  
his index finger 1602 to use (e.g. to manipulate) said mouse. Accordingly to this  
position, the user uses his thumb (not shown) to manipulate the keys of a keypad  
(not shown) which is located in the front side (e.g. other side) of said device.

20 Mobile devices should preferably, be manipulated by only one hand. This  
is because while the users are in motion (e.g. being in a bus or in a train) the users  
may use the other hand for other purposes such as holding a bar while standing in  
a train or using one hand to hold a newspaper or a briefcase).

By implementing the mouse in the back of a device such as a mobile  
phone, the user may manipulate said device and to enter data with one hand. He  
can use simultaneously, both, the keypad and the mouse of said device.

Of course, if he desires, said user can use his both hands to manipulate  
5 said device and its mouse.

Another method of using said device is to dispose it on a surface such as  
on a desk and slide said device on said surface in a same manner as a regular  
computer mouse and enter the data using said keypad.

It is understood that the any type of mouse including the ones described  
10 before, may be integrated in any part of a mobile device. For example, a mouse  
may be located in the front side of said device. Also said mouse may be located  
on a side of said device and being manipulated simultaneously with the keypad  
by fingers explained before.

It should be noted that a mouse has been used through out this discussion,  
15 however any point and click data entry device such as stylus computer integrated  
in an electronic device and combined with a telephone-type keypad is within the  
contemplation of the present invention.

#### External integrated data entry unit

20

Also, an external integrated data entry unit comprising a keypad and  
mouse may be provided and used in electronic devices requiring data entry  
means such as keyboard (or keypad) and/or mouse. There may be provided an

integrated data entry unit having the keys of a keypad (e.g. a telephone-type keypad) in front of said unit and a mouse being integrated within the back of said unit. Said data entry unit may be connected to a desired device such as a computer, a PDA, a camera, a TV, a fax machine, etc.

5           Figs. 19 shows a computer 1900 comprising a keyboard 1901, a mouse 1902, a monitor 1903 and other computer accessories (not shown). In some circumstances (e.g. when a user does not desire to sit down on a desk chair in front of a monitor and he prefers, for example, to lie down on his bed while interacting with said computer) instead of a large keyboard and/or corresponding  
10   mouse a user may utilize a small external integrated data entry unit. There may be provided an external data entry unit 1904 containing features such as keypad keys 1911 positioned on the front side of said data entry unit, a microphone which may be an extendable microphone 1906, a mouse (not shown) integrated within the back side of said data entry unit (described before). Said data entry  
15   unit may be (wirelessly or by wires) connected to said electronic device (e.g. said computer 1900). An integrated data entry system such as the one described before (e.g. using voice recognition systems combined with interaction of keys by a user) may be integrated either within the said electronic device (e.g. said computer 1900) or within said data entry unit 1904. Also a microphone may be  
20   integrated within said electronic device (e.g. computer). Said integrated data entry system may use one or both microphones located on said data entry unit or within said electronic device.(e.g. computer).

For a better view of while interacting, specially when interacting from far with an electronic device such as said computer 1900, a display unit 1905 may be integrated within said a entry unit such as said integrated data entry unit 1904 of this invention. When interacting from far with a monitor 1903 of said electronic device 1900, a user may have a general view of the display 1910 of said monitor 1903. A closed area 1908 around the arrow 1909 or another area selected by using the mouse on the display 1910 of said monitor 1903 may simultaneously be shown on said display 1905 of said data entry unit 1904. The size of said area 1908 may be defined by manufacturer or by the user. Preferably the size of said area 1908 may be closed to the size of the display 1905 of said data entry unit 1904. This may permit a closed and/or if desired a real size view of the interacting area 1908 to the user (e.g. by seeing said area on the data entry screen 1905). While having a general view of the display 1910 of the monitor 1903, a user may have a particular closed view of the interacting area 1908 which is simultaneously shown on the display 1905 of said data entry unit 1904. For example a user may use the keypad mouse (not shown, in the back of the keypad) to navigate the arrow 1909 on the computer display 1910. Simultaneously said arrow 1909 and the area 1908 around said arrow 1909 on said computer display 1910 may be shown on the keypad display 1905.

For an interaction such as opening a file, a user may for example, navigate an arrow 1909 on the screen 1910 of said computer an position it on a desired file 1907. Said navigated areas 1908 and said file 1907 may be seen on said data entry screen 1905. By having the display 1905 of said data entry unit 1904 closed

to his eyes, a user can clearly see his interactions on the display 1905 of said data entry unit 1904 while having a general view on a large display 1910 of said electronic device 1900 (e.g. computer).

It is understood that said interaction area 1908 may be defined and vary according to different needs or definitions. For example, said interacting area may be the area around an arrow 1909 wherein said arrow is in the center of said area or said area is the area at the right, left, top, bottom , etc. of said arrow or any area on the screen of said monitor, regardless of the location of said arrow on the display of said monitor).

Fig. 20 shows a data entry unit 2000 such as the one described before being connected to a computer 2001. During a data entry such as a text entry, the area 2002 around the interacting point 2003 (e.g. cursor) is simultaneously shown on the keypad display 2004.

Figs. 21a-21b show an example of different electronic devices which may use the above described data entry unit. Fig. 21a shows a computer 2100 and fig. 21b shows a TV 2101. The data entry unit 2102 of said TV 2101 may also operate as a remote control of said TV 2101. For example, by using the mouse (not shown) situated in the back side of said data entry unit 2102, a user may locate a selecting arrow 2103 on the icon 2104 representing a movie or a channel and opening it by double tapping (double clicking) on a key 2105 of said data entry unit. Of course said data entry unit 2102 of said TV may also be used for data entry such as internet through TVs or sending messages through TVs, cable

TVs, etc. In this case the integrated data entry system of this invention may be integrated within for example, the TV's modem 2106.

#### Extendable Microphone

5

An extendable and /or rotatable microphone may be integrated in electronic devices such as cellular phones. Said microphone may be a rigid microphone being extended towards a user's mouth.

10 With the advancement of the technology, new input systems and devices are coming to the market to permit easy interacting with instruments. Many of those input systems use voice/speech recognition system wherein a user speaks the data or commands to be input. Because it is a natural way to input data, voice recognition system is becoming very popular. Computers, telephones, toys, and many other instruments are equipped with this different kinds of data entry  
15 system using voice recognition systems.

Although this is a good method of input, it has an important shortcoming. It is not a discrete method of input. A user, usually, does not want others to hear what he speaks, and in the other hand people do not like other people's loud speaking.

20 To overcome (or at least reduce) significantly this problem, the user must speak quietly. To not cause misinterpretation of user's voice/speech by a voice recognition system, the microphone must be closed to user's mouth.

It is the subject of this invention to provide instruments using a user's voice as data, with a microphone extending from said instruments towards the user's mouth.

There are many advantages using such a microphone. One advantage of such a microphone is that by extending said microphone towards said user's mouth and speaking closed into it the voice/speech recognition system may better distinguish and recognize said voice/speech. Another advantage is that by positioning said microphone close to user's mouth (e.g. next to the mouth), a user may speak silently (e.g. whisper) into it. This permits an almost silent and a discrete data entry. Still, another advantage of said microphone is that because of being integrated in corresponding electronic device, in order to keep said microphone in a desired position (e.g. close to a user's mouth), a user may not have to hold said microphone by his hand(s). Also, said user does not have to carry said microphone separately from said electronic device.

By combining the features such as the enhanced keypad of the invention, the mouse, the extendable microphone and the data entry method in a manner such as the manners explained before, either in an electronic device or as an external unit to be connected to an electronic device, a completely enhanced data entry system may be provided. A user, may for example, by only using one hand, hold an electronic device such as a data entry device (e.g. mobile phone, PDA, et.), use all of the features such as the enhanced keypad, integrated mouse, and the extendable microphone, etc., and in the same time by using his natural

habitudes (e.g. pressing keys of the keypad and in needed, speaking) provide a quick, easy, and specially natural data entry.

One of the most important applications of the extendable microphone is when the data entry systems of mobile communication devices combine use of keypad and voice/speech recognition system. In this method a user interacts with a key (for example by pushing it), and in the same time he may speak for example, a symbol on said key. In order to press a key containing a desired symbol, the user may need to see the keypad. He also may need to see the data on a display of the device. In the other hand, the user may prefer to speak said symbols quietly. The extendable microphone permits to position the mobile phone far from eyes, enough to see that keypad, and in the same time to have the microphone closed to the mouth, permitting to speak quietly.

As they many people are used to, they may hold their mobile phone in one hand, while pressing the keys of the keypad with a thumb of the same hand. The second hand may be used to either hold said hand around the microphone to reduce the outside noise, or to keep the microphone in an optimal relationship with the mouth.

If the microphone of an instrument is wireless, or the member connecting it with the instrument is made from non-rigid materials, the user may hold the microphone in a manner to position it at the palm side of his hand, between two fingers. Then by positioning the palm o said hand around the mouth he can significantly reduce the outside noise while speaking.

It is understood that the user interface containing the data entry unit and the display, of an electronic device using a user's voice to input data, may be of any kind. For example, instead of a keypad it may contain a touch sensitive pad, or it may be equipped only with a voice recognition system without the need of a keypad.

Fig. 18, shows according to one embodiment of the invention, an electronic device 1800 such as a cellular phone or a PDA. As shown, the keypad 1801 is located in the front side of said device 1800. A mouse (not shown) is located in the backside of said device 1800, An extendable microphone 1802 is also integrated within said device. Said microphone may be extended and positioned in a desired position (e.g. next to the user's mouth) by a user. Said device may also contain a data entry method as described before. By using only one hand, a user may proceed to a quick and easy data entry with a very high accuracy. Positioning said microphone next to user's mouth, permits a better recognition of the voice/speech of the user by the system. Said user, may also speak silently (e.g. whisper) into said microphone. This permits an almost silent data entry.

In alternative embodiments of the present invention Figs. 18b to 18c, show a mobile phone 1800 having a keypad 1801 and a display unit. The mobile phone is equipped with a pivoting section 1803 with a microphone 1802 installed at its end. By extending the microphone towards his mouth, the user may speak quietly into the phone and in the same time being capable to see the display and keypad

1801 of his phone and eventually use them simultaneously while speaking to  
microphone 1802.

Fig. 18d, shows a rotating extendable microphone 1810 to permit a user to  
position the instrument at a convenient relationship to him, and in the same time  
5 by rotating and extending the microphone accordingly, to bring microphone 1810  
close to his mouth or to a desired location. It must be noted that the member  
connecting the microphone to the instrument may have at least two sections,  
being extended/retracted according to each other and to the instrument. They may  
have folding, sliding, telescopically and other movement for extending or  
10 retracting.

Figs. 18e and 18f, shows an integrated rotating microphone 1820 being  
telescopically extendable. In this embodiment, the extendable section comprising  
microphone 1820 may be located in the instrument. When desired, a user may  
pull this section out and extend it towards his mouth. Microphone 1820 may also  
15 be used, when it not pulled out.

According to another embodiment of the invention as shown in Figs. 18g  
and 18h, the extending member 1830 containing a microphone 1831, may be a  
section of a multi-sectioned device. This section may be used as the cover of said  
device. The section comprising the microphone 1831 may itself been multi-  
20 sectioned to be extendable and/or adjustable as desired.

According to embodiment shown in Fig. 18i, an extendable microphone  
1840 as described before, may be installed in a computer or similar devices.

Also, according to another embodiment of the invention, a microphone of  
an instrument may be attached to a user's ring, or itself being shaped like a ring,  
and be worn by said user. This microphone may be connected to said instrument,  
either wirelessly or by wire. When in use, the user approaches his hand to his  
5 mouth and speaks.

It is understood that instruments shown in the drawings are shown as  
example. The extendable microphone may be installed in any instrument. It may  
also be installed at any location on extending section.

In communication devices, the extending section comprising the  
10 microphone may be used as the antenna of said instruments. In this case the  
antennas may be manufactured as sections described, and contain integrated  
microphones.

It must be noted that in addition to at least an extendable microphone, an  
instrument may comprise at least one additional regular microphone, wherein  
15 said microphones may be used separately or simultaneously with said extendable  
microphone.

It must be noted that the extendable member comprising the microphone  
may be manufactured with rigid materials to permit positioning the microphone  
in a desired position without the need of keeping it by hand.  
20 For better manipulation, the section comprising the microphone may also be  
manufactured by semi rigid or soft materials.

It must be noted that any extending/retracting methods such as  
unfolding/folding methods may be used.

As described before, the integrated keypad and/or the mouse and/or the extendable microphone of this invention may also be integrated within a variety of electronic devices such as a PDA, a remote control of a TV, and a large variety of other electronic devices. For example, by using said integrated keypad and mouse within remote control of a TV, a user may point on an icon, shown on the TV screen relating to a movie and select said movie by using a predefined key of said remote control.

Also, as described, said integrated keypad and/or mouse and/or extendable microphone may be manufactured as a separated device and to be connected to said electronic devices.

Of course said keypad, alone or integrated with said mouse and/ or said extendable microphone, may be combined with a data and text entry method such as the data entry method of this invention.

Fig. 17 shows some of the electronic devices which may use the enhanced keypad, the enhanced mouse, the extendable microphone, and the data entry method of this invention.

An electronic device may contain at least one or more of the features of this invention. It may, for example, contain all of the features of the invention as described.

#### Data entry through a land line phone

The data entry method described before, may also be used in land-lined phones and their corresponding networks. As known, each key of a telephone keypad generates a predefined tone which is transmitted through the land line networks. There are twelve predefined tones assigned to twelve keys of telephone  
5 keypads. By using, a land line telephone and its keypad, for the purpose of a data entry such as entering text, there may be the need of additional tones to be generated. To each symbol, there may be assigned a different tone so that the network will recognize a symbol according to the generated tone assigned to said symbol.

10

**A wrist-worn multi-sectioned data entry unit**

Fig. 22a shows as example, different embodiments of a data entry units 2201-2203 of this invention as described before. To reduce the size of said data  
15 entry unit a multi-sectioned data entry unit 2202-2203 which may have a multi-sectioned keypad 2212-2222 as described before, may be provided. said multi-sectioned data entry unit may have some or all of the features of this inventions. It may also have an integrated data entry system described in this application. As example, the data entry unit 2202 comprises a display 2213 an antenna 2214  
20 (may be extendable), a microphone 2215 (may be extendable), a mouse integrated in the beck of said data entry unit (not shown).

An embodiment of a data entry unit of this invention may be carried on a wrist. It may be integrated within a wrist worn device such as a watch or within a

bracelet such as a wristwatch band. Said data entry unit may have some or all of the features of the integrated data entry unit of this invention. This will permit to have a small data entry unit attached to a user's wrist. Said wrist-worn data entry unit may be used as a data entry unit of any electronic device. By connecting his wrist-worn data entry unit to a desired electronic device, a user for example, may open his apartment door, interact with a TV, interact with a computer, dial a telephone number, etc.. A same data entry unit may be used for operating different electronic devices. For this purpose, an access code may be assigned to each electronic device. By entering (for example, through said data entry unit) the access code of a desired electronic device a connection between said data entry unit and said electronic device may be established.

Fig. 22b shows an example of a wrist-worn data entry unit 2290 (e.g. multi-sectioned data entry unit having a multi-sectioned keypad 2291) of this invention (in open position) connected (wirelessly or through wires 2292) to a hand-held device such as a PDA 2293. Said multi-sectioned data entry unit 2290 may also comprise additional features such as some or all of the features described in this application. In this example, there are provided a display unit 2294 an antenna 2295, a microphone 2296 and a mouse 2297.

It is understood that said multi-sectioned keypad may be detached from the wrist worn device/bracelet 2298. For this purpose different detachment/attachment known to people skill in the art may be provided. For example, as shown in fig. 23a, a housing 2301 for containing said data entry device may be provided within a bracelet 2202. Fig. 23b shows said housing

2303 in open position. A detachable data entry unit 2304 may be provided within  
said housing 2301. Fig 23c shows said housing in open position 2305 and in close  
position 2306. In open position (e.g. when using said data entry unit), part of the  
elements 2311 (e.g. part of the keys and/or display, etc) of said data entry unit  
5 may lie down within the cover 2312 of said housing.

According to one embodiment of the invention, a device such as a wristwatch 2307 may be provided in the opposite side on the wrist within the same bracelet. For example, there may be provided a wristwatch band having a housing to contain a data entry unit. Said wristwatch band may be attached to any wrist device such as a wristwatch, a wrist camera, etc. The housing of the data entry device may be located on one side 2308 of a wearer's wrist and the housing of said other wrist device may be located on the opposite side 2309 of said wearer's wrist. To attach said wristband to a device such as a wristwatch the traditional wristwatch band attachment means 2310 (e.g. bars) may be provided.

15           The above mentioned wristband housing may also be used to contain any other wrist device. for example, instead of containing a data entry unit, said wrist housing may be adapted to contain a variety of electronic devices such as a wristphone.

There may be a lot of advantages when using a wrist-worn data entry unit of this invention. for example, a user may carry an electronic device in for example, his pocket, and having a display unit (may be flexible) of said electronic device in his hand. The interaction with said electronic device may be provided through said wrist-worn data entry unit. In another example, the wrist-worn data

entry unit of this invention may be used to operate an electronic news display (a PCT application regarding an electronic news display has been filed on October 27<sup>th</sup>, 2000 by the inventor).

5     **Extendable Display Unit**

According to one embodiment of the invention an extendable display unit may be provided within an electronic device such as data entry unit of the invention or within a mobile phone. Fig. 24a shows an extendable display unit  
10    2400 in closed position. This display unit may be made of rigid and/or semi rigid materials and may be folded or unfolded for example by corresponding hinges 2401, or being telescopically extended or retracted, or having means to permit it being expanded and being retracted by any method.

Fig 24b shows a mobile computing device 2402 such as a mobile phone  
15    having said extendable display 2400 of this invention, in open position, When open, said extended display unit may have the width of an A4 standard paper permitting the user to see and work on a real width size of a document while, for example, said user in writing a letter with a word processing program or browsing a web page.

20       The display unit of the invention may also be made from flexible materials. Fig 25a shows a flexible display unit 2500 in closed position.

It is understood that the display unit of the invention may also display the information on at least part of it's other (e.g. exterior} side 2505. This is

important because in some situations a user may desire to use the display unit without expanding it.

Fig. 25b shows an electronic device 2501 having a flexible display unit 2500 of the invention, in open position.

5 By having an electronic device such as the data entry unit of the invention, a mobile phone, a PDA, etc., having at least one of the enhanced features of the invention such as an extendable/non extendable display unit comprising a telecommunication means as described before, a mouse of the invention, an extendable microphone, an extendable camera, a data entry system  
10 of the invention, a voice recognition system, or any other feature described in this application, a complete data entry/computing device, which may be held and manipulated by one user's hand, may be provided. This is very important because as is well known that in mobile environment computing/data entry at least one of the user's hand must be free.

15

#### **Extendable Camera**

As described for extendable microphone, an electronic device may also be equipped with an extendable camera. For example, for the data entry system of  
20 the invention combining keys presses and lip reading (instead or in addition to voice/speech of the user) an extendable camera may be provided in corresponding electronic device or data entry unit..

Fig.26 shows a mobile computing device 2600 equipped with a pivoting section 2601. Said pivoting section may have a camera 2602 and/or a microphone 2603 installed at, for example, its end. By extending the camera towards his mouth, the user may speak to the camera and the camera may transmit images of the user's lips for example, during data entry of the invention using combination of key presses and lips. The user, in the same time may be capable to see the display and the keypad of his phone and eventually use them simultaneously while speaking to the camera. Of course the microphone installed on the extendable section may transmit the user's voice to the voice recognition system of the data entry system.

The extendable section 2601 may contain an antenna, or itself being the antenna of the electronic device.

Also, the extendable microphone and/or camera of the invention may be detachably attached to an electronic device such as a mobile telephone or a PDA. This is because in many situations manufacturers of electronic devices (such as mobile phones) do not desire to modify their hardware for new applications.

According to one embodiment of the invention, the external pivoting section comprising the microphone and/or a camera may be a separate unit being detachably attached to the corresponding electronic device. Fig. 27 shows a detachable unit 2701 and an electronic instrument 2700, such as a mobile phone, being in detached position. The detachable unit 2701 may comprise any one of a number of component, including but not limited to, a microphone 2702, a camera 2703, a speaker 2704, an optical reader (not shown) or other components

necessary to be closed to the user for better interaction with the electronic instrument. The unit may also comprise at least one antenna or itself being an antenna. The unit may also comprise attachment and/or connecting means 2705, to attach unit 2701 to electronic device 2700 and to connect the components available on the unit 2701 to electronic instrument 2700. For attaching and connecting purposes, attachment and connecting means 2705 may be adapted to use the ports 2706 available within an electronic device such as a mobile phone 2700 or a computer, the ports being provided for connection of peripheral components such as a microphone, a speaker, a camera, an antenna, etc. It is understood that ports 2706 may be the standard ports such as a microphone jack or USB port, or any other similar connection means available in electronic instruments. In this case, the attachment/connecting means may, for example, be standard connecting means which plug into corresponding port(s) available within the electronic instrument.

It is understood that the attachment and/or connecting means of the external unit may be provided to have either mechanical attaching functionality or electrical/electronic connecting functionality or both. As shown in Fig. 27a, for example, the external unit 2701 may comprise a pin 2705 fixedly positioned on the external unit for mechanically attaching the external unit to the electronic instrument. The pin may also electrically/electronically connect for example, the microphone component 2702 available within the unit 2701 to the electronic instrument shown before. In addition to the pin, the external unit may contain another connector 2707 such as a USB connector, connected by wire 2708 to for

example, a camera 2703 installed within the external unit 2701. In this case, the connector 2707 may only electronically/electrically connect the unit 2701 to the electronic instrument.

For better mechanical attachment more than one port may be used by attachment and connecting means of the external unit. For example, the attachment and connecting means may comprise two attachment means, such as two pins fixedly positioned on the external unit wherein a first pin plugs into a first port of the electronic instrument corresponding to for example an external microphone, and a second pin plugs into the port corresponding to for example an external speaker.

Fig. 27b shows the detachable external unit 2701 and the electronic instrument 2700 of the invention, in attached position.

After attaching the external unit 2701 to the electronic instrument 2700 (for example, by plugging the pin 2705 into corresponding port 2706) the user may adjust the external unit 2701 in a desired position by extending and rotating movements as described before in this application for extendable microphone and camera. Again, it must be noted that the detachable unit of the invention may have characteristics similar to those of the extendable section of the invention as described before for the external microphone and camera in this application. For example, the detachable unit 2701 of the invention may be multi-sectioned having at least two sections 2710-2711, wherein each section having movements such as pivoting, rotating and extending (telescopically, foldable/unfoldable),

relating to each other and to the external unit. Attaching sections 2712-2714 may  
be used for these purposes.

The detachable unit as described permits to add external/peripheral  
components to an electronic instrument and use them as they were part of the,  
5 original instrument. This firstly permits to use the unit without holding the  
components in hand or attaching it to user's body (e.g. a headphone which must  
be attached to user's head) and secondly, it permits to add the components to the  
electronic instrument without obliging the manufacturers of the electronic  
instruments (such as mobile phones) to modify their hardware.

10 The data entry method of this invention may also use other data entry  
means. For example, instead of assigning the symbols to the keys of a keypad,  
said symbols may be assigned to other objects such as the fingers (or portions of  
the fingers) of a user. Also instead of (or in addition to) voice/speech input, the  
system may recognize the data input by reading (recognizing the movements of)  
15 the lips of the user in combination with/without key presses. The user may press  
a key of the keypad and speak a desired letter among the symbols on said key. By  
recognizing the movements of the user's lips speaking said letter combined with  
said key press, the system may easily recognize and input the intended letter.

Also as mentioned, example given in method of configuration described  
20 in this application were showed as samples. Variety of different configurations  
and assignment of symbols may be considered depending on data entry unit  
needed. The principle in this the method of configuration is to define different  
group of symbols according to different factors such as frequency of use, natural

pronunciation, natural non-pronunciation, etc, and assign them accordingly assigning them priority rates. The highest priority rated group (with or without speaking ) is assigned to easiest and most natural key interaction (e.g. a single press). This group also includes the highest ranked non-spoken symbols. Then the  
5 second highest priority is assigned to second less easier interaction (e.g. double press) and so on.

With continuous reference to data entry system described before, the assignment of symbols to the keys of a keypad may be made in manner to still more enhance the recognition by voice/speech or lip-reading systems. Fig. 28  
10 shows a keypad 2800 wherein letter symbols having closed pronunciation are assigned to the keys of said keypad in a manner to avoid ambiguity between them. As shown, letters having closed pronunciations "c" & "d", "j" & "k", "m" & "n", "v" & "t", are separated and placed on different keys. This will help the speech recognition system to more easily recognize said letters. For example, to  
15 select the letter "c", a user may press the key 2801 and says "c". To select the letter "d", the user presses the key 2802 and says "d". Other letters having closed pronunciations such as "b" & "p", "t" & "d", "f" & "s", are also assigned to different keys.

Embedded speech recognition systems for small devices are designed to  
20 use memory as less as possible. Separating symbols having resembling pronunciation and assigning them to different keys, dramatically simplifies the recognition algorithms resulting the use of less memory.

With continuous reference to Fig. 28, as shown, the configuration of letters is provided in a manner to maintain the letters a-z in continuous order (e.g. a,b,c,.....z). Configuration of symbols on the keypad 2800 is made in a manner to keep it as similar as possible to a standard telephone-type keypad. It is understood that this order may be changed if desired.

Also, separation of resembling lip-articulated symbols may help lip-reading (lip recognition) systems to more easily recognize them. For example, assigning letters "j" & "k" to different keys will dramatically ease their recognition.

It is understood that for recognizing a spoken symbol such as a letter, more than one image of user's lips at different times during speaking said letter may be provided to lip recognition/reading system.

Lip reading (recognition) system of the invention may use any image-producing and image-recognition processing technology for recognition purposes. For example, as mentioned before, a camera may be used to receive image(s) of user's lips while said user is saying a symbol such as a letter and is pressing the key corresponding to said symbol on the keypad. Other image producing and/or image capturing technologies may also be used. For example, instead of a camera, a projector and receiver of means such as light or waves may be used to project said means to the user's lips ( and eventually, face) and receives back said means providing a digital image of user's lips (and eventually user's face) while said user is saying a symbol such as a letter and pressing the key corresponding to said symbol on the keypad.

The data entry system of the invention which combines key press and user behavior (e.g. speech) may use different behavior (e.g. speech) recognition technologies. For example, in addition to movements of the lips, the pressing action of the user's tongue on user's teeth may be detected for better recognition of the speech.

According to one embodiment of the invention, as shown in fig. 29, instead of (or in addition to) a camera, the lip reading system of the invention may use a touch/press sensitive component 9900 removably mounted on user's denture and/or lips. Said component may have sensors 9903 distributed within its surface to detect a pressure action on any part of it permitting to measure the size, location, pressure measure, etc., of the impact between the user's tongue and said component. Said component may have two sections. A first section 9901 being placed between the two lips (upper and lower lips) of said user and a second 9902 section being located on the user's denture (preferably the upper front denture). An attaching means 9904 permits to attach/fix said component on user's denture.

Fig. 29a shows a sensitive component 9910 as described hereabove, being mounted on a user's denture 9919 in a manner a section 9911 of the component is located between the upper and lower lips of said user (in this figure, the component, the user's teeth and tongue are shown outside user's body). Said user may press the key 0013 which contains the letters "abc", and speak the letter "b". By saying "b" the lips 9914-9915 of the user press said sensitive section 9911 between the lips. The system recognizes that the intended letter is the letter "b" because saying the two other letters (e.g. "ab") do not require pressing the lips on

each other. If the user presses the key 9913 and pronounces the letter "c", then the tongue 9916 of the user will slightly press the inside portion 9912 of the denture section of the component located on the front user's upper denture. The system will recognize that the intended symbol is the letter "c", because other  
5 letters on said key (e.g. "bc") do not require said pressing action on said portion of the component. If the user presses the key 9913 and says the letter "a", then no pressing action will be applied on said component. Then the system recognizes that the intended letter is the letter "a". In other example, if the user presses the key 9917 and says the letter "j" the tongue of the user presses the inside upper  
10 portion of the denture section of the component. If the user presses the key 9917 and says the letter "l", then the tongue of the user will press almost the whole inside portion of the denture section of the component. In this case, almost the whole sensors distributed within the inside portion of the denture section of the component will be pressed and the system recognizes that the intended letter is  
15 the letter "l".

The above-mentioned lip reading/recognition system permits a discrete and efficient method of data input with high accuracy. This data entry system may particularly be used in sectors such as the army, police, or intelligence.

Hereafter an example of a letter input recognition system through a  
20 telephone-type keypad, according to one embodiment of this invention:

|    |                                                                                       |                                                                               |                                                                            |                                                                               |
|----|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 5  | ABC key<br>A<br>no pressure                                                           | B<br>lip section pressed                                                      | C<br>upper inside portion of<br>the denture section is<br>slightly pressed |                                                                               |
|    | DEF key<br>D<br>whole inside denture<br>section is pressed                            | E<br>no pressure                                                              | F<br>lip section pressed                                                   |                                                                               |
|    | GHI key<br>G<br>upper inside portion<br>of the denture section<br>is strongly pressed | H<br>upper inside of portion<br>of the denture section<br>is slightly pressed | I<br>no pressure                                                           |                                                                               |
| 20 | JKL key<br>J<br>upper inside portion<br>of the denture section<br>is slightly pressed | K<br>no pressure                                                              | L<br>whole inside denture<br>section is pressed                            |                                                                               |
| 25 | MNOkey<br>M<br>lip section pressed                                                    | N<br>whole inside denture<br>section pressed                                  | O<br>no pressure                                                           |                                                                               |
| 30 | PQRSkey<br>P<br>lip section pressed                                                   | Q<br>lip section pressed<br>(on sides)                                        | R<br>no pressure                                                           | S<br>upper inside<br>portion of the<br>denture section is<br>slightly pressed |
| 35 | TUVkey<br>T<br>whole inside denture<br>section is pressed                             | U<br>lip section pressed<br>(on sides)                                        | V<br>lip section pressed                                                   |                                                                               |
| 40 |                                                                                       |                                                                               |                                                                            |                                                                               |
| 45 | WXYZkey<br>W<br>lip section pressed                                                   | X<br>upper inside portion<br>of denture section<br>is pressed                 | Y<br>no pressure                                                           | Z (zed)<br>whole inside<br>portion of the<br>denture is<br>pressed            |

It must be noted that the table above is only shown as an example to show the easiness of distinguishing the letters by saying a desired letter (while using the described hardware) and pressing the corresponding key. It is understood that other distinguishing parameters such as the timing of the pressure on the hardware (e.g. when saying "g" or saying "h", both being on the same key and maybe having similar pressure levels) based on this system may be taken in consideration by the recognition system and people skilled in the art. Also, saying other symbols such as numbers (e.g. 0-9) by the user and recognizing them may be considered by the above-mentioned system.

10 In addition, the sensitive component of the invention may be connected to processing device (e.g. a cellphone) wirelessly or by means wires. If it is connected wirelessly, the component may contain a transmitter for transmitting the pressure information. The component may further comprise a battery power source for powering its functions,

15 As described before, the invention combines key presses and speech for improved recognition accuracy. In one embodiment, a grammar is made on the fly to allow recognition of letters corresponding only to the key presses.

As is well know in the art (e.g., LetterWise), letter-pair frequency probabilities can be used to determine the next letter given the previous letter.

20 The above grammars created to support the combination of key presses and speech can be augmented with probability information to provide for higher accuracy.

For example, if a user presses 8-4-3 and says T-H-E, then the system should recognize T-H-E. However, since the 3 key includes the letters D-E-F, it could also incorrectly recognize T-H-D. To avoid this problem, we can add probabilities.

5 For the key 8, we have the letters T-U-V; for 4 we have G-H-I; and for 3 we have D-E-F. Given the key presses 8-4-3, the system would create the following grammar using standard grammar notation:

$\langle s \rangle = (T \mid U \mid V) (G \mid H \mid I) (D \mid E \mid F);$

10

This can also be expressed as

$\langle s \rangle = T \langle s1 \rangle;$

$\langle s \rangle = U \langle s1 \rangle;$

15  $\langle s \rangle = V \langle s1 \rangle;$

$\langle s1 \rangle = G \langle s2 \rangle;$

$\langle s1 \rangle = H \langle s2 \rangle;$

$\langle s1 \rangle = I \langle s2 \rangle;$

$\langle s2 \rangle = D;$

20  $\langle s2 \rangle = E;$

$\langle s2 \rangle = F;$

Adding simple unigram probabilities for the first set of letters and bi-gram

probabilities (for example, trained on a word corpus such as dictionary) we might

have something such as:

<s>, 0.80 = T <s1\_T>;

5 <s>, 0.15 = U <s1\_U>;

<s>, 0.05 = V <s1\_V>;

<s1\_T>, 0.05 = G <s2\_G>;

<s1\_T>, 0.65 = H <s2\_H>; // 0.65 represents the probability of H preceded by T

in the current context

10 <s1\_T>, 0.30 = I <s2\_I>;

<s1\_U>, 0.30 = G <s2\_G>;

<s1\_U>, 0.50 = H <s2\_H>;

<s1\_U>, 0.20 = I <s2\_I>;

<s1\_V>, 0.01 = G <s2\_G>;

15 <s1\_V>, 0.04 = H <s2\_H>;

<s1\_V>, 0.95 = I <s2\_I>;

<s2\_G>, 0.05 = D;

<s2\_G>, 0.85 = E;

<s2\_G>, 0.10 = F;

20 <s2\_H>, 0.10 = D;

<s2\_H>, 0.85 = E;

<s2\_H>, 0.05 = F;

<s2\_I>, 0.20 = D;

<s2\_I>, 0.20 = E;

<s2\_I>, 0.60 = F;

Note that the grammars are larger, but since they are built on the fly they  
5 are still manageable for embedded applications.

Note that the probabilities can be based strickly on letter-pair frequencies,  
but also weighted by the relative word frequency from which they come. For  
example, the letter pair T-H might count for more from the word THE vs the  
word THIN.

10 Note that the recognizer will pursue all paths in parallel and combine the  
acoustic probabilities with the grammar probabilities to compute the overall best  
answer.

Usually, during data (e.g. text) entry by voice/speech, a  
microphone/transducer perceives the user's voice/speech and transmits it to a  
15 processor of a desired electronic device for recognition process by a voice/speech  
recognition system. A great obstacle (specially, in the mobile environment) for an  
efficient speech to data/text conversion by the voice/speech recognition systems  
is the poor quality of the inputted audio, said poor quality being caused by the  
outside noise. It must be noted that the microphone "hears" everything without  
20 distinction.

Many efforts have been made by researchers to distinguish and eliminate  
an outside noise from a desired audio. Until now those efforts have permitted to  
only partially reduce the outside noise but still much more work must be done to

achieve an acceptable result. Unfortunately, the current noise cancellation/reduction technologies also reduce the quality of the desired audio, making said audio inappropriate for recognition by the voice/speech recognition systems.

5           To reduce (or even completely eliminate) the outside noise during data entry into an electronic device by voice/speech input, without degrading the quality of said voice/speech input an ear-integrated microphone/transducer unit positioned in a user's ear can be provided. Said microphone/transducer may also permit a better reception quality of the user's voice/speech, even if said user  
10       speaks low or whispers.

          As is well known, when humans speak, the bone vibrations caused by, and corresponding to, said speech are conducted to ear resulting the air vibrations corresponding to said speech in the inner ear and in the ear canal.

          According, to one method, said air vibrations may be perceived by an ear-  
15       integrated microphone positioned in the ear, preferably in the ear canal.

          According to another method, said ear bone vibrations, themselves, may be perceived from the inner ear by an ear-integrated transducer positioned in the ear.

          Fig. 30 shows a microphone/transducer unit 5300 designed in a manner to  
20       be integrated within a user's ear in a manner that the microphone/transducer component 5301 locates inside the user's ear (preferably, the user's ear canal).

          Preferably, in addition to microphone/transducer component 5301, said unit 5300 may also have hermetically isolating means 5302 wherein when said

microphone 5301 is installed in a user's ear (preferably, in the user's ear canal),  
said hermetically isolating means 5302 may isolate said microphone from the  
outside (ear) environment noise, permitting said microphone 5301 to only  
perceive the user's voice/speech formed inside the ear. The outside noise which is  
5 a major problem for voice/speech recognition systems will dramatically be  
reduced or will even be completely eliminated.

The user may adjust the level of hermitically isolation as needed. For  
example, to cancel the speech echo in the ear canal said microphone may be less  
isolated from outside ear environment by slightly extracting said microphone unit  
10 from said user's ear canal. The microphone unit may also have integrated  
isolating/unisolating level means.

Said microphone/transducer 5301 may be connected to a corresponding  
electronic device, by means of wires 5303, or by means of wireless  
communication systems. The wireless communication system may be of any kind  
15 such as blue-tooth, infra-red, RF, etc.

The above-mentioned, ear integrated microphone/transducer may be used  
to perceive the voice/speech of a user during a voice/speech-to-data (e.g. text)  
entry system using the data entry system of the invention combining key press  
and corresponding speech, now named press-and-speak (KIKS) technology. By  
20 pressing a key and saying the desired symbol (e.g. a letter) assigned to said key,  
as described before, the voice/speech recognition system tries to match said  
speech to one of speech patterns of only few symbols assigned to said key. In this  
case, even if an ear-integrated microphone/transducer has lower equality audio

perception than a standard microphone, the quality of spoken symbols perceived by said ear-integrated microphone/transducer will still be fair enough to permit the voice/speech recognition system to easily recognize a spoken symbol among said few symbols on that key.

5           According, to one embodiment of the invention, as shown in fig. 31, an ear-integrated microphone 5400 may be provided and be connected to a mobile electronic device such as a mobile phone 5402. As shown, the microphone 5401 is designed in a manner to be positioned into a user's ear canal and perceive the user's speech/voice vibrations produced in the user's ear when said user speaks.

10       Said speech may then be transmitted to said mobile phone 5402, by means of wires 5403, or wirelessly.

          By being installed in the user's ear and having hermetically isolating means 5404, said microphone 5401 will only perceive the user's voice/speech. The outside noise which is a major problem for voice/speech recognition systems

15       will dramatically be reduced or even completely be eliminated. As mentioned before, the level of isolation may be adjustable, automatically, or by the user.

          For example, when a user presses a key 5405 and speaks the letter "k" which is located on said key, the vibrations of said speech in the user's ear may be perceived by said ear-integrated transducer/microphone and be transmitted to a

20       desired electronic device. The voice/speech recognition system of the invention has to match said speech to already stored speech patterns of a few symbols located on said key (e.g. in this example, "J, K, L, S"). Even if the quality of said

speech is not good enough (e.g. because the user spoke low), said speech could be easily matched with the stored pattern of the desired letter.

As just noted, another advantage of this system is that the user may speak low or even whisper. Because on one hand, the microphone is installed in the user's ear and directly perceives the user's voice without being disturbed by outside noise, and on the other hand the recognition system tries to match a spoken symbol to only few choices, even if a user speaks low, whispers, the quality of the user's voice will still be good enough for use by the voice/speech recognition system. For the same reasons the recognition system may be user-independent. Of course, training the system with the user's voice (e.g. speaker dependent method) will cause greatly better recognition accuracy rate by the recognition system.

In addition to the microphone/transducer, the ear-integrated unit may also contain a speaker located beside the microphone/transducer and also being integrated within the user's ear for listening purposes.

According to one embodiment of the invention, as shown in fig. 32, an ear-integrated microphone and speaker 5500 can be provided in a manner that the microphone 5501 installs in a first user's ear (as described here-above) and the speaker 5502 installs in a second user's ear.

The above specifications should not be construed as limiting the scope of the invention but merely describing some of the preferred embodiments of the invention. Many variations are to be considered within the scope of the present invention. For example, in the example of the ear-integrated unit of the fig. 32,

both ears may be provided by both, microphone and speaker components. In  
another example, when said ear-integrated unit is wirelessly connected to a  
corresponding electronic device, a battery power source may be provided within  
said ear-integrated unit. Also for better speech reception quality, the ear-  
5 integrated microphone unit of the invention may also comprise at least an  
additional standard microphone situated outside of the ear (for example, on the  
transmitting wire). The inside ear microphone combined with the outside ear  
microphone may provide more audio signal information to the speech/voice  
recognition system of the invention. It must also be noted that the data entry  
10 system of the invention may use any microphone or transducer using any  
technology to perceive the inside ear speech vibrations.

15

20

### **Background**

A method of general data entry combining key press and speech has been explained in PCT application PCT/US00/29647.

As described in said application, by pressing a key and speaking/not speaking a desired symbol such as a character among a group of symbols assigned to said key, said desired symbol may be selected. For example, for entering the word "morning" through a standard telephone-type keypad (see Fig 81) a user may:

- press the key 8101 and say 'm' ;
- press the key 8101 and say 'o' ;
- press the key 8106 and say 'r' ;
- press the key 8108 and say 'n' ;
- press the key 8104 and say 'i' ;
- press the key 8106 and say 'n' ;
- press the key 8104 and say 'g' ;

By speaking a word, letter by letter (or symbol by symbol), and pressing the corresponding keys, said word may be inputted.

The data entry system described in said PCT may permit a keyboard having reduced number of keys (e.g. telephone keypad) to act as a full-sized PC keyboard (e.g. one pressing action per symbol).

### **• Word by Word Data Entry System**

To enhance the above-mentioned data entry system, a word level data entry system has been proposed in said PCT application. In said application, there was described that a user can enter a word by speaking said word and pressing the keys corresponding to the letters constituting said word.

The speech of each word in a language may be constituted of a set of phoneme(s) wherein said set of phoneme(s) comprises one or more phonemes. Fig. 82 shows as an example, a dictionary of words 8200 wherein for each entry (e.g. word) 8201, its character set 8202, relating key press values 8203 (using a telephone keypad), phoneme set 8204 corresponding to said word, and speech model 8205 (to eventually be used by a voice/speech recognition system) of said phoneme set are shown.

According to one method of speech recognition, when a user speaks a word, his speech may be compared with said memorized speech models, and one or more best matched models will be selected by the system. Then the word(s) (e.g. character sets) corresponding to said selected model(s) may be selected by the system. If the selection contains one word, said word may become the final selection. If the selection comprises more than one word, then said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example pressing a "select" key.

The above-mentioned method of recognition of words based on their speech, is described only as an example. It is understood that other methods of recognition by speech may be considered by the people skilled in the art.

Recognizing a word based on its speech only, is not an accurate system. There are many reasons for this. For example, many words may have similar or confusing pronunciations. Also factors such as the outside noise may result ambiguity in a word level data entry system. Inputting arbitrary words by voice requires complicated software, taking into account a large variety of parameters such as accents, voice inflections, user intention, or noise interaction. For these reasons speech recognition systems are based on recognition of phrases wherein for example, words having similar pronunciations may be disambiguated in a phrase according to the context of said phrase. Speech recognition systems based on recognition of phrases require large amount of memory and CPU use, making their integration in small devices such as mobile phones, impossible at this time.

The press and speak technology invented by this inventor and described in different PCT and US provisional applications filed earlier, may solve the above-mentioned problems. In addition to/combination with a character by character entry system as described in said applications, a word-level data entry technology of the invention may provide the users of small/mobile/fixed devices with a natural quick (word by word) text/data entry system.

As mentioned, in the PCT application PCT/US00/29647, there was described that a user can speak a word while pressing the keys corresponding to the letters constituting said word. There was also mentioned that for this purpose a word dictionary data base may be used. According to that and by referring to the fig. 81, when a user speaks the word "card" and presses the corresponding keys (e.g. keys 8102, 8102, 8106, 8109 of the telephone-type keypad), the system selects from said word dictionary (such as the one shown in fig. 82), the words corresponding to said key presses. In this example, the same set of key presses may also correspond to other words such as "care", "bare", "base", "cape", and "case". The system then, may compare the user's speech (of the word) with the speech of said words having the same key presses and if one of them matches said user's speech, the system selects said word. If speech of none of said words matches the user's speech, the system then, may select the word (or words) that its (their) speech best match(es) said user's speech.

According to this method, the recognition system will select a word among only few candidates (e.g. 6 words, in the example above). As result the recognition becomes easy and the accuracy of the speech recognition system dramatically augments, permitting a general word-level text entry with high accuracy. It must also be noted that speaking a word while typing it is a human familiar behavior.

According to another embodiment of the invention, for entering a word, a user may press few (e.g. one, two, and if needed, more) keys corresponding to the letter(s) of the beginning of a word and (preferably, simultaneously) speak said word. According to said few key presses and said speech, the system may recognize the intended word. For this

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purpose, according to one method, for example, the system may first select the words of the dictionary data base wherein the beginning characters of said words correspond to said key presses, and compares the speech of said selected words with the user's speech. The system, then selects one or more words wherein their speech best matches said user's speech. Selecting the words existing in a dictionary of words database according to the first few key presses, dramatically reduces the number of said selected words to be compared with the user's speech. This permits a very high accuracy of the input of an intended word. According to another method, for example, the system may first select the words of the dictionary wherein their speech best match said user's speech. The system then, may evaluate the beginning characters (evaluating to which key presses the belong) of (the character sets constituting) said words with said user's corresponding few key presses to finally select the character set(s) which their beginning characters match said user's key presses.

In the above-mentioned embodiments, if the selection contains one word, said word may become the final selection. If the selection comprises more than one word, then said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example pressing a "select" key.

The above-mentioned methods of speaking a word and pressing the keys corresponding to the characters constituting at least part of said word, and comparing said key presses with the key presses corresponding to the letters of the words in a dictionary of words, requires the use of a substantial amount of memory. Having stored the phoneme sets/speech (e.g. models) of all of the words available in a language, a database of the chain of characters corresponding to said words available in one or more languages, and also having a data base of the key presses corresponding to said words available in said dictionary data base require large amount of memory.

Also, as described in the prior applications, in the character by character data entry system of the invention a symbol such as a punctuation mark may be assigned to a key of the keypad and be inputted as default by pressing said key without speaking speech. For said reason, in the word level data entry system of the invention as described before, a user may finish to speak a word before finishing to enter all of its corresponding key presses. This may confuse the recognition system because those last key presses which were not covered by user's speech may be considered as said default characters. There are some solutions to overcome this problem. For example, a user may first speak a word and then press the corresponding keys. This may indicate to the system that the set of key presses accruing after the speech correspond to said speech.

In another example, the system may exit the text mode and enter into another mode such as a punctuation/function mode, by a predefined action such as, for example, pressing a mode key. As explained in said PCT applications, to each key of a keypad one or two special characters such as punctuation marks, space character, or a functions, may be assigned. By a single press on a key of said keypad without speaking, a symbol such as punctuation mark on said key will be inputted. A double press on the same key without speech may provide another (e.g. punctuation) symbol assigned to said key. By pressing a

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key while the system is in said special character mode, a symbol such as a punctuation mark may be entered at the end (or any other position) of the word, also indicating to the system the end of said word.

• **Data Entry System Based on sub-speeches**

There must be considered that when a user speaks a word while typing it, he naturally, may break said speech of said word into one or more sub-speech portions (e.g. while he types the letters corresponding to each sub-speech) according to for example, the syllables of said speech. For example, while typing the word "morning" using a keyboard such as a keypad, the user may naturally, first say a first sub-speech, "mor" and/while he presses the corresponding keys. Then the user may pronounce a following sub-speech, "ning" and type the corresponding keys. For easier demonstration, in this application, the word "sub-speech" is used for the speech of a portion of the speech of a word. For example, the word "perhaps", may be spoken in two sub-speeches "per" and "haps". Also for example, the word "pet" may be spoken in a single sub-speech, "pet".

Also, for example, for entering the word "playing", the user may first pronounce the phonemes corresponding to the first syllable (e.g. "ple") while typing the keys corresponding to the letters "pla", and then pronounce the phonemes corresponding to the second syllable (e.g. "ying") while typing the set of characters "ying".

It must be noted that one user may divide a word into portions differently from another user. Accordingly, the sub-speech and the corresponding key presses, for each portion may be different. After completing the data (e.g. key press and sub-speech) entry of all portions of said word by said users, the final results will be similar.

In the above-mentioned example, said another user may pronounce the first portion as "plā" and press the keys of corresponding character set, "play". He then, may say "ing" and press the keys corresponding to the chain of characters: "ing". Also for example, a third user may enter the word "playing" in three sequences of sub-speeches and key presses. Said user may say, "ple", "yin", and "g" (e.g. spelling the character "g" or pronouncing the corresponding sound) while typing the corresponding keys. It is understood that the most natural way of dividing a word in different sequences of speech and key presses is that each sequence of speech correspond to a syllable of said word. Therefore, it must be noted that even though in many paragraphs of this application we note a syllable as a portion/sequence of a word, the data entry system of the invention applies to any form of division of a word in one or more portions.

According to the above-mentioned principles, the word "trying" may be pronounced in two portions (e.g. syllables) "tri", and "ing". Also for example, the word "playground" may be divided and inputted in two portions (e.g. according to its two syllables), "plā", and "ground".

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As it is shown in the examples above, part of the speech of different words in one (or more) languages may have similar pronunciations (e.g. being composed by a same set of phonemes). For example, the words, "trying" and "playing" have common sub-speech portion "ing" (or "ying") within their speech.

According to the above-mentioned principles, there may be created a method of data entry wherein by memorizing predefined sets of phonemes/speech-models corresponding to sub-speeches of a word and considering at least part of the key presses corresponding to the characters sets assigned to corresponding phoneme sets, recognition of entire words in a press and speak data entry system of the invention may become effective. Fig. 84 shows a dictionary of phoneme sets 8401 corresponding to sub-speeches of whole words dictionary 8402, and a dictionary of character sets 8403 corresponding to the phoneme sets of said phoneme set dictionary 8401, also comprising a dictionary of key press values (according to a telephone keypad) 8404 corresponding to said dictionary of character sets 8403 corresponding to said dictionary of phoneme sets 8401. according to different embodiments of the invention, one or more of these data bases may be used by the data entry system of the invention.

Because in many cases, a same phoneme set (sub-speech model) may be used in order to recognize other words (having the same sub-speech pronunciation in their speech), less memorized phoneme-sets/speech-models are required for recognition of entire words available one or more dictionary of words, reducing the amount of the memory needed. This will result in assignment of reduced number of phoneme sets to the corresponding keys of a keyboard such as a telephone-type keypad and will, dramatically, augment the accuracy of the speech recognition system.

Fig. 83 shows exemplary samples of words of English language 8301 having similar speech portions 8302. As shown, four short phoneme sets 8302, may produce the speech of seven entire words 8301. It is understood that said phoneme sets 8302 may represent part of speech of many other words in English or other languages, too.

Based on the above-mentioned principles, a natural press and speak data entry system using reduced number of phoneme sets for entering any word (e.g. general dictation, arbitrary text entry) through a mobile device having limited size of memory (e.g. mobile phone, PDA) and limited number of keys (e.g. telephone keypad) may be provided. The system may also enhance the data entry by for example, using a PC keyboard for fixed devices such as personal computers. In this case, (because a PC keyboard has more keys), still more reduced number of phoneme sets will be assigned to each key, augmenting the accuracy of the speech recognition system. Hereafter, different detailed embodiments of the invention are described.

#### **All Keys-At Least Part of the Phonemes**

According to one embodiment of the invention, a user may divide the speech of a word into different sub-speeches wherein each sub-speech is represented by a phoneme-set. By speaking each phoneme set and/while pressing the keys corresponding to the letters corresponding to said phonemes sets and repeating (in order, from first to last) this

procedure for all of (or at least part of) said sub-speeches, said entire word (e.g. in characters) may be inputted.

As shown in Fig. 81, for example, the letter "t" is located on the key 8101 of the keypad 8100. To said key different sets of phonemes such as "tē", "tī", "tā", "tō", etc., and/or corresponding speech models may be assigned (see table 1, fig. 85). Pronouncing "tē" may correspond to different sets of letters such as "tea", "tee", or even "the" (if the user is for example not an American/English native). To produce the word "teabag" a user may press the "t" key 8101 and say "tē" and continue to press the remaining keys corresponding to the remaining letters, "ea". The system compares the speech of the user with the speech (e.g. models) assigned to the first pressed key (in this example, "t" key 8101). After matching said user's speech to one (or more) of said phoneme-sets/speech-models assigned to said key, the system selects on or more of the character set(s) assigned to said phoneme set(s)/speech-model(s). As mentioned, in this example, a same speech may correspond to two different sets of characters, one corresponding to the letters "tea" (e.g. key presses value 832) and the other corresponding to letters "tee" (e.g. key presses value 833). The system compares (e.g. the value of) the keys pressed by the user with the (e.g. values of) the key presses corresponding to the character sets of said list and if one of them matches the user key presses the system chooses it to eventually being inputted/outputted. In this case the letters "tea" may be the final selection for this stage. An endpoint (e.g. end of the word) signal such as a space key press may inform the system that the key presses and speech for the current entire word are ended.

In the above-mentioned example, the selection is not final. The user then may press the "b" (e.g. corresponding to the first character in the following syllable in the word) key 8102 and say "bag" and continue to press the remaining keys corresponding to the remaining letters "ag". The system proceeds like before and selects the corresponding character set, "bag". The user now, signals the end of the word by for example, pressing an space key.

By saying "tē" and pressing the keys "8, 3, 1" and then saying "bag" and pressing the keys "1, 1, 4", the word "teabag" may be produced. As noticed, the word "teabag" is produced by speech and key presses without having its entire speech model/phoneme-set in the memory. In fact the speech model of the word "teabag" was produced by two other sub-speech models (e.g. of "te" and "bag") available in the memory, each representing part of said speech model of the entire word "teabag" and together producing said entire speech model. The speech models of "tē" or "bag" may be used as part of the speech-models/phoneme-sets of other words such as "teaming" or "Baghdad", respectively.

Although in this embodiment, the recognition accuracy is very high, it may happen that sometimes the final selection is an erroneous word which do not exist in the data base. For this reason, before inputting/outputting said word, the system may compare the final selection with the words of a dictionary of the word of the desired language. If said selection does not match a word in said dictionary, it is rejected.

Also, according to one method, while pressing the corresponding keys of a portion of a word and speaking it, the user may speak in a manner that his speech covers said

corresponding key presses during said entry. This will have the advantage that the user's speech at every moment corresponds to the key being pressed simultaneously, permitting easier recognition of said speech. On the other hand, at the end of the entry of a word, a user may press any key without speaking. This may inform the system that the word is entirely entered (e.g. pressing a key and not speaking may be assigned to characters such as punctuation marks, PC functions, etc. This matter has already been explained in the PCT applications that have already been filed by this inventor).

After completion of the recognition procedures described above, if the selected output comprises more than one word, said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example pressing a "select" key.

It must be noted that in some cases, recognizing part of the phonemes of one or more sub-speeches of a word (preferably, those at the beginning of said sub-speeches), may be enough for recognition of the corresponding word in the press and speak data entry system of the invention.

According to one embodiment of the invention instead of considering all of the phonemes corresponding to a sub-speech of a word, only a few phonemes, (preferably those at the beginning of said sub-speech) may be considered and assigned to the key corresponding to the first letter of the character set(s) corresponding to said phoneme set. Said phoneme set may be used for the recognition purposes by the press and speech data entry system of the invention. Thanks to this method, the number of the speech-models/phoneme-sets necessary for recognition of many entire words may dramatically be reduced. In this case, to each key of a keyboard such as a keypad, only few phoneme sets will be assigned permitting easier recognition of said phoneme sets by the voice/speech recognition system.

By using a speech recognition system for evaluation of all/few (preferably the beginning) characters of each sub-speech (preferably, the first) of a word along with consideration of all of the key presses corresponding to all of the characters of said word, a word in a language may be recognized by the data entry system of the invention.

According to this embodiment, for each letter different sets of phonemes (or speech models) according to sub-speeches of the words in a language may be considered and memorized. Said sets of phonemes may be located at any position within a word. Each of said sets of phonemes may correspond to one or more sets of characters having similar/almost similar pronunciation. Fig. 85 shows an exemplary table showing some of the phoneme sets that may occur at the beginning (or anywhere else) of a syllable of a word starting with the letter "t". In the last row, of the table also shows an additional example of a phoneme set and a relating character set for the letter "i".

Although phoneme sets having more phonemes (e.g. taps, take, tãst, etc.) may be considered, modeled, and memorized to help recognition of a word, in this embodiment wherein the user presses all of the keys corresponding to the letters of a word, evaluating/recognizing few beginning characters of one or more portions (e.g. syllables) of

said word by the voice/speech recognition and also using dictionary of words data base and relating databases (such as key presses values) as shown in fig. 84, may be enough for producing said word, obviously, when needed, longer phoneme sets may also be used for better recognition and disambiguity.

As an example, by considering fig. 81 and also using the table 1 of the fig. 85, to produce the word "title", a user may press the key 8101 corresponding to the letter "t" and say "ti" and then press the remaining key presses corresponding to remaining letters "tle". At the end of the word the user presses for example, an end-of-the-word key such as a space key. To the phoneme set "ti", character sets such as "ti, ty, tie" are assigned. The first letter "t" is obviously, selected. Second letter will be "i", because of pressing the key 8103 (e.g. "y" is on the key 8104). The next key pressed is the key 8101 relating to the letter "t", in this case the character set "tie" possibility is rejected. So "ti" will be definitively selected. The system now considers "ti" along with the remaining key presses 8 (e.g. "i, u, v"), 5 (e.g. "g, h, i"), and 3 (e.g. "d, c, f"). Comparing these input with a dictionary of words having corresponding key presses data base will reveal that the only word corresponding to these input is the word "title". The system then selects the word "title".

For better recognition, the user may speak more than one sub-speech of a word while pressing the corresponding keys. In this case, the system may consider the input of characters corresponding to more than one sub-speech of said word.

By typing a word (having one or more portions/syllables) through a keyboard/keypad and speaking said word partially/entirely, in almost every case, recognition of few beginning characters of at least one of said syllables (preferably, the first syllable) of said word by the speech recognition system (helped by the evaluation of the corresponding key presses), combined with the evaluation of the key presses corresponding to the rest of the characters of said word will produce said word.

In another example, to enter the word "taken" which comprises two sub-speeches/syllables, "ta" and "ken", when typing the first character "t" (key 8101), the user says "ta" and then presses the rest of the keys (e.g. "a") corresponding to the rest of the characters of the first syllable. The user then naturally proceeds to the next syllable and says "ken" while pressing the key 8105 corresponding to letter "k" and continues to press the remaining keys of said next syllable corresponding to the letters "en". He then may press a space key to inform the system of the end of data entry.

After completion of the recognition procedures described above, if the selected output comprises more than one word, said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example pressing a "select" key.

**Shortcut: Less Key Presses Combined With at least Part of the Phonemes**

Small mobile electronic devices having keypads with limited number of keys are commonly used worldwide. Users press the keys of said keypads by using the fingers (e.g. thumb, forefinger) of one hand. Even in a the above-mentioned data entry systems

wherein each symbol is entered by a single pressing action on a corresponding key, the speed of data entry is slower than the speed of the data entry using a PC keyboard wherein the users usually use the fingers of both hands to press the keys of the keyboard.

To enhance the data entry system of the invention and to permit quicker data (e.g. text) entry, a macro-level data/text entry system have been proposed in the PCT application PCT/US00/29647. In said PCT application, there was mentioned that macros (e.g. a chain of letters/characters) can be assigned to a key of a keypad and inputted by a single pressing action combined with/without voice/speech. By assigning at least part of the characters of a word to a single key press an entire word may be inputted by few key presses. By applying this method within the press and speak data entry method of the invention, a quick data entry for mobile environment/small devices may be provided. In this method, the number of key presses are less than the number of the characters of a word (except for the single characters and some words such as out-of-dictionary-words, which may require character by character entry)

According to the preferred embodiment of the invention a user may press the key(s) corresponding to the first letter of portion(s) of a word while, preferably simultaneously, speaking said corresponding portion(s). For this purpose a user may divide a word to different portions according to, for example, the syllables of said speech. Speaking each portion/syllable of a word is called "sub-speech" in this application.

According to this embodiment, for example, to enter the word "tiptop" which may be divided in two sub-speeches (e.g. according to its syllables) "tip" and "top", the user may first press the key 8101 (e.g. letter "t" is assigned to said key) and (preferably, simultaneously) say "tip" (e.g. the first sub-speech of the word "tiptop"), then he may press the key 8101 and (preferably, simultaneously) say "top" (e.g. the second sub-speech of the word "tiptop"). Using the table in the fig. 85, set of characters "tip" is assigned to the set of phonemes "tip" and to the letter "t" on the key 8101. When the user presses the key 8101 and says "tip", the system compares the speech of the user with all of the phoneme sets/models which are assigned to the key 8101. After selecting one (or more) of said phoneme sets which match said user's speech, the system selects the character sets which are assigned to said selected set(s) of phonemes. In the current example, only one character set (e.g. tip) was assigned to the phoneme set "tip". The system then proceeds in the same manner to the next portion (e.g. sub-speech) of the word, and so on. In this example, the character set "top" was the only character set which was assigned to the phoneme set "top". The system selects said character set. After selecting all character sets corresponding to all of the sub-speeches/syllables of the word, the system then assembles said character sets (e.g. an example of assembly procedure is described in the next paragraph) providing different groups/chains of characters. The system then compares each of said group of characters with the words (e.g. character sets) of a dictionary of words data base available in the memory. For example, after selecting one of the words of the dictionary which best matches to one of said groups of characters, the system may select said word as the final selection. In this example, after entering the second portion/syllable, the user presses for example, a space key, or another key without speaking to inform the system that the word was entirely entered (e.g. pressing a key and not speaking may be assigned to characters

such as punctuation marks, PC functions, etc). This matter has already been explained in the PCT applications that have already been filed by this inventor ). The system assembles the character sets 'tip' and 'top' and produces a group of characters 'tipop'. The system then compares said group of characters with the words available in a dictionary of words data base of the system (e.g. an English dictionary) and if one of said words matches said group of characters the system inputs/outputs said word. In this example, the word "tipop" exists in an English dictionary of the system. Said word is finally inputted/outputted.

Fig 86 shows a method of assembly of selected character sets of the embodiments. For example, when a user tried to enter the word "envelope" in three sequences by using an embodiment of the invention, the system selected one to two character sets 8601 for each portion. The system then assembles said character sets according to their respective position within said word, providing different group of characters 8602. Said group of characters 8602 will be compared with the words of the dictionary of words of the system and the group(s) of characters which match(es) one or more of said words will be finally selected and inputted. In this example, the character set 8603 (e.g. envelope"), is the only character set which matches a word in said dictionary. Said word is finally selected.

As mentioned, in some cases, the speech recognition system may select more than one phoneme set/speech model for the speech of all/part (e.g. a syllable) of a word. For example, if a user having a "bad" accent tries to enter the word "teabag" according the current embodiment of the invention, he first presses the key 8101 and simultaneously says "tē". The system may not be sure whether the user said "te", or "the". In this case the system may select different character sets corresponding to both phoneme sets. By using the same procedure, the user then enters the second portion of the word. In this example, only one character set, "bag", was selected by the system. The user finally, presses an space key. The system, then may assemble (in different arrangements) said character sets to produce different group of characters and compare each of said group of characters with the words of a dictionary of words data base. In this example the possible group of characters may are:

- "teebag"
- "tcabag"
- "thebag"

The only group of characters that matches a word in a dictionary of words in for example, English language, is the word "teabag". This word may be considered as the final selection.

As just demonstrated, it may happen that the system selects more than one character set for each/some phonemic sets of a word. In this case, more than one group of characters may be assembled. Therefore, probably, more than one word of the dictionary may match said assembled groups of characters. In this case, said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example pressing a "select" key. Also, if the system comprises enough memory and processing speed, a speech recognition system may be used to select one of said selected word according to the corresponding phrase context.

If a word/portion-of-a-word comprises many phonemes but its speech comprises a single syllable, according to one method, a phoneme-set/model comprising all of said phonemes of said word/portion-of-a-word may be assigned to said word. For example, to enter the word "thirst", a phoneme set constituting of all of the phonemes of said word may be assigned to said word and to the letter "t" (e.g. positioned-on/assigned-to the key 8101). The user presses the key 8101 and says "thirst". As explained before, the system selects the character set(s) (in this example, only one, "thirst") of sub-speech(es) (in this example, one sub-speech) of the word, and assembles them (in this example, no assembly). The system then, may compare the said characters set with the words of the dictionary of the word of the system and if said character set matches one of said words in the dictionary, then it selects said word as the final selection. In this case, the word "thirst" will be finally selected.

In some cases, specially when words are comprised of only one syllable, more than one key press for a syllable may be necessary for disambiguation of a word. For this purpose, different user-friendly methods may be implemented. For example, the word "fire", which originally comprises one syllable may be pronounced in two syllables comprising phoneme sets, "fi", and "re", respectively. The user in this case may first press the key corresponding to the letter "f" while saying "fi". He then, may press the key corresponding to the letter "r", and may say "re".

Also, for example, the word "times", may be pronounced in two syllables, "ti" and "mes", or "tīm" and "es". Also a word such as "listen", may be pronounced in two syllables, "lis", and "ten" which may require the key presses corresponding to letters "l" and "t", respectively. Also according to this principle, the word "thirst", may be divided in three portions, "thir", "s", and "t". For example, by considering that the phoneme set "thir" may already been assigned to the key comprising the letter "t" (e.g. key 8101), the user may press the key 8101, and say "thir", then he may press the key 8106 corresponding to the letter "s" and pronounce the sound of the phoneme "s". He then, may press the key 8101 corresponding to the letter "t" and pronounce the sound of the phoneme "t". At the end of the word, the user may press an end-of-the-word key such as a space key 8107.

Also for better disambiguation and also for reducing the number of phoneme-sets necessary for words having for example, the same speech at their beginning (e.g. "bring" and "brings"), in addition to pressing the first key of a syllable, and speaking said syllable, in some cases one or more character such as the last character(s) (e.g. "s") of a word/syllable may be pressed and spoken. For example, a user may press a key corresponding to the character "b" and say "bring" (e.g. phoneme-set "bring" was assigned to the key "8102). He then, may press the key corresponding to the letter "s", and either pronounces "s" or speaks the sound of the phoneme "s". After providing an end-of-the-word signal such as pressing the "space" key, the system will consider the two data input sequences, and provides the corresponding word "brings" (e.g. its phoneme set was not assigned to the key 8102). It is understood that entering one or more single character(s) by using the method here, may be possible in any position (such as in the beginning, in the middle, or at the end)

within a word. For not confusing the system, when a user enters a portion (of a word) comprising a letter, by the word entry system of the invention, he preferably may speak the sound of said letter. For example, instead of saying "em", the user may pronounce the sound of the phoneme "m". Also in a similar case, speaking saying "t", may be related by the system to the chain of characters "tea", "tea" and the letter "t", while pronouncing the sound of the phoneme "t", will be related to only the letter "t"

As described before, for better disambiguation, a word/portion-of-a-word/syllable-of-a-word/sub-speech-of-a-word (such as "thirst" or "brings") having substantial number of phoneme sets may be divided into more than one portion wherein some of said portions may contain one phoneme/character only, and entered according to the data entry system of the invention. Also as mentioned, according to this approach, multiple phoneme-sets wherein each comprising fewer number of phonemes may replace a single phoneme-set comprising substantial number of phonemes, for representing a portion of a word (e.g. a syllable). Also as described before, dividing the speech of a long portion (e.g. long syllable comprising substantial number of phonemes) of a word into shorter sub-speech/phoneme-set portions, will reduce the total number of phoneme-sets necessary for recognition of all of the words available in a dictionary data base. As also described before, this will permit to assign less phoneme-sets to each key of the keyboard/keypad

According to one embodiment of the invention, based on the above-mentioned principles, to each key of a keyboard/keypad short phoneme-sets comprising few phonemes may be assigned. For this purpose, for example, if a phoneme-set starts with a consonant it may comprise following structures/phonemes:

- only said consonant
- said consonant at the beginning, and at least one vowel after that
- said consonant at the beginning, at least one vowel after said consonant, and one consonant after said vowel(s)

If the phoneme-set starts with a vowel, it may have the following structures:

- at least one vowel at the beginning
- said vowel(s) at the beginning, and one consonant after that

Fig. 88 shows some examples of the phoneme-sets 8801 for the constant "t" 8802 and the vowel "u" 8803, according to this embodiment of the invention. Columns 8804, 8805, 8806, show the different portions of said phoneme-sets according to the sound groups (e.g. consonant/vowel) constituting said phoneme-set. Column 8807 shows corresponding exemplary words wherein the corresponding phoneme-sets constitute part of the speech of said words. For example, phoneme set "tar" 8808 constitutes portion 8809 of the word "stair". Column 8810 shows an estimation exemplary of the number of key presses for entering the corresponding words (one key press corresponding to the first character of each portion of the word according to this embodiment of the invention). For example, to enter the word "until" 8811, a user will first press the key 8101 (see fig. 81) corresponding to the letter "u" and preferably simultaneously, says "un". He then presses again the key 8101 corresponding to the letter "r", and also preferably simultaneously, says "til". To end the word, the user then informs the system by an end-of-the-word signal such as pressing a

space key. The word until was entered by two key presses (excluding the end-of-the-word signal) along with the user's speech. According to the current embodiment based on the principles described before, a consonant phoneme which has not a vowel, immediately, before or after it, may be considered as a separate portion of the speech of a word. For example, the "s" at the beginning of the word "study" 8812, and the "s" in the middle of the word "understood" 8813 may follow this rule. This will extremely reduce the number of phoneme-sets necessary for entering of any word available in a dictionary (e.g. maybe less than one hundred phoneme-sets per the beginning phoneme/character of a portion of a word may be enough for recognition of all of the words in for example, the English language). Fig. 88 shows other beginning phonemes/characters such as "v" 8814, and "th" 8815 assigned to the key 8101 of a telephone-type keypad. For each of said beginning phonemes/characters, phoneme-sets according to the above-mentioned principles may be considered. It is understood that if needed/desired longer sub-speech portions of a word, having more phonemes may also be considered with the short phoneme-sets of the system. Also for examples, phoneme sets representing more than one syllable of a word may also be considered. Also for easier recognition, as described in previous embodiments, to permit better recognition of the speech pronounced by the users that, in many cases, may be natives of non English spoken regions, character-sets corresponding to phoneme sets (such as "tō" and "tō") having ambiguously similar pronunciation, may be assigned to all of said phoneme-sets.

Memorized short phoneme-sets/speech-models may permit the recognition and entry of words in many languages. For example, the phoneme set "sha", may be used for recognition of words such as

"shadow", in English,  
"chaleur", in French,  
"shalom", in Hebrew,  
"shabab", in Arabic,  
"Geisha", in Japanese, Etc.

To each of said phoneme sets, corresponding character-sets in a corresponding language may be assigned. As mentioned before, by doing so, a powerful multi-lingual data entry system based on phoneme-set recognition may be provided. For this purpose one or more data bases in different languages may be available within the system. Different methods to enter different text in different languages may be considered.

According to one method, by having a common short phoneme-sets data base and the corresponding character-sets database in many languages, for entering text in a desired language, a user may select a language mode by informing the system by a predefined means. For example, said user may press a mode key to enter into a desired language mode. In this case after entering a word by entering the portions of a said word according to a corresponding embodiment of the invention, the system will compare the selected corresponding groups/chains of assembled character-sets with the words of a dictionary of words corresponding to said selected desired language. After matching said group of characters with one or more words of said dictionary, the system selects said matched word(s) as the final selection to be inputted/outputted. If the selection contains one word,

said word may become the final selection. If the selection comprises more than one word, then said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example using a "select" key.

According to another method, all data bases in different languages available with the system will be used simultaneously, permitting to enter an arbitrary word entry in different languages. For example, after entering a word by entering the portions of a said word according to one embodiment of the invention, the system will compare the selected corresponding groups of characters with the words of a all of the dictionaries of words available with the system. After matching said group of characters with the words available in different dictionaries available with the system, the system selects said matched word(s) as the final selection to be inputted/outputted. If the selection contains one word, said word may become the final selection. If the selection comprises more than one word, then said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example using a "select" key.

In some languages such as Hebrew or Arabic, wherein most of the vowels are not presented by separate characters, the system may even work with higher accuracy.

The system may also work without the step of comparison of the assembled selected character-sets with a dictionary of word. This is useful for entering text in different languages without worrying about their existence in the dictionary of the words of the system. For example, if the system does not comprise a Hebrew dictionary of words, a user may enter a text in Hebrew language by using the roman letters. To enter the word "Shalom", the user will use the existing phonemic sets "sha" and "lom" and their corresponding character sets available within the system. A means such as a mode key may be used to inform the system that the assembled group of characters will be inputted/outputted without said comparison. If more than one assembled group of characters has been produced, they will be may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example pressing a "select" key.

In the word entry embodiments of the invention, if the inputted/outputted word is not the one desired by the user, a word-erasing function may be assigned to a key. Similar to a character erasing function (e.g. delete, backspace) keys, pressing a word-erase-key will erase the word before the cursor on the display.

According to another embodiment of the invention, most phonemic-sets of the system will have only one consonant. Fig. 89 shows some of them as example. According to this embodiment, for example, to enter the word "teabag" 8901, the user first presses the key 8101 while saying "te". He then presses the key 8102 while saying "ba". He finally presses the key 8103 while saying "g" (or pronouncing the sound of the phoneme "g"). As in other embodiments, at the end of the word he may press a key such as space key.

For better response and to augment the accuracy of the system, an auto-correction software may be combined with the embodiments of the invention. Auto correction software are known by the people skilled in the art. For example, when a user tries to enter the word

"network", he first presses the key 8108 of the keypad to which the letter "n" is assigned and simultaneously says "net". To the same key 8108 the letter "m" is also assigned. In some situations, the system may misrecognize the user's speech and select a character set such as "met" for said speech. The user proceeds to entering the next syllable by pressing the key 8104 corresponding to the first letter, "w", of said syllable and says "work". The system recognizes the phoneme set "work" pronounced by the user and selects a corresponding character set "work". Now the system assembles the two selected character sets and gets the word "mework". By comparing this word with the words existing in the dictionary of the words database of the system, the system can not match said assembled word with any of said words of said database. The system then will try to match said assembled word with the most resembling word. In this case, according to one hypothesis the system may replace the letter "m" by the letter "n", providing the word "network", which is available in said dictionary. According to another hypothesis, by considering that "m", and "n" may be misrecognized by the voice recognition system and both are located on a same key, the system will replace the phoneme set "met" by the phoneme set "net" and select the character set "net" assigned to the phoneme set "net". Then, by replacing the character set "met" by the character set "net", the word "network" will be assembled. Said word is available in the dictionary of the words of the system. It will finally be selected.

In another example, entering "that" may be recognized as "vat" by the system. Same procedure will disambiguate said word and will provide the correct word, "that".

In another example, if the system does not match an assembled group of characters with a word of the dictionary, the auto-correction software of the system may evaluate the position of the characters of said assembled character-set (relating to each other) in a corresponding portion (e.g. syllable) and/or within said assembled group of characters, and tries to match said group of characters to a word of the dictionary. For example, if a character is missing within said chain/group of characters, by said comparison with the words of the dictionary, the system may recognize the error and output/input the right word. For example, if a user enters the word "un-der-s-tand" (e.g. in 4 portions), and forgets to enter the portion "s" of said word, one of the assembled group of characters may be the chain of characters "undertand". By considering the characters of said chain of characters and their position relating to each other in said chain, and comparing said chain of characters with the words of the dictionary, the system may recognize that the intended word is the word "understand" and eventually either will input/output said word or may present it to the user for user's decision. The auto-correction software of the system may have part of, or all of the functionalities any auto-correction software known by the people skilled in the art.

Words such as "to", "too", or "two", having the same pronunciation, may follow special rules. For example, the most commonly used word among these words is the word "to". This word may be entered according to the embodiment of the invention. The output for this operation will be the word "to" by default. The word "too", may be entered (in two syllables) by pressing the key corresponding to the letter "t", while saying "tōō". Before pressing the end-of-the-word key, the user may also enter an additional character "o", by pressing the key corresponding to the letter "o", and saying "o". Now he may press the

endpoint key. The word "too" will be recognized and inputted. To enter the word "two", the system may either enter it character by character, or assign a special speech such as "tro" to said word and enter it using this embodiment. Also for example, to enter "two", the user may press the key 8101 and pronounce a long "too". To enter the digit "2", the user presses the corresponding key 8102, and pronounces said digit.

A very interesting issue has just been mentioned. For example, by saying "fiv" and pressing the key 8109 corresponding to the first letter of the word "five", the word "five" will be entered. Interestingly, by saying "fiv" and pressing the key 8105 corresponding to the digit "5", the digit "five" will be entered. By saying a word having two different output symbols, and using key presses, the user intention is clarified. This is one of the shortcomings of the data entry by the speech alone wherein the user intention may not be considered by the voice/speech recognition system. Also for example, to a same digit, more than one speeches may be assigned. For example, to the digit "4", two speeches, "four", and "forty", may be assigned. A user may produce the number "45", by either saying "four", "five" while pressing the corresponding keys, or he may say "forty five" while pressing the same keys. Also when a user presses the key 8106 and says "seven", the digit "7" will be inputted. This is because to enter the word "seven", the user may press the key 8106, and say "se". He then may press the key 8101 and say "ven".

In other languages such as French, wherein the speech of the digit "7", comprises one syllable, for disambiguation purpose, a custom made speech having two syllables may be assigned to the character set "sept". For example, the word "septo" may be created by a user and added to the dictionary of the word. This word may be pointed to the word "sept" in the dictionary. When a user enters the word "septo" (according to the current embodiment of the invention) the system will find said word in the dictionary of the words of the system. Instead of inputting/outputting said word, the system will input/output the word pointed by the word "septo". Said word is the word "sept". The created symbols pointing to the words of the dictionary data base may be arranged in a separate database. It must be noted that the sub-speech-level data entry system of the invention is based on the recognition of the speech of at least part of a word (e.g. sub speech of a word). Considering that many words in one or more languages may have common sub-speeches, by slightly modifying/adding phoneme sets and assign the corresponding characters to said phoneme sets, a multi-lingual data entry system may become available. For example, many languages such as English, German, Arabic, Hebrew, and even Chinese languages, may comprise words having portions/syllables with similar pronunciation.

It is understood that a user may add new standard or custom-made words and corresponding speech to the dictionary database of the system. accordingly, the system may produce corresponding key press values and speech models and add to corresponding databases.

As mentioned before, to enter a word, a user may press a key corresponding to the first character/letter of a first portion of a word and speak (the phonemes of) said portions. If said word is spoken in more than one portions, the user may repeat this procedure for each of the remaining portions of said word.

For example, by using the table of the fig. 85, to enter the word "trying" (e.g. phonemes "tri-ing), the user may first press the key 8101 and say "tri". The system matches the user's speech to the corresponding phonemic set assigned to the key 8101 and selects the corresponding character sets (e.g. in this example, "try", "tri"). The user then presses the key 8103 corresponding to the character "i" and says "ing". In this case, the system matches the beginning of the user's speech to the phonemic set "in" assigned to the key 8103 (e.g. phonemic set "ing" does not exist in the exemplary data base, therefore it is not assigned to said key) and selects the corresponding character set "in". The user now has finished to enter the word and he enters an endpoint (e.g. end of the word) symbol such as pressing a space key or pressing any key without speaking (e.g. pressing a key and not speaking may be assigned to characters such as punctuation marks, PC functions, etc. This matter has already been explained in the PCT applications that have already been filed by this inventor). The system now may create different groups of characters each comprising possible characters of at least part of the beginning characters of each syllable of the desired word.

Only the second group of characters (e.g. "try in") corresponds to an existing word in the English dictionary wherein said word comprises the letters "try" at the beginning of its first syllable, and also comprises the letters "in" at the beginning of another (e.g. second) syllable of said word. Said word is the word "trying"

In this system the quantity of phoneme sets/speech models necessary for recognition of many entire words may dramatically be reduced. On the other hand the number of the sets of character representing said phoneme sets may be augmented but will not have a significant impact on the amount of memory needed.

In many cases only one of said assembled characters may match a word in the dictionary. Said word will be inputted/outputted. If more than one assembly of character sets correspond to words available in the dictionary, said words may be presented to the user (e.g. in a list printed at the display) and the user may select one of them by for example pressing a "select" key.

To permit better recognition of the speech pronounced by the users that, in many cases, may be natives of non English spoken regions, character sets assigned to phoneme sets (such as "vo" and "tho") having ambiguously similar pronunciation, may be assigned to all of said phoneme sets.

Entering data such as text through a small keypad severely reduces the data entry speed. The data entry systems of the invention based on pressing a single key for each portion/syllable of a word, while speaking said portion/syllable dramatically augments the data entry speed. The system has also many other advantages. One advantage of the system is that the system may recognize (with high accuracy) a word by pressing maybe a single key per each portion (e.g. syllable) of said word. Another great advantage of the system is that the users do not have to worry about misspelling/mistyping a word which, particularly, in word predictive data entry systems result in misrecognition/non-recognition of an entire word. Also another great advantage of the system is in that when a user presses the key corresponding to the first letter of a portion of a word, he speaks (said portion) during said key press. At the end of a word, the user may enter a default symbol such as a punctuation mark (assigned to a key) by pressing said key without speaking. As mentioned before, this key press may also be used as the end-of-the-word signal. For example, a user may enter the word "hi", by pressing the key 8103 and simultaneously say "hi". He then may press the key 8107 without speaking. This will inform that the entry of the word is ended and the symbol "." must be added at the end of said word. The final input/output will be the character set "hi."

The data entry system described in this invention is a derivation of the data entry systems described in the PCTs and US provisional applications filed by this inventor. The combinations of a character by character data entry system providing a full PC keyboard function as described in the previous applications and a word/portion-of-a-word level data entry system as described in said PCT application and here in this application will provide a complete fast, easy and natural data entry in mobile (and even in fix) environments permitting quick data entry through keyboards having reduced number of keys (e.g. keypads) of small electronic devices.

#### A Method of Configuration of Symbols on a Keypad

Different methods of configuration of symbols have been proposed in prior patent applications filed by this inventor. Fig. 87 shows a method of assignment of symbols to the keys of a keypad 8700.

As before, Letters a-z, and digits 0-9 are positioned on their standard position on a telephone-type keypad and may be inputted by pressing the corresponding key while speaking them.

Also as before, many punctuation characters and functions are assigned to the keys of said keypad and may be inputted by pressing (or double pressing) the corresponding keys without speaking them.

In this configuration, some of the punctuation marks such as "+" sign, which are naturally spoken by the users, are assigned to some keys and may be inputted by pressing a the corresponding key and speaking them.

Also according to this arrangement some symbols such as the "-" sign 8702, which may have different meaning and according to a context, may be pronounced or not pronounced according to the context of the data, are positioned in a key, in two locations. They are once grouped with the symbols requiring speaking while entering them, and also grouped with the symbols who should not be spoken while entering them. To a symbol requiring speech, more than one speech may be assigned according to the context of the data. For example, the sign "-" 8702 assigned to the key 8703, may be inputted in different ways.

- A user may press the key 8703 and say "minus"
- A user may press the key 8703 and say "dash"
- A user may press the key 8703 without speaking.

Thus, while there have been shown and described and pointed out fundamental novel features of the invention as applied to alternative embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the disclosed invention 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 claims appended hereto. It is to be understood that the drawings are not necessarily drawn to scale, but that they are merely conceptual in nature. For example, the features described in this application and the applications filed before may apply to all of the embodiments of the invention. Also an embodiment of the invention may be function separately or it may function combined with one or more other embodiments of the invention.

Thus, while there have been shown and described and pointed out  
fundamental novel features of the invention as applied to alternative  
embodiments thereof, it will be understood that various omissions and  
substitutions and changes in the form and details of the disclosed invention may  
5 be made by those skilled in the art without departing from the spirit of the  
invention. It is to be understood that the drawings are not necessarily drawn to  
scale, but that they are merely conceptual in nature. For example, instead of  
providing a separate pressure system to each key of a keypad, a single pressure  
sensitive system (e.g. a pressure sensitive pad) may be provided with all of them  
10 (e.g. a single large pad above or under the keys). Also a user may interact with a  
key by other means than his fingers. For example, said user may use a pen to  
press a key.

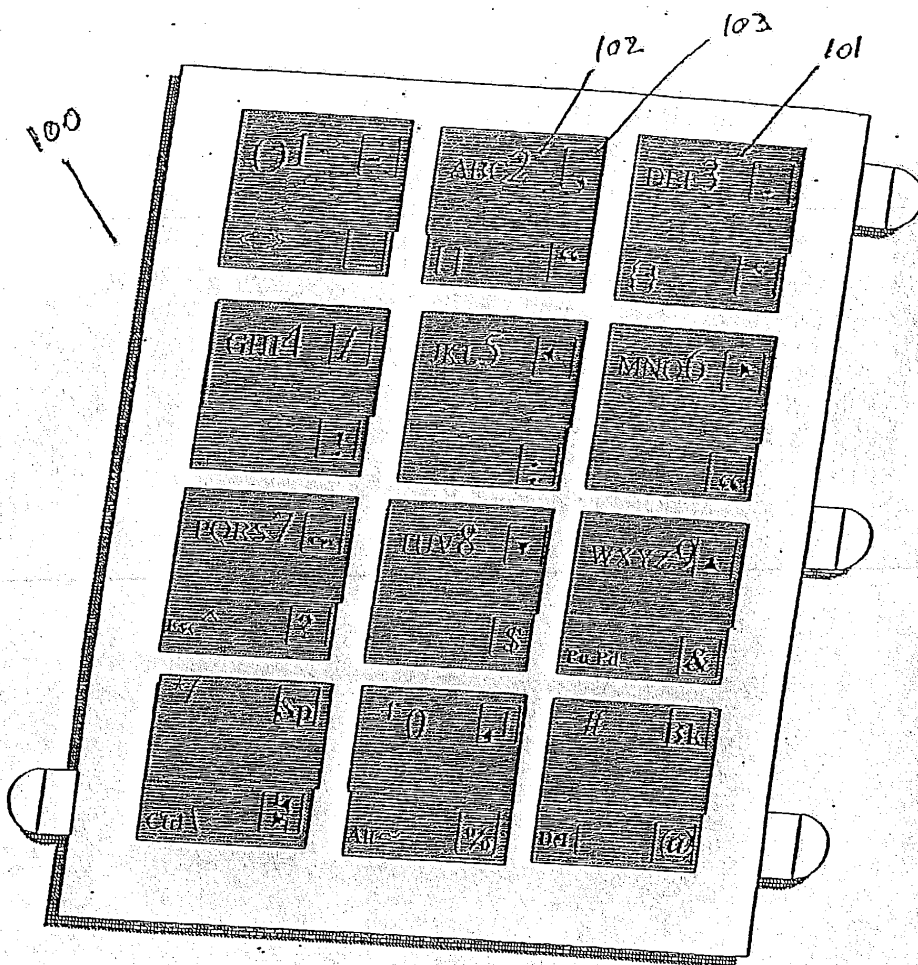


Fig 1

1/4a

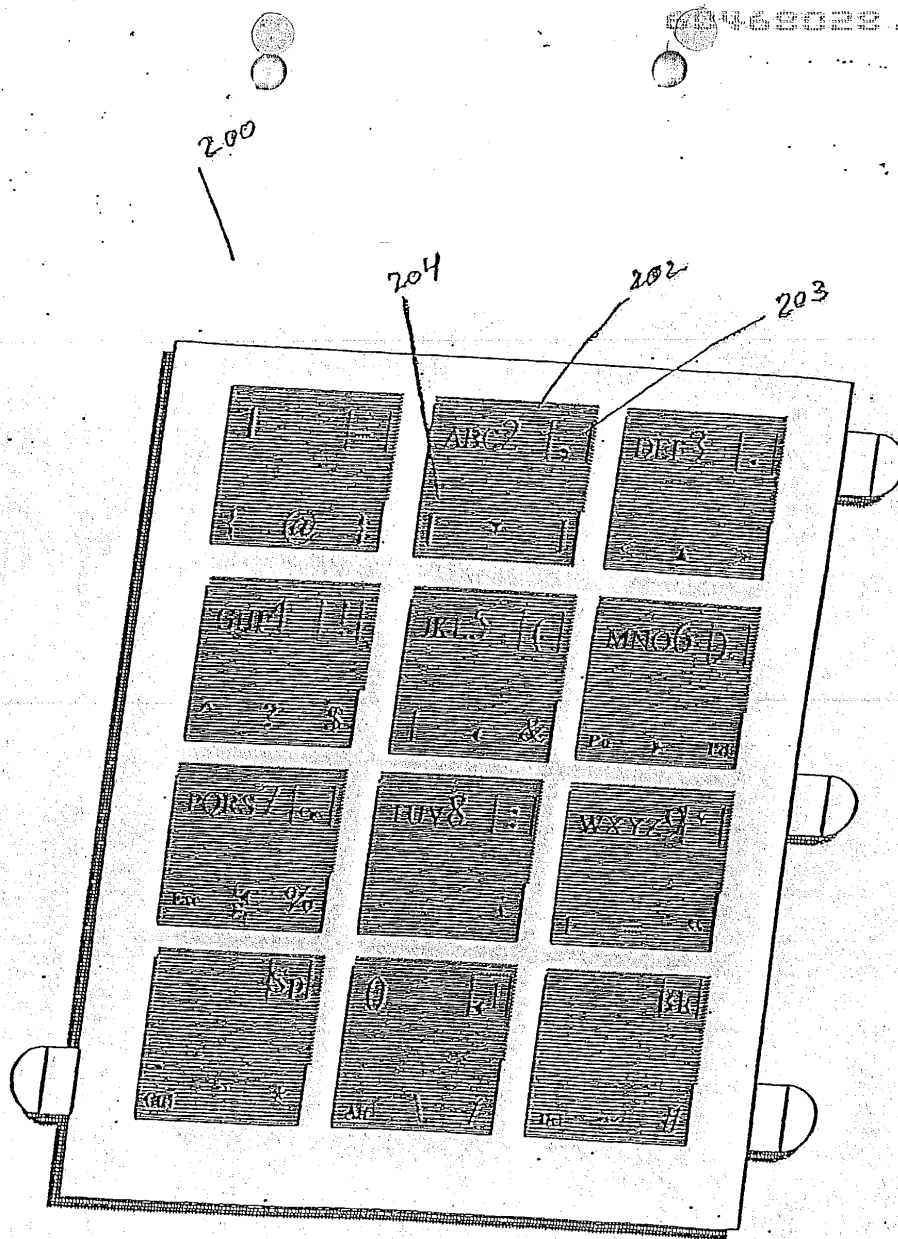


Fig 2

2/4a

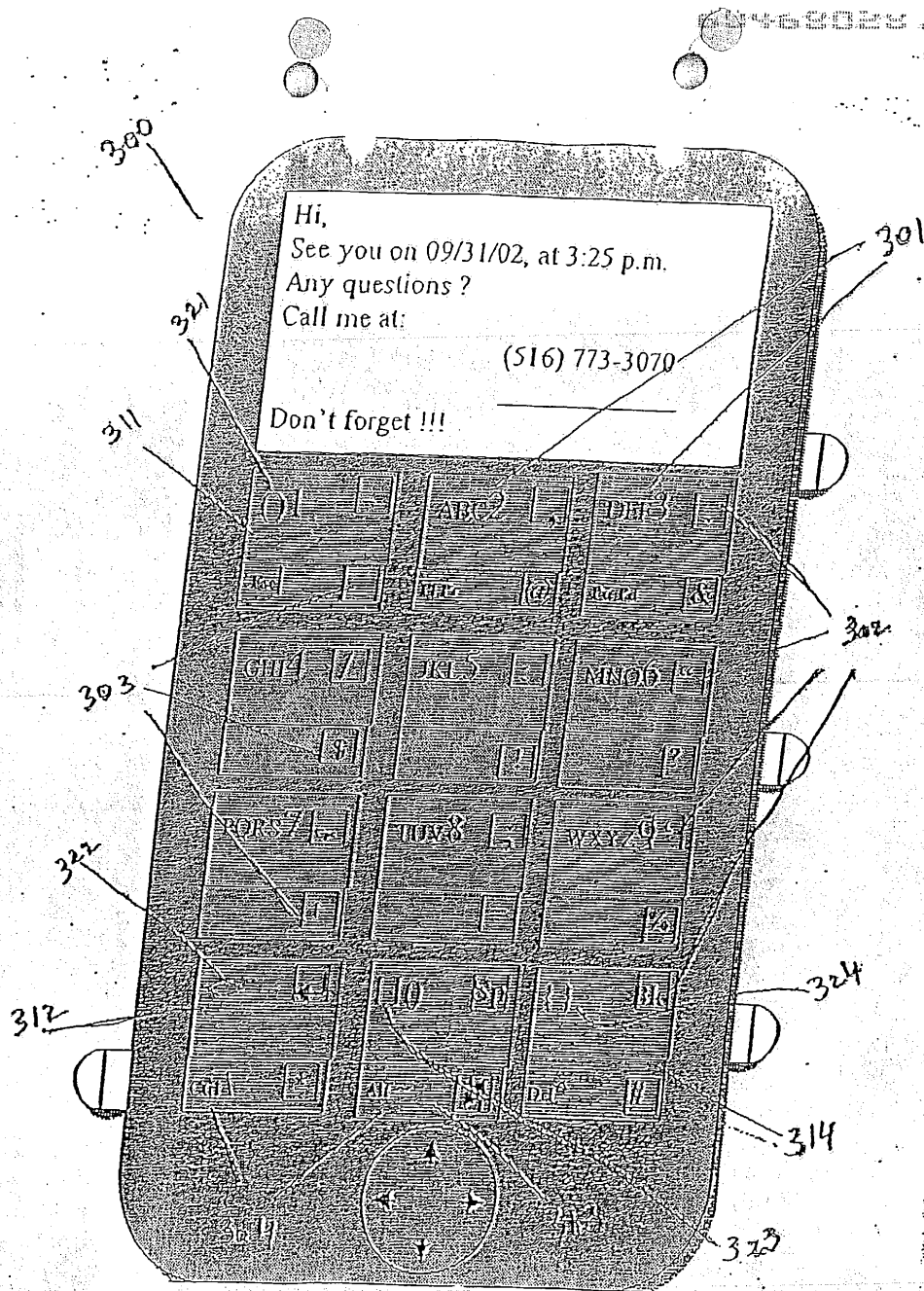


Fig 3-

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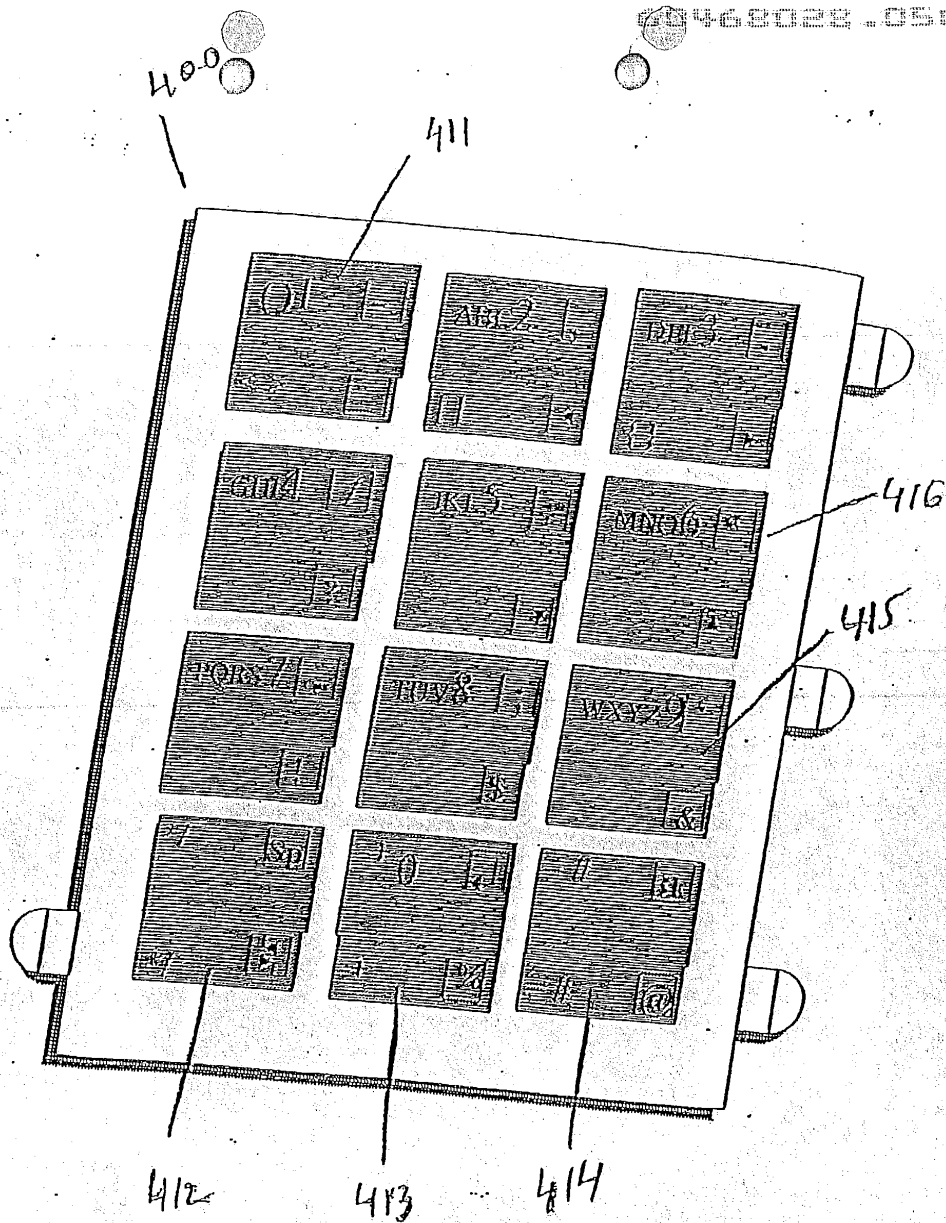


Fig 4

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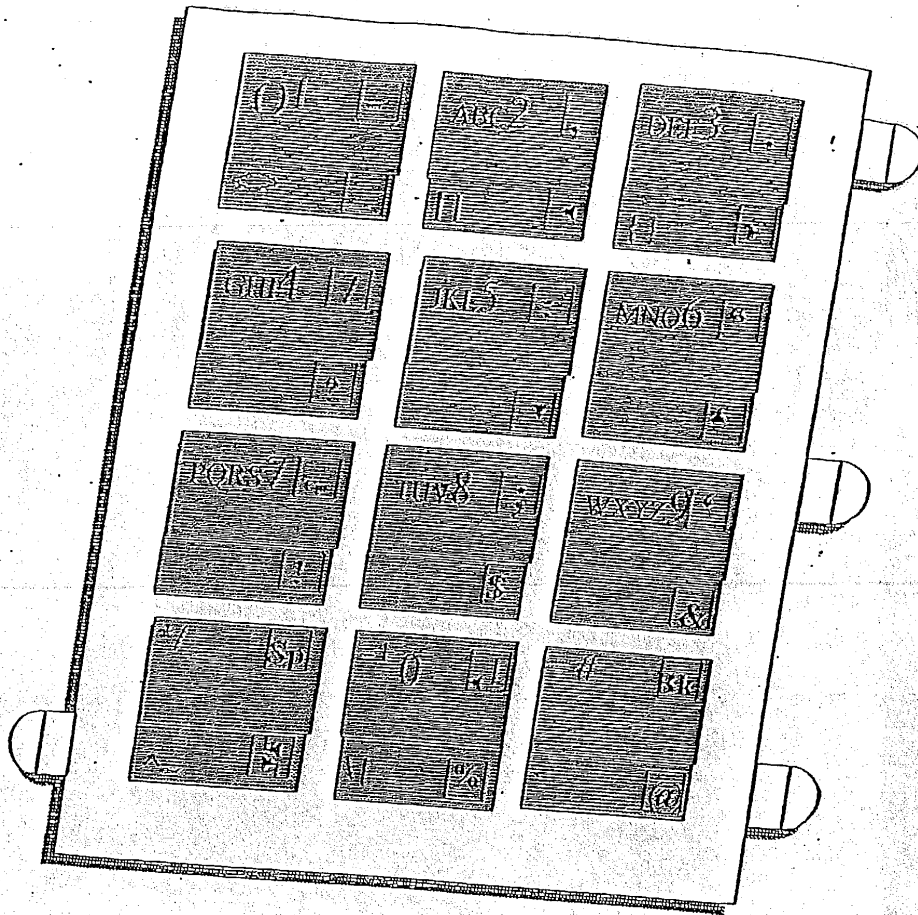
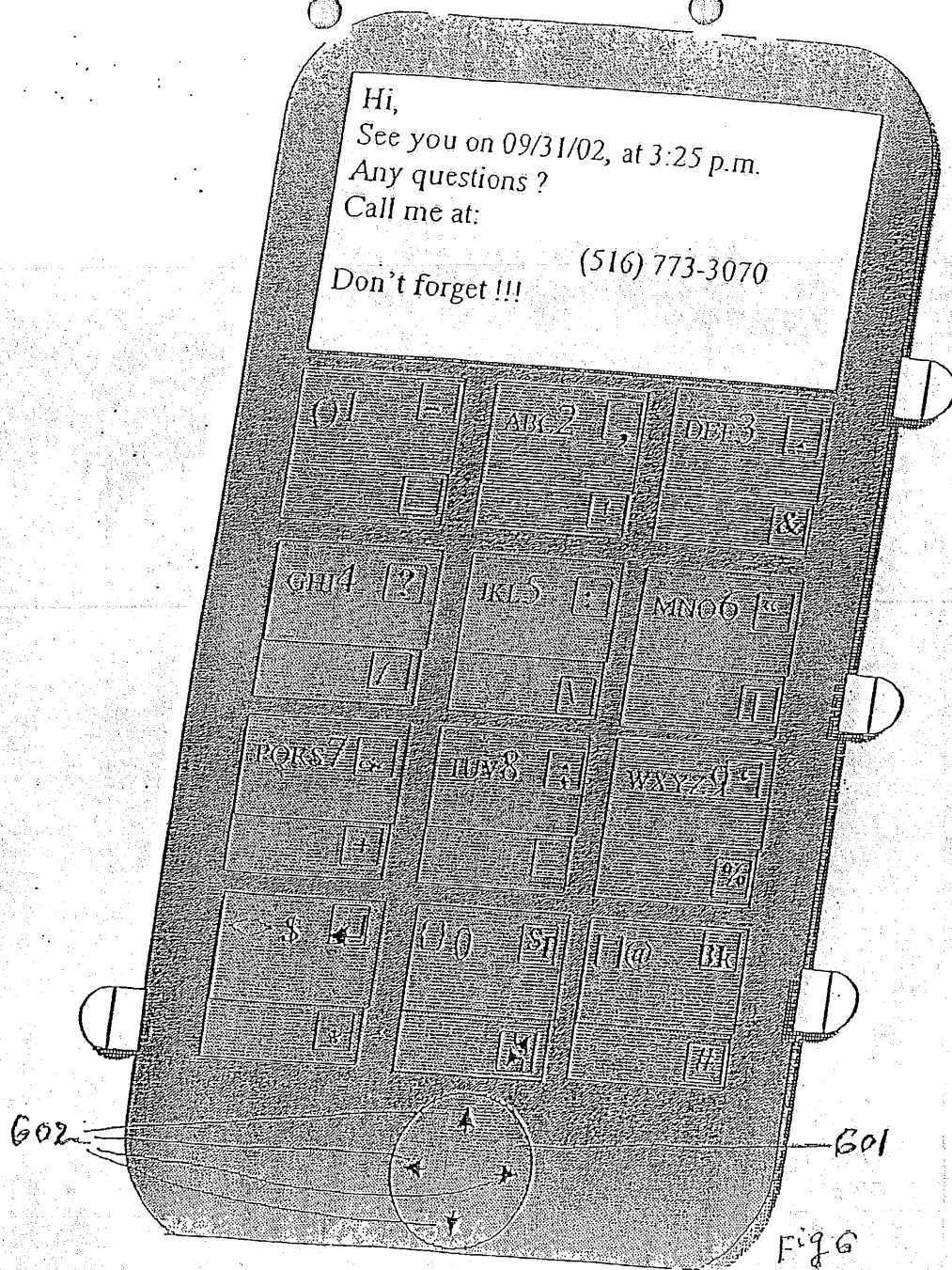
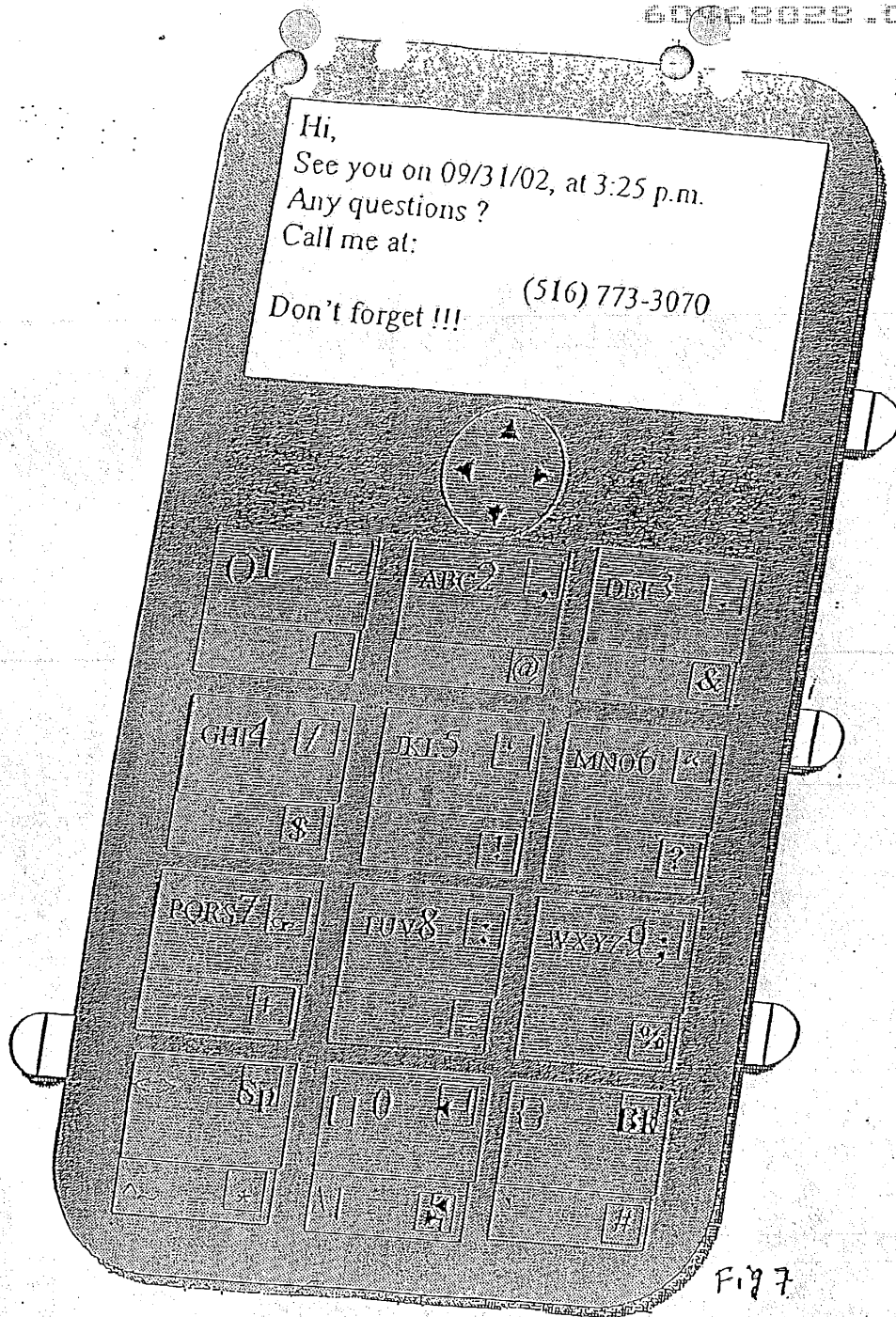


Fig 5

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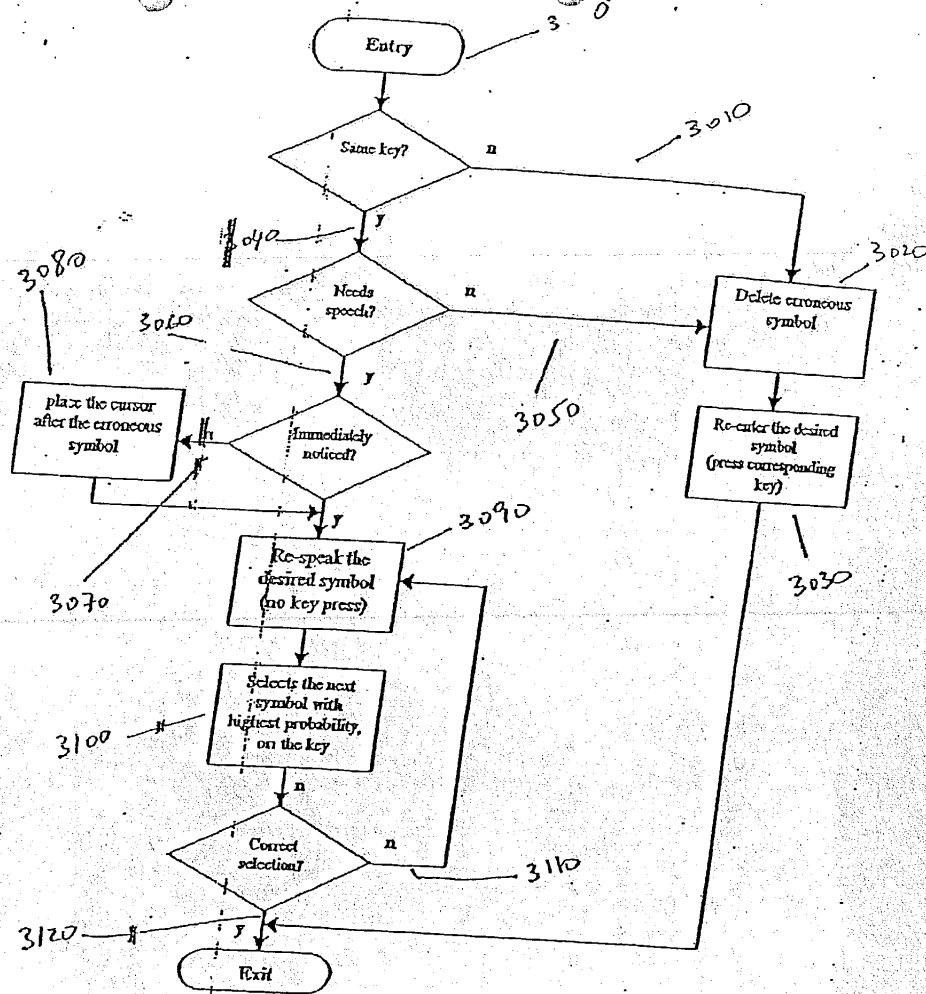


Fig 7B

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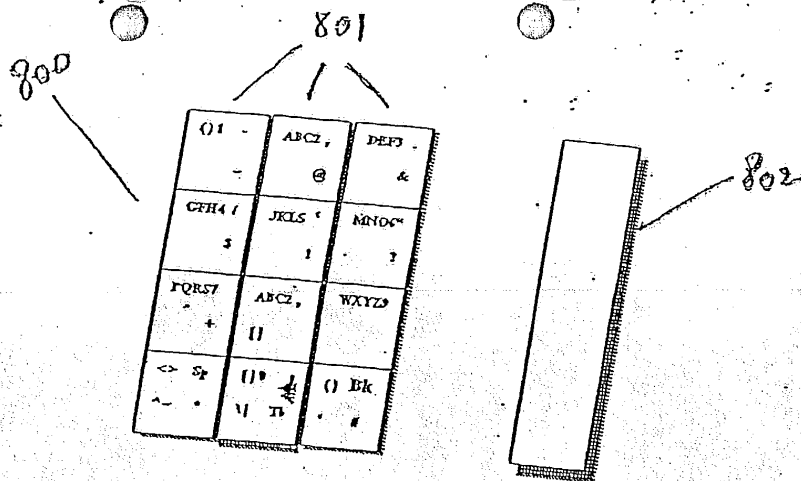


Fig 8

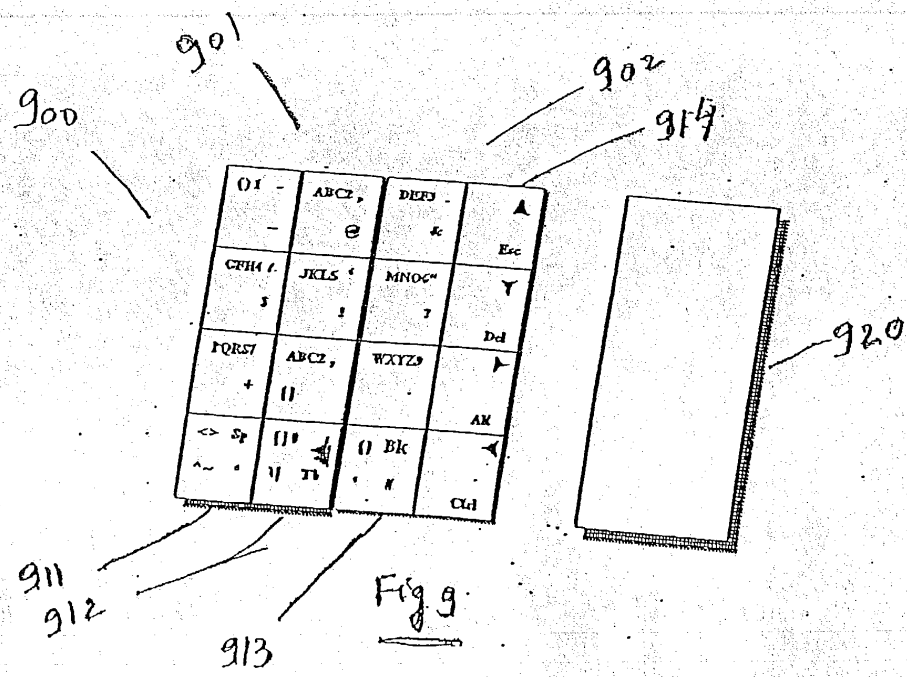


Fig 9

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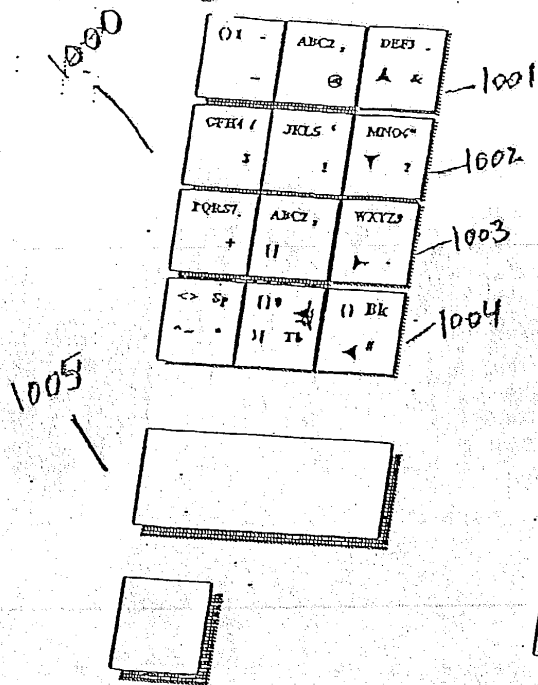


Fig 10

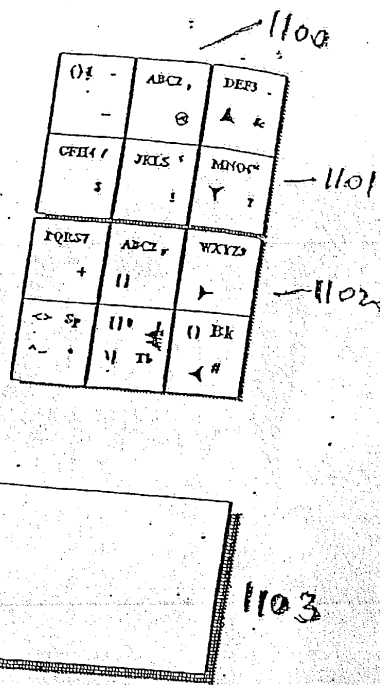


Fig 11

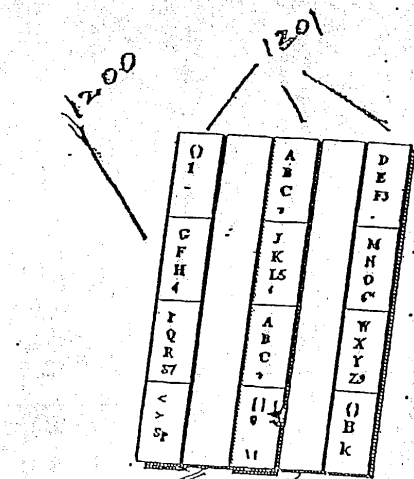
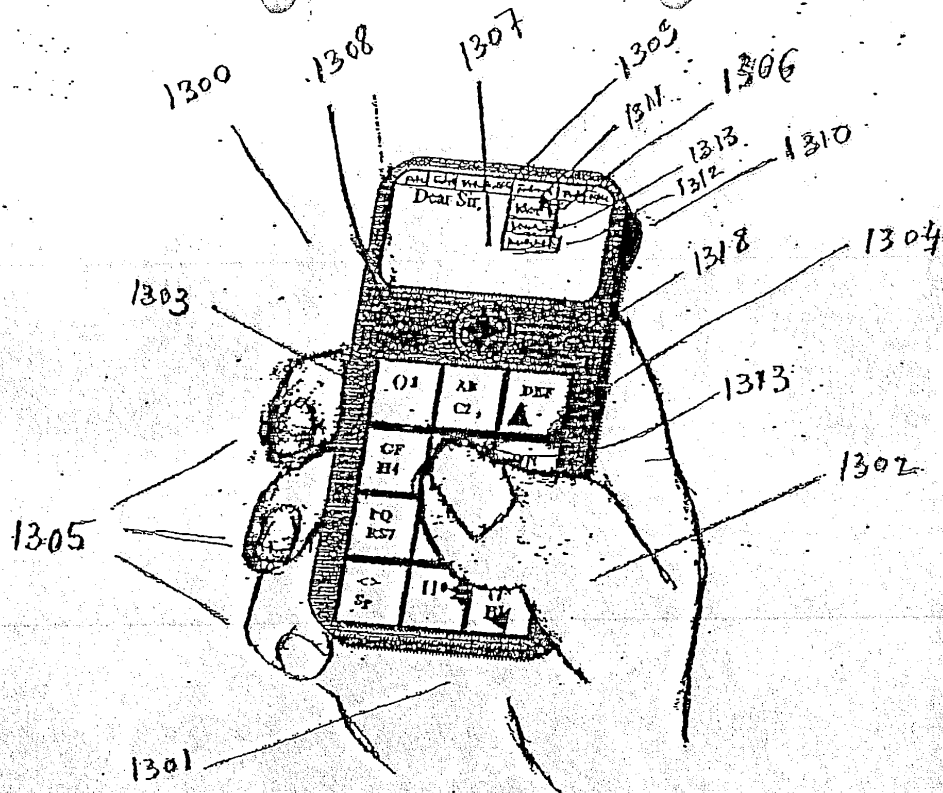


Fig 12

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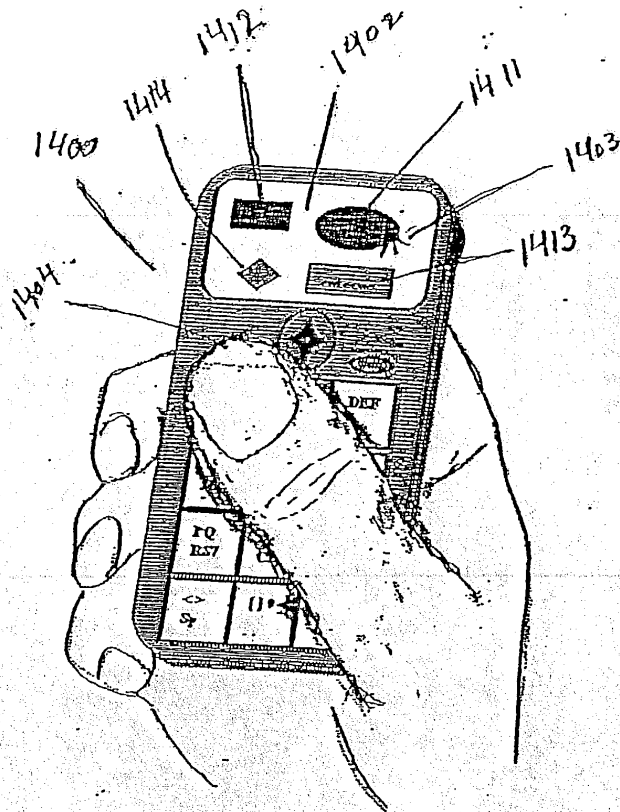
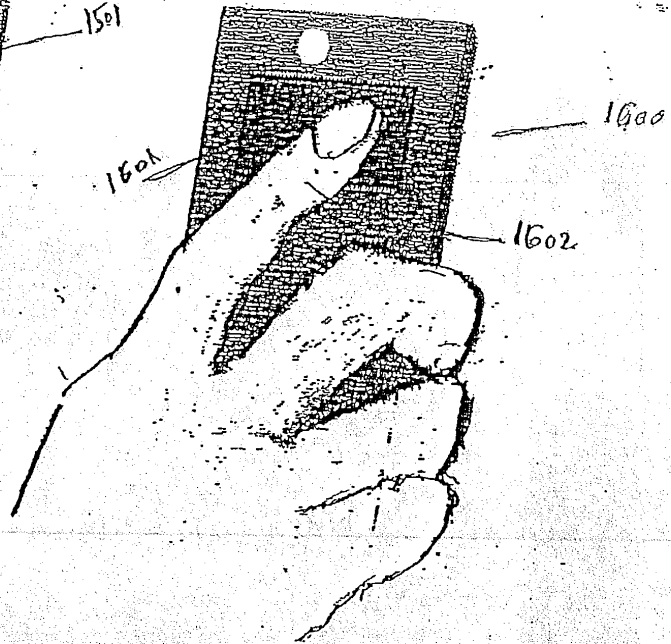
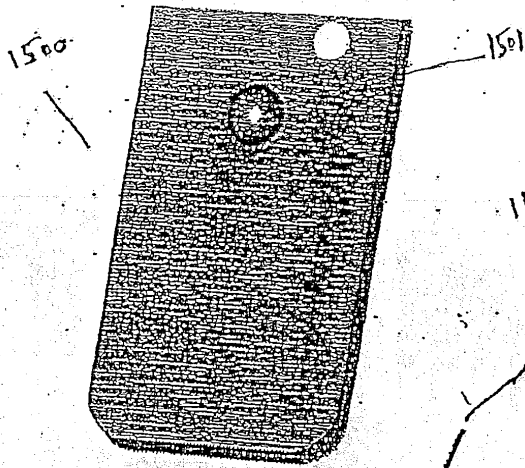
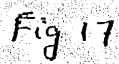


Fig 14

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1802

1800

1801

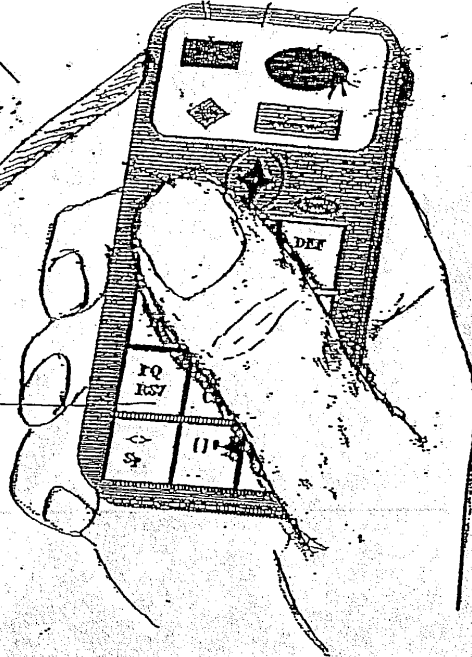


Fig 18

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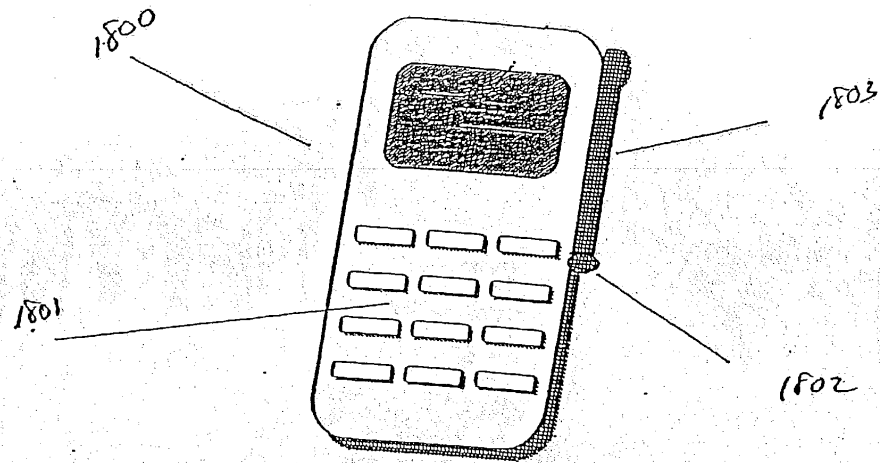
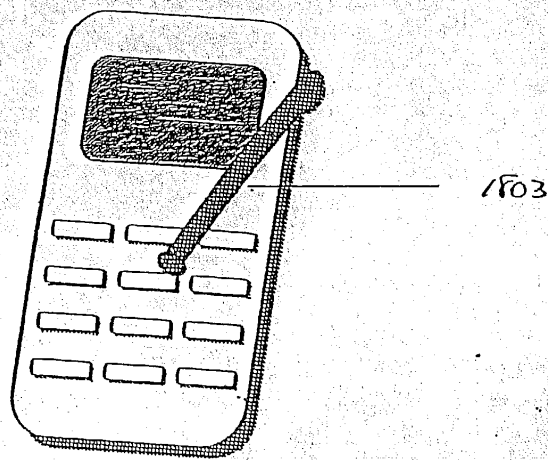


Fig. 18B



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Fig 18C

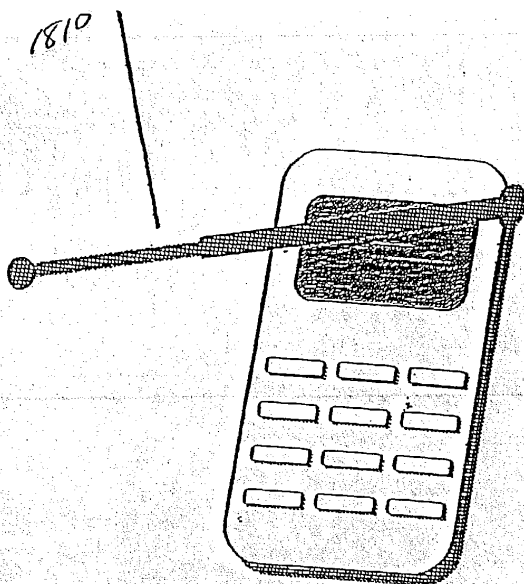


Fig 18D

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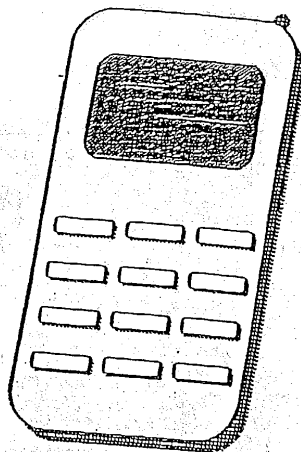


Fig 18E

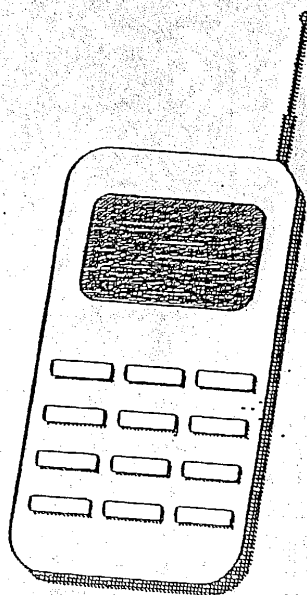


Fig 18F

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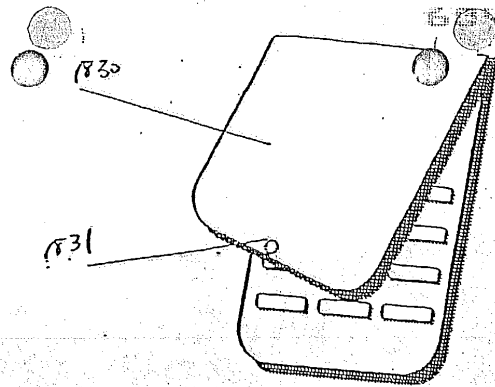


Fig 186

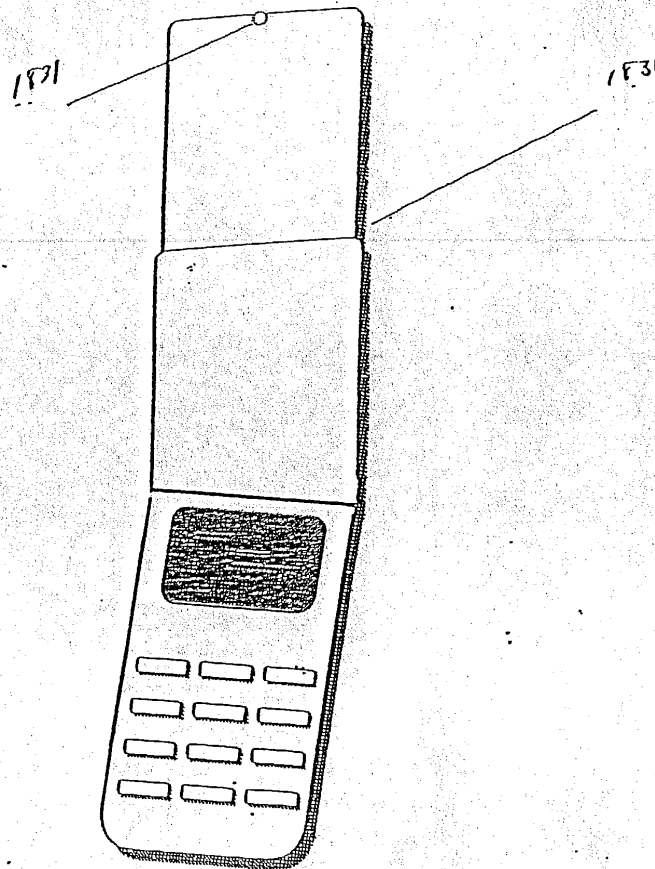


Fig 184

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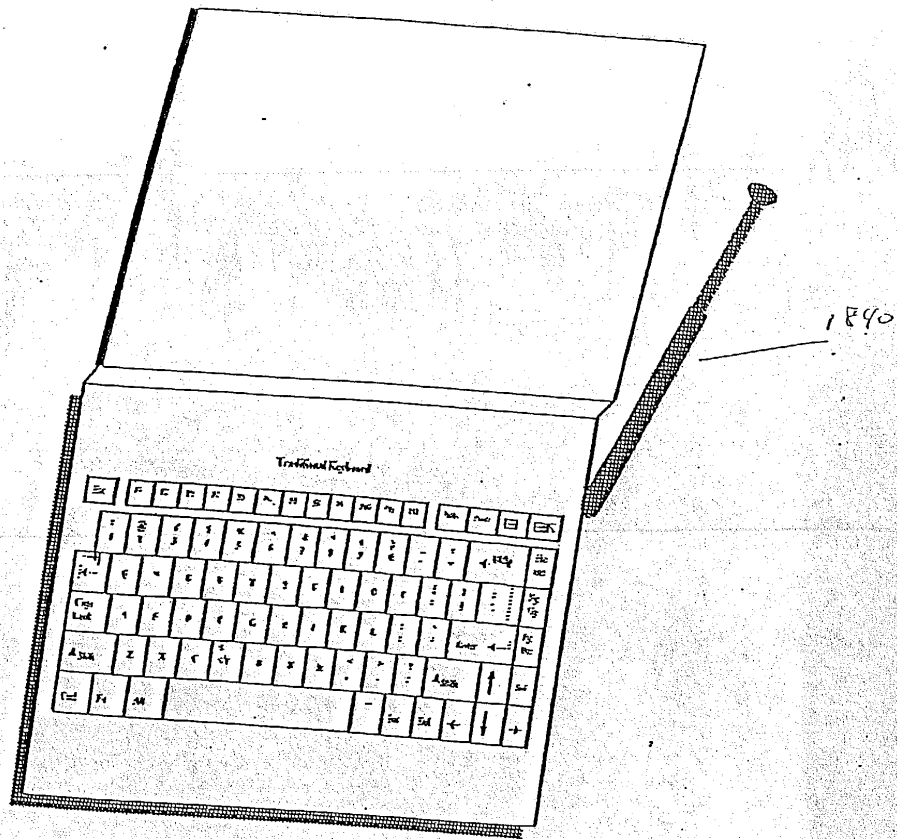


Fig 18I

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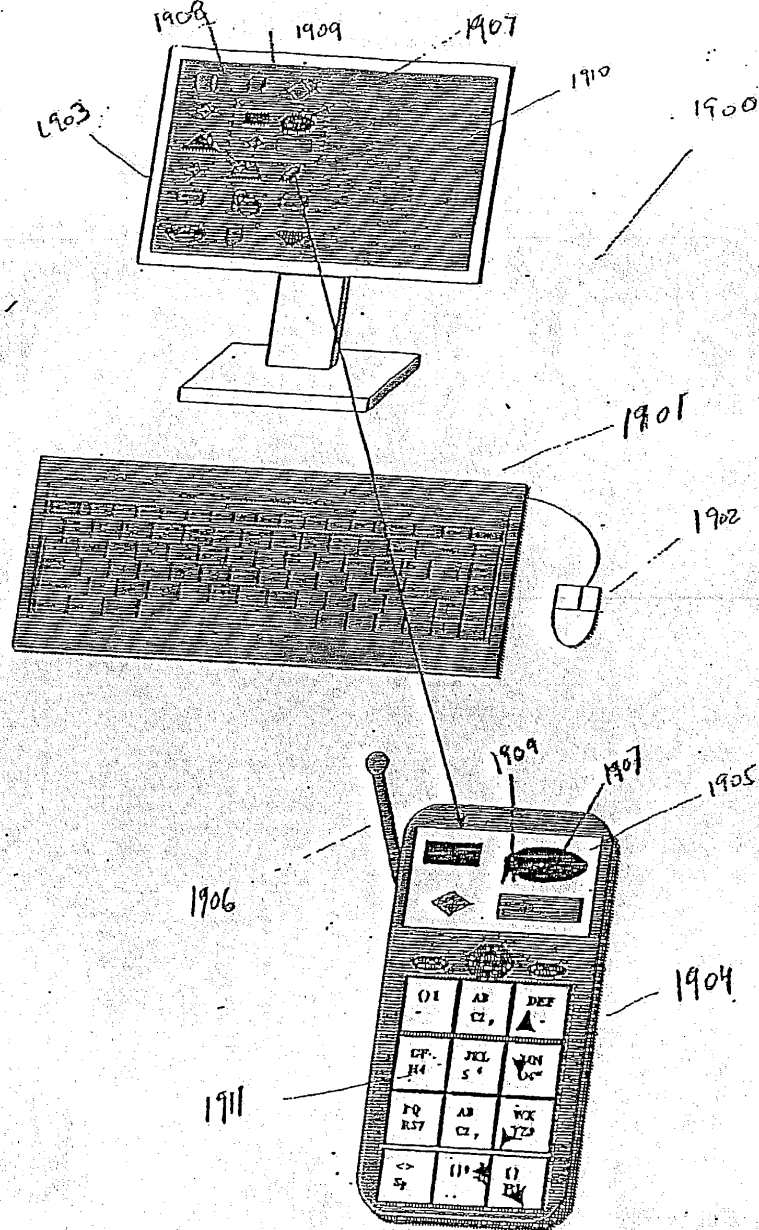


Fig 19

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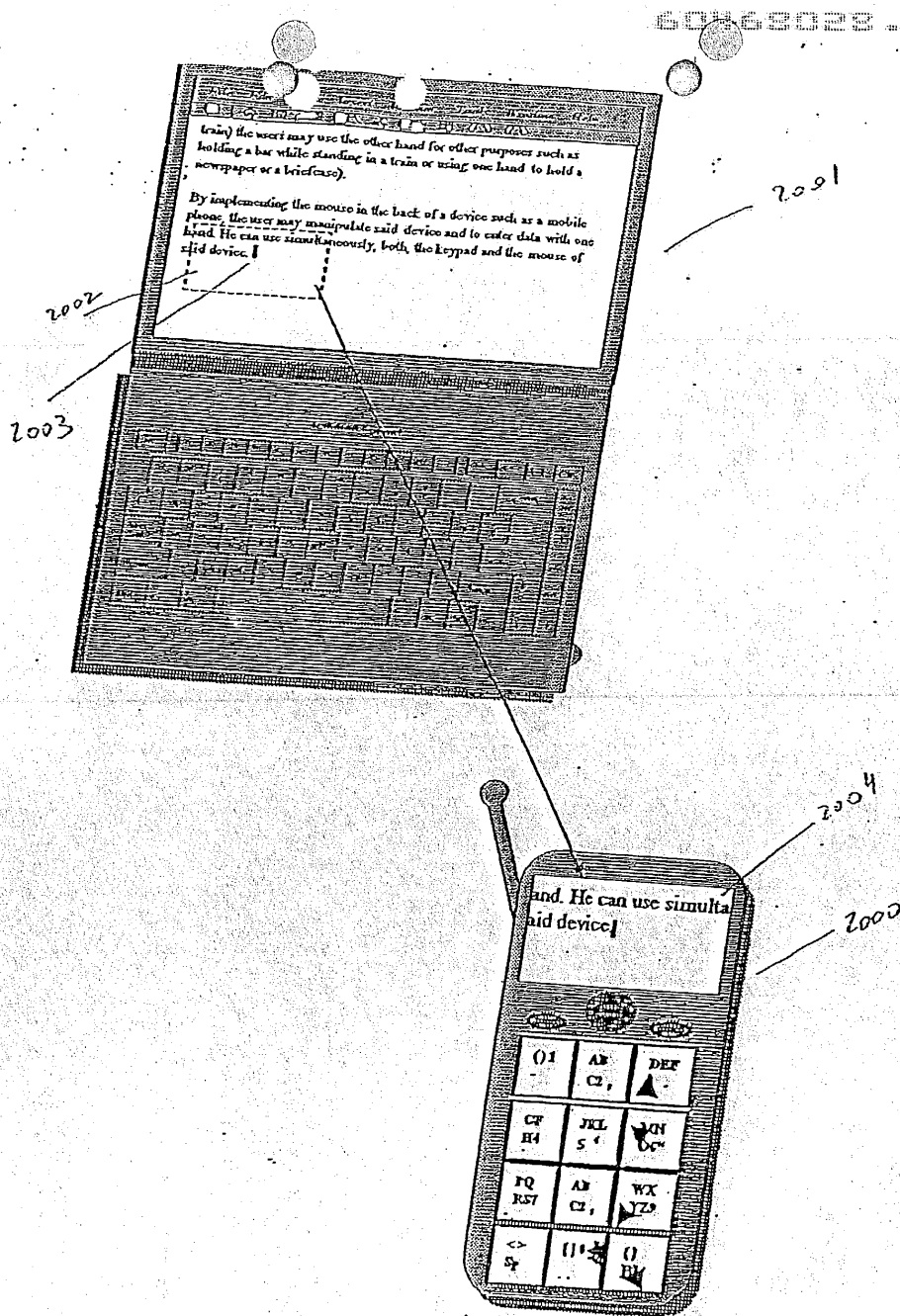


Fig 20

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2100

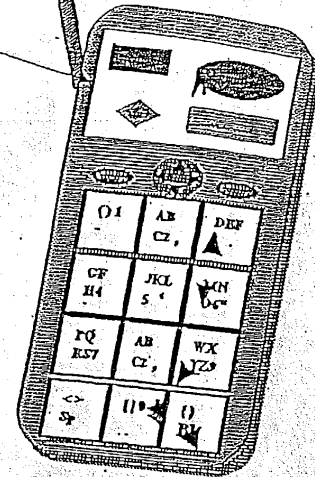
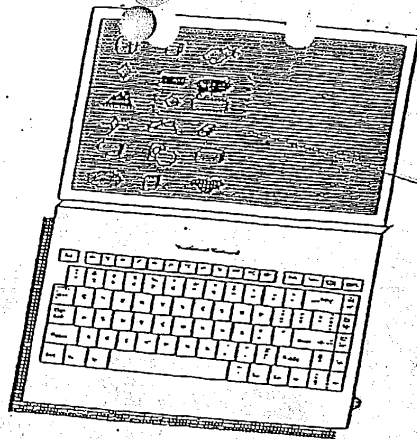
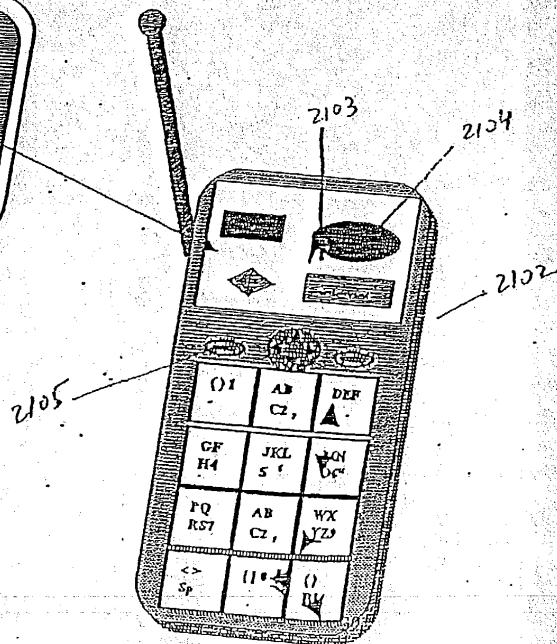
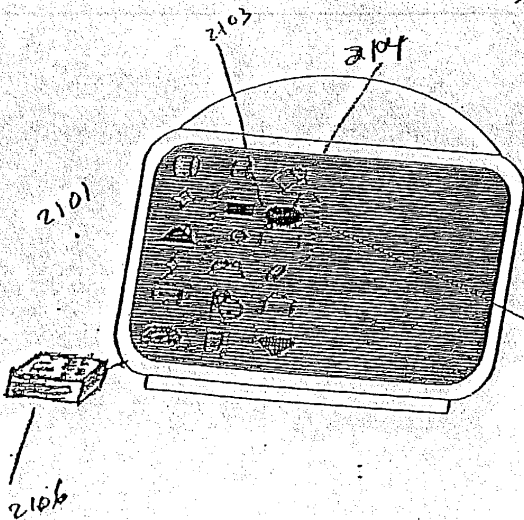
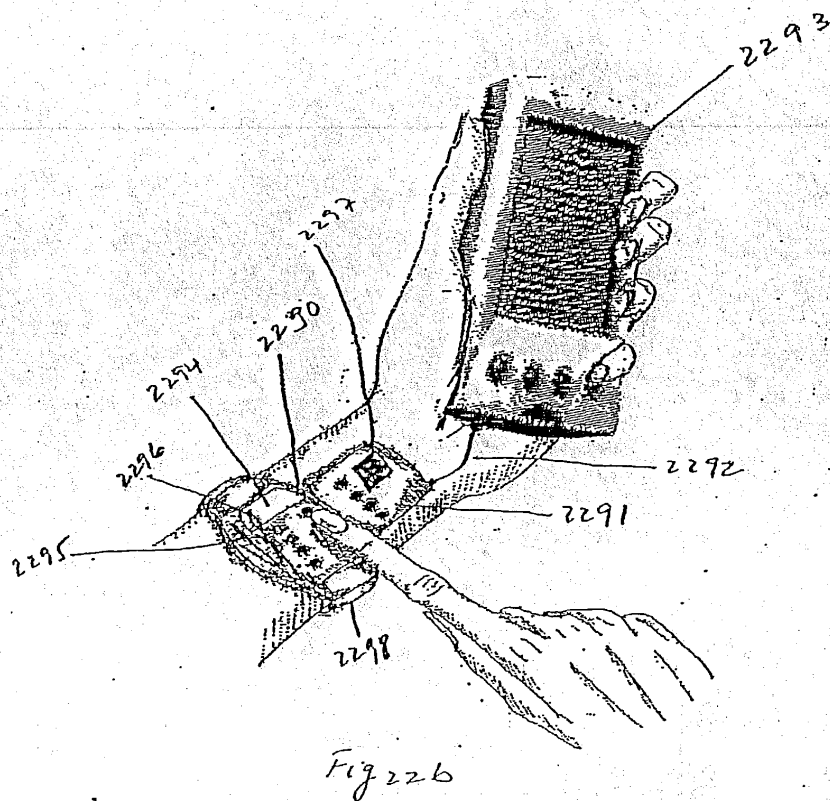
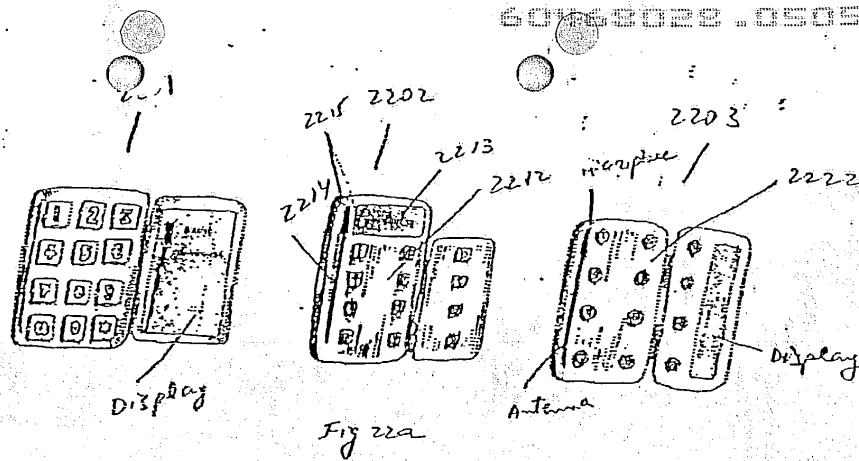


Fig 21a



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Fig 21b



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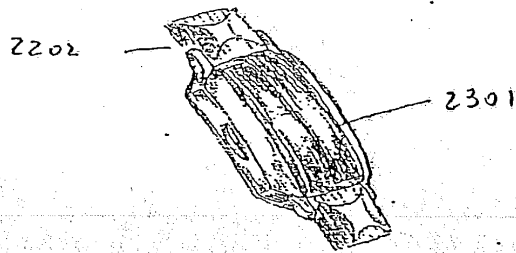


Fig. 23a

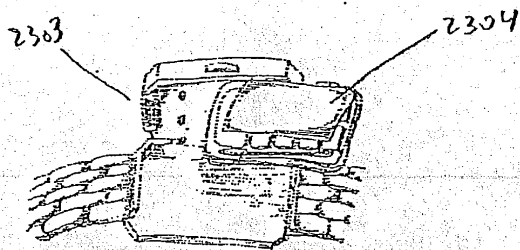


Fig. 23b

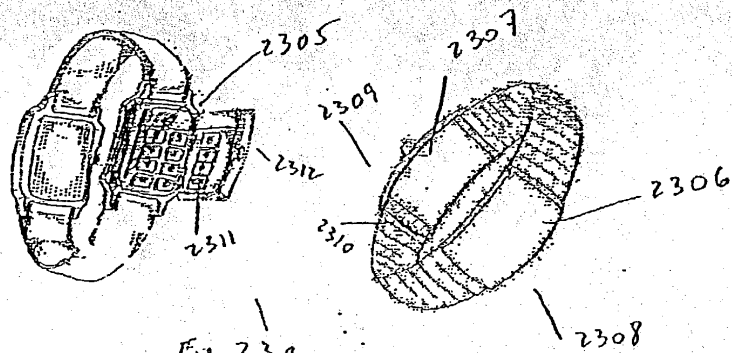


Fig. 23c

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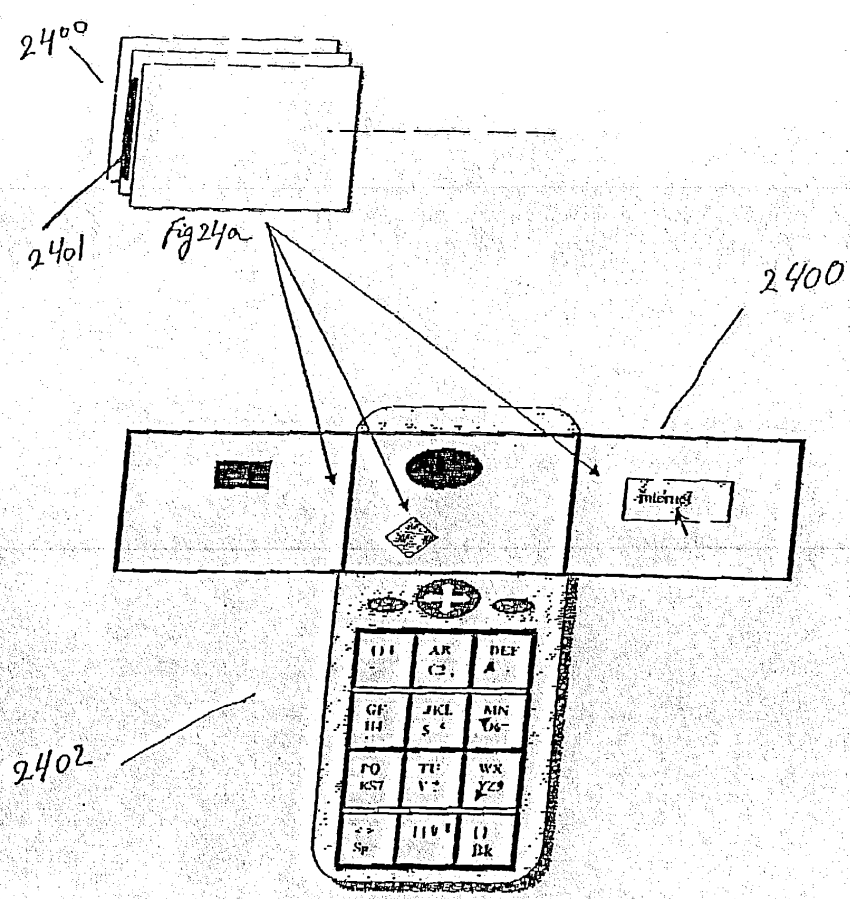
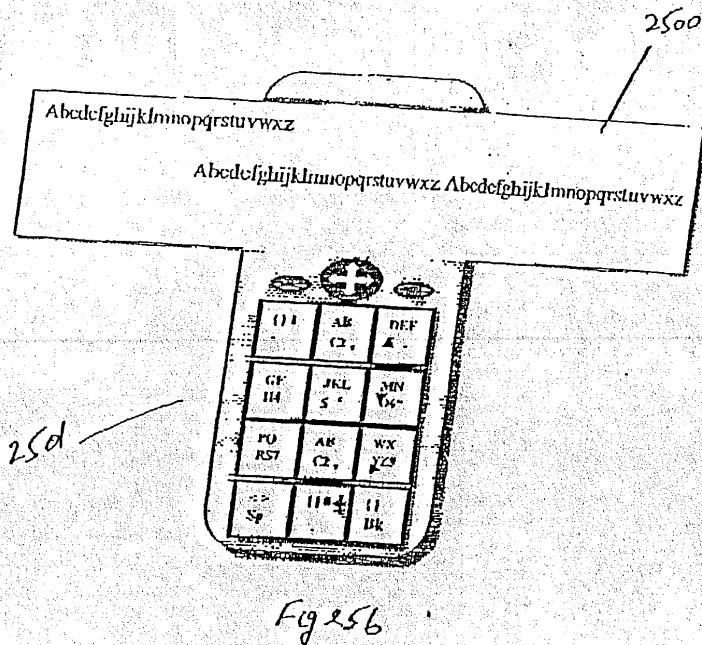
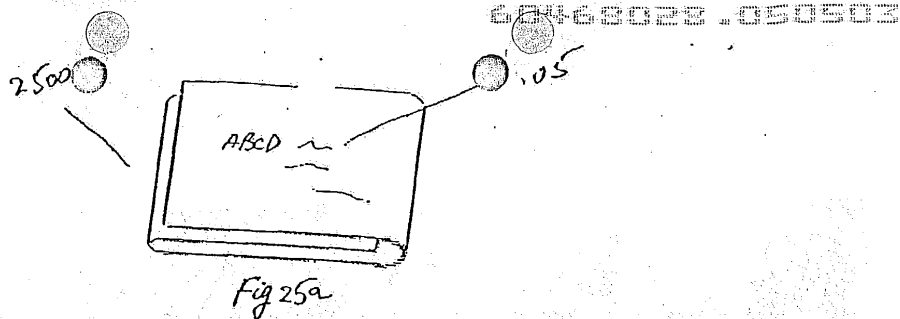


Fig 246

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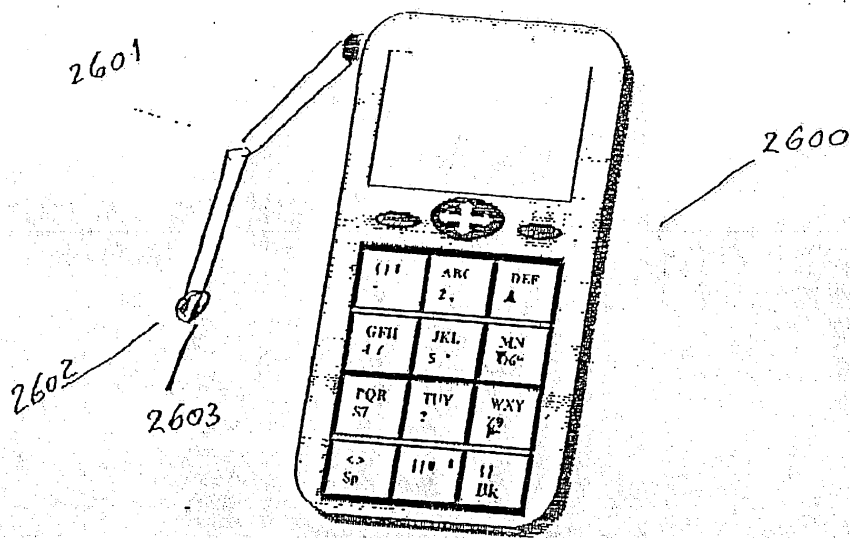


Fig 26

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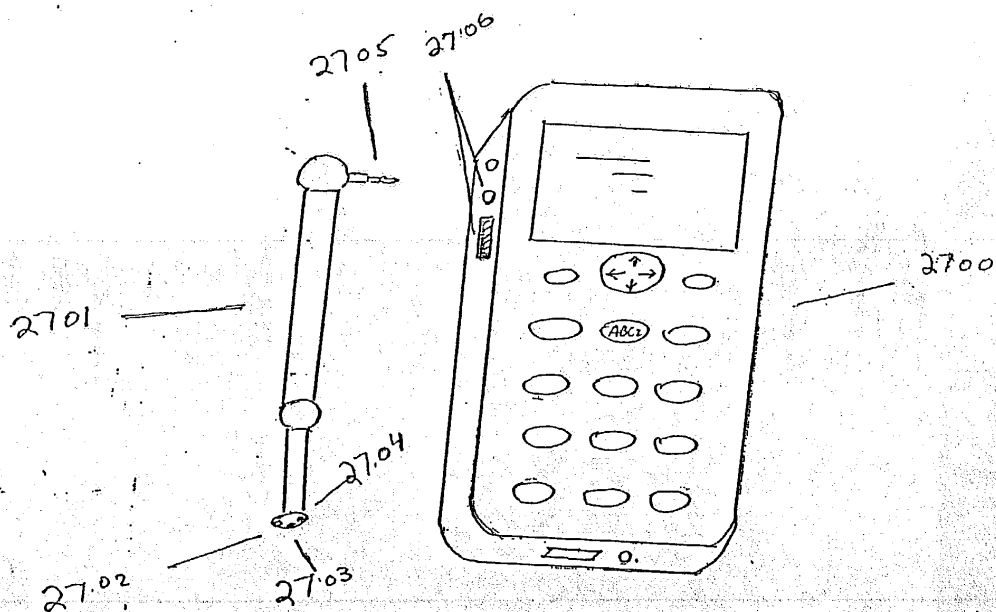


Fig 27

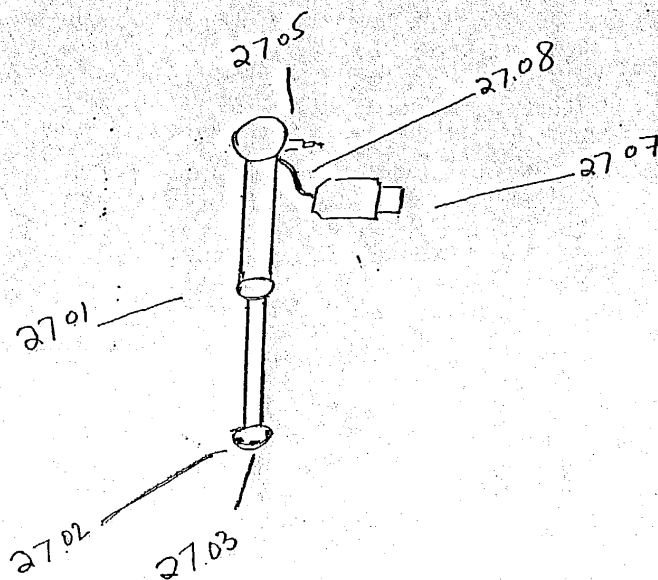


Fig 27a

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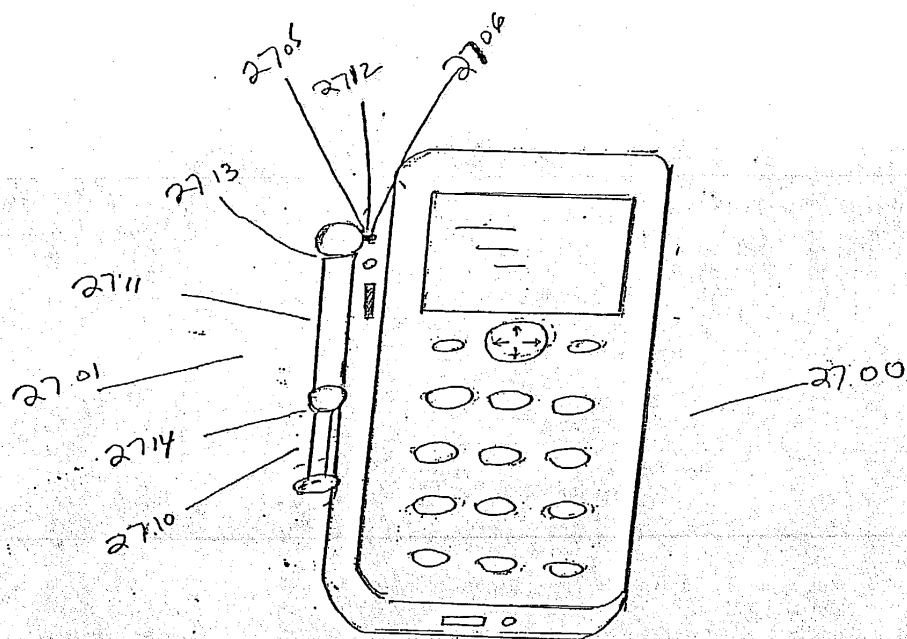


Fig. 27.6

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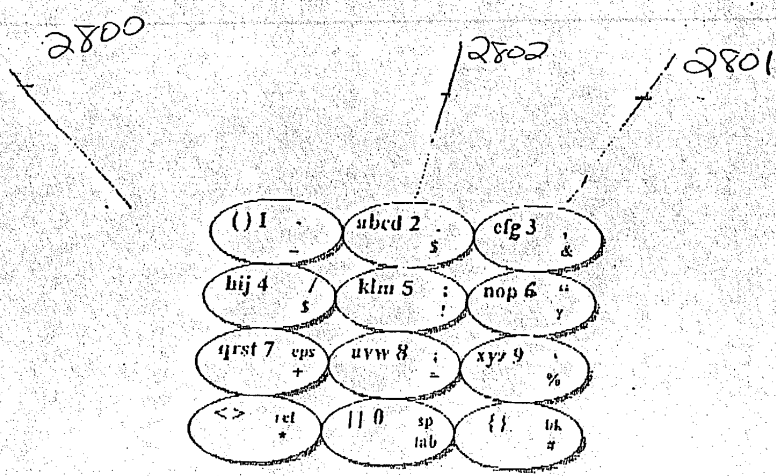
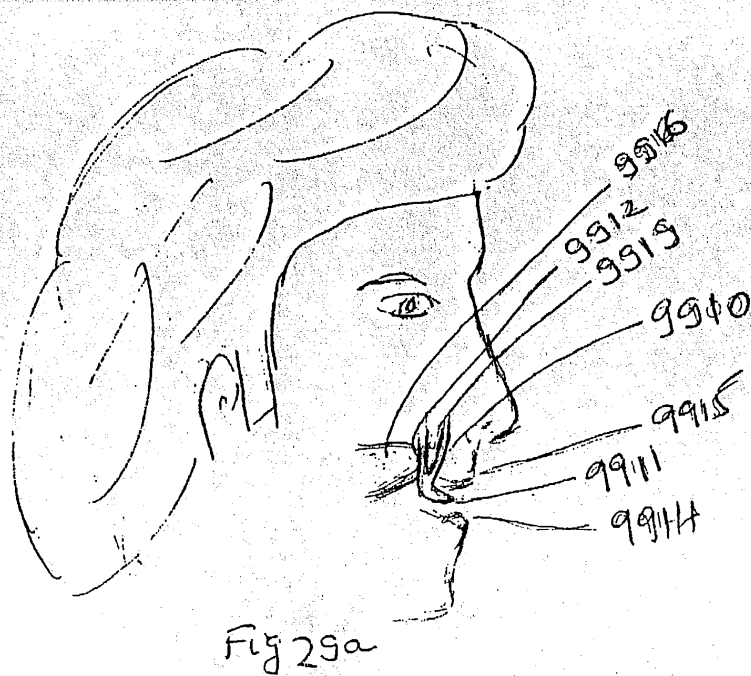
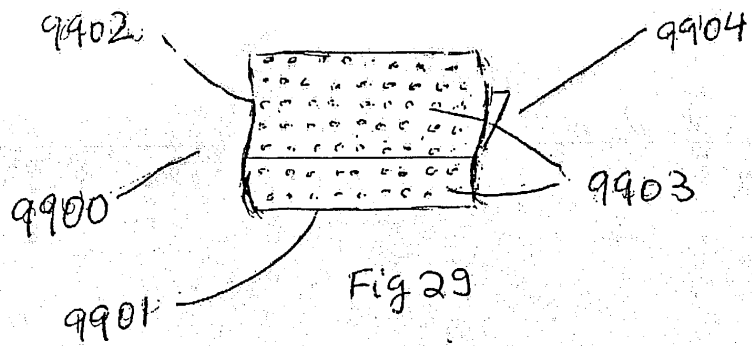


Fig. 28

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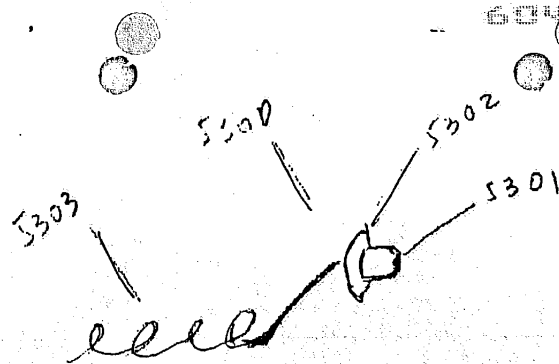


Fig 30

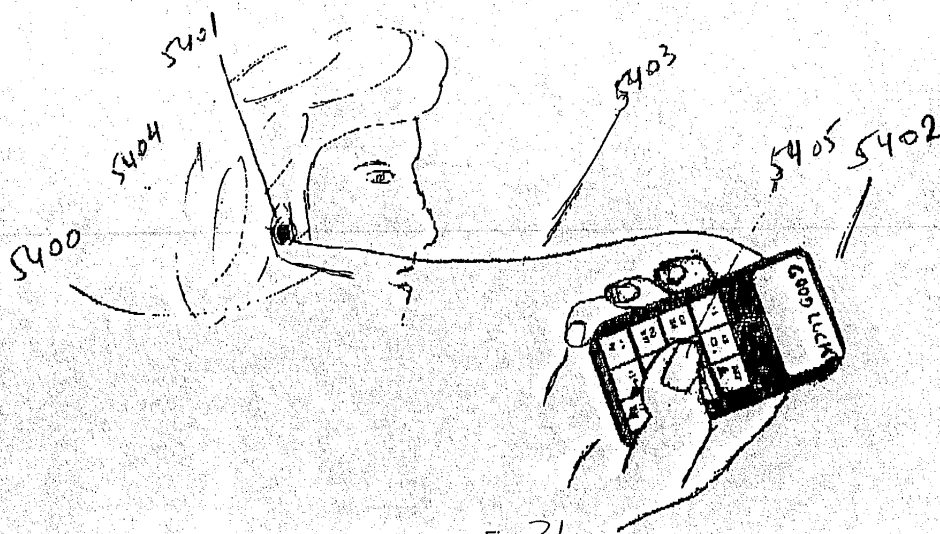


Fig. 31

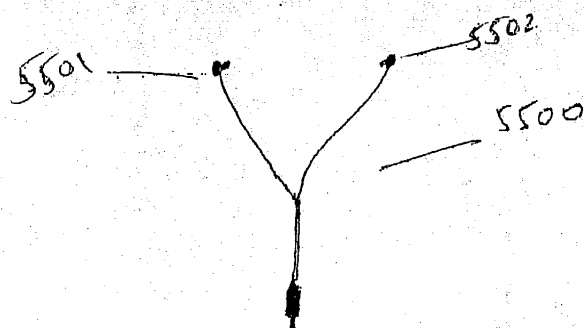


Fig. 32

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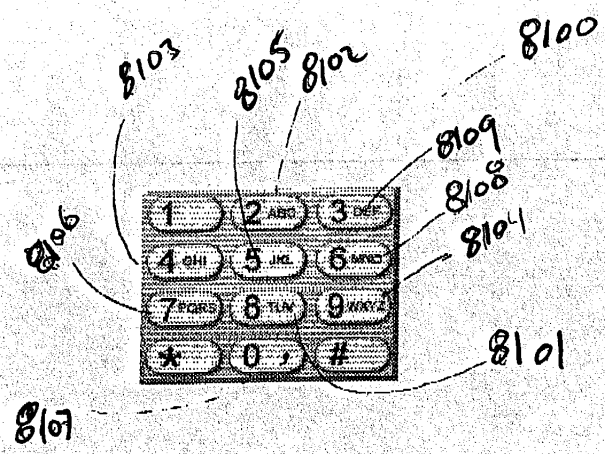


fig. 81

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A whole word dictionary data base

| <u>Whole Words</u><br><u>(by characters)</u><br><u>Dictionary</u> | <u>Corresponding key</u><br><u>presses</u> | <u>Corresponding</u><br><u>phoneme sets</u><br><u>(e.g. lexicon)</u> | <u>Corresponding</u><br><u>speech models</u> |
|-------------------------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------|----------------------------------------------|
| And                                                               | 263                                        | and                                                                  | #n                                           |
| ..                                                                | ..                                         | ..                                                                   | ..                                           |
| Ball                                                              | 2255                                       | boll                                                                 | #n li                                        |
| Dancing                                                           | 3267464                                    | Dancing                                                              | #n+j                                         |
| Enter                                                             | 66837                                      | Enter                                                                | ..                                           |
| ..                                                                | ..                                         | ..                                                                   | ..                                           |
| Trying                                                            | 879464                                     | Tring                                                                | ..                                           |
| Ten                                                               | 832                                        | Te                                                                   | #n tk                                        |
| Teabag                                                            | 832224                                     | Tebag                                                                | ..                                           |
| Tee                                                               | 833                                        | Te                                                                   | #n+k                                         |
| Young                                                             | 96864                                      | Yung                                                                 | ..                                           |
| Zen                                                               | 936                                        | Zen Fig. 82                                                          | #n tj                                        |

Fig. 82

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8301

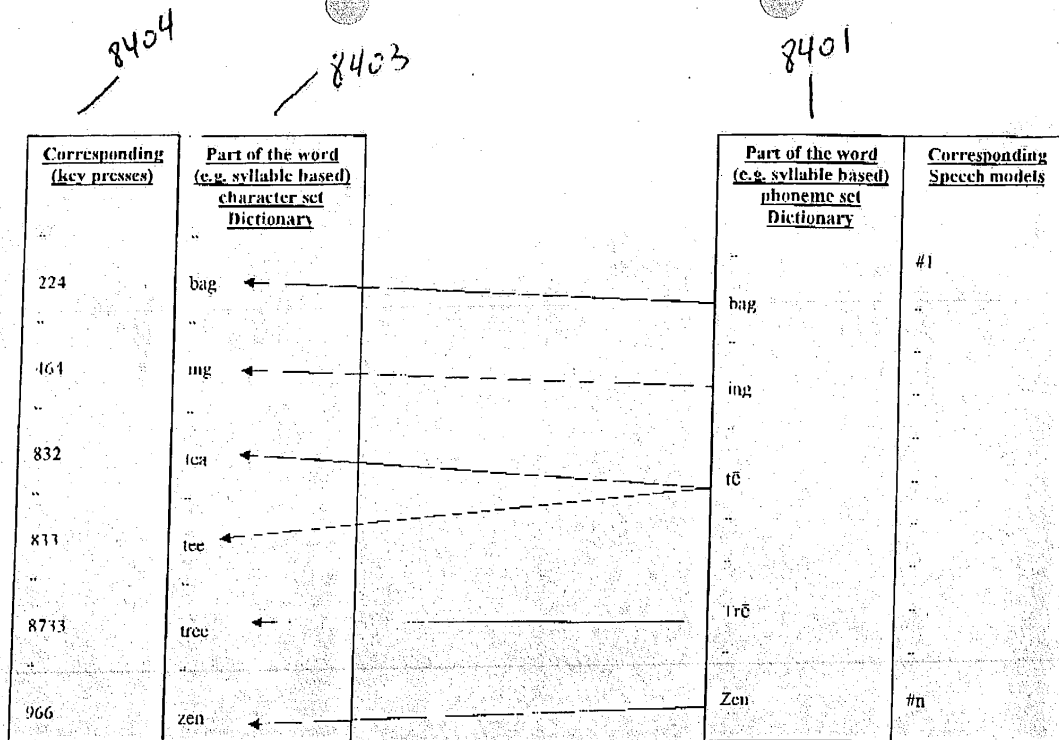
|         |        |         |      |        |      |        |
|---------|--------|---------|------|--------|------|--------|
| outrage | timing | timeout | time | raging | rage | outing |
|---------|--------|---------|------|--------|------|--------|

8302

|     |     |     |     |
|-----|-----|-----|-----|
| out | rāj | tīm | ing |
|-----|-----|-----|-----|

Fig. 83

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8402

| <u>Whole Words</u><br><u>(characters)</u><br><u>Dictionary</u> |
|----------------------------------------------------------------|
| And                                                            |
| -                                                              |
| Ball                                                           |
| Dancing                                                        |
| Enter                                                          |
| ...                                                            |
| Try ing                                                        |
| Tea                                                            |
| Teabag                                                         |
| Tee                                                            |
| Young                                                          |
| Zoo                                                            |

Fig. 84

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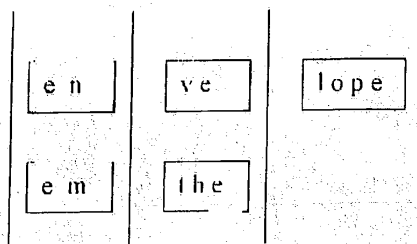
| A<br>Speech/phonemes<br>at the beginning of<br>a syllable in a word | B<br>Characters sets having<br>pronunciation similar<br>to the phonemes set of A | C<br>words having syllables<br>with starting<br>characters sets of B      |
|---------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| ta                                                                  | ta,                                                                              | tap, tango                                                                |
| ta                                                                  | ta, tai,                                                                         | take, tailor                                                              |
| tā                                                                  | tas,                                                                             | taste                                                                     |
| tō                                                                  | ta, tau                                                                          | talk, taupe                                                               |
| top                                                                 | top                                                                              | Top                                                                       |
| te                                                                  | te                                                                               | tent                                                                      |
| ti                                                                  | ti                                                                               | tilt                                                                      |
| tip                                                                 | tip                                                                              | tippet                                                                    |
| ti                                                                  | ti, tie, ty                                                                      | re-tire ("ti" in the beginning of the<br>middle syllable), tiebreak, type |
| tē                                                                  | t, tee, tea, ty                                                                  | t, teeth, team, security                                                  |
| tōo                                                                 | to, too, two                                                                     | to, tooth, two                                                            |
| tri                                                                 | tri, try                                                                         | tried, re-try                                                             |
| thi                                                                 | thi, thir, thirst                                                                | thin, thirst, thirst                                                      |
| thro                                                                | thro                                                                             | throw                                                                     |
| ing                                                                 | in                                                                               | trying                                                                    |

Table 1

Fig. 85

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8601



8602

em the lope

em ve lope

en the lope

em ve lope

8603

Fig. 86

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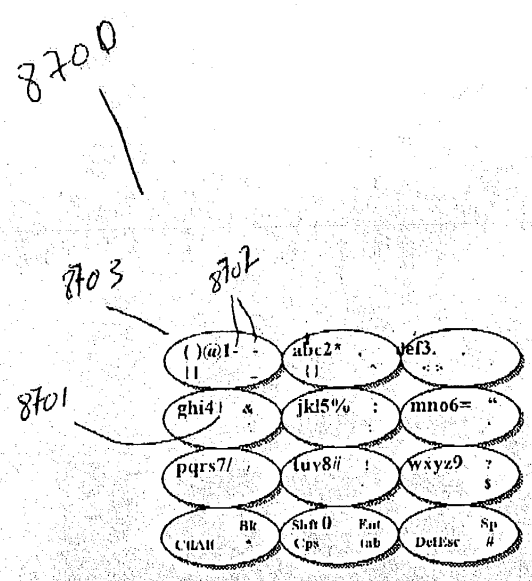


Fig 87

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| Phoneme-Set                   | Consonant | Vowel | Consonant | Word           | Number of Key Presses |
|-------------------------------|-----------|-------|-----------|----------------|-----------------------|
| <b>T</b>                      |           |       |           |                |                       |
| t                             | t         |       |           | thir-s-t       | 3                     |
| ta                            | t         | a     |           | ta-riff        | 2                     |
| tab, tac,                     | t         | a     | b         | tab-let        | 2                     |
| tā                            | t         | ā     |           | s-ta-ble       | 3                     |
| tār, ...                      | t         | ā     | r         | s-tair         | 2                     |
| te                            | t         | e     |           | te-nan-t       | 3                     |
| tem, ter, ...                 | t         | e     | m         | tem-pe-ra-ture | 4                     |
| te,                           | t         | ē     |           | tca-bag        | 2                     |
| tēch, tēm,                    | t         | ē     | ch        | teach-ing      | 2                     |
| ti                            | t         | i     |           | mul-ti-tude    | 3-4                   |
| til, tip,                     | t         | i     | l         | un-til         | 2                     |
| tō                            | t         | o     |           | to-ner         | 3                     |
| tōr,                          | t         | o     | r         | tor-na-do      | 3                     |
| tu                            | t         | u     |           | s-tu-dy        | 3                     |
| tuf, tud, ...                 | t         | u     | d         | s-tuff/s-tuf-f | 2-3                   |
| tōō                           | t         | ōō    |           | to             | 1                     |
| tōōd, tōōl, ...               | t         | ōō    | l         | un-der-s-tood  | 4                     |
| tyōōn                         | t         | yōō   | n         | tunc/tu-nc     | 1-2                   |
| <b>U</b>                      |           |       |           |                |                       |
| yōō                           |           | yōō   |           | u-ni-ver-sal   | 4                     |
| yōōz                          |           | yoo   | z         | use/u-se       | 1-2                   |
| un, um, ul                    |           | u     | n         | un-der         | 2                     |
| <b>V</b>                      |           |       |           |                |                       |
| Similar principles as for "T" |           |       |           |                |                       |
| <b>TH</b>                     |           |       |           |                |                       |
| Similar principles as for "T" |           |       |           |                |                       |

Fig. 88

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| Phoneme-Set                   | Consonant           | Vowel            | Word          | Number of Key Presses |
|-------------------------------|---------------------|------------------|---------------|-----------------------|
| <b>T</b>                      |                     |                  |               |                       |
| t                             | t                   |                  | thi-t-s-t     | 4                     |
| ta                            | t                   | a                | la-ri-f-f     | 4                     |
| tā                            | t                   | ā                | s-ta-b-le     | 4                     |
| te                            | t                   | e                | te-na-n-t     | 4                     |
| tē                            | t                   | ē                | tca-ba-g      | 3                     |
| ti                            | t                   | i                | mu l-ti-tu-de | 5                     |
| tō                            | t                   | o                | to-ma-to      | 3                     |
| tu                            | t                   | u                | s-tu-dy       | 3                     |
| tōō                           | t                   | oo               | to            | 1                     |
| tyōō                          | t                   | yōō              | tu-ne         | 2                     |
| <b>U</b>                      |                     |                  |               |                       |
| yōōz                          | <i>vowel</i><br>yōō | <i>consonant</i> | u-sc          | 2                     |
| un, um, ul, ....              | u                   | n                | un de-r       | 3                     |
| <b>V</b>                      |                     |                  |               |                       |
| Similar principles as for "T" |                     |                  |               |                       |
| <b>TH</b>                     |                     |                  |               |                       |
| Similar principles as for "T" |                     |                  |               |                       |

8901

Fig. 89

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