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(54) **Visual display apparatus.**

(57) Visual display apparatus comprises one or more rows of light emitting sources (5) arranged to move cyclically through a display zone. The illumination of the light sources is controlled so that, to an observer, an image appears to be formed in the zone. The apparatus also includes a programming device which encodes artwork or the like in a form suitable for use by the visual display apparatus.

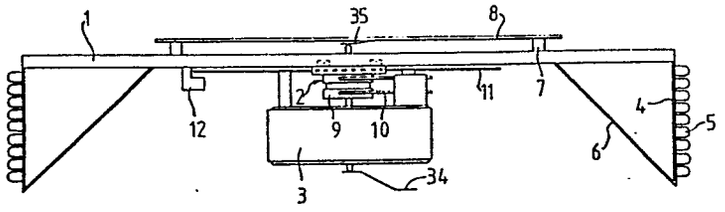

Fig 1

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Visual Display Apparatus

This invention relates to visual display apparatus for use in displaying alphanumeric and graphic visible images.

It is well known to produce display boards having an array of individual light sources. These light sources can be selectively energised to produce an image. Moving images can also be produced by appropriate sequential control of the light sources. With such display boards it is generally the case that the parts of the display board which are not illuminated remain visible to an observer. This can detract from the quality of the image displayed.

According to the present invention there is provided visual display apparatus comprising means for forming an array of light emitting sources, means for causing said array to move cyclically so that said sources perform a repetitive scanning of a display zone, and control means for controlling the state of illumination of said light sources during said cyclic movement so as to cause said light sources to create in said display zone the appearance of an image which extends in the direction of movement of the array.

Preferably, said array forming means is arranged to form a plurality of said arrays of light emitting sources arranged to scan said display zone in repeating succession.

Preferably also, the or each said array of sources is carried on a rotatable support.

Preferably also, means are included for providing an indication of the rotational position of the said array or arrays to permit synchronisation of the state of illumination of said light sources in accordance with the rotation of said arrays.

Preferably also, said control means includes data memory means for storing data determining for each increment of movement of the or each said array, the state of illumination of each said light emitting source in said arrays.

Preferably also, said data memory means is in the form of a detachable memory storage device.

Preferably also, means are included for programming said data memory means with data representative of artwork to be displayed as an image by the apparatus.

Preferably also, said means for programming said data memory means comprises a rotatable drum for attachment of artwork, a light source for projecting light towards a segment of said artwork on said drum, sensor means for detecting light reflected from said segment of said artwork and memory means entering data representative of the light reflected from said segment of said artwork into said data storage means.

Preferably also, said means for programming said data

storage means includes means for detecting different colours on said artwork.

Preferably also, said means for detecting different colours on said artwork comprises means for projecting different coloured light sources towards said artwork and means for detecting corresponding coloured light reflected from said artwork.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a side view of a first embodiment of visual display apparatus in accordance with the present invention;
Fig. 2 is a side view of a second embodiment of visual display apparatus in accordance with the present invention;
Fig. 3 is a perspective view of part of a third embodiment of visual display apparatus in accordance with the present invention;
Fig. 4 is a schematic circuit diagram of control circuitry of visual display apparatus in accordance with the present invention;
Fig. 5 is a schematic diagram of programming apparatus for visual display apparatus of the present invention;
Fig. 6 is a perspective view of programming apparatus for visual display apparatus in accordance with the present invention; and
Fig. 7 is a detail view to a larger scale of a sensor head of the apparatus of Fig. 6.

Referring to Fig. 1 of the drawings, a first embodiment of

visual display apparatus comprises a rotary beam support 1 secured by way of a bush 2 to the spindle of a motor 3. Each end of the beam 1 carries a depending bracket 4 upon which an array, in this case a vertical row, of light sources 5 is carried. In this embodiment each array includes nine such light sources, one array comprising red light emitting diodes and the other array comprising green light emitting diodes. Each bracket 4 is braced by a tie bar 6 extending obliquely from the lower end of the bracket 4 to an intermediate point on the beam support 1. Mounted on the beam support 1 by means of stand-off pillar supports 7 is a circuit board 8 which carries part of the electronic circuitry for controlling the energisation of the two arrays of light sources 5. Wires (not shown) extend from the circuit board 8 to the light sources 5 along the outer portions of the beam support 1.

The bush 2 includes a pair of commutator rings 9 which are contacted by brush contacts 10 through which power can be supplied to the circuitry carried on the circuit board 8, which rotates with the beam support 1. The bush 2 extends through a central aperture in a disc 11 which is fixedly mounted with respect to the casing of the motor 3. The outer periphery of the disc 11 is regularly slotted to provide an optical grating comprising a regular succession of alternately light transmissive and opaque segments which can be detected by an optical reading device 12 carried on the underside of the beam support 1. This device 12 includes a light source arranged to illuminate the edge of the disc 11 from one side thereof and a photo detector arranged to view the illuminated edge of the disc from the other side. the photo detector produces a pulse, or an oscillating electrical output of which the frequency is indicative of the instantaneous speed of rotation of the beam support. A count of the pulses or maxima of such

output provides an indication of the instantaneous position of the disc and therefore of the light source arrays.

The electronic circuitry carried on the circuit board 8, is provided for controlling the energisation of the light emitting diodes, which form the light sources 5, in synchronism with the output of the optical reading device so as to cause the diode arrays to display a predetermined image. This can be achieved by deriving for successive synchronizing pulses or maxima successive binary words each comprising data bits defining, for a given rotational increment, the state of energisation of the light emitting diodes in one or both arrays. The linear patterns displayed instantaneously by the diode arrays change very rapidly as they rotate, to cause the image to appear to the relatively slowly responding human eye to be displayed.

A second embodiment of visual display apparatus will now be described with reference to Fig. 2. In this construction, a circuit board 13 is mounted on a rotary spindle 14 and itself constitutes a support member on which diametrically opposed upstanding brackets 15, carrying respective arrays of different coloured light emitting diodes 16, are mounted. The upper ends of the brackets 15 are braced against outward movement due to centrifugal forces by a bracing plate 17 also mounted on the spindle and spaced axially from the circuit board 13. The spindle 14 carries, beneath the circuit board 13, a bush 18 including commutator rings 19 contacted by brush contacts 20 for the supply of electrical power for the control circuit carried on the circuit board 13. Above the bush 18 the spindle 14 carries a driven pulley 21 around which passes a drive belt 22 driven by a drive pulley 23 connected to the spindle 24 of a drive motor 25. The pulley 21 carries a pair of upwardly projecting electrically conductive pins 39 which are electrically

connected with the respective rings 19 and which locate in sockets 40 in the circuit board 13 for the supply of power. The pins 39 also transmit torque from the pulley 21 to the circuit board 13 to cause the rotation of the latter. To produce the synchronising pulse or oscillating wave form there is provided beneath the rotary circuit board 13 a fixed non-rotating optical grating element in the form of an upstanding cylindrical optically segmented flange 27 which is carried on a support 41 and which is straddled by an optical reading device 28, again having a light source and photodetector between which the optical path is intermittently interrupted by rotation of the segmented flange 27. The optical reading device 28 is fixed to the underside of the circuit board 13. This construction is advantageous in permitting removal and replacement of the spinning assembly comprising the circuit board 13, brackets 15 carrying diode arrays 16, bracing plate 17, and optical reading device 28 by vertical sliding along the spindle 14. When a new assembly is positioned on the spindle, its sockets 40 are located over and caused to receive the pins 39, and its optical reading device 28 lowers directly onto the segmented flange 27 without the lateral adjustment which is necessary in the arrangement of Fig. 1. The flange may comprise a cylindrically formed strip of film.

With reference to Fig. 4, a form of circuitry is illustrated which may be used for the control of the light sources in the visual display apparatus of Figs. 1 and 2. For the purposes of explanation, the circuit components to the right of the broken dividing line are carried on the circuit board 8 or 13 of the devices as illustrated in Figs. 1 and 2; these components comprises a data store 29 of the random access memory (RAM) type which can store, for each increment of rotation of the light source arrays a code or codes, in binary word form determining the state of energisation for

each light source in the arrays. It should be noted that the two lights source arrays may be electrically interconnected to be synchronously controlled, or may be separately controlled depending upon the nature of the display required.

A counter 30 is provided for counting the pulses, or maxima in the wave form of the signal put out from the optical reading device 12 or 28.

The RAM 29 is arranged to be addressed by the incrementing count output from counter 30 so as to produce on outputs 31,31a the sets of energising signals for the two light source arrays in synchronism with their rotation.

A mode control/reset unit 32 determines the mode of display of the device at any given time. For example, the display may be controlled to display a stationary image or a forwardly or backwardly moving image or a positive or negative image. To determine whether the device will operate in a stationary or moving image mode, the reset unit 32 determines the manner of reset of the counter 30. For example, if the optical read-out cooperates with the segmented disc to produce 144 pulses per complete revolution of the light source arrays, and the reset unit 32 operates to reset the counter 30 after each 144 counted pulses, the displayed image will appear stationary, since the cycle of the sequential supply of energising control signals is exactly synchronized with the rotation of the diode arrays. Thus at each given rotational position of the diode arrays, the code determining the state of energisation of each light source will be the same in one revolution as in the preceding revolution. However, if the reset unit 32 operates to reset the counter after 145 pulses the arrays will have advanced by one increment when energised in

accordance with a given stored code with respect to their positions during the previous revolution when they were energised in accordance with that same code; accordingly, the displayed image will appear to move forward (i.e. in the direction of rotation of the arrays) at a speed determined by the spacing of the rotational increments and the speed of rotation of the arrays. Conversely, if the reset unit 32 operates to resent the counter 30 after 143 pulses, the displayed image will appear to move backwards (i.e. in the opposite direction to the direction of rotation of the arrays). The reset unit 32 can also cause an inverter unit 33 to invert the energising signals on outputs 31, 31a so as to change between positive and negative image forming modes (i.e. by causing inversion of the energising signals).

A third embodiment of visual display apparatus will now be described with reference to Fig. 3. In this embodiment, a support member and electronic circuit board 50 is mounted on a rotary spindle and carries a pair of diametrically opposed upstanding brackets 51, carrying respective array boards 52 of different coloured light emitting diodes.

The array boards 52 have decoding and latching devices included, thus cutting down the number of electrical connectors needed to the boards. Groups of light emitting diodes are displaced along the vertical axis as illustrated at 53a, 53b, 53c and 53d. This allows for the fact that when each group of light emitting diodes is multiplexed in sequence the array boards 52 move a finite amount with relation to other groups. The groups are thus offset by this amount.

The array boards 52 comprise: the light emitting diodes, diode driver circuits, which also contain latches, and a decoder which receives a binary count and converts it into

individual lines which then control the strobing of the various diode latches and drivers. This type of multiplexing means that 64 light emitting diodes (32 red and 32 green) can be controlled by an eight line (data bus) selected by three lines of binary notation so that any combination of those three lines produce a decimal number in the range 0-7.

For example, '0' may strobe the common data bus into the top eight red light emitting diodes; '1' may strobe the top eight green light emitting diodes and so on giving a total combination of eight decimal addresses each controlling their on/off state according to the eight bit data bus at the time of strobe.

Other lines to the array boards 52 are power lines to supply the logic and the diode supplies, and earth returns.

The single circuit board for controlling the two array boards 52 comprises an on board free running oscillator which is carefully controlled so as to be able to present an apparently stationary image to the viewer by maintaining the same display information at each physical sweep of the arrays, thereby overlaying the displayed information.

In this embodiment the picture information is contained in a single PROM (programmable read only memory) which may either be on a separate circuit board or designed to attach to a plug in memory receptor 54 on the circuit board 50.

This embodiment of the display apparatus also includes a personality module which is a plug in chip which contains specific information to control the rest of the electronics and control which page of information is to be displayed at any one time.

The personality module chip is a PROM which has eight outputs used by various circuits. Some of these circuits are three lines which control part of the address of the program prom thereby being able to select any one of eight pages with the remaining 5 outputs controlling other special effect functions, for example:

1. Moving the picture clockwise by slowing down the oscillator.
2. Moving the picture anti-clockwise by speeding up the oscillator.
3. Flashing the picture by controlling the outputs of the program prom.
4. Alternate pictures by selecting 2 pages and alternating them over a few seconds.
5. Animate pictures by selecting either 4 or 8 pages and rapidly changing them to produce movement.
6. Resetting the cycle.
7. Synchronise the picture to the front by invoking a photo sensor which is looking at a stationary emitter and resetting positional information to it.

The personality chip is designed to contain a number of different personalities which are accessed by a bank of switches 55. Assume each personality takes up to thirty two sequential instructions which may be, for example:

1. select page 1 and flash
2. select page 1 and rotate left
3. select page 2 and rotate right, etc

32. RESET TO 1

Only five address lines of the personality chip have been used, these are drawn from a binary counter. The other

address lines, are held High or Low by switches making it possible to select other segments of the chip which now contain other personalities, for example

1. select page 6
2. select page 4 and rotate right
3. ditto

24. RESET TO 1

The circuit elements to the left of the broken dividing line in Fig. 4 constitute programming apparatus which can be used to pre-program the display device with the information defining the images to be displayed. In one embodiment of the programming apparatus, the apparatus and the electronic circuitry on the circuit board 8 are temporarily coupled during programming by way of a multiple contact coupling, one part of which is carried on the board. The programming data is supplied in parallel form through the coupling. An alternative method of data supply is by way of a contact 34 contacting the spindle of the motor 3 and a contact 35 carried on the underside of the circuit board 8 contacting the other end of the spindle. In this alternative method, the data would be put in serial form in the programming unit supplied to contact 34, and decoded by appropriate means on the circuit board.

The programming apparatus is operable to write into the RAM 29 the binary words constituting codes to be read for each increment of rotation of the light source arrays. For this purpose, the programming apparatus comprises a binary word generator and an incremental programming counter 37. In the writing mode, the counter 37 advances the program counter 30 which in response addresses successive groups of memory locations of the RAM 29. Each time a new set of memory

locations is addressed, a binary word is put out from the word generator 36 and written into the store 29 by way of the write line 38 for storage. The word generator 36 may, for example, be one which reads punched tape to generate, in accordance with the code on the tape the binary words for storage in RAM 29.

The mode control/reset unit 32 may be programmable to provide any of a variety of display mode sequences. For example, it may be operable to control the resetting of counter 30 and mode of the inverter unit 33 so as first to display a stationary image then to cause forward movement of the image, then to invert the image and cause reverse movement thereof, and then to revert to the stationary positive form of the displayed image.

A second embodiment of programmer apparatus will now be described with reference to Figs. 5, 6 or 7.

Referring to Fig. 5, programmer apparatus comprises a cylindrical drum 60 to which artwork or graphics 61, which is to be displayed by the display apparatus, is attached. Sensor apparatus generally represented at 62 is positioned next to the drum 60 and serves to enter information representative of the artwork into a memory 63. In use light from a source 64 is projected via a fibre optic tube 65 to a sensor head 66 and reflected back off the artwork 61 along a fibre optic tube 67 to a light sensor 68. When a dark area of the artwork passes the sensor head 66 the light sensor 68 registers a pulse in the memory 63. The stored pulses are then used to produce a picture on the display apparatus.

Referring now to Figs. 6 and 7, detailed views of the apparatus of Fig. 5 are illustrated.

A control unit 70 operates a drive motor 71 which drives the drum 60 via a drive belt 72. A bank of sensors 66 is positioned over part of the picture. The sensor head also contains an illuminating lamp 73 (Fig. 7) which passes through a colour filter 74 (the colour at which it is set being governed by information from the control unit 70). As the picture passes the head, the colour which is being directed from the lamp reflects best off of the same colour on the picture. Sensors 68 receive this extra intensity and are actuated if that colour is present.

This information is then sent back to the control 70 unit where it is stored in the memory.

The memory locations are updated every time a 'pulse' is received from the positional sensor which is looking at a series of lines on the paper corresponding to the required matrix size of the picture.

Alongside each of these lines is a hex number which can be cross referenced to the control unit 70 which will also be displaying a hex number. This aids the operator to interrogate the memory contents and to see what the control unit 70 has interpreted for that segment of picture.

When a complete revolution of the drum 60 has been completed, the colour filter 74 is automatically changed for the next colour and the process is repeated. This time however, the control unit 70 allocates a different area of memory for that colour.

When all colours have been read (the amount of colours may vary for different models) a carriage motor 75 moves the sensor head 66 to the next segment of picture to be read. Information from an appropriate micro switch positional

sensor 76 tells the control unit 70 when to stop the carriage motor 75.

The process is then repeated for segment two and so on, each time a new segment of colour occurs, the control unit 70 switches automatically to a different area of memory.

The sensor head shown in Fig. 7 is 'colour discriminating'. It may be substituted by a head which is not colour discriminating. In this option the original artwork of the picture would be broken down into its primary colours and a separate sheet of artwork 61 would be fastened to the drum 60 for each colour. Although each sheet would be monochrome.

The control unit 70 can recognise the two different types of head and activate the drum/carriage colours accordingly.

When the picture information has been transferred to the memory the user can manipulate this data and eventually commit it to a memory module which will then unplug from the programmer and plug into the visual display apparatus whereupon the memory module will be interrogated by the display apparatus electronics and display this data which will be an electronic copy of the original artwork.

The construction of the display device to produce a circumferential image provides considerable versatility in image display. For example, the display zone in which images can be displayed extends around the full 360^{o} of rotation of the light source arrays and therefore permits viewing the displayed images from any circumferential position. A circumferentially confined image can be displayed at a number of circumferential positions and a moving image can similarly be viewed from any desired

circumferential position.

Various modifications to the control circuitry described above will be envisaged by those skilled in the art; for example, when using one or more programmable read only memory (PROM) devices time sharing of advertising display time, where the device is used for the display of advertising material, is possible, with each PROM being pre-programmed with data defining matter to be displayed in visual form by the display device as advertising material for a particular customer.

Although the above described devices use light emitting diodes as their light sources, other forms of light source may be applicable.

In the above described spinning arrangements, a simple modification can provide three dimensional display. Thus, by mounting one array of light sources closer to the rotational axis than the other array, an arrangement may be provided in which the outer array forms an image while the inner array forms a background for the image, or another image which is intended to appear behind the image of the outer array.

Modifications and improvements may be made without departing from the scope of the invention.

CLAIMS

1. Visual display apparatus comprising means for forming an array of light emitting sources, means for causing said array to move cyclically so that said sources perform a repetitive scanning of a display zone, and control means for controlling the state of illumination of said light sources during said cyclic movement so as to cause said light sources to create in said display zone the appearance of an image which extends in the direction of movement of the array.

2. Visual display apparatus according to Claim 1, wherein said array forming means is arranged to form a plurality of said arrays of light emitting sources arranged to scan said display zone in repeating succession.

3. Visual display apparatus according to Claim 1 or Claim 2, wherein the or each said array of sources is carried on a rotatable support.

4. Visual display apparatus according to Claim 3, wherein means are included for providing an indication of the rotational position of the said array or arrays to permit synchronisation of the state of illumination of said light sources in accordance with the rotation of said arrays.

5. Visual display apparatus according to any one of the preceding Claims, wherein said control means includes data memory means for storing data determining for each increment of movement of the or each said array, the state of illumination of each said light emitting source in said arrays.

6. Visual display apparatus according to Claim 5, wherein

said data memory means is in the form of a detachable memory storage device.

7. Visual display apparatus according to Claim 5 or Claim 6, wherein means are included for programming said data memory means with data representative of artwork to be displayed as an image by the apparatus.

8. Visual display apparatus according to Claim 7, wherein said means for programming said data memory means comprises a rotatable drum for attachment of artwork, a light source for projecting light towards a segment of said artwork on said drum, sensor means for detecting light reflected from said segment of said artwork and memory means entering data representative of the light reflected from said segment of said artwork into said data storage means.

9. Visual display apparatus according to Claim 8, wherein said means for programming said data storage means includes means for detecting different colours on said artwork.

10. Visual display apparatus according to Claim 9, wherein said means for detecting different colours on said artwork comprises means for projecting different coloured light sources towards said artwork and means for detecting corresponding coloured light reflected from said artwork.

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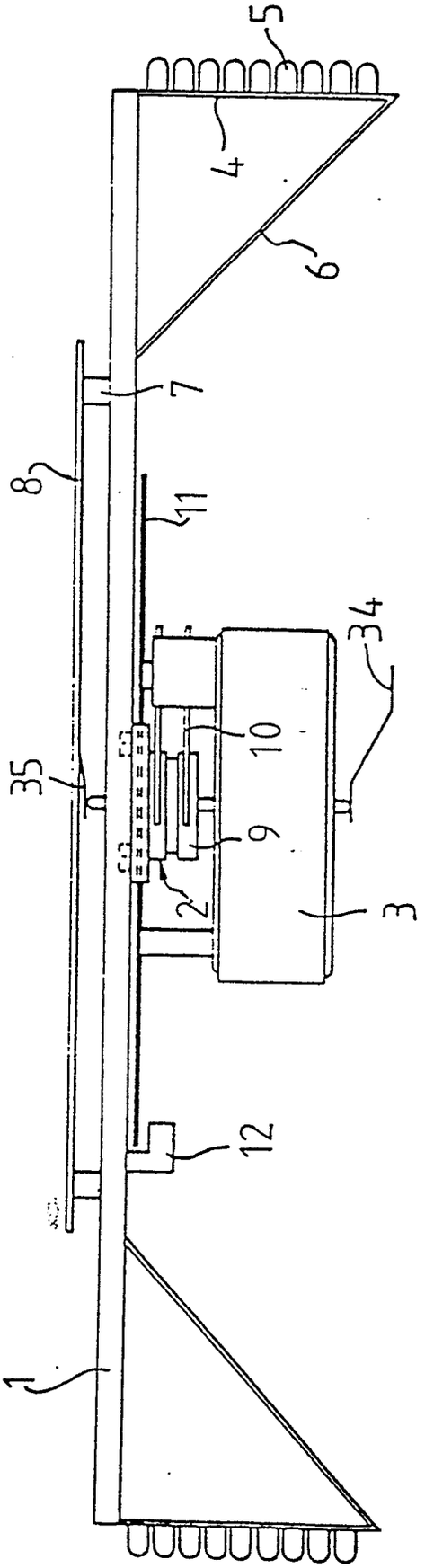

Fig 1

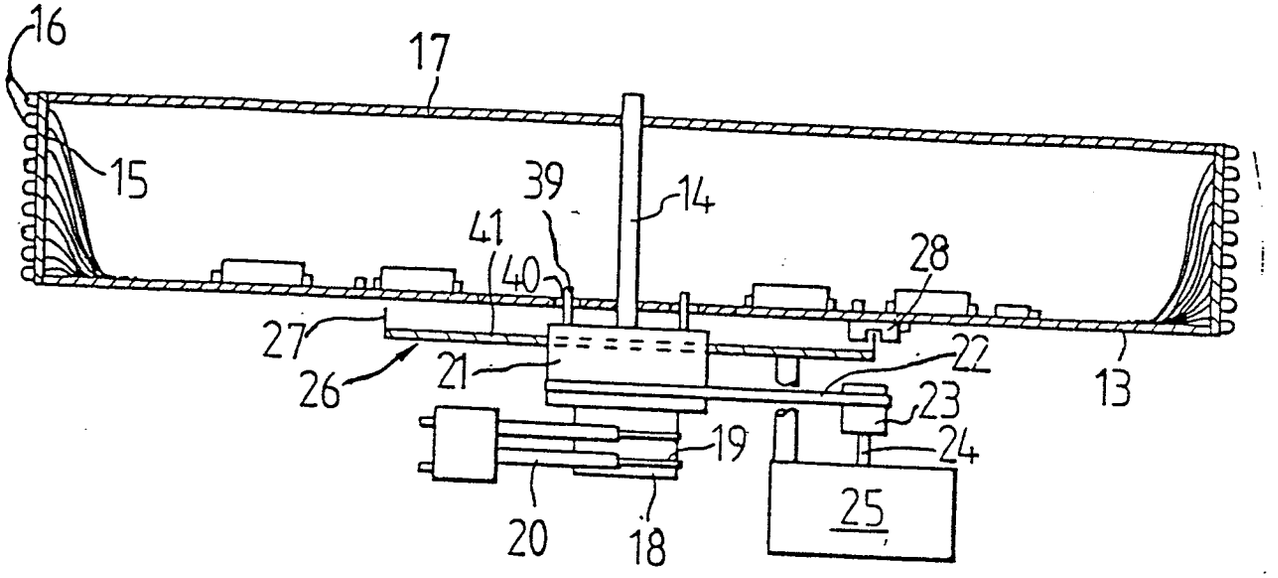
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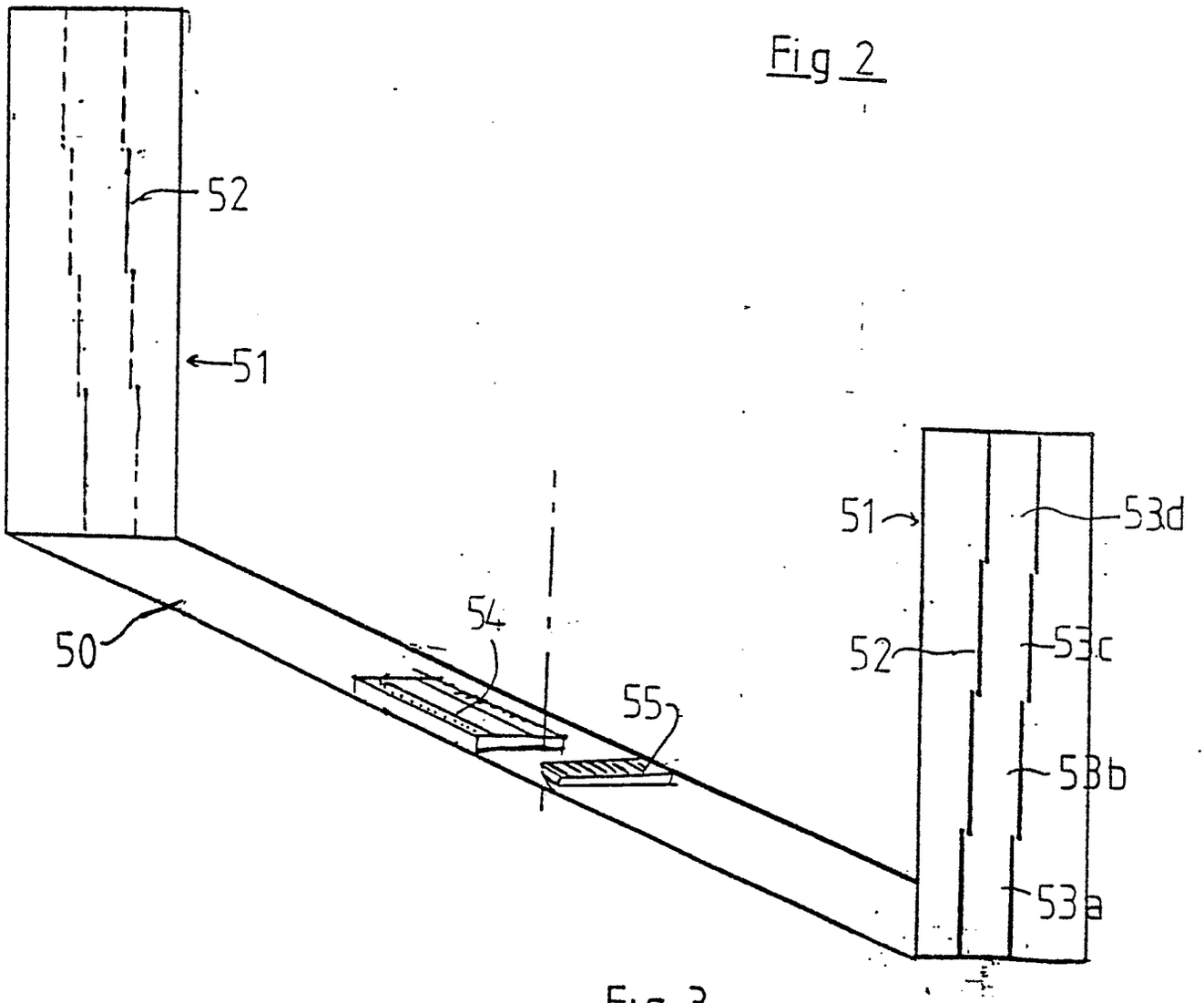
Fig 2


52
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53d
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53c
53b
53a

Fig 3

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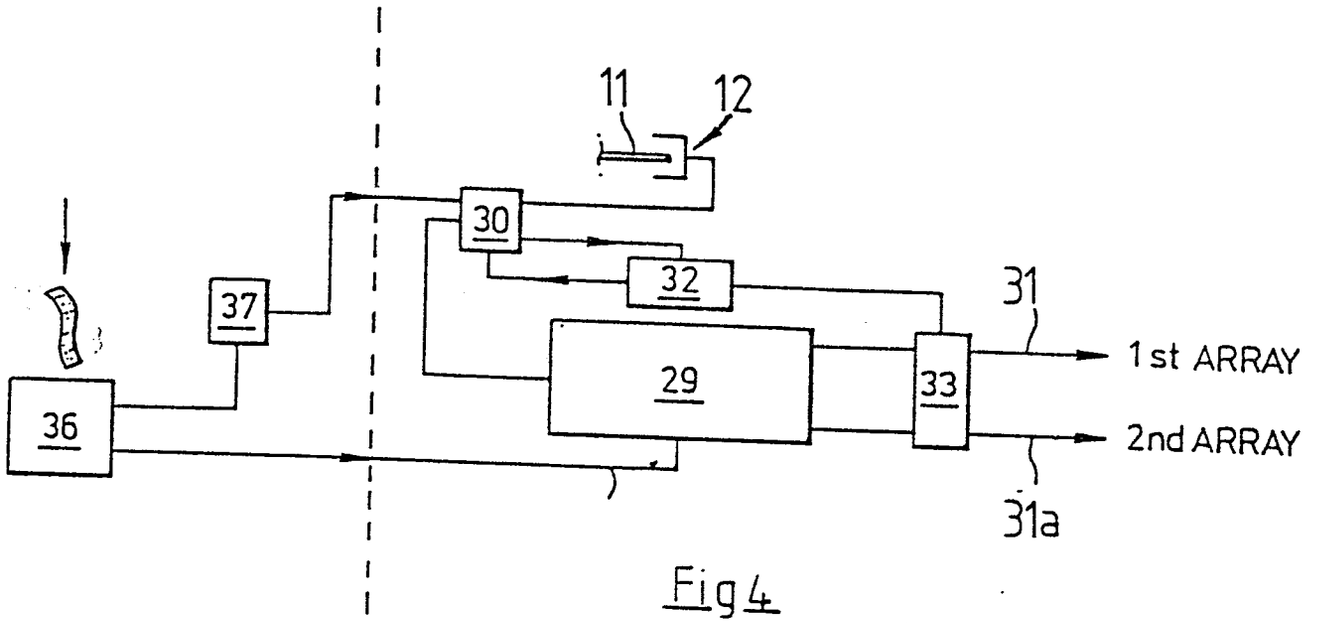

Fig 4

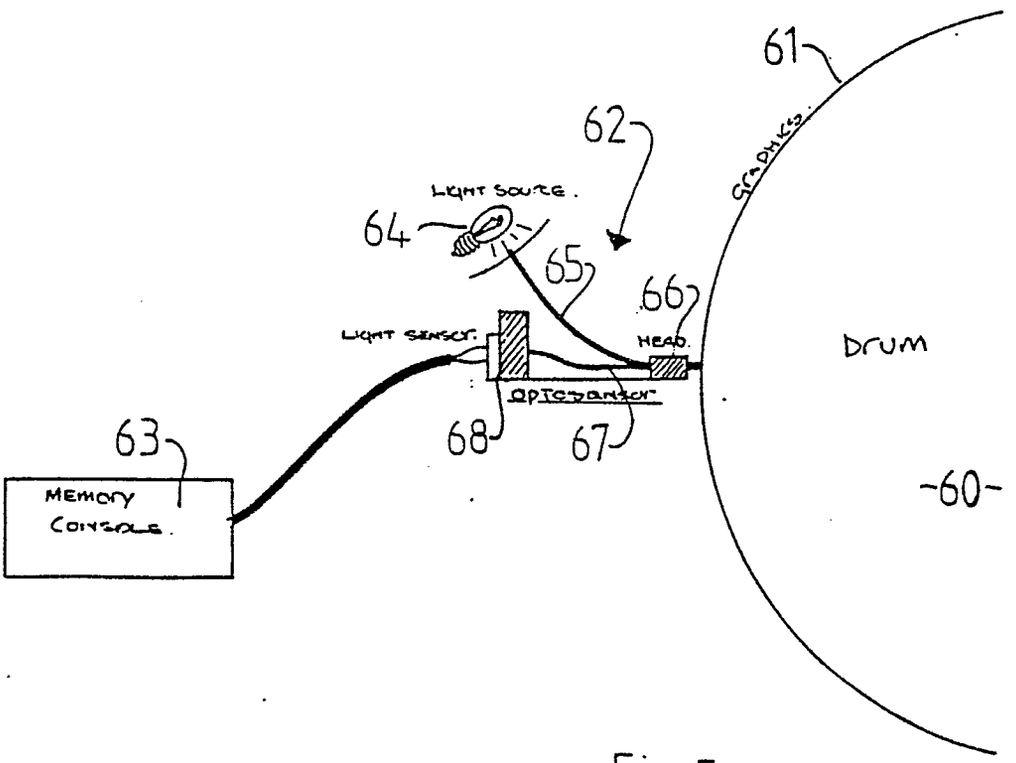

Fig 5

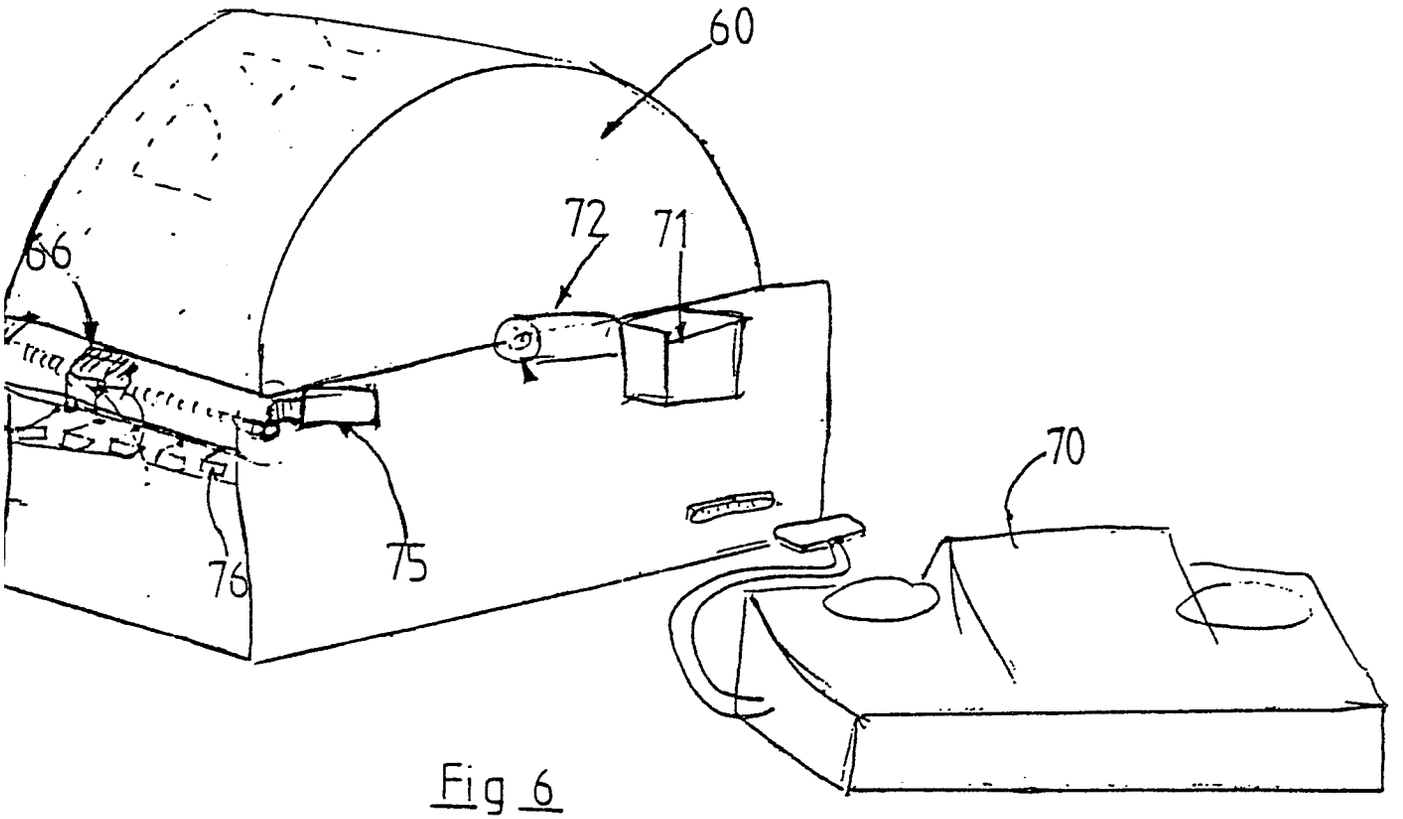

Fig 6

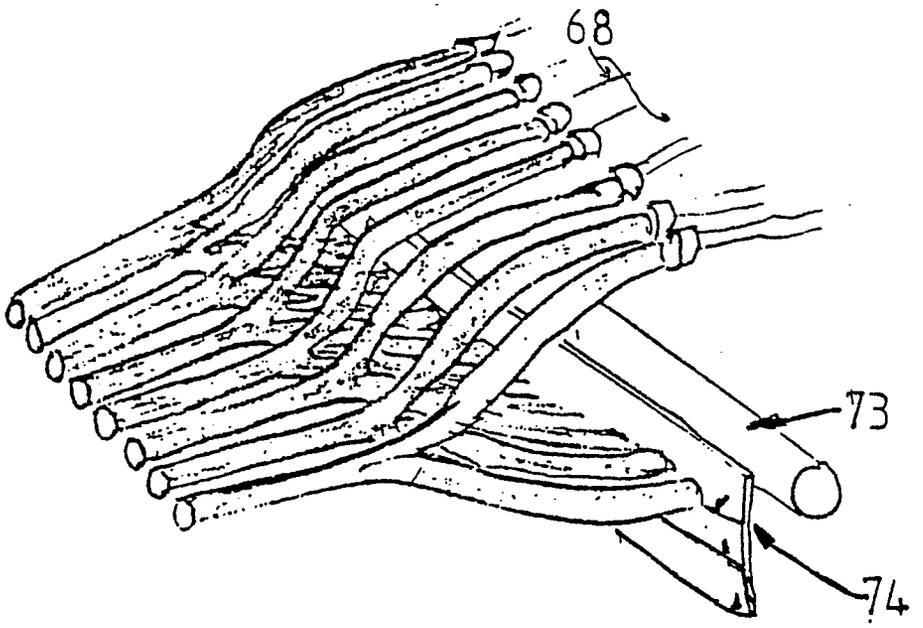

Fig 7