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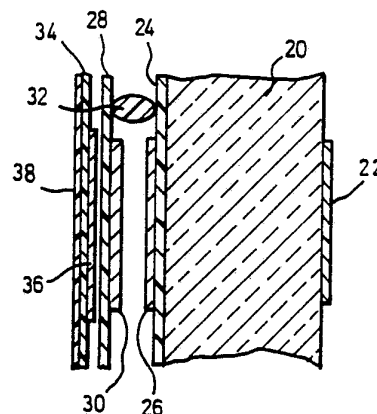
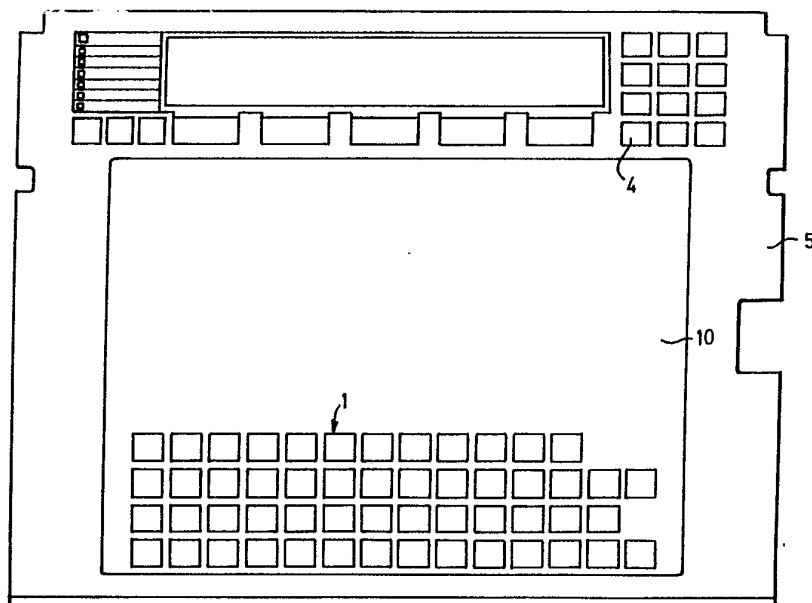
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(54) Title: KEYBOARD HAVING VISIBLE AND INVISIBLE STATES



(57) Abstract

A chart recorder or other instrument has a window (10) within which is a key panel (1) composed of materials which are transparent in normal conditions. Incorporated in or associated with the individual elements of the key panel are display element (22) applied to the transparent window material (20). The display elements are normally transparent but become visible for example by fluorescence, when illuminated by radiation transmitted through the body of the transparent window material (20), rendering the key panel visible when needed for use.

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KEYBOARD HAVING VISIBLE AND INVISIBLE STATES

This invention relates to display devices and has particular but not exclusive reference to the construction of keyboards and the like.

It is an object of the invention to enable a symbol, character, image or the like to be displayed in conjunction with another display, or an observation window or the like, in such a way that the other display, or the observation window is normally required to be unobstructed and can be made with the greatest possible area.

One application of the present invention is in chart recorders and other devices, in which an instrument or recorder incorporates a window or is placed behind a window, through which it can be observed in normal operation. Such devices may be provided with operating buttons, keyboards and the like, for controlling or adjusting their operation, inputting and outputting information, and so on. Providing conventional push buttons, keyboards and the like will often either reduce the area available for the observation window or increase the overall size of the device. It is an

object of the invention to provide for an auxiliary display, either forming part of an input-output system or simply as a display, which does not reduce the space available for the window and which when not in use does not obstruct the normal observation of what lies behind the window.

According to one aspect of the present invention, a recording or measuring device or the like is provided with an observation window through which it can be observed in normal operation, and the window is provided with at least one display element having an operative state in which it is visible and an inoperative state in which it is substantially invisible.

According to another aspect of the present invention, a display device comprises a transparent substrate, for example a panel of transparent material, at least one symbol, character, image or the like provided on a surface of the substrate and normally substantially transparent and means for illuminating the display element with radiation to which the said element is responsive, for example visible or ultraviolet light, thereby to render the element visible.

According to a further aspect of the invention there is provided a keyboard device comprising a transparent panel, transparent circuit elements thereon defining a keyboard, at least one radiation-responsive display element forming part of or in register with at least one said circuit element, said display element being normally transparent, and a radiation source for selectively irradiating the display element thereby to render it visible for revealing the keyboard.

The display element may have an active response to the radiation, e.g. fluorescence, chemoluminescence, polarisation etc.

Conveniently, the display element is fluorescent, and is illuminated by radiation transmitted within the panel or substrate acting as a light guide.

Alternatively the display element may comprise a local change in composition, surface texture or other physical characteristic of the panel or substrate, such as to scatter or otherwise passively redirect light when illuminated and thereby to reveal the positions of the elements.

To enhance transmission of the activating radiation from the substrate to the display element, the display element may be composed of a medium which etches or otherwise modifies the surface of the substrate.

Yet another possibility is the use of display elements responsive to an applied electrical stimulus e.g. liquid crystal elements rendered visible by an applied voltage.

The substrate is preferably provided with transparent electrical tracks or circuit elements in predetermined relationship with the display element or elements, and forming part of a keyboard or the like, all composed of electrically conductive substantially transparent material, for example indium tin oxide (ITO), to form a keyboard or the like which is normally invisible but can be rendered visible, in effect, e.g. by application of radiation to activate the display element or elements, so that the display elements reveal the positions of the keyboard components.

The display elements may be separate from but in register with the tracks or circuit elements, or may be combined with the tracks or circuit elements.

The present invention has a particular, but not exclusive, application to keyboards for chart recorders and similar instruments.

Modern electronic chart recorders are complex instruments, incorporating data-processing electronics capable of being programmed. Such instruments are commonly provided with a keyboard of some kind, for use by the regular operator to control the recorder and to enter or extract information. This may be for example a simple numeric keypad or dedicated keys.

It is also desirable that the circuitry be accessible at a higher level, for example by a supervisor or by a programmer to change the programming of the controlling electronics. Such a person may require the use of more extensive input/output facilities, in particular a full alphanumeric keyboard. It is also desirable that these more extensive access facilities should not be usable by the normal operator.

These requirements can be met, for example, by the provision of an input/output port, through which a separate terminal or other peripheral device can be connected to the recorder for example to enter text

strings. This is inconvenient. It is also possible to provide a keyboard for the operator and a separate full text keyboard for use by a supervisor or programmer, but if this is done using conventional keyboard constructions, the full text keyboard inevitably occupies a considerable amount of space on the front panel of the instrument, which either increases the size of the front panel or reduces the area available for viewing the recording chart in operation, which of course is an essential feature of a chart recorder.

In accordance with the present invention, a full text keyboard can be incorporated in the viewing area of the front panel. Normally, a source of activating radiation is not in operation and therefore the keyboard is not visible, leaving the entire area of the front panel or viewing window unobstructed for observation of the chart by the normal operator. When a programmer or supervisor wishes to use the full text keyboard, the source of activating radiation is energized, thereby rendering this keyboard visible within the normal viewing area.

It is to be understood that the electrical elements of this keyboard may remain invisible, but their positions are indicated by the activation of display elements in register with them, enabling them to be used.

The invention will be further described with reference to the accompanying drawings, which illustrate one embodiment of the invention, by way of example only, and in which:

Figure 1 is a front view of a chart recorder panel

Figure 2 is a fragmentary cross-section of a lower region of the panel, enlarged, and

Figure 3 illustrates one possible arrangement of the radiation source for rendering the keyboard visible.

Figure 1 shows the front panel of an electronic chart recorder. The panel is made of a transparent synthetic resin sheet material for example an acrylic sheet or a polycarbonate sheet, with a thickness of, for example, 3mm. It forms or is set into the front of a housing of the chart recorder.

The central region 10 of the panel is transparent. The peripheral region 5 is opaque, for example grey. The clear region 10 forms an observation window through which an operator can observe the chart or charts within the housing.

It is to be understood that the chart recorder mechanism and electronic circuitry can take any convenient form and constitute no part of nor limitation of the present invention. In accordance with conventional practice, the chart recorder comprises a closed housing within which is a mechanism for advancing a recording chart, and pens, printing means or the like for marking the chart as it advances, to provide a record of one or more variables with time. The marked chart can be inspected at any time through the observation window to show the current and past values of each variable, and is subsequently removed as a permanent record. Input signals to the chart recorder, for example from industrial process sensors, are processed by electronic circuitry in the chart recorder before being displayed.

The upper region of the illustrated panel, above the window 10, incorporates an operator's keyboard and operating display devices, although these are optional and not an essential part of the invention. By way of example only, a conventional numeric keypad 4, for example a conventional membrane keyboard, is provided in the upper right corner of the opaque peripheral area, this keypad is intended for everyday use by the normal operator of the chart recorder. The upper region of the

panel may also contain display regions. This keypad and display regions are connected to the electronic controlling and signal-processing circuitry of the chart recorder and are employed in the every-day use of the chart recorder.

In the lower region of the panel, within the clear observation window area 10, is a keypanel, such as a full alphanumeric key panel 1, also connected to the controlling and signal-processing circuitry. In normal conditions this is substantially invisible and it does not significantly impede the observation of the recording charts. For use by a programmer, it can be made visible. At this time, it partly obstructs the observation window but this does not matter.

The key panel 1 can access the circuitry at a relatively high level, suitable for use by a supervisor or by a programmer, as explained previously. The operator's keypad 4 can access the circuitry only at a lower level, appropriate to everyday operations during the normal operation of the chart recorder. Accordingly, it is important that the viewing window be unobstructed while an ordinary operator uses the keypad 4, but it is not important that the window may be partly obstructed by

the key panel 1 when this is being used by a supervisor or programmer, as this will happen rarely and will not normally require that the user be able simultaneously to observe the recording chart with ease.

The positions of the operating keys of the keyboard 1 are indicated in Figure 1 by respective rectangles. Each of these is associated with one or more display elements which are normally invisible but can be rendered visible to indicate the positions and functions of the individual keys. The construction of this keyboard is shown in Figure 2.

Figure 2 shows, in cross-section, a portion of the transparent plastics panel. On the rear surface of the panel are individual normally transparent display elements 22, for example individual alphanumeric characters or other key-identifying symbols. In the described embodiment they are fluorescent, but other modes of activation can be used within the scope of the invention.

In front of the plastics panel is a transparent membrane keyboard, with individual key elements 26, 30 in register with the corresponding display elements 22.

The membrane keyboard includes a rear sheet of polyester material 24 adhered to the front surface of the window panel 20, and individual contact pads 26 and associated tracks deposited on the front surface of the polyester sheet 24, the contact pads and tracks being made of transparent indium tin oxide (ITO). In front of this is a further, flexible, polyester sheet 28 carrying on its rear surface transparent ITO key contact pads 30 and connecting tracks for these, the pads 30, in register the pads 26, and display elements 22 all being in register. The polyester sheets 24, 28 are separated by spacers 32 between adjacent key contact pad positions so that operation of one key will not affect adjacent keys.

In front of the polyester sheet 28 is a further flexible polyester sheet 34, on the rear surface of which is reverse silk screen printed artwork 36.

The front of the polyester sheet 34 carries a hard coat protective layer 38, also transparent. Thus, all constituents of the keyboard 1 are transparent. The spacers 32 are preferably made of a transparent or translucent material, but since these will normally be very narrow they will not seriously impede observations of the chart behind the keyboard even if they are not transparent.

To render the display elements 22 visible, a light source 40 (Figure 3) at the lower edge of the panel, when lit, injects radiation into the panel, this radiation being of a wavelength which will cause the display elements to become visible, in particular to fluoresce. The radiation will usually be visible radiation but may be ultraviolet. The refractive index of the panel material is such that the radiation, having entered the panel, is substantially trapped within the panel by total internal reflection, so that the panel, when viewed, does not appear to be illuminated. However, at the positions of the display elements 22, radiation will leak from the surface of the panel because of the local change in the refractive index of the adjacent medium and/or in the surface flatness of the panel under the display element. Radiation will therefore pass from the panel into the medium of the display elements, causing it to become visible and render the display elements visible. The keyboard 1 is thereby revealed to a user, although the electrical elements of the keyboard remain invisible, the light from the display elements passing out through them. The areas between the display elements remain effectively transparent and unilluminated.

The display elements, when not illuminated, are transparent as already described. The nature of the ink or other medium used to form the display elements is selected, as to its nature, density and thickness, to ensure the transparency and invisibility of the display elements.

The display elements can be applied for example by silk screen printing. The printing medium may for example be an fluorescent ink-varnish composition. The ink type used, the proportion of ink to varnish and the thickness of the printing screen all affect the ratio of transparency when not illuminated to luminance when illuminated, and therefore the visibility of the keyboard. Different coloured display elements can be achieved by using different ink colours in the printing medium. Alternatively different coloured display elements can be achieved by interposing a colour filter between the light source and the display panel.

For maximum visibility of the display element, clearly the greatest possible amount of light should be introduced into and trapped within the panel, and then the maximum amount of light emitted from the display elements is to be transmitted to the front of the panel.

The transmission of light into the display elements and therefore the intensity of illumination can be enhanced, if the rear surface of the panel is slightly roughened or recessed under the display elements. This can be achieved by using an ink which will etch the material of the panel.

The light source and its relation with the panel should be such as to maximise light input into the panel. Preferably, the light source would extend along and directly adjacent to the bottom edge of the panel. However, if there is not enough space for this arrangement, the light source may be arranged adjacent to a face of the panel, close to an edge of the panel, with the panel edge beveled or chamfered so that light entering the panel through its face is reflected by the internal surface of the chamfered edge into the interior of the body of the panel. Such an arrangement is illustrated by Figure 3. The angle α of the lower edge may for example be 50° from a right-angled edge, that is to say, the included angle between the internal surface of the edge and the internal surface of the light-emitting face is for example 40° .

The chamfered edge surface 42 may be externally silvered to improve conduction of light into and along the panel.

If there is any printing on the panel between the light source and the keys, it is preferably overlaid on silver or white to minimise light loss from the panel at the print positions, e.g. in region 5 in that portion at the bottom of the panel.

The described combination viewing panel and keyboard has a number of significant advantages. Without reducing the effective viewing area, it permits entry of alpha-numeric information by a user without the need of additional devices. Because the size of the keyboard is not subject to any limitation, a full character set of keys can be provided, avoiding the use of shift keys, and the individual keys can be large enough for easy operation (a key size of at least 100² mm is normally recommended).

Numerous variations are possible within the scope of the invention. For example, the keyboard may have any desired layout. Although plastics materials have been mentioned as panel materials, a glass panel may also be used.

The upper and lower keyboards may form part of a single touch-panel keyboard overlay covering the entire area of

the transparent panel 1 and incorporating all necessary colouring to define different areas of the observation window and the respective keyboards and display areas. Alternatively, separate upper and lower keyboard assemblies may be provided. The upper keyboard may be omitted or placed elsewhere on the instrument.

It will be understood that the lower "invisible" keyboard may incorporate display elements additional to those specifically associated with individual keys, for example warnings and other information applicable to programming operations.

CLAIMS

1. A recording or measuring device provided with an observation window through which the device can be observed in normal operation, which window is provided with at least one display element having an operative state in which it is visible and an inoperative state in which it is substantially invisible.
2. A device as claimed in claim 1 in which the window comprises a transparent substrate, at least one radiation-activatable symbol, character, image or the like provided on a surface of the substrate and normally substantially transparent, and means for selectively illuminating the display element with activating radiation to render it visible.
3. A display device which comprises a transparent substrate, at least one radiation-activatable symbol, character, image or the like provided on a surface of the substrate and normally substantially transparent, and means for selectively illuminating the display element with activating radiation to render it visible.

4. A device as claimed in claim 2 or 3 in which the display element is fluorescent, and is illuminated by radiation transmitted within the substrate acting as a light guide.

5. A device as claimed in claim 4 in which the illuminating means is placed adjacent an edge of the substrate.

6. A device as claimed in claim 5 in which the edge of the substrate is bevelled and the illuminating means is placed to direct radiation through a face of the substrate onto the internal surface of the bevelled edge for total internal reflection of the radiation into the body of the substrate.

7. A device as claimed in any of claims 2 to 6 in which the substrate is provided with transparent electrical tracks and/or circuit elements in predetermined relationship with the display element or elements, and forming part of a keyboard or the like, all composed of electrically conductive substantially transparent material to form a keyboard or the like which is normally invisible but can be rendered visible, by application of said activating radiation to activate the display element or elements.

8. A device as claimed in claim 7 in which the display elements are separate from but aligned with the tracks and/or circuit elements.

9. A keyboard device comprising a transparent panel, transparent circuit elements thereon defining a keyboard, at least one radiation-responsive display element forming part of or in register with at least one said circuit element, said display element being normally transparent, and a radiation source for selectively irradiating the display element thereby to render it visible for revealing the keyboard.

10. A device as claimed in any of claims 2 to 9 in which the panel or substrate surface is etched or otherwise modified at the position of the display elements.

11. A device as claimed in claim 1 or 2 comprising a chart recorder.

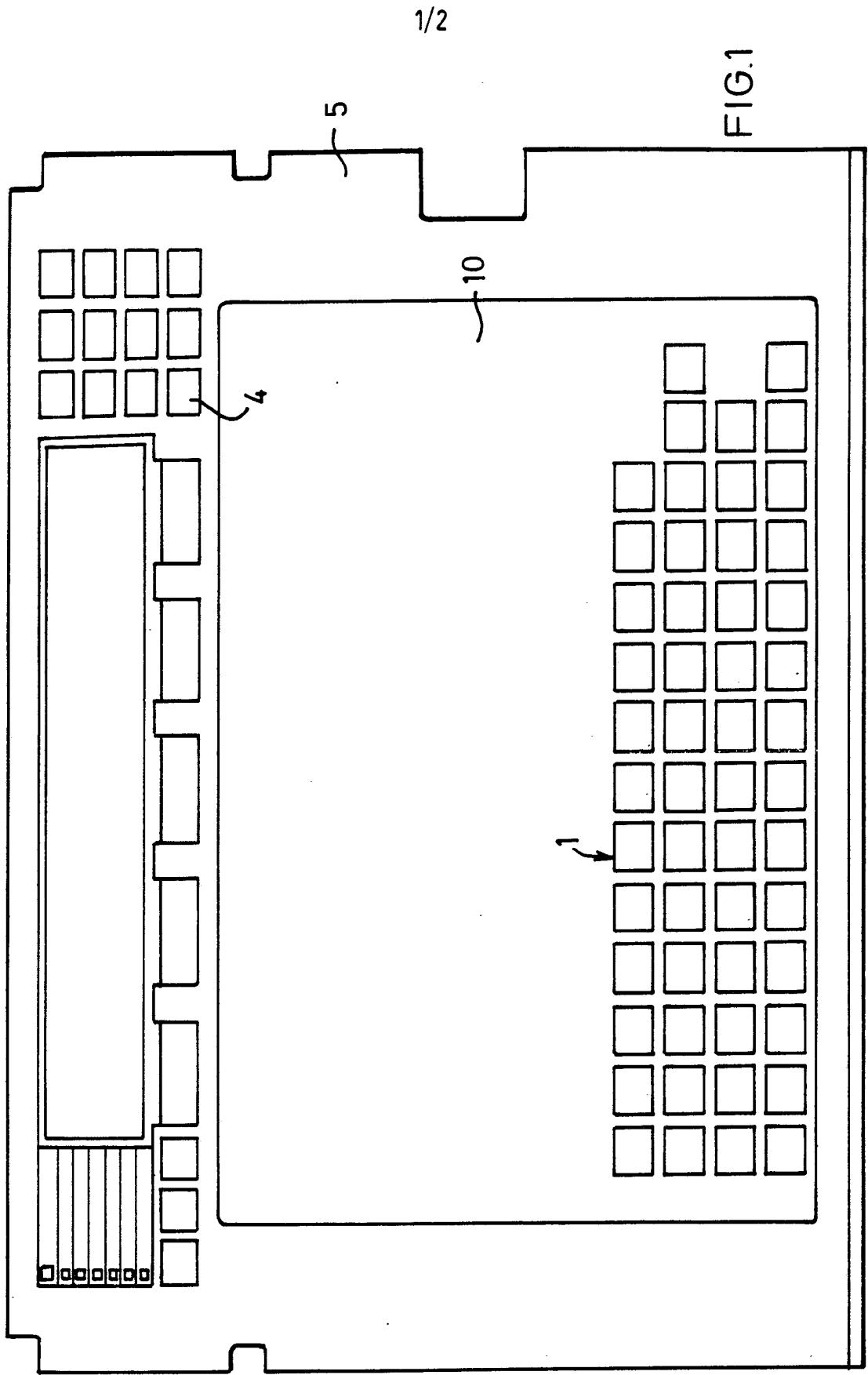
12. A chart recorder incorporating as an observation window a display device as claimed in any of claims 3 to 11.

13. A chart recorder incorporating a keyboard as claimed in claim 7, 8 or 9, or claim 10 when dependent thereon.

14. A chart recorder as claimed in claim 12 in which the said keyboard is adapted to access control circuitry of the recorder at a first higher level and in which a further operator's keyboard is provided which can access the circuitry only at a second lower level.

15. A chart recorder as claimed in claim 12 or 13 in which the first-mentioned keyboard occupies at least part of the viewing area of a window of the recorder.

16. A chart recorder incorporating a keyboard substantially as herein described with reference to the accompanying drawings.



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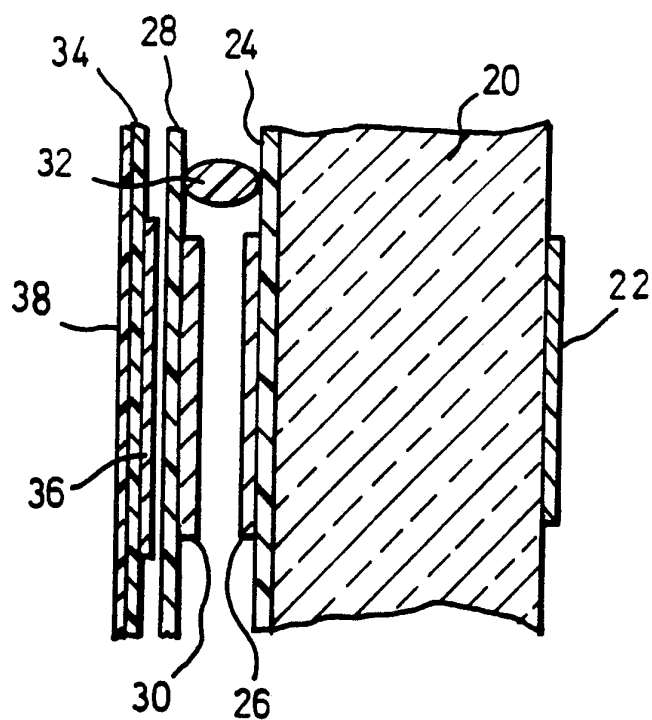


FIG. 2

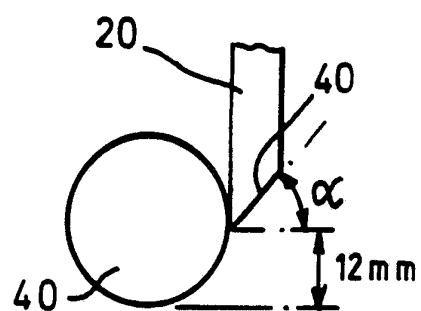



FIG. 3

INTERNATIONAL SEARCH REPORT

PCT/GB 91/00794

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 G01D9/00 ; G01D11/28 ; G09F13/20		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	G01D ; G09F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	MEDIZINTECHNIK vol. 29, no. 2, 1989, BERLIN DD pages 58 - 59; VON HOLGER ZORN: 'MEHRKANALIGE LANGZEITREGISTRIERUNG LANGSAMVERLAUFENDER FUNKTIONEN ' see the whole document ---	1-4, 9, 11-16
Y	WO,A,8 702 813 (HOLMAN ASSOCIATES) May 7, 1987 see claims 1,2 ---	1-4, 9, 11-16
<p>¹⁰ Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
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06 AUGUST 1991	22. 08. 91	
International Searching Authority	Signature of Authorized Officer	
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

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SA 47498

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06/08/91

Patent document cited in search report	Publication date	Patent family member(s)	Publication date

WO-A-8702813	07-05-87	NL-A- 8503017	01-06-87
		AU-A- 6622086	19-05-87
		EP-A- 0250478	07-01-88
