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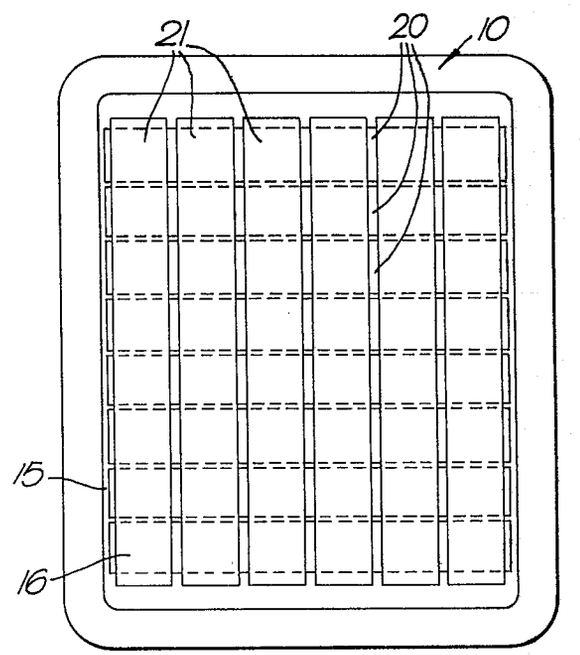
## (54) Information display devices.

(57) In an information display device for viewing at close quarters, a flood gun CRT (10) has intervening electrode structure 15, 16 arranged such that any of the addressable areas formed by rows (20) and columns (21) may be controllably activated. Each area is associated with an information legend (not shown) and may be activated to indicate the status of the associated information.

The present invention overcomes the problem of providing an easily addressed, bright and chromatically consistent display for use in rugged environments including aircraft.

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# INFORMATION DISPLAY DEVICES

This invention relates to devices for the display of information and in particular to devices for display of information legends for viewing at close quarters.

A known method of information display involves illumination of an indicator associated with a legend bearing information status details. To date indicators such as lamps and light emitting diodes have been employed. Problems with such indicators include device failure, inconsistent brightness between devices and the difficulty of maintaining chromatic consistency as brightness varies, for example the shift towards red which occurs as a lamp filament carries less and less current.

Recently the use of comparatively reliable Cathode Ray Tubes (CRT) has been proposed for information display applications, such as for example in an aircraft. Unfortunately use of a CRT, with its associated time base and scan drive components is an expensive display compared with simple indicators. If a colour display is contemplated, for example red for danger, use of a conventional shadow mask CRT compounds expense and complexity. Use of a shadow mask CRT may be ruled out for some applications due to the mass of the shadow mask and alignment problems, such as applications where the CRT may be subjected to vibration and g-force, including use in a vehicle.

According to the present invention an information display device for local viewing includes a flood gun cathode ray tube

having an electron emissive cathode, a light emissive phosphor on a viewing face, and an intervening electrode structure providing addressably activatable areas on the viewing face, and an information legend associated with each activatable area such that activation within an area displays information by revealing the associated legend.

Preferably an information legend is applied to the CRT face over an addressable area as a light blocking stencil or alternatively an electron blocking legend included in the intervening electrode structure. An area may advantageously be activated to provide a legend background. In a preferred embodiment of the present invention areas of different phosphor give a colour presentation and colour change is used to further indicate information status, advantageously by a voltage controlled penetron phosphor.

Alternatively a legend may be revealed in an area by selective activation of addressably activatable segments within that area. In this way a dynamic legend within an area may be formed. Legends may be formed of alpha-numeric characters or alternatively convey information status by overall shape within an area.

Display arrangements based on flood gun CRTs are described in UK Patents 1,536,776 and 1,569,973. It will be appreciated that these patent specifications, which relate to the art of displaying a character for distant viewing and not information at close quarters, disclose a CRT structure in which addressable areas of a CRT face may be illuminated. As will be appreciated by those skilled in the art to which the present invention relates, in the present invention use is made of a flood gun CRT with an electrode structure providing addressably activated areas together with a realisation that such a structure can provide edge resolution suitable for viewing at close quarters.

In order that features and advantages of the present invention may be appreciated embodiments and examples will now be described with reference to the accompanying diagrammatic drawings, of which:

Fig 1 represents a flood gun CRT,

Fig 2 shows electrode structure of the CRT of Fig 1,

Fig 3 represents a typical information display,

Fig 4 shows electrode structure detail,

Fig 5 a further information display,

Fig 6 shows alternative electrode structure,

Fig 7 shows further electrode structure,

Fig 8 shows electrical installation for an aircraft,

Figs 9 and 10 show physical installation in an aircraft, and

Fig 11 shows a further information display.

In a flood gun CRT having a glass envelope 10 (Fig 1) an electron flood is provided by emissive filaments, such as filament 11, and rear electrode 18 towards phosphor 12 by means known in the art. The flood emission is accelerated by a field mesh 14 and controlled by a first intervening electrode 15 and a second intervening electrode 16. The way in which first and second electrodes 15 and 16 control the electron flood to provide addressably activatable areas on CRT face 17 is documented, as for example in the UK patent specifications referenced above. Electrodes 15 and 16 may be of mesh construction and arranged in row stripes (such as stripes 20) and column stripes (such as stripes 21) as may be more clearly seen in Fig 2. It will be appreciated that by suitably addressing the electrode stripes by means known in the art any area, or with multiplexing any combination of areas may be activated.

In accordance with the present invention an item of information is associated with each addressable area, and activation of the area as described above is controlled to display the status of that information. For example in a display 30 (Fig 3) for local viewing and including addressable areas arranged in eight rows of two columns a static information legend, such as legend 31 is applied as lettering directly on the CRT face 32. Activation of the area behind the lettering indicates status by drawing attention to that information. It will be appreciated that a feature of this embodiment of the present invention is its simplicity. It may be implemented using a dedicated electrode for each area without a need for multiplexing. It will be further appreciated that if illumination of the letters themselves is preferred as an indication of status this may be achieved by applying the legend in the form of a stencil.

In an alternative embodiment of the present invention a static legend 40 (Fig 4) formed of solid metallic letters is supported by an electrode mesh 41. The electrode mesh is positioned as an intervening electrode in a flood gun CRT as described above. It will be appreciated that when the electrode mesh 41 is held at activating potential the corresponding CRT area will illuminate, save for the legend 40 due to the electron blocking properties of the letters. It will further be appreciated that illuminating letters may be similarly achieved.

In a further embodiment of the present invention static legends, such as legends 50 and 51 (Fig 5) are used in combination with dynamic legends such as legends 52 and 53 wherein addressable segments within an area are arranged in the form of a bar graph 54 or a seven segment format 55. In this embodiment a colour display is achieved by depositing phosphors of different colours at the addressable areas, for example orange for bar graph 54 and green for seven segment matrix 55.

In order to reduce as far as practicable the number of separate connections required to be made to individual electrodes multiplexing is employed in the areas of dynamic legends. Separate connections may be made to electrodes associated with static legends, such as legend 50. Common connections may be made to corresponding segments of each bar graph display, so that a segment may be selected, and the required bar graph selected by further connections to further electrodes, one associated with each bar graph.

In an information display device (Fig 7) in which areas of dynamic legend 160, 161 in the form of bar graphs and areas of static legend 162, 163, 164, 165 are controlled by mesh electrode structure, such as mesh electrode 166, supported in a stamped plate 67; the way in which activation of each segment or area by applying suitable potential to the electrodes, such as electrode A, for area 162 will be apparent to those skilled in the art. Suitable potential applied to an electrode will cause that electrode to block electron passage, thereby producing no illumination of the tube face, (not shown).

Static legends are activated by direct connection to the electrode area, such as connection $A_1$ to electrode 162. Corresponding segments on the bar graph legends 160, 161, such segments 168, 169 have a common connection ($S_1$). By applying suitable potential to connections $S_1$ to $S_{11}$ any combination of segments may be selected for illumination. Gate electrodes 170, 171 mounted in front of the segmented electrodes select the left or right column respectively so that any individual segment in either graph may be individually addressed for activation. Hence by selecting connections $S_1$ to $S_{11}$ in combination with $G_1$ or $G_2$ any segment of any bar graph may be illuminated. The way in which further bar graphs may be controlled and how control may be timed to give apparently continuous illumination will be known to those skilled in the art. The principle of multiplexing may be readily extended to

control a plurality of dynamic numeric legend areas, such as areas 56, 57 (Fig 5).

In accordance with the present invention the status of information may be further indicated by a colour change within an area by means of depositing a phosphor of the penetron type in that area and multiplexing CRT extra high tension (EHT) voltage in accordance with known principles. Suitable phosphors exist to effect a green to yellow to orange to red colour change pattern to legend 50 (Fig 5) as, for example, fuel is used.

It will now be appreciated by those skilled in the art that the present invention provides a CRT display, which may be used for example in an aircraft, without requiring the complex drive circuitry of a conventional raster scan. A colour, including a colour change, display is provided without recourse to shadow masking techniques, embodiments of which are not suited to rugged conditions. With the present invention a bright display of good edge resolution, adequate for example as a source of a gun sight for projection via an aircraft head up display (HUD), which can be accurately positioned in space may be obtained and which due to low mass of the intervening electrodes is suitable for use in a vehicle subject to vibration and g-force.

A particular advantage of the present invention is chromatic consistency with narrow band emission over a range of brightness. A problem with a conventional display based on filament lamps is the emission over a broad band of wavelengths, drifting towards red, and into infra-red as the lamps are dimmed. This can hamper use of infra-red receptive vision goggles as the lamps are dimmed at night. The present invention provides a solution to this problem, and in accordance with the present invention phosphors may be chosen with emission characteristics substantially outside the reception of such goggles.

A further advantage of the present invention is ease of interface with information processing equipment since a highly informative display may be provided with relatively simple electrode structure and hence tube connections, and low switching voltage for control of local area activation. Typically a 10 to 15 volt potential difference may determine area illumination.

In an aircraft instrumentation system a plurality of information display devices in accordance with the present invention may be employed. A typical device, such as the engine management display of Fig 5, is driven by a display driver 70 (Fig 8), controlled by a display computer 71. Display control is derived from aircraft sensors 72 and aircraft systems data 73, via aircraft computer 74. The function of the display driver is to control the display device by means of direct inputs A to $A_{41}$ and multiplexed inputs $S_1$ to $S_{11}$ and $G_1$ to $G_4$. Since display device 75 has areas of penetron phosphor, display driver 70 controls colour via high voltage (EHT) generator 77 and input E.

A penetron phosphor is composed of two or more phosphor components, the relative emissions of which are influenced by applied voltage. Thus in areas of penetron phosphor, a colour change may be produced by varying EHT voltage E. The way in which EHT may be time multiplexed (in a way analogous to areas of dynamic legend) will be apparent to those skilled in the art and is effected by display driver 70 via EHT generator 76.

In devices having both static and multiplexed dynamic legends attention must be paid to ensure that the brightness of the static areas does not swamp the multiplexed areas. This may be achieved by pulsing the static areas so that the overall duty cycle is equivalent to that of a multiplexed segment. The duty cycles applied to individual activatable areas or segments is preferably made to track within an overall brightness timing cycle.

A potential problem with dynamic legends wherein information is conveyed by shape is the lack of a smooth change as for example, successive segments of a bar graph are illuminated. One solution is to provide a legend of many segments, but this can add considerable complexity and expense. As an alternative a segment may be faded as a transition is made. One or two segments to each side of an indicated value may be faded or brightened as necessary to provide a vernier when the bar graph legend is relatively coarse, for example 20 to 30 segments. Such a legend may be backed up by an accurate numeric dynamic legend. It will be appreciated that brightness may be straightforwardly controlled in a segment by varying the duty cycle when that segment is selected for activation.

It will now be apparent that the present invention enables many of the advantages of the flexibility of electronic displays to be introduced for example to an aircraft without the expense and other problems of multi-function CRTs. In particular by employing arrays of devices in accordance with the present invention physical cockpit panel layout change is not necessary to effect an instrument layout change.

In accordance with the present invention, alternative information may be displayed for viewing at close quarters in the same general area of the display, provided exact overlap is avoided. The alternative legends may be built up by aligned superimposed electrodes.

In a segment 60 of a masking plate the electron flood is masked, save for stamped out areas, such as areas 61, 62. It will be realised that on the region of the CRT face (not shown) corresponding to segment 60, only those areas for which a stamped out area has been made can be activated. Activation is controlled by a first electrode, having a segment aligned with plate segment 60 along axis 64, and a second electrode having a segment 65 similarly aligned. First electrode segment 63 carries an electrode mesh 66 in areas representing a first display

Second electrode segment 65 carries an electrode mesh 67 in areas representing an alternate second display. It will be appreciated that by controlling voltages applied to the electrodes, either legend may be revealed.

In a cockpit layout for display devices in accordance with the present invention, (Fig 9), devices 80, 81 bearing important information such as threat warnings and weapons status are positioned either side of a head up display 82. Further display devices such as device 83 are positioned along the cockpit coaming line 84. Further devices may be placed in other positions where there is no room for the much deeper conventional displays, for example the panel edges. Displays 85, 86 are viewed superimposed on an outside view from the cockpit through a partial reflector 90 (as may be seen more clearly in Fig 9) of approximately 30% reflectance and 70% transmission, which directs light from a horizontally mounted display devices 87, 88. Reflector 90 is planar since the displays are intended for direct viewing. It will be appreciated that this layout permits installation of conventional direct view instruments in the panel space below the coaming line 84 such as instrument 180. Horizontal device installation gives very little obscuration of conventional panel space and it may permit introduction of display devices into existing cockpit layouts.

A particularly advantageous application for a reflected horizontally mounted display would be stand-by instrumentation, or example a direct view version of a head up display format. Back up of such a primary flight instrument in a prime viewing position with little panel space overhead, is of considerable advantage. Preferably such a device is installed close to the main HUD, for example as display 85, and arranged such that reflector 90 is stowed flat when the standby is not required.

In a display device for use as stand-by (Fig 11) speed, height, pitch and roll are indicated by numeric dynamic legends 100, 101, 102 and 103 respectively. Horizon is indicated by illumination of relevant segments of a circular dynamic legend area 104, about an aircraft symbol 105. Ways in which colour may be used to enhance the display, for example blue above the horizon 106, and green below 107 will be apparent to those skilled in the art. Bar graph dynamic legends 108, 109 may be used to provide flying aids, such as pitch bars. Separately activatable segments, such as segments 110 in each segmented legend may provide addition symbols, such as a caret symbol. In this embodiment, brightness gradation of segments to each side of an activation boundary is particularly effective in reducing distraction caused by sudden legend changes, especially when attention is on other instruments and the device consequently in peripheral vision.

CLAIMS

The matter for which the applicant seeks protection is:

1. An information display device for local viewing including a flood gun cathode ray tube having an electron emissive cathode, a light emissive phosphor on a viewing face, and an intervening electrode structure providing addressably activatable areas on the viewing face, and an information legend associated with each activatable area such that activation within an area displays information by revealing the associated legend.

2. An information display device as claimed in claim 1 and wherein an information legend is applied to the cathode ray tube face over an activatable area as a light blocking stencil.

3. An information display device as claimed in claim 1 or claim 2 and wherein the intervening electrode structure includes an electron blocking legend.

4. An information display device as claimed in claim 1, claim 2 or claim 3 and wherein different phosphors are used in activatable areas to give a colour presentation.

5. An information display device as claimed in any preceding claim and including an area of penetron phosphor.

6. An information display device as claimed in any preceding claim wherein an information legend is revealed in an activatable area by selective activation of addressably activatable segments within that area.

7. An information display device as claimed in any preceding claim having an area providing a dynamic display legend.

8. An information display device as claimed in any preceding claim having a first activatable area addressable directly to provide a static display legend, and a second activatable area

addressable via multiplexing to provide a dynamic display legend.

9. An information display device as claimed in any preceding claim and wherein the phosphor has emission characteristics substantially outside infra-red.

10. An information display as claimed in any preceding claim wherein the intervening electrode structure includes a plurality of electrodes each having electron blocking segments, segments on each electrode aligning with but not overlapping segments on other electrodes so that dynamic legends may be built up in the same general area of the viewing face.

11. Information display apparatus including an information display device as claimed in any preceding claim, and timing circuitry so that brightness within each addressable area may be controlled by varying activation duty cycle applied within each area.

12. Information display apparatus as claimed in claim 11 and havingasegmented activatable area wherein the timing circuitry includes means for varying the duty cycle applied to individual segments.

13. Information display apparatus as claimed in claim 12 and wherein a dynamic indication is made by progressive activation of neighbouring segments to give a moving activation boundary and wherein the timing circuity includes means for varying brightness by duty cycle control in segments to either side of the activation boundary.

14. A vehicle including an information display device as claimed in any of claims 1 to 10.

15. A vehicle as claimed in claim 14 and wherein the display device is arranged for indirect viewing via a reflective plate.

16. A vehicle as claimed in claim 15 and wherein the display device is arranged for viewing via a partially reflective plate, the view being superimposed on an outside view from the vehicle.

17. A vehicle including information display apparatus as claimed in any of claims 11 to 13.

18. An information display device substantially as herein described with reference to the drawings.

19. Information display apparatus substantially as herein described with reference to the drawings.

20. An information display device as claimed in any of claims 1 to 10 and arranged for use as a standby instrument.

Fig.1.

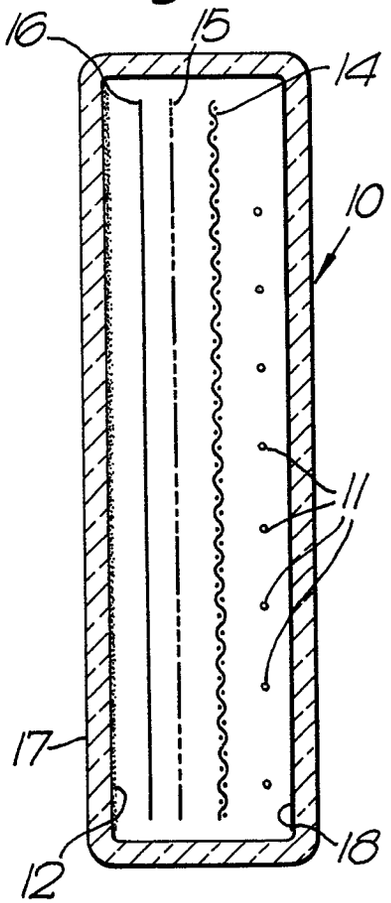


Fig.2.

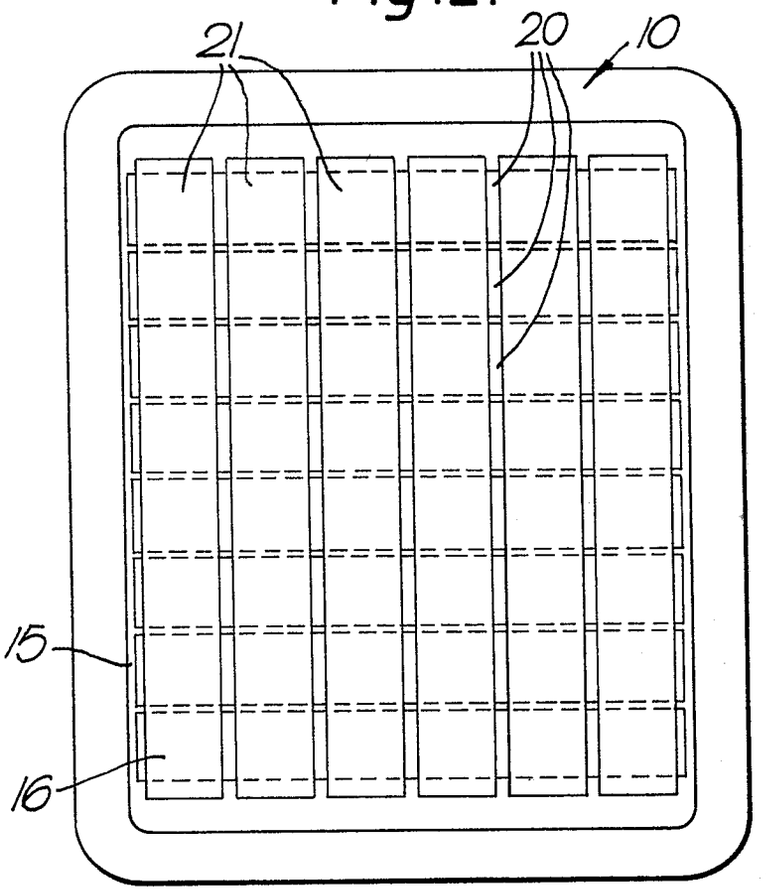


Fig.3.

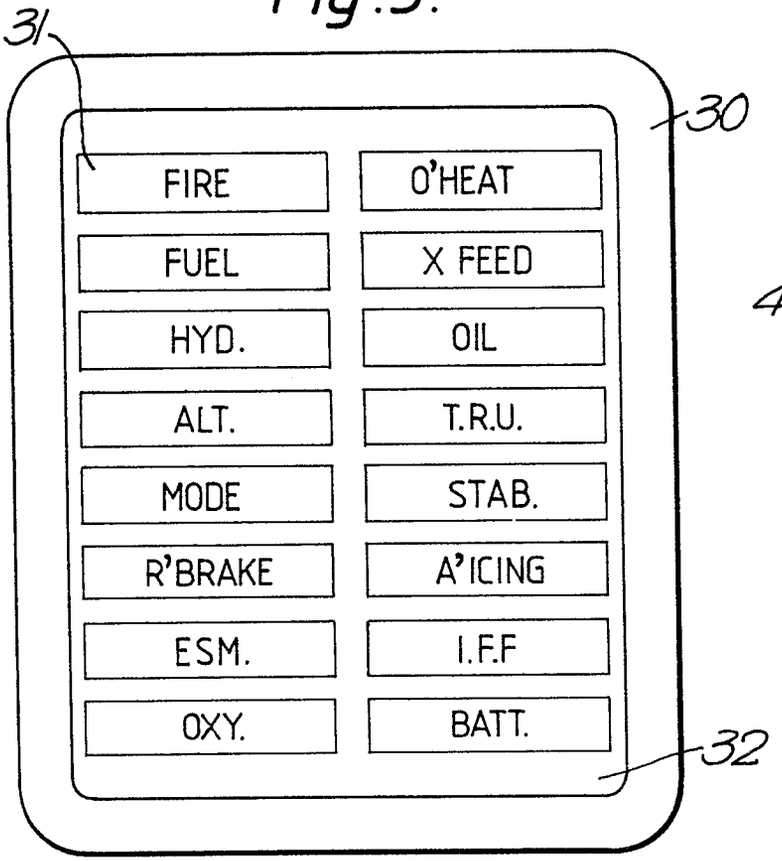


Fig.4.

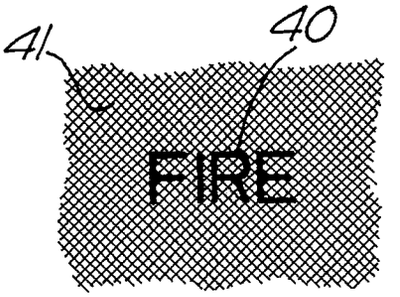

Fig.5.

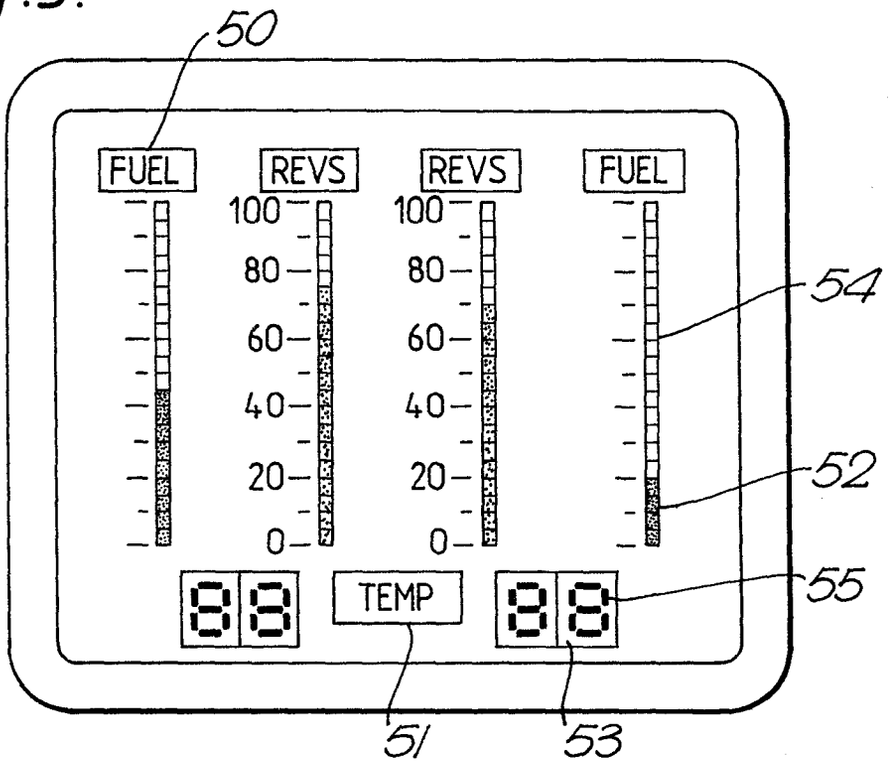
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Fig.6.

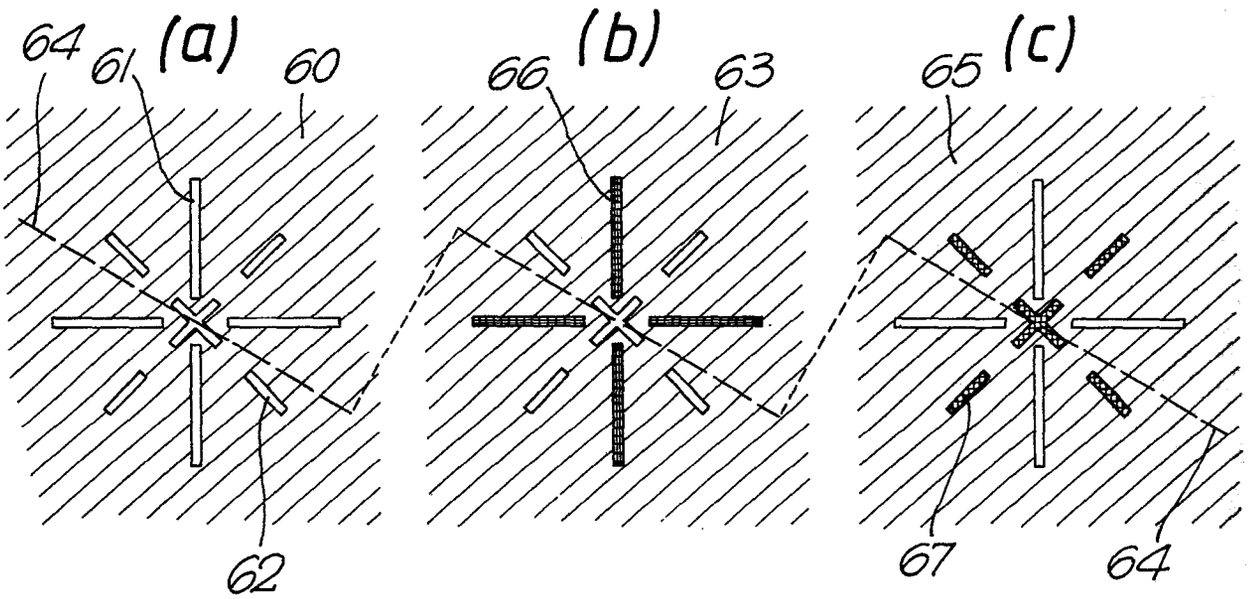
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Fig. 7.

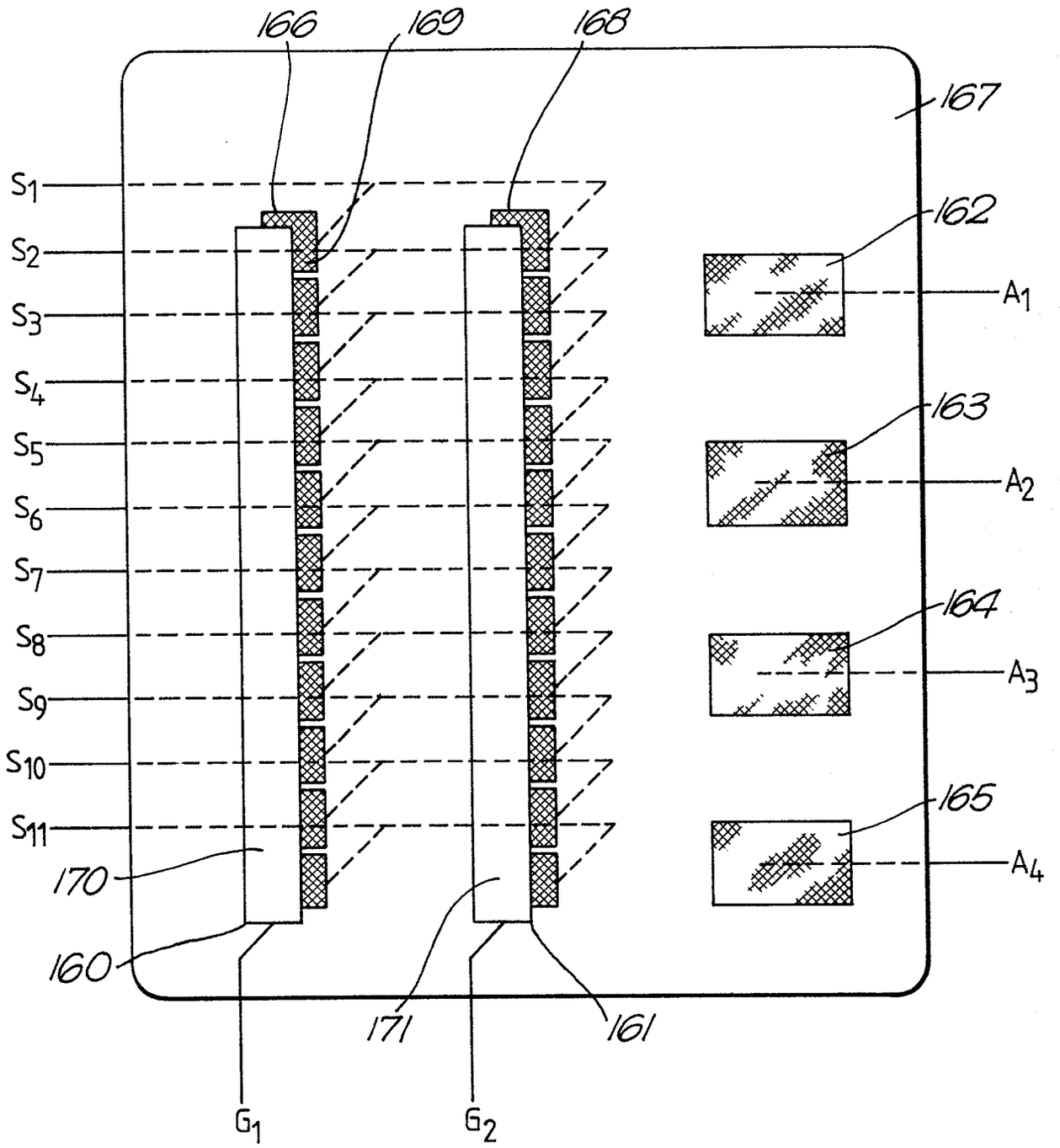
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Fig.8.

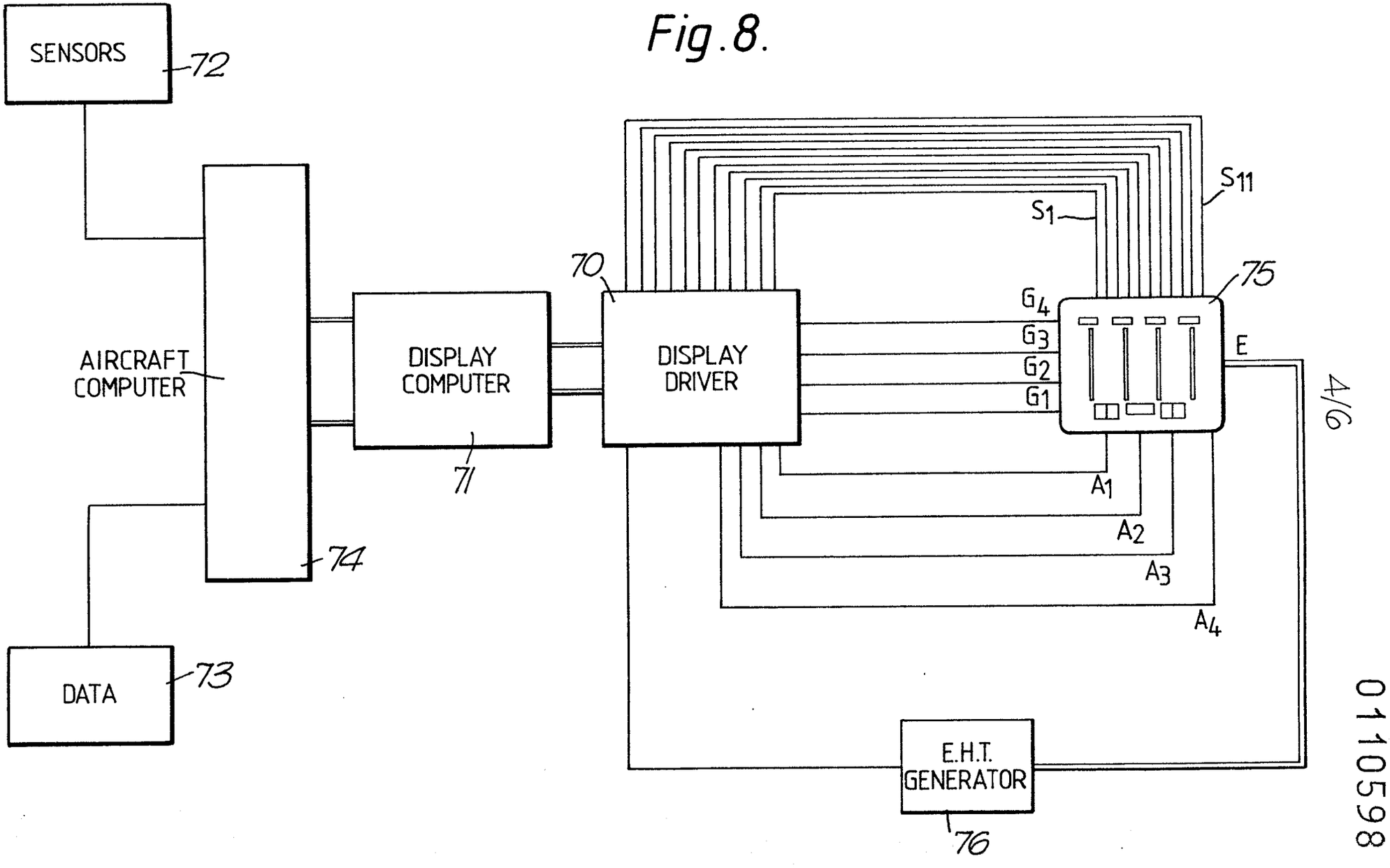




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Fig. 9.

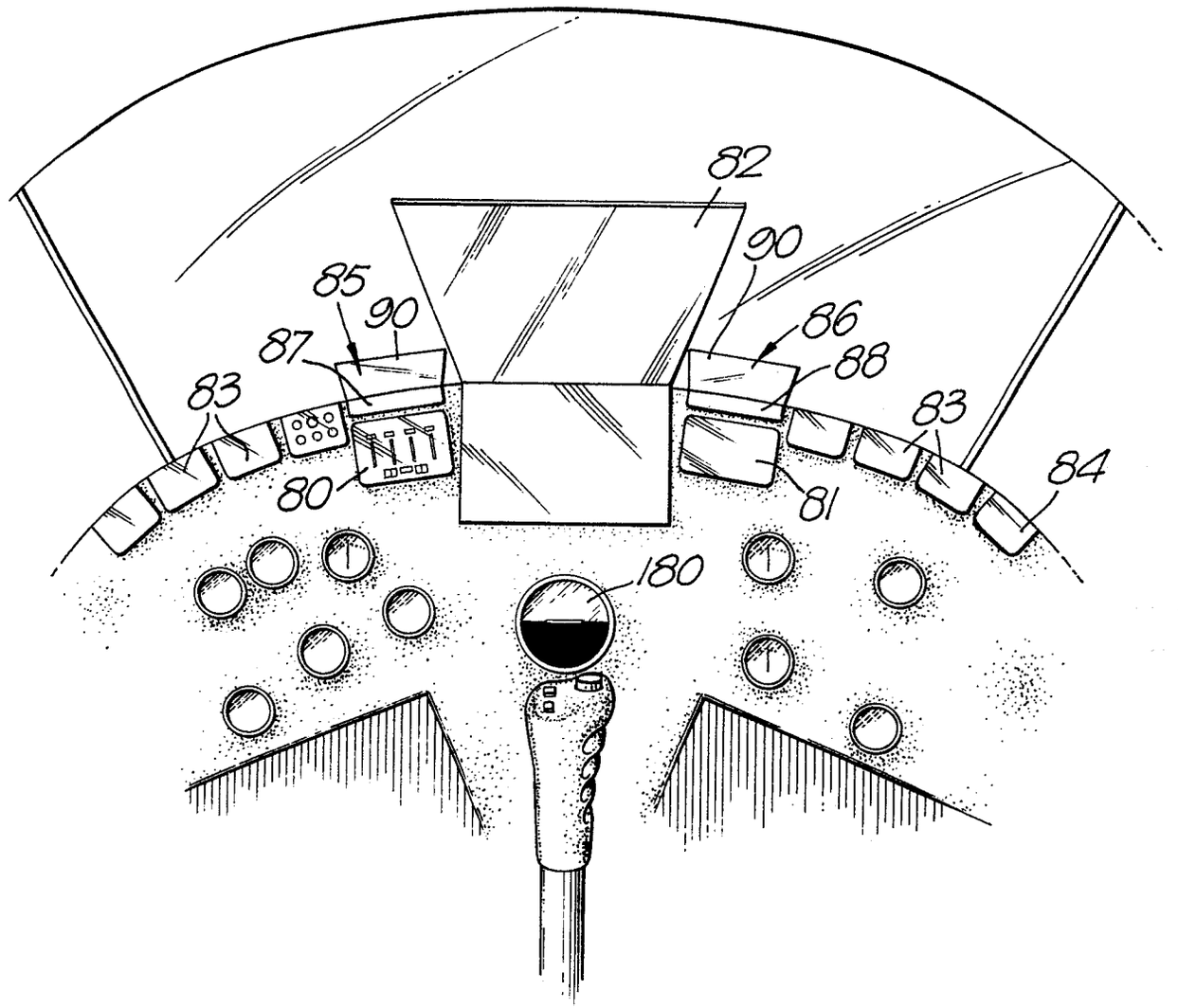
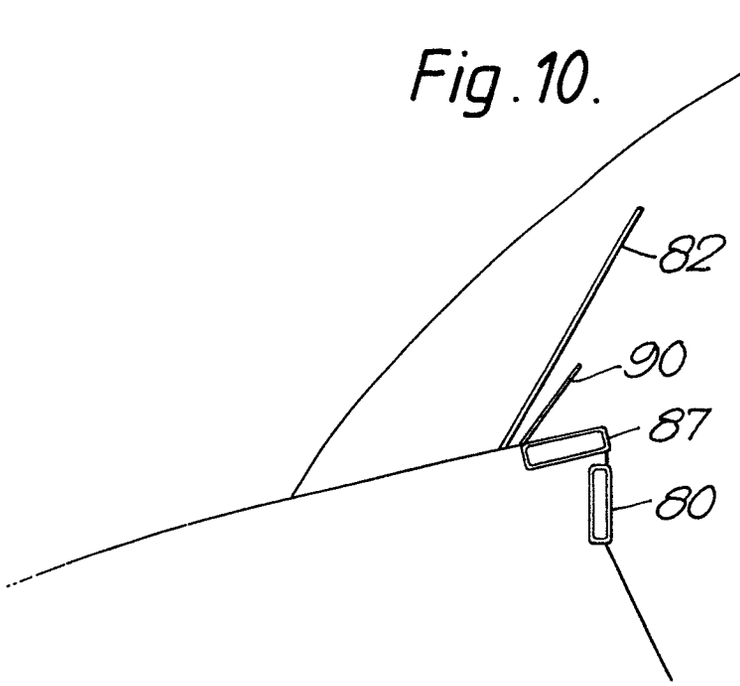



Fig. 10.



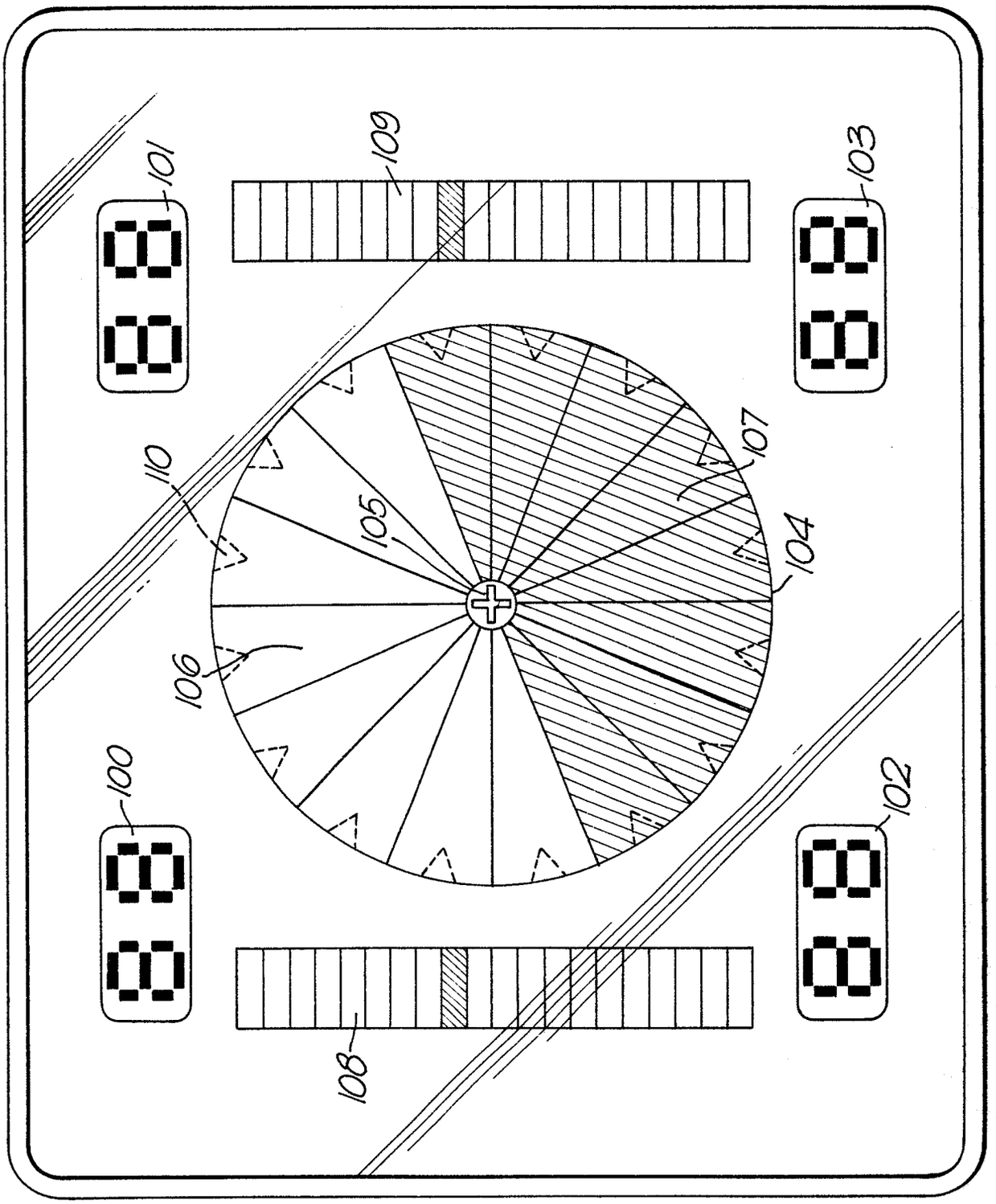



Fig. 11.

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# EUROPEAN SEARCH REPORT

0110598

Application number

EP 83 30 6829

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl. ³) |
|---|---|---|---|
| Y | EP-A-0 009 963 (ENGLISH ELECTRIC VALVE COMPANY LTD.) * Page 3, line 21 - page 6, line 10; figures 1-4 * | 1,3 | H 01 J 31/16 |
| Y | US-A-2 999 178 (C.H. CASH et al.) * Column 1, lines 40-68; column 4, line 45 - column 5, line 20; figures 1-3 * | 1,2,11 | |
| A | FR-A-2 023 605 (ISE ELECTRONICS CORP.) * Page 2, line 14 - page 5, line 27; figures 1-5 * | 1,3 | |
| A | US-A-3 407 331 (F.J. SALGO et al.) * Column 1, lines 47-64; column 2, lines 53-72; column 3, lines 52-72; column 4, line 28 - column 5, line 34; figures 1-6 * | 1,4 | TECHNICAL FIELDS SEARCHED (Int. Cl. ³) H 01 J 31/00 B 64 D 43/00 |
| A | GB-A-2 058 444 (ENGLISH ELECTRIC VALVE COMPANY LTD.) * Page 1, line 80 - page 2, line 49; figures 1,2 * | 1,4 | |
| A | FR-A-2 373 872 (ENGLISH ELECTRIC VALVE COMPANY LTD.) * Page 2, lines 14-27; figures 1,2 * | 3 | |

-/-

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 21-02-1984 | DELANGUE P.C.J.G. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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|---|---|---|---|
| A | DE-A-1 954 359 (DORNIER AG) * Page 2, line 5 - page 3, line 32; figures * | 14-16 | |
| A | FR-A-2 487 120 (THOMSON CSF) | | |

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 21-02-1984 | DELANGUE P.C.J.G. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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