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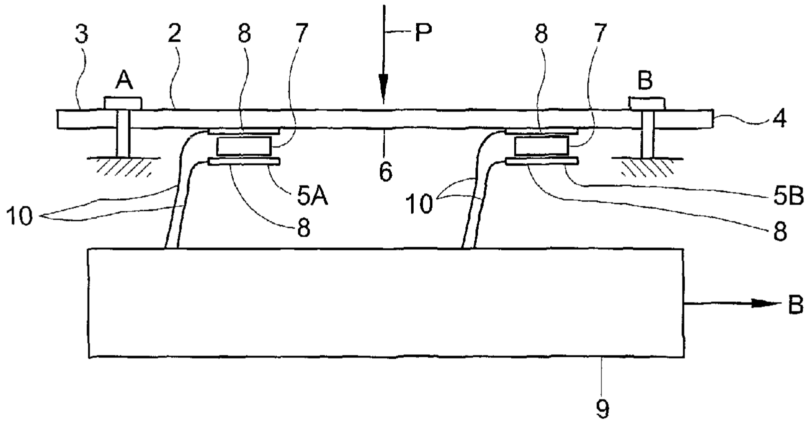
(54) Title: TOUCH PANEL



(57) Abstract: An operating system comprising an operating element which is arranged to produce an operating signal by means of striking of the operating element at a position, the operating signal corresponding, in a predetermined manner, to the position at which striking takes place, wherein the operating is arranged to deform under the influence of the striking of the operating element, the operating element being provided with at least two deformation sensors spacially and electrically separated from each other,which are arranged to co-defrom during the deformation of the operating element, each deformation sensor further being arranged to generate, during the co-deformation an electrical signal which is dependent on a deformation behavior of the deformation sensor, the system comprising processing means for processing, in combination, the electric signals generated by the deformation sensors, to obtain the operating signal.

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TOUCH PANEL

The invention relates to an operating system comprising an operating element which is arranged to produce an operating signal by means of striking of the operating element at a position, the operating signal corresponding, in a predetermined manner, to the position at which striking takes place.

Such a system is known per se. In operating apparatuses such systems are frequently used. Thus, for instance, a telephone apparatus and a keyboard are equipped with such a system. Also, a so-called touch screen in which by touching a position an operating signal corresponding with that position is produced, is a system as described above. In such known systems the operating element is arranged such that each position forms part of a couple in which only one individually excitable position and one recording means is included. Individually excitable positions are understood to mean positions which are each excitable fully independently of each other. The excitation or striking of an individual position belonging to a couple is recorded by the recording means belonging to that couple. The recording means will ensure that a predetermined operating signal is produced.

A disadvantage is that each individual position has to be provided with a recording means so that the number of excitable positions and the number of recording means are equal. Moreover, the individual positions are included in the operating element such that when striking a selected position a recording means belonging to another position does not record the striking of the selected position. This involves a complex operating element. The production cost of such a system is therefore high.

The invention has for its object to remove the above-mentioned disadvantages.

This object is achieved with the system according to the invention, which is characterized in that the operating element is arranged to deform under the influence of striking of the operating element, the operating element being provided with at least two deformation sensors spatially and electrically separated from each other, which are each arranged to co-deform during the deformation of the operating element, each deformation sensor further being arranged to generate, during the co-deformation, an electric signal which is dependent on a deformation behavior of the deformation sensor, the system comprising processing means for processing, in combination, the electric signals generated by the deformation sensors, to obtain the operating signal.

This offers the advantage that not every position which, when striking, results in the production of an operating signal corresponding, in a predetermined manner, with the position at which striking takes place, necessarily needs to be provided with a recording means. In fact, according to the invention the operating element is provided with at least two deformation sensors spatially and electrically separated from each other, which are each arranged to co-deform during the deformation of the operating element. The operating element will deform nearly completely, even if this deformation may be very slight, when striking at a position of the operating element. The number of positions that is strikable and leads to an operating signal which exclusively corresponds with one of the strikable positions may be a multiple of the number of deformation sensors. The operating system according to the invention can therefore be manufactured in a simpler and less expensive manner. Besides, the positions which, when striking, each result in the production of an operating signal corresponding with the position struck, need not be deformable independently of each other. This also saves material and production cost.

From a theoretical insight it can be derived that with two deformation sensors the position at which the striking of the operating element takes place with respect to an imaginary dividing axis extending over the operating element in one dimension, and the force with which striking takes place at that position, are determinable. In fact, at a specific deformation of the operating element the deformation sensors will each generate an individual electric signal which is characteristic of the deformation of the deformation sensors occurring as a result of that determined deformation. The processing means may be arranged in a simple and known manner to recognize the characteristic signals and to relate them to the position at which, and the force with which, the striking of the operating element takes place. This means that with only two deformation sensors it can be determined of more than two positions with respect to the one-dimensional dividing axis whether the striking of the operating element takes place at one of those positions and with which force. The operating element may therefore have a large number of positions where striking can take place, and of which it can be determined that striking takes place there, without necessitating an equally large number of deformation sensors to determine the positions. In other words, it turns out that, as already indicated before, it is not necessary to provide nearly every position along an imaginary one-dimensional axis of the operating element with a deformation sensor to enable detection of the striking of the operating element at each position. It also turns out that it is not necessary to ensure that the operating element practically only deforms at a position where the striking of the operating element takes place. This makes the frequent use of deformation sensors unnecessary and involves the possibility of savings in cost of component parts and in cost of production of the system since, as stated before, the system may be of less complex design.

An operating element which is provided with two deformation sensors is preferably strip-shaped so that the positions located along an imaginary dividing axis extending in a longitudinal direction of the strip can each correspond with an individual operating signal.

In a special embodiment of an operating system according to the invention, it holds that the operating element is provided with at least three deformation sensors. Thus it is possible to have an operating element flat in shape, of which the position at which the striking of the operating element takes place can be determined with respect to a two-dimensional dividing axis, together with the force with which striking takes place. In brief, each position on a surface of the operating element can correspond with an operating signal related to that position. In this case the processing means have to be arranged to recognize small differences between electric signals. It can also be said that at a constant recognizing power of the processing means, with an increasing number of deformation sensors disposed on the operating element, an increasing number of mutually different positions can correspond with an operating signal related to a position. In other words, the electric signals which are generated by the deformation sensors will, in this case even at small differences between the positions at which the striking of the operating element takes place, differ sufficiently for the processing means to be recognized by the processing means. This means that per unit area of the operating element a larger number of different operating functions can be performed by the selective striking of the operating element when a relatively large number of deformation sensors is disposed on the operating element. Moreover, this implies that the processing means can be designed in a relatively simple and thus inexpensive manner.

The deformation sensors are preferably located near mutually different ends of the operating element. This has the advantage that the distances between the deformation sensors will be relatively great and that the mutual differences in deformation behavior can also be great. As a result thereof, the generated electric signals will mutually differ relatively strongly so that it will be relatively simple to determine by the processing means, on the basis of the electric signals, the position at which striking takes place.

It is further advantageous if at least one of the deformation sensors comprises a piezoelectric polymer. This offers the advantage that, in use, the mechanical energy supplied to the system by striking the operating element is, at least partly, converted into electric energy. In fact, when striking the operating element, the deformation sensors deform along with the operating element as a result of which the deformation sensors each generate an electric signal during the deformation. By means of these signals the position at which the striking of the operating element takes place is determinable. In such an embodiment of a system according to the invention, therefore, relatively little energy, delivered by a battery or another supply, is consumed to enable the determination of the position at which the striking of the operating element takes place.

A special embodiment of an operating system according to the invention is characterized in that the system comprises a display, the display being arranged to show at least one operating function, the at least one operating function being performable by means of the selective striking of the operating element. This offers the advantage that the number of possible operating functions to be performed by striking the operating element can be highly increased. In fact, the display may show very many different images. An operating function may even comprise the search for another selection menu so that the number of functions to be operated with a simple operating element is practically unlimited.

An even more special embodiment of an operating system according to the invention is characterized in that the operating element and an image shown by the display may be similar in shape, the at least one operating function being performable at an imaging position by striking the operating element at a position which corresponds with the imaging position. This has the advantage that a user can keep watching the display and can have the desired operating function performed by striking the operating element "by feel" at the right position.

In an advantageous embodiment of an operating system according to the invention, the operating element is transparent, which has the advantage that, for instance, the display can be observed through the operating element.

A very advantageous embodiment of an operating system according to the invention is characterized in that the operating element is disposed before the display such that at least one of the operating functions, shown in an image, is performable by striking the operating element on the image at a position behind which the respective operating function is shown by the display. This offers the advantage that the ease of operation of the operating element is very high since the striking of the operating element at an undesired position is practically impossible because the position at which striking has to take place to have a specific operating function performed more or less corresponds with the striking of the position at which the desired operating function is shown.

In a special embodiment the operating element comprises at least a part of a housing. This ensures a robust operating system. Furthermore, this part of the housing may be manufactured by means of injection molding. The operating element may, for instance, be included in the housing of a display. As a result, the system can be manufactured in a very simple, rapid and inexpensive manner.

Furthermore, the invention relates to an operating element for use in such an operating system.

The invention will now be explained with reference to a drawing. In this drawing:

Fig. 1 diagrammatically shows a first embodiment of an operating system according to the invention;

Fig. 2 diagrammatically shows a top view of the embodiment shown in Fig. 1;

Fig. 3 diagrammatically shows a top view of a second embodiment of an operating system according to the invention;

Fig. 4 diagrammatically and exemplarily shows a first part of the processing means with which the system according to the invention is provided;

Fig. 5 diagrammatically and exemplarily shows a second part of the processing means with which the system according to the invention is provided;

Fig. 6 diagrammatically shows a third embodiment of a system according to the invention;

Fig. 7 shows a diagrammatic section of a fourth embodiment of a system according to the invention;

Fig. 8 perspectively shows a fourth embodiment.

Fig. 1 shows an operating system 1 comprising an operating element 2 which is arranged to produce an operating signal by striking the operating element 2 at a position. The operating element 2 is arranged to deform under the influence of the striking of the operating element 2. In the exemplary embodiment shown in Fig. 1 the operating element is therefore designed as an elongated strip which is only supported by a support A located at an end 3 of the strip and a support B located at another end 4. The operating element 2 is, in this manner, arranged to deform under the influence of striking, for instance in the direction of arrow P. The operating element 2 is therefore somewhat flexible. Often, the operating element 2 comprises a strip which comprises, for instance, relatively thin Plexiglas. The operating element 2 is, as shown in Fig. 1, provided with two deformation sensors 5a, 5b spatially and electrically separated from each other, which are each arranged to co-deform during the deformation of the operating element 2. To this end, the deformation sensors 5a, 5b are, for instance, glued to a surface 6 of the operating element 2. The deformation sensors are, to this end, often designed as a film 7. The deformation sensors 5a, 5b are each also arranged to generate an electric signal during the co-deformation. The electric signal is dependent on the deformation behavior of the deformation sensor 5a, 5b by which the electric signal is generated. To this end, the deformation sensor 5a, 5b preferably comprises a piezoelectric polymer, such as, for instance, polyvinylidene fluoride (PVDF). The polymer PVDF is built up from chains with covalently bonded polar groups therein. This polarity is caused by the great difference in electronegativity. The fluorine atom (F) in PVDF is somewhat negatively charged with respect to the carbon atom (C). The C-F bond therefore forms a permanent dipole. When the dipoles are arbitrarily directed, there is no net dipole moment on a macroscopic scale and the material is not piezoelectric. When the material is deformed, the dipoles orient themselves as a response to the deformation. By means of the conductive layers 8 which are provided on either side of the film 7 the electric signal generated during the deformation of a deformation sensor, as a result of the polarization of the film, can be transferred to processing means 9. Of course, an electrically conductive wire 10 is provided between each conductive layer 8 and the processing means 9. The processing means 9 are further arranged to process the electric signals generated by the deformation sensors 5a, 5b in combination, to achieve the operating signal. The operating signal then corresponds with the position at which the striking takes place. In fact, the position at which the striking of the operating element 2 takes place determines the deformation behavior of the deformation sensors 5a, 5b. And the deformation behavior subsequently determines the electric signal which is generated by the deformation sensor 5a, 5b. In other words, the electric signals indicate at which position the striking of the operating element 2 takes place. The processing means 9 are arranged to produce, according to a predetermined relation, on the basis of the electric signals, an operating signal which corresponds, according to a predetermined relation, with the position at which the striking of the operating element 2 takes place.

Fig. 2 indicates, in a top view of the system diagrammatically shown in Fig. 1, that the strip-shaped operating element 2 can be divided into zones 11 which each form a position on the operating element 2. By means of the two deformation sensors 5a, 5b it can be determined on the basis of the generated electric signals in which zone 11, or at which position of the operating element 2, the striking of the operating element 2 takes place. Moreover, the force can be determined with which this striking at the respective position, or in the respective zone 11, takes place. With an operating element 2 of Figs. 1 and 2, for instance, several functions can be performed. Thus, for instance, by striking one of the zones 11 an operating signal can be produced, from which it appears that the volume of an apparatus (not shown) connected to the operating system 1 is increased. In this connection the degree in which the volume of, for instance, a television set is increased may be dependent on the force with which the striking of the operating element 2 in the respective zone 11 takes place. Thus, when striking one of the other zones 11, for instance the contrast in the image shown by a television set, can be increased. The increase in contrast may then correspond with the force with which the striking of the operating element 2 in the respective zone 11 takes place.

Fig. 3 diagrammatically shows a top view of a plate-shaped operating element 2. The operating element 2 is, in this case, supported by four supports A, B, C, D. This operating element 2 is provided with four deformation sensors 5a, 5b, 5c, 5d. The operating element 2 is, in this case, subdivided into fifteen zones 11, which are arranged over the operating element 2 adjacent to each other in two mutually different directions. The operation of such an operating element 2 is analogous to the operation of an operating element 2 as shown in Figs. 1 and 2. It is, as can be derived from a theoretical insight, possible to determine with three out of the four deformation sensors 5a, 5b, 5c, 5d a position, or a zone 11, in which the striking of the operating element 2 shown in Fig. 2 takes place. Not only the position at which the striking takes place, but also the force with which the striking takes place can be derived from three separately generated signals. As shown in Fig. 3, preferably four deformation sensors are provided, which means that the position at which the striking takes place can be determined with greater accuracy and that the operating element can be subdivided into relatively many zones 11. The deformation sensors 5a, 5b, 5c, 5d are located preferably near mutually different ends of an operating element 2. It turns out that the degree of deformation during the striking is greatest near a support A, B, C, D where the operating element 2 is fixed.

The processing means 9 comprise, for instance, a charge amplifier 12 as diagrammatically shown in Fig. 4. Preferably, each deformation sensor 5a, 5b, 5c, 5d is connected with such a charge amplifier 12. The charge amplifier 12 comprises a capacitor 13, a resistor 14, and an OP AMP 15. In use, the charge amplifier 12 produces an output signal V_{piezo}, which comprises a voltage difference with the earth 18. The voltage difference V_{piezo} of each charge amplifier 12 forms an input signal $V_{piezo\ x}$ (x = 1, 2, 3, 4) of the summator shown in Fig. 5, which may also be included in the processing means 9. With this summator 16 a trigger signal T may be formed, with which a processing program written in an appropriate programming language can be executed. Moreover, each output signal $V_{piezo\ x}$ (x = 1, 2, 3, 4) is led to a channel K_0, K_1, K_2, K_3 of a computer 18, with which the program can be executed. Fig. 6 diagrammatically shows how the operating element 2 shown in Fig. 3 is connected with the computer 18 by means of the charge amplifiers 12 and the summator 16. The processing program, which can be written by a skilled person by way of routine, ensures that the signals of each deformation sensor are read in separately, that the position at which the striking of the operating element 2 takes place is calculated rapidly, and that the force with which the striking of the operating element 2 takes place is determined. Moreover, the processing program ensures that the operating signal which corresponds with the calculated position and the calculated force is produced and that an operating function corresponding with this position is performed with or without observance of the calculated force.

Fig. 7 diagrammatically shows a cross-section of a so-called handheld 21, in which an operating system according to the invention is included. The operating element 2 comprises, in this example, a part 22 of the housing 20 of the handheld 21. In other words, the operating element 2 is an integral part of a part 22 of the housing 20. This part 22 of the housing 20, or this operating element 2, can be manufactured in an injection mold, while it is even possible that the deformation sensors 5a, 5b are placed in the injection mold before the housing designed as operating element is injection molded.

The design of the part 22 of the housing 20 designed as operating element 2 is such that the operating element is arranged to deform when striking the operating element. In this variant the operating element therefore need not be supported by specifically provided supports. This saves production cost. Moreover, such a design of a system according to the invention is very robust.

Fig. 8 shows an example of the use of the embodiment shown in Fig. 7 in cross-section.

Many variants are possible. Thus, the operating system can be accommodated in a display housing. The operating element 2 is, in this case, of transparent design. The display may then be arranged to display operating functions. The operating functions may be performable by means of the selective striking of the operating element 2. In other words, an operating function shown on the display can be performed by striking the operating element 2 at a position behind which the respective operating function is shown. Preferably, the deformation sensors 5 are also of transparent design. The operating system 1, and in particular the operating element 2 and the deformation sensors 5a, 5b disposed thereon, may be integrally accommodated in the housing of the display, which considerably accelerates and makes less expensive the manufacturing process. In that case the operating element will be included in the injection mold and, preferably during the injection molding, be connected at some positions with, for instance, the display housing 20, such that the operating element 2 can deform when, in use, the striking of the operating element 2 takes place.

The invention is by no means limited to the exemplary embodiments shown. Thus, the operating system 1 may comprise a display 21 on which an image of operating functions is shown and in which the operating element 2 is held in the hand, for instance separately from the display 21. The operating functions are, in this case, performable by means of the selective striking of an operating element 2. Preferably, in this case the operating element 2 and an image shown by the display 21 are of a design similar in shape so that an operating function is performable at an imaging position by striking the operating element 2 at a position corresponding with the imaging position. In such an embodiment, even several operating elements 2 may be connected with one display 21 so that, for instance, different operators can have another operating function performed. Such an embodiment can be very suitable for personally answering quiz questions shown on the display 21. The operating function comprises, in this case, recording the answers of each individual operator. An operator need, for that matter, not be a person. The operating element may also be included in, for instance, an apparatus with which, for instance, a selection can be made on the basis of a position at which striking of the operating element 2 takes place and the force with which the striking of an operating element 2 takes place. In this connection, for instance, objects projected with equal initial speed, which objects may have mutually different and unknown masses, may be considered. The positions at which the objects strike the operating element 2 may give a mass distribution of the objects. As indicated, the operating element 2 may be of transparent design, but the operating element 2 may also be of opaque design. In that case the operating element may be provided at different positions with signs or colors indicating which operating function is performed when striking the operating element 2 at a specific position. The operating element 2 may be included in a readily operable toy, but also in a target, or for instance in a remote control. The number of deformation sensors may be simply extended. Thus, a larger number of mutually different positions at which the striking can take place can be distinguished from each other. In this manner a larger number of different operating functions can also be performed. The generated signals which correspond with the individual positions can be determined previously by way of experiment so that when recognizing the generated electric signals the processing means will produce the operating signal. It is also possible that the generated electric signals are calculated on the basis of, for instance, a finite element method by which the deformation behavior of the deformation sensors can be determined. The deformation sensors may be disposed on the operating element 2, but may also be included in the operating element 2.

Although the deformation sensors preferably comprise a piezoelectric polymer, the invention does not exclude the use of a strain gauge as deformation sensor. When a strain gauge deforms along with the operating element 2, the resistance of the strain gauge changes, as a result of which an electric signal already present changes. The generation of an electric signal is, in this connection, therefore understood to mean the change of an electric signal which is already present before the strain gauge is deformed. The processing means may, as shown in the examples, be of very simple design, but may also be of very complicated design (not shown). Thus, the processing means may be arranged to distinguish minimum differences between electric signals so that with a minimum of deformation sensors 5 the position at which the striking of the operating element 2 takes place can be determined.

The operating element need, for that matter, not be flat. Curved and bent surfaces are, as long as a deformation is possible, also allowable. The operating element 2 may, as indicated, even be designed as a housing of an apparatus. Such an apparatus may be of completely watertight design and applications in aqueous environments or even under water are therefore to be expected.

Such variants are all considered to fall within the scope of the invention.

CLAIMS

1. An operating system comprising an operating element which is arranged to produce an operating signal by means of striking of the operating element at a position, the operating signal corresponding, in a predetermined manner, to the position at which striking takes place, characterized in that the operating element is arranged to deform under the influence of the striking of the operating element, the operating element being provided with at least two deformation sensors spatially and electrically separated from each other, which are each arranged to co-deform during the deformation of the operating element, each deformation sensor further being arranged to generate, during the co-deformation, an electric signal which is dependent on a deformation behavior of the deformation sensor, the system comprising processing means for processing, in combination, the electric signals generated by the deformation sensors, to obtain the operating signal.

2. An operating system according to claim 1, characterized in that the operating element is provided with at least three deformation sensors.

3. An operating system according to any of the preceding claims, characterized in that the deformation sensors are located near mutually different ends of the operating element.

4. An operating system according to any of the preceding claims, characterized in that at least one of the deformation sensors is designed as a film.

5. An operating system according to claim 4, characterized in that the deformation sensor is provided with conductive layers which are disposed on either side of the film.

6. An operating system according to any of the preceding claims, characterized in that at least one of the deformation sensors is connected with a surface of the operating element by means of a glue.

7. An operating system according to any of the preceding claims, characterized in that at least one of the deformation sensors is included in the operating element.

8. An operating system according to any of the preceding claims, characterized in that at least one of the deformation sensors comprises a piezoelectric polymer.

9. An operating system according to claim 8, characterized in that the piezoelectric polymer comprises polyvinylidene fluoride.

10. An operating system according to any of the preceding claims, characterized in that the operating element comprises an organic or inorganic glass type.

11. An operating system according to any of the preceding claims, characterized in that the system comprises a display, the display being arranged to show at least one operating function, the at least one operating function being performable by means of the selective striking of the operating element.

12. An operating system according to claim 11, characterized in that the operating element and an image shown by the display are of a design similar in shape, the at least one operating function being performable at an imaging position by striking the operating element at a position which corresponds with the imaging position.

13. An operating system according to any of the preceding claims, characterized in that the operating element is transparent.

14. An operating system according to claims 11-13, characterized in that the operating element is disposed before the display such that at least one of the operating functions, shown in an image, is performable by striking the

operating element on the image at a position behind which the respective operating function is shown by the display.

15. An operating system according to any of the preceding claims, characterized in that at least one of the deformation sensors is of transparent design.

16. An operating system according to any of the preceding claims, characterized in that the operating element comprises at least a part of a housing.

17. An operating system according to claim 16, characterized in that the part of the housing is manufactured by means of injection molding.

18. An operating element for use in an operating system according to any of the preceding claims.

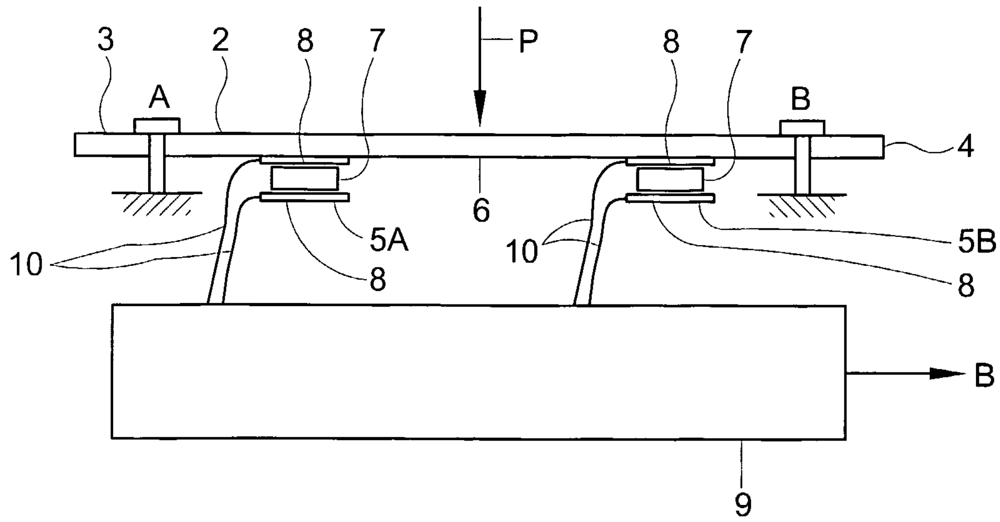

Fig. 1

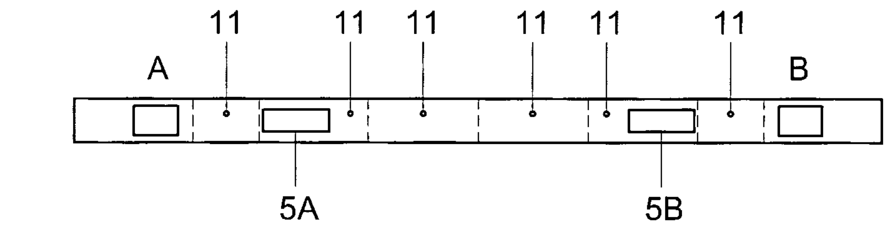

Fig. 2

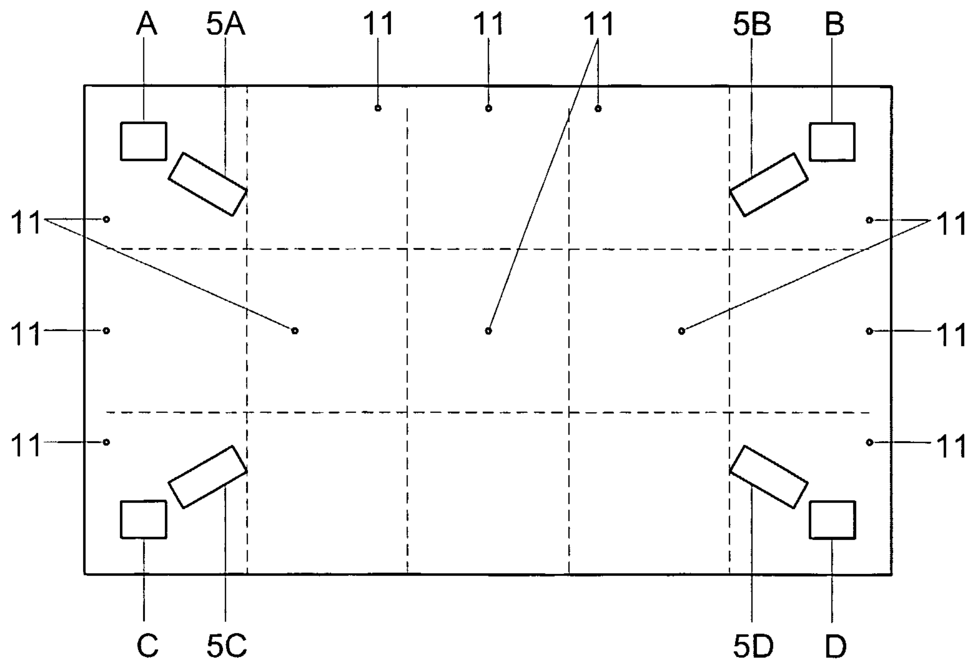

Fig. 3

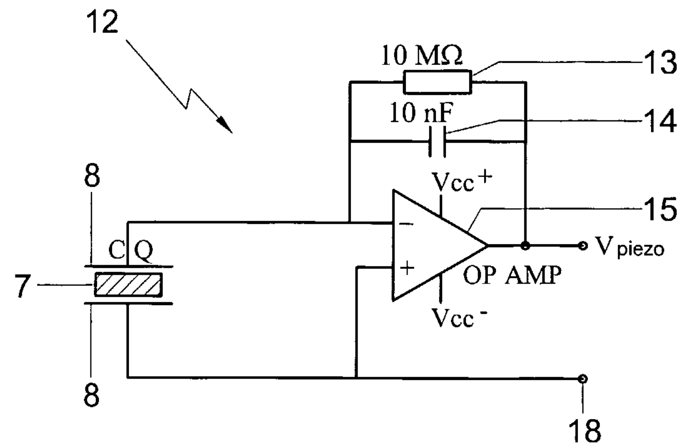

Fig. 4

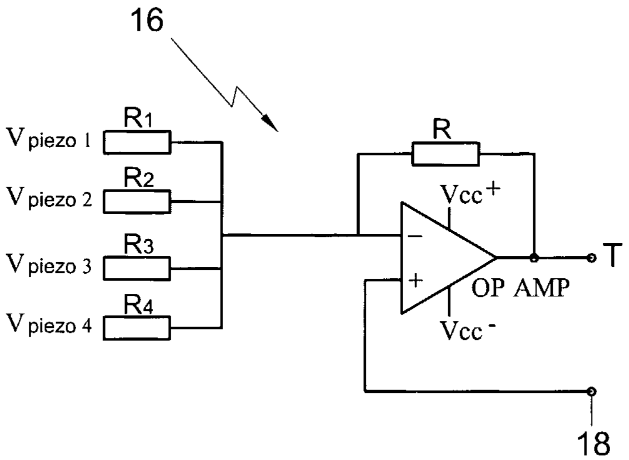

Fig. 5

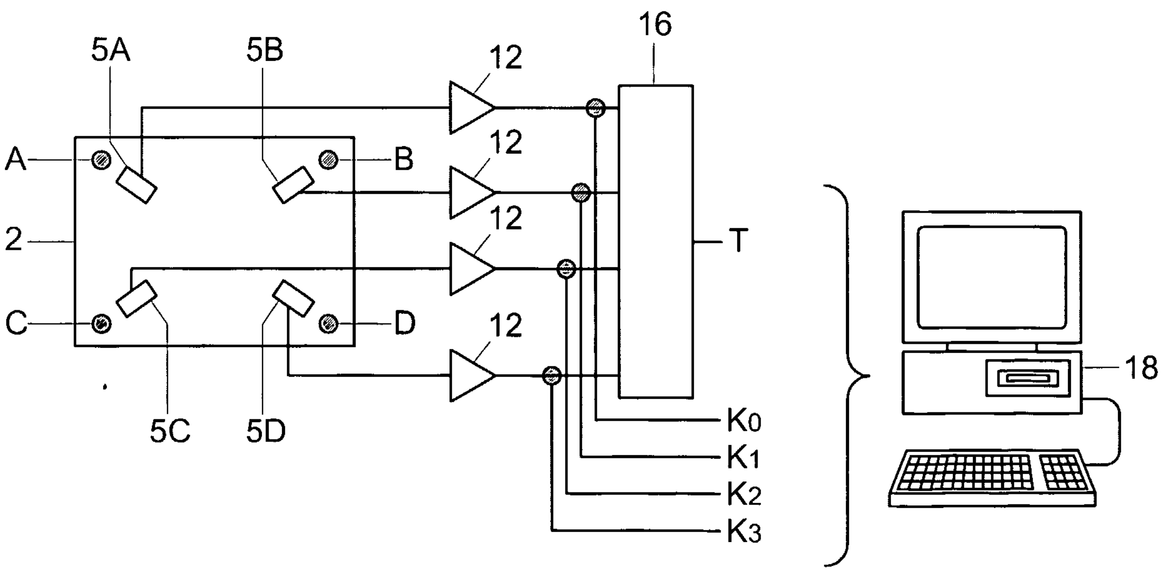

Fig. 6

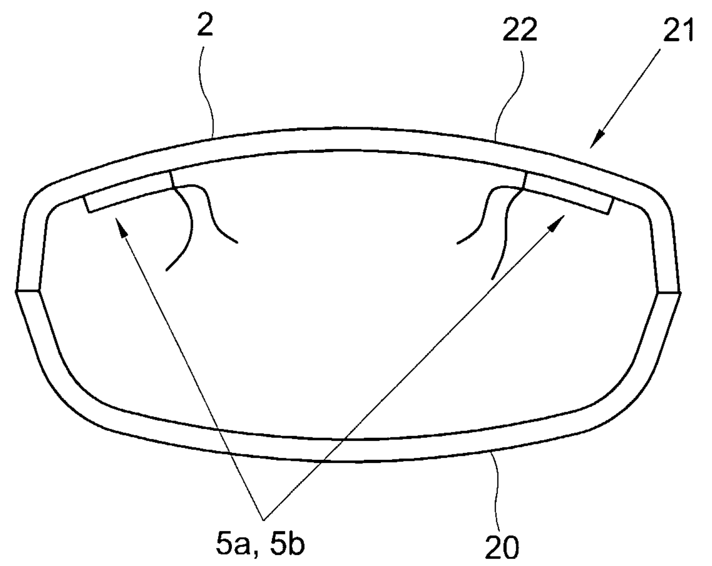

Fig. 7

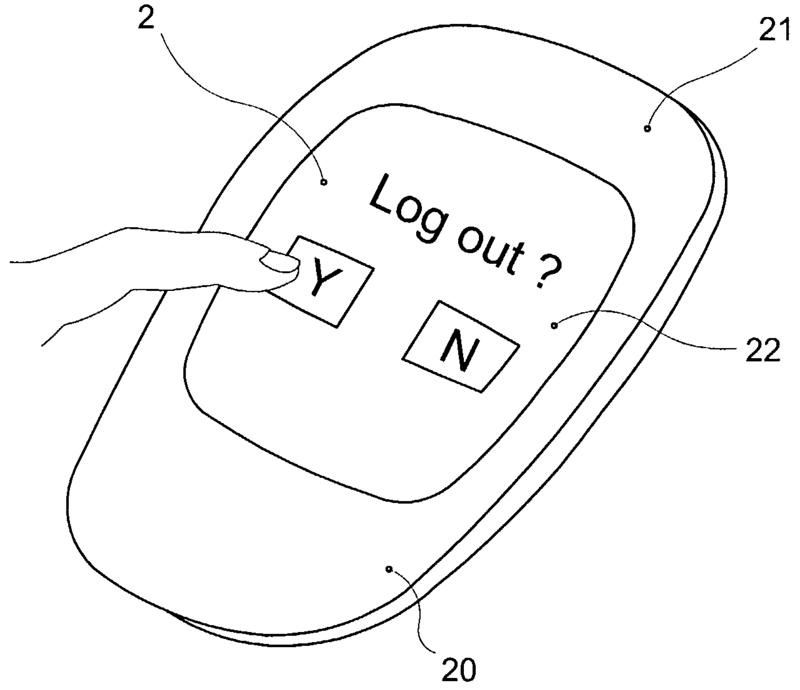

Fig. 8

INTERNATIONAL SEARCH REPORT

PCT/NL 02/00700

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06K11/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 511 760 A (GARWIN RICHARD L ET AL) 16 April 1985 (1985-04-16) abstract column 4, line 20 -column 6, line 3; figures 1-4 ---	1-14, 16-18
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 January 2003	20/01/2003

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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