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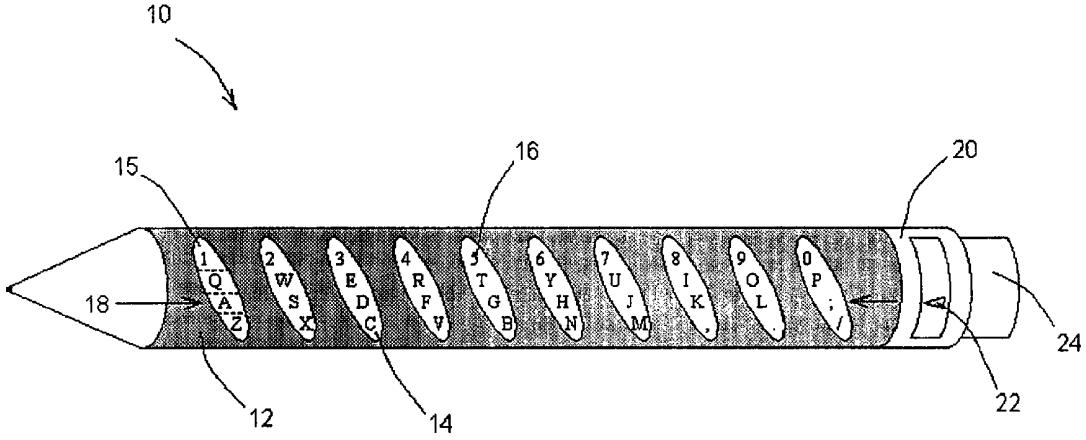
(54) **Title:** DATA ENTRY DEVICE



(57) **Abstract:** A data entry device comprises a generally elongated body and has a plurality of keys arranged along its length. Each key is associated with a plurality of values assigned to respective regions on the key, where the regions of adjacent keys forming a plurality of rows. A row selection device is used to select a specific row. A key entry module receives data signals from the keys and the row selection device. The value assigned to an actuated key is determined by the specific value associated with the actuated key and also assigned to the region in the selected row. In a particular arrangement, the body is pen-shaped and the keys are arranged along the length of the pen. The plurality of values assigned to each key correspond to a particular set of values in a column of keys in a QWERTY layout keyboard. Text is entered by selecting the desired row and then actuating the column key with the appropriate value in it. The row selection can be manual or can be in responsive to the orientation of the body, e.g., as indicated by a gravity switch.

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DATA ENTRY DEVICE

FIELD OF THE INVENTION:

This invention is related to a data entry device and, more particularly, to an alphanumeric data entry device suitable for implementation on the body of a pen or other hand-held device.

BACKGROUND:

There are an increasingly large number of hand-held electronic devices which have been released for consumer use. Many of these devices are communication devices which permit the user to enter alphanumeric data. Several methods are available to enable the user to enter text information, including handwriting recognition systems and keyboards. Handwriting recognition systems are computationally expensive and can be of limited accuracy. Further, a large writing surface must be available, limiting the minimum size of the overall device. Thus, for many applications, a basic keyboard device remains the design of choice.

However, a severe constraint on the size of key-based data entry devices is the area available in which to place keys which are large enough to be easily and accurately pressed by adult-sized fingers. In pen or data-wand type devices, this is a particularly severe design issue because the devices are generally small and have only a limited surface area on which the keys can be placed. Three primary approaches to this problem have been taken. The first is simply to make the keys small enough to fit in the given area. This solution, while workable, can result in keys

which are too small to press easily, thus making the data entry more cumbersome and error prone. A second approach utilizes a "chord" based keyboard in which different data is entered by depressing two or more keys simultaneously, such as disclosed in U.S. Patent No. 3,937,939. Although a chord keyboard can provide a large number of key combinations with only a few keys, the input is non-intuitive when compared with typical devices, such as a QWERTY keyboard, and also requires a reasonable amount of training to be able to use proficiently. A third approach has been to use keys with multiple contacts, where the contact which is engaged depends on how the key is depressed. For example, U.S. Patent No. 4,029,915 to Ojima discloses a calculator pen with only 5 keys, each of which has four separate contact points. The contact closed when a key is pressed depends on whether the key is pressed upwards, downward, to the right, or to the left. Although each conventional arrangement is adequate for devices which have a small number of required inputs, such as a calculator, none of these solutions are particularly suitable for data entry application which require more keys.

Accordingly, it is an object of the present invention to provide a key-based data entry system which can be implemented in a limited area and which provides for entry of a large number of different data values.

Another object of the invention to provide an improved data entry pen which supports entry of a large number of data values with a lesser number of data entry keys.

A further object of the invention is to provide a pen-type device having a keyboard thereon which can be used to enter alphanumeric data in an intuitive and easy-to-use way.

SUMMARY OF THE INVENTION:

These and other objects are achieved by a keyboard data entry device according to the invention in which a plurality of keys are arranged along the length of a pen or wand-like device. Each key is assigned a plurality of values which can be indicated by indicia on the key. The indicia on respective keys are placed to form rows. A selection device is used to activate a particular row of values for the keys. By selecting a different row, the value of each key is changed accordingly. Preferably, the row selection device comprises a gravity switch and is configured so that the particular active row is determined by the orientation of the device. Alternatively, a manual row selector may be used. In a preferred embodiment, the keys and assigned values corresponds to a conventional Qwerty keyboard layout, wherein each particular key corresponds to a diagonal column of keys on the keyboard. Advantageously, the entire alphanumeric keyboard can be mapped onto a very small number of keys which only need to support a single on-off state.

To enter a particular value, a user merely locates the key with the desired value and then rotates the pen so that the value is facing up or is otherwise selected, as indicated, e.g., by an indicator or a backlit row. Arranging the keys and values to correspond to a conventional keyboard provides a data entry system which has only a limited number of easy to depress keys and yet permits the entry of a large number of data values. Further, these values can be easily selected and entered in a manner closely related to the selection and entry of keys on a conventional keyboard.

A control system located within the body of the device receives input indicating which of the plurality of keys has been depressed and a signal from the orientation detector (or manual row selector) and determines the appropriate data

value to be attributed to a detected key press. Once the value of a key press has been determined, it can be processed using conventional techniques. In one embodiment, a display is provided along the body of the device on which the data entered by the user is shown. A memory may also be provided to store data for subsequent transmission to an external device. A key based system according to the invention can advantageously be implemented in conjunction with a personal digital assistant or alphanumeric paging device to permit the user to enter text as needed.

BRIEF DESCRIPTION OF THE FIGURES

The foregoing and other features of the present invention will be more readily apparent from the following detailed description and drawings of illustrative embodiments of the invention in which:

Fig. 1 is a top plan view of a keyboard entry device according to one embodiment of the invention;

Fig. 2 is a block diagram of a system implementing a keyboard entry device according to invention;

Fig. 3 is a cross-sectional view of a first gravity switch for selecting keyboard rows;

Figs. 4a and 4b are partial front and side views of a second gravity switch for selecting keyboard rows;

Fig. 5 is a perspective view of an alternative embodiment of the invention; and

Fig. 6 is a view of another alternative embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning to Fig. 1, there is shown a plan view of a data entry device 10 according to the invention. The device 10 preferably has a generally cylindrical elongated body 12, such as pen or wand. A plurality of keys 14 are arranged along the length of the device. Each key 14 is conceptually divided into a plurality of regions 15, each of which can be assigned a respective value. The assigned values can be represented by indicia 16 on or adjacent the key 14. In the embodiment shown in Fig. 1, the indicia on the keys corresponds to the alphanumeric layout on a conventional QWERTY keyboard and this exemplary embodiment will be used in the following discussion. However, it will be appreciated that other larger or smaller sets of key values can also be used. For example, alternative embodiments implementations geared for use as input to a telephonic or calculator device might not use a full alphanumeric key set but can include additional function keys specific to the application.

The regions 15 on the adjacent keys 14 form a plurality of rows, such as row 18. A selection device 20 is used to select one of the rows 18. The value attributed to each of keys 14 is determined by the particular row 18 which is selected when the key is depressed. Preferably, an indicator 22 is also provided to indicate which of the rows 18 is presently selected. By selecting a particular row 18, the value attributed to all of the keys 14 is adjusted accordingly. For example, with keys which assigned values corresponding to the QWERTY keyboard as illustrated in Fig. 1, when the uppermost row is selected, the keys are assigned the respective values of 1-9 and 0. When the lowermost row is selected, the value attributed to the keys is changed to correspond to the bottom row of a QWERTY keyboard. Advantageously,

the use of a row selection scheme as disclosed herein allows many values to be assigned to each key while also permitting the keys themselves to be both large, and therefore easy to press, and simple, requiring only a single on-off state as opposed to a multi-position rocker switch.

Various different row selection devices 20 may be used. In a preferred embodiment, the row selection device 20 includes a gravity switch which responds to the axial orientation of the device 10. In this manner, different value rows can be easily and intuitively selected simply by rotating the pen 10 along its axis until the desired row is selected, e.g., as indicated by row selection indicator 22, and then the desired key pressed. Selection device 20 can be configured such that the most vertically positioned row is selected since this condition is the easiest to discern. Preferably, the axial orientation required to select a row is adjustable by the user, perhaps by allowing the gravity switch portion of the row selection device 20 to be rotated axially within the device and then locked into place at the desired position. Row selection indicator 22 is shown as a pointer to the selected row. However, alternative indicators can also be used, such as one or more LEDs which are placed at the end and/or within the rows and which are illuminated in accordance to the selected row. In yet a further embodiment, the keys themselves can be backlit or otherwise configured to directly highlight the indicia in the selected row.

Although an automated row selection device is preferred, alternatively, a manual row selection device 20 can be provided which comprises a manual selection knob 24 or other selection switch, dial, etc., for use in selecting a specific row. Manual selection can also be provided in conjunction with automated selection and the user permitted to choose which type of activation to use.

Turning to Fig. 2, there is shown a block diagram of a system for implementing the device 10 according to the invention. As illustrated, each key 14 is configured to produce a signal 33 which indicates when the key has been depressed. Various types of key switching technology can be used for keys 14 and the type of signal 33 produced is dependent on the implementation technology. In one embodiment, keys 14 are conventional push-button switches with a single on-off state. With these type of keys, signal 33 may alternate between floating and connected to a fix potential, such as ground, or between two fixed potentials. Switches 14 may also be implemented using various other types of technology, such as membrane, capacitive, or even optical switches.

The signals 33 from each of the switches 14 are received by a key entry module 30. The key entry module 30 also receives at least one signal 32 from row selector 20 indicating which of the plurality of rows has been selected or containing data which can be interpreted to derive this information. Key entry module 30 contains appropriate logic circuitry to interpret a received signals 34 indicating a key depression in accordance with a row selection indication signal 32 to determine the data value to be attributed to the depressed key. If each key 14 is separately wired to key entry module 30, module 30 can be implemented using a simple look-up table arrangement. Alternatively, the keys 14 can be wired according to a conventional scanned keyboard arrangement and an appropriate keyboard scanning algorithm implemented in module 30. Various techniques for detecting the depression of a particular one of a plurality of keys are known to those of skill in the art and any suitable mechanism can be utilized in accordance with the invention.

Once a key depression has been identified and an appropriate data value assigned to the key in accordance with the selected row, the data value is provided to a data processing module 36, e.g., by a signal 38. The functionality of the data processing module 36 depends upon the particular application the device 10 is designed for. Although not required, generally data processing module 36 will include a memory or buffer for storing a plurality of entered data values and an interface for outputting this data to an external device. A display 40, preferably implemented on a portion of the device 10 but possibly external to the device 10, can be driven by the processing module 36 via signal 42 so that data will be displayed as it is entered by the user.

There are various ways in which row selector 20 can be implemented, as will be recognized by those skilled in the art. One implementation is illustrated in Fig. 3, which shows a cross-section of the row selector 20 along the device axis. The selector 20 includes a cavity 50, which can be formed within the body of device 10, and which has a plurality of electrical contacts 52 therein. Within cavity 50 is a movable electrically conducting mass 54, such as a blob of mercury or a steel ball bearing. Depending upon the orientation of the pen above its axis, conducting mass 54 will make electrical contact with different terminal 52 within the cavity 50. By determining which of the terminals 52 in the cavity are electrically shorted together by the conducting mass 54, the axial orientation of the device 10 can be determined. Also shown in Fig. 3 is indicator 22 which may consist, for example, of a plurality of LEDs 56 adjacent respective rows 18. A control signal generated by the key entry module 30, for example, can be provided to illuminate the led 56 adjacent the determined selected row. Alternatively, selector 20 can be configured such that ball

54 interrupts one of a plurality of light paths which are subsequently detected and processed.

Figs. 4a and b illustrate a second embodiment of selector 20. A pivoting element 58 having a weighted end 60 is mounted along an axis 62 which is parallel to the axis of the device 10. The weighted end 60 fits within a grove or channel 61 in a wall. A plurality of detectors 63 are provided within cavity 61 to detect the position of pen of the weighted element 60. Various types of detectors may be used, including electrical, mechanical, and electro-optical. For example, as shown in the side view of Fig. 4b, the detector 63 comprises an optical emitter 66 in register with a suitable detector 68. The emitter and detector 66, 68 are spaced such that weighted portion 60 or an extension thereof can pass between the emitter and detector and obstruct the light path. An extension 64 terminating in indicator 22 can be provided to supply a visual indication of the position of the pivoting element 58 and thereby an indication of the selected row. A transparent window or other opening can be provided through which the indicator is visible. Alternatively, other indication means, such as the LEDs illustrated in Fig. 3, can be used.

Advantageously, a keyboard device according to the invention can be implemented in a personal digital assistant or pager. These devices are becoming very sophisticated and it is increasingly necessary for a user to be able to enter a substantial amount of text data into a very compact device. While any data values can be assigned to the various keys 14, the use of a QWERTY keyboard layout, such as shown in Fig. 1, advantageously provides a device which is intuitive to use for those used to typing on conventional keyboards. By rotating the device such that the desired letter is facing up, the correct row is automatically selected. As a result, data can be

entered in a rapid fashion with little or no training. In addition, the small number of keys needed to implement some or all of an alphanumeric keyboard means permits the use of keys large enough to be easily depressed by adult-sized fingers while still allowing a compact device.

It can be useful to permit entry of both upper and lower case letters. One method for enabling this type of data entry is the use of dual positions switches, such as rocker type switches, instead of single-value switches. In this variation, at least some of the switches would be capable of entering two separate values. The different values can be used to indicate, for example, upper or lowercase letters. In an alternative variation, a separate switch, such as a push-button switch, can be provided for use as a shift or function key. Preferably, such a key is located at one of the ends of the pen so that it can be depressed with the palm of the hand coincidently with the depression of another key. Key entry module 30 can also be configured to recognize capital letters by other means. For example, a capital can be indicated by depressing key 14 for a predetermined period of time.

Although the device 10 according to the invention has been discussed with regard to a pen or wand shaped implementations, the device 10 can be any generally cylindrical shape. Moreover, the device 10 need not be strictly "hand-held". For example, a keyboard entry device according to the invention can be implemented as a generally cylindrical amulet 70, such as shown in Fig. 5. The selection device 20 can be implemented within the body of amulet 70. When worn by the user, such as on the forearm or wrist, the user can select an appropriate row simply by rotating their arm or wrist.

In the embodiments above, the selection devices operated along a single axis. However, in a further alternative embodiment of the invention, the selection device can operate along more than one axis or multiple selection devices can be provided, each responsive to motion along a particular axis. For example, and with reference to Fig. 6, a device 80 can include a data entry area 82 comprising a plurality of value regions 84 arranged in, e.g., a series of rows 86 and columns 88. By selecting a particular column and row, a specific value is identified. The value can then be entered by pressing a data entry key, which key can be situated outside or within the data entry area 82. The selected row and column or just an individual key can be visually indicated in any appropriate manner such as backlighting the data entry area 82 or by means of indicators 92 arranged along the periphery or within data entry area 82. Although a position-sensing selection device, such as a gravity switch, is preferred for this implementation, selection along one or both of the axes can alternatively be made using a manual selection device, such as a sliding switch.

While the invention has been particularly shown and described with reference to a preferred embodiments, it should be understood by those skill in the art that various changes in form of details maybe made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A data entry device comprising:

a generally elongated body;

a plurality of keys arranged along a length of the body, each key being associated with a plurality of values assigned to respective regions, the regions of adjacent keys forming a plurality of rows;

a row selection device having a selected row signal as output; and

a key entry module receiving at least one data signal from the plurality of keys and the selected row signal as input and producing an output value data signal indicating the particular value which is associated with an actuated key and assigned to the region in the row indicated by the selected row signal.

2. The data entry device of claim 1, wherein each key is a binary key having an on state and an off state.

3. The data entry device of claim 1, wherein the plurality of values associated with each key correspond to a particular set of values in a key-column of a QWERTY layout keyboard.

4. The data entry device of claim 1, wherein the row selection device is responsive to the orientation of the body, whereby different rows can be selected by altering the orientation of the body.

5. The data entry device of claim 1, wherein the row selection device comprises a gravity switch.

6. The data entry device of claim 1, wherein the row selection device comprises a manual selection knob.

7. The data entry device of claim 1, further comprising a shift key.

8. The data entry device of claim 1, further comprising a data processing module receiving the value data signal and driving a display which indicates values entered into the device.

9. The data entry device of claim 1, further comprising an indicator identifying a presently selected row.

10. The data entry device of claim 9, wherein the indicator comprises a plurality of LEDs, each LED associated with a respective row.

11. The data entry device of claim 1, wherein the body is generally pen shaped.

12. The data entry device of claim 1, wherein the body is generally cylindrical.

13. The data entry device of claim 12, wherein the body is configured to be worn by a user.

14. A data entry device comprising:

a body;

a data entry area situated on the body and having a plurality of value regions defining a plurality of rows and a plurality of columns, each value region having an associated particular value;

a selection device having a selected row signal and a selected column signal as output;

at least one data entry key; and

a key entry module receiving at least one data signal from the at least one data entry key and the selected row and selected column signals as input and producing an output value data signal indicating the particular value which is associated with the column and row indicated by the selected column and row signals.

15. The data entry device of claim 14, wherein the selection device comprises:

a first selection device responsive to the orientation of the body along an axis generally perpendicular to the columns and having the selected column signal as output; and

a second selection device responsive to the orientation of the body along an axis generally perpendicular to the rows and having the selected row signal as output.

16. A data entry method using a device comprising a plurality of keys, the method comprising the steps of:

associating each of the keys with a plurality of values;

assigning the values to respective regions on the device in a plurality of rows;

selecting a row signal for output;

receiving at least one data signal from the keys and the selected row signal as input;

actuating one of the plurality of keys assigned to the region indicated by the selected row signal; and

producing an output value data signal indicating the particular value which is associated with the actuated key.

17. The method of claim 16 further comprising the step of axially orienting the device wherein the selecting step is responsive to orientation of the device where different rows are selected by altering the orientation.

18. The method of claim 17 wherein the selecting step is responsive to gravity.

19. The method of claim 16 further comprising the steps of:

receiving the value data signal; and

driving a display which indicates values entered into the device.

20. The method of claim 16 further comprising the step of identifying a presently selected row wherein the identifying step uses a plurality of light emitting diodes (LED) each LED being associated with a respective row.

Fig. 1

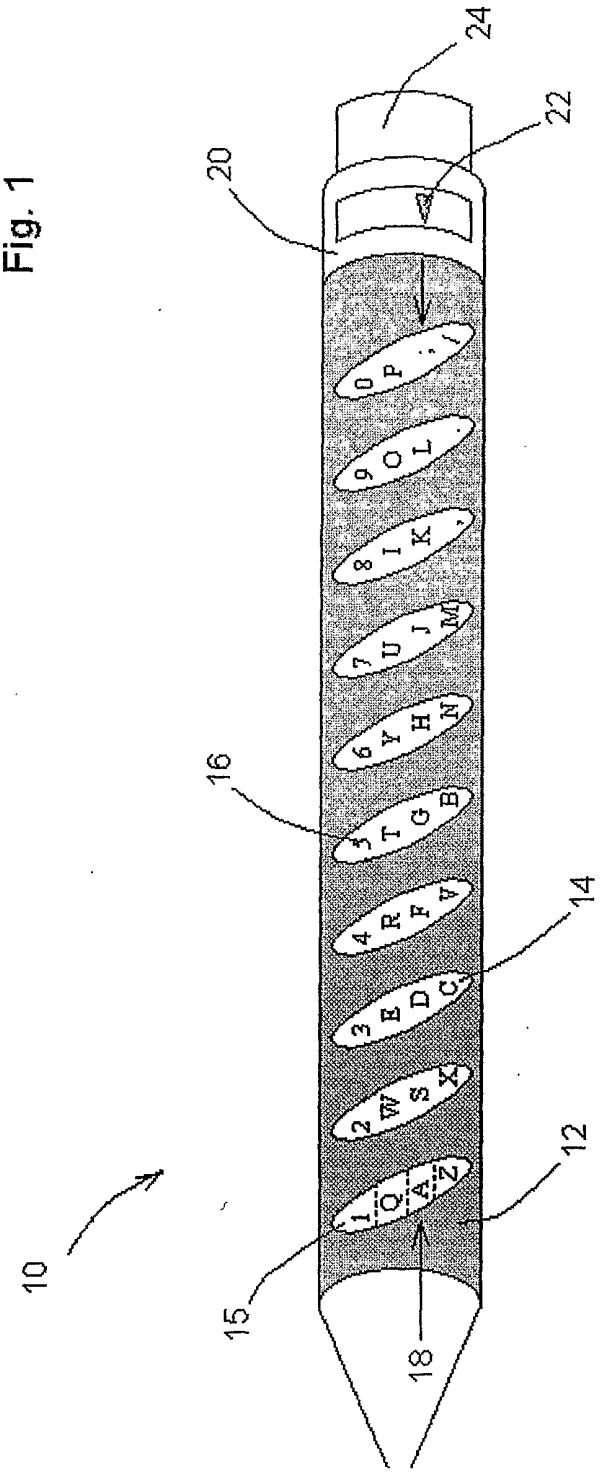
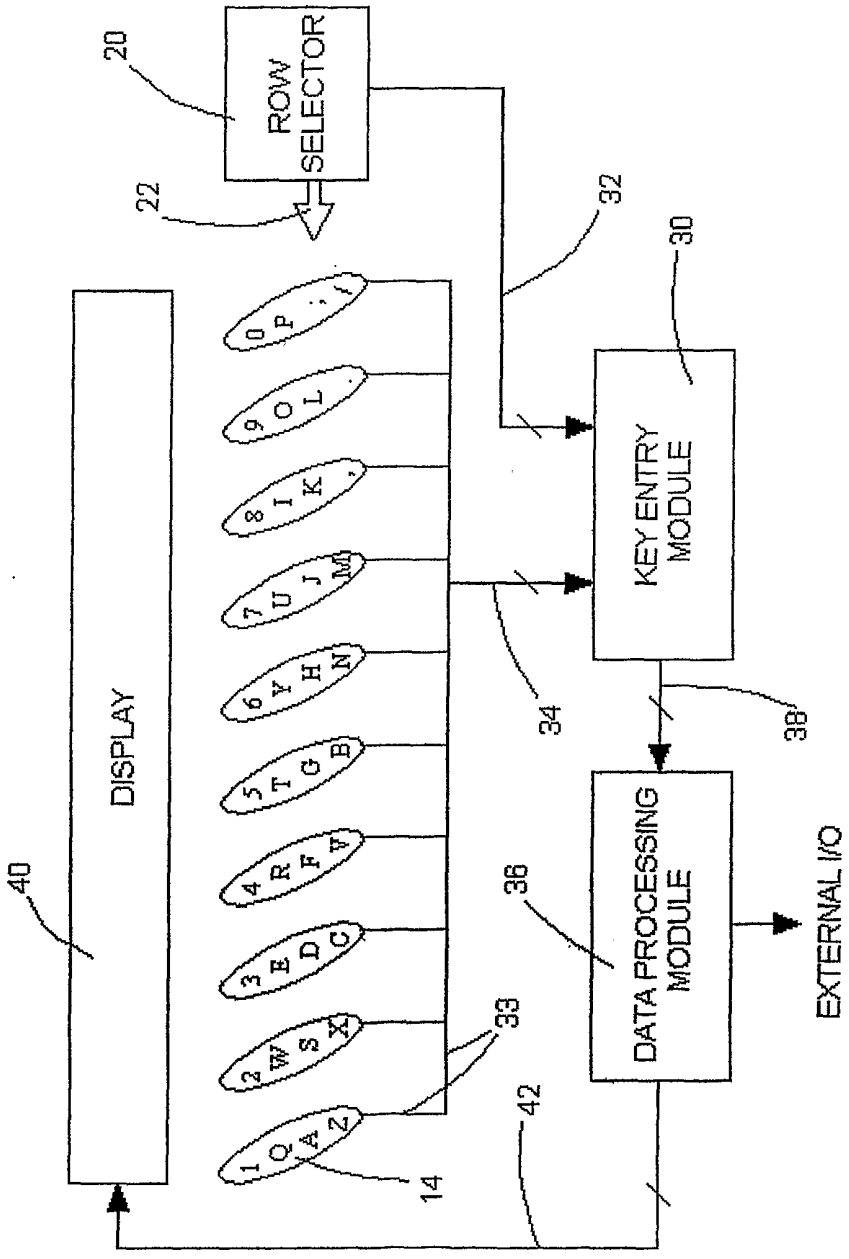


Fig. 2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ROW SELECTOR
22
32
30
KEY ENTRY MODULE
34
38
DISPLAY
40
DATA PROCESSING MODULE
36
EXTERNAL I/O
33
42
14
0 P ; /
9 O L .
8 I K ,
7 U J M
6 Y H N
5 T G B
4 R F V
3 E D C
2 W S X
1 Q A Z

Fig. 3

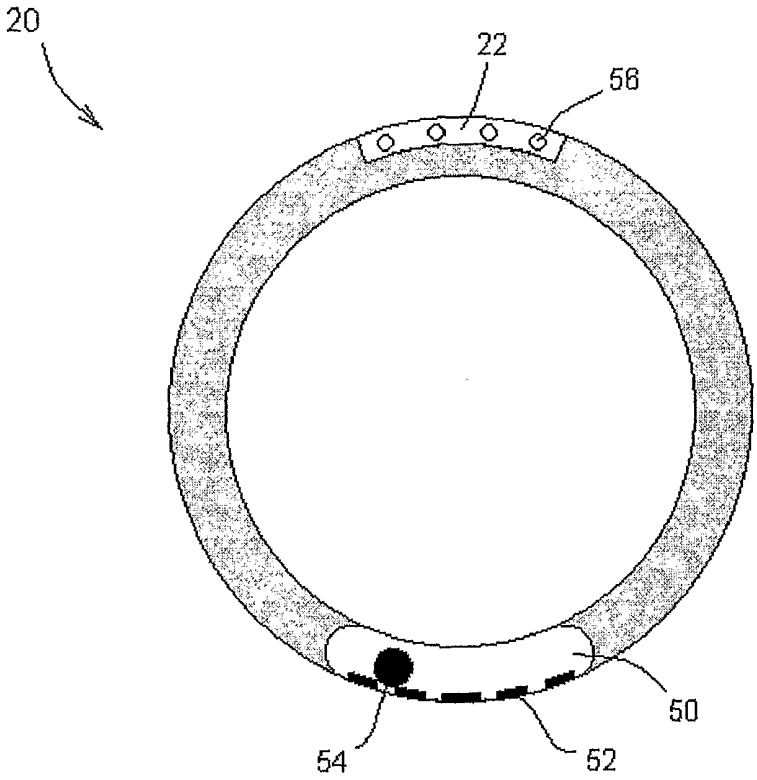


Fig. 4A

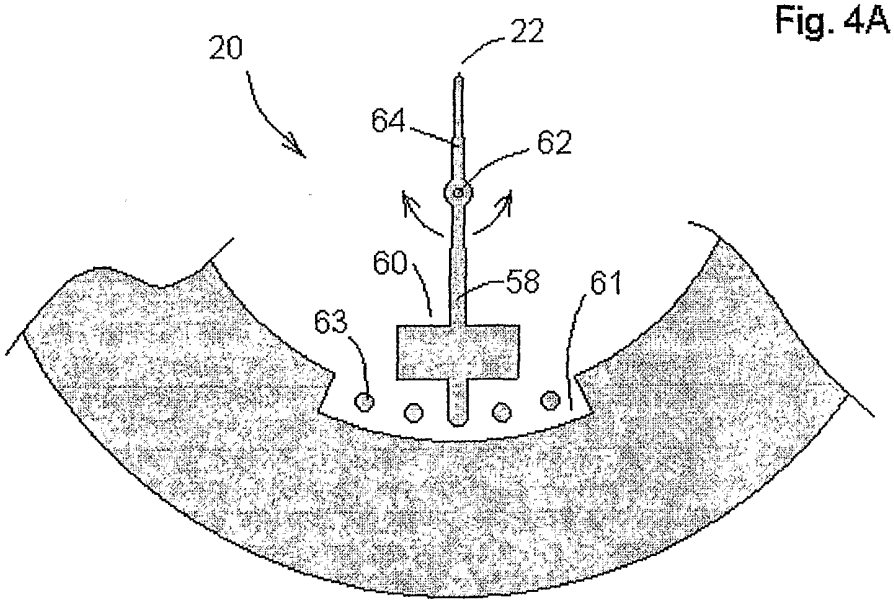
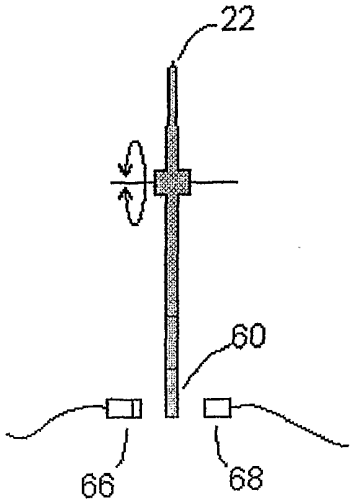


Fig. 4B



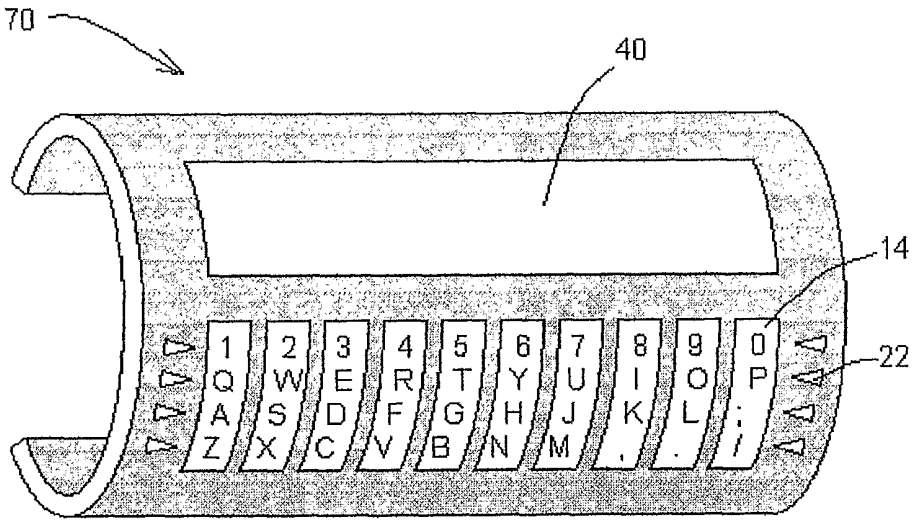
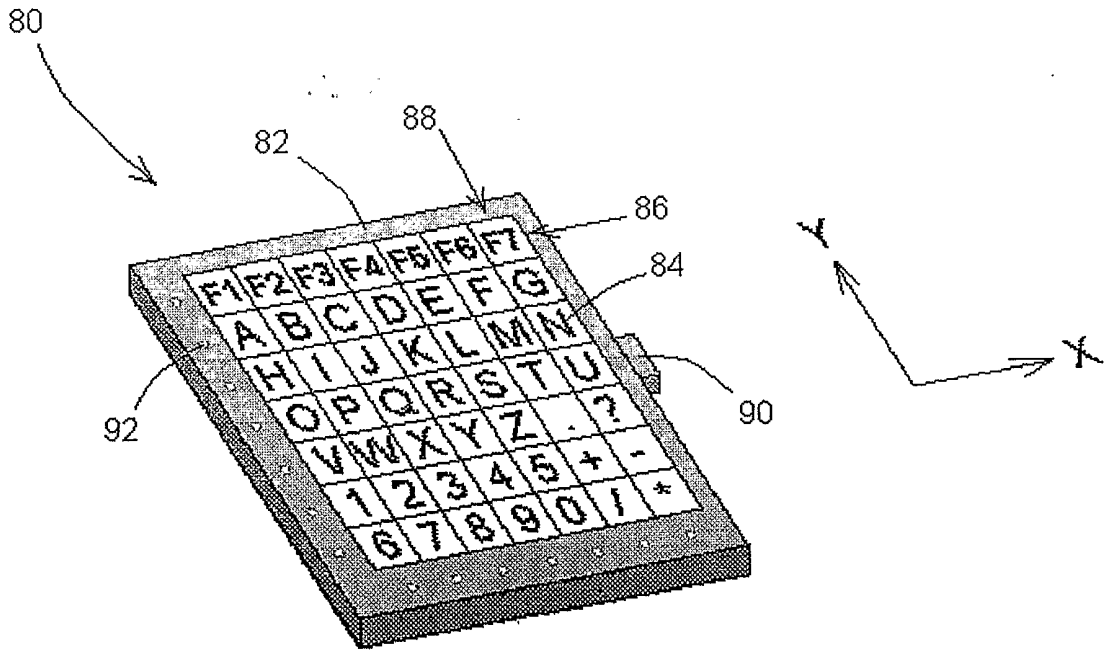


Fig. 5

Fig. 6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