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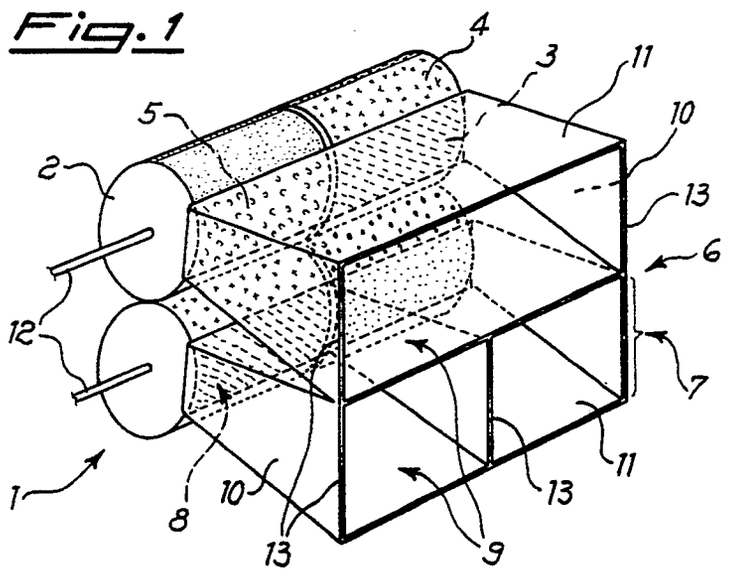
(54) Information display apparatus and method.

(57) A pixel matrix display apparatus (1) comprises a plurality of axially symmetric elements (2) in a visualizing plane and a grill structure (6) coplanar and adjacent to said plane and consisting of a plurality of prismatic funnels (7) corresponding to one or more elements (2), said funnels (7) being provided with a first opening (8) adjacent to said element (2) and a second opening (9) opposite to said first opening and constituting the actual pixels.

Fig. 1



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INFORMATION DISPLAY APPARATUS AND METHOD

This invention relates to an outside light source display for black and white and/or colour visualization of graphic or alphanumerical communications. The display has been designed in order to work both utilizing sunlight as a light source, outdoor, and with artificial light by night and indoor. Also, the invention utilises pixel matrix panels and has a modular structure, thus covering a wide range of dimensions according to each particular need, from the shop to the stadium.

As it is known, display apparatuses divide into two main families according to where the light source is. Displays with an internal light source can be those using a matrix of LEDs or of incandescent lamps, or those utilizing a matrix of video monitors each showing a portion of the whole image. They both are rather expensive and require a high power consumption of many kWatts per square meter. The display apparatuses utilizing an outside light source can be represented by the common display used in airports and/or stations to give passangers the required information about leaving/arriving times etc. The messages are formed by rotation of a number of tesseras, each mounted by one of its sides on a support rod as sheets in a book. These displays do not require a high power consumption and are quite resistant, but they can show only a limited number of predetermined messages and images.

Another apparatus utilizing an outside light source is a matrix based display, each matrix comprising a number of axially symmetrical elements provided with differently coloured faces which are magnetically or mechanically rotated.

This display is rather economical and can preserve the message also during a power failure, but has the main disadvantage that can use only triangular or quadrangular elements, as disclosed in US-A-4268821. Actually, the use of rotatable elements with more than four sides will lower the ratio of representative surface versus total surface to unacceptable figures. In fact, the visible part of a rotatable element having more than four sides is comprising both the selected coloured face and part of the adjacent differently coloured faces. It is thus necessary to position a hiding panel in front of the visualizing plane of the panel, provided with a plurality of openings having such dimensions as to let be visible the selected faces only.

Thus the need remains of a display apparatus which: utilizes matrix panels, can have at least 3 colours plus black and white - preferably six different colours; has a representative efficiency which is more than 80%; can preserve the message also during a power failure; requires a law capacity; has a modular structure, where each module is easily replaceable; utilizes an outside light source and is easily and economically manufacturable. An object of this invention is therefore to provide an apparatus and a method for displaying information having the mentioned requirements.

Accordingly, the invention provides an information display apparatus of the kind having a plurality of axially symmetric elements coaxially aligned by rows or columns in a matrix arrangement,provided with differently coloured surface areas and with means for their controllable rotation around their axis of symmetry in order to alternatively display said coloured areas in correspondence with a visualizing plane, characterized in that it is provided with a grid structure coplanar and adjacent to said visualizing plane and consisting of a plurality of prismatic cells, or funnels, each positioned adjacent and in correspondence to at least one of said rotatable elements, and each being provided with a first opening positioned in interfacing relationship with one coloured surface of at least one of said coaxial rotatable elements, a second opening opposed to the first one, and reflecting walls.

Further characteristics of the present invention will be disclosed in the following passages of the specification referring to the accompanying drawings, which however are merely illustrative of how the invention might be put into effect. Thus,the specific form and arrangement of the invention features shown is not to be understood as limiting the invention.

In the drawings:

- Fig. 1 is a perspective view of a possible embodiment of the invention;
- Fig. 2 is a sectional view of fig.1 embodiment;
- Fig. 3 is a perspective view of an alternative embodiment of a rotatable element according to fig. 1 embodiment;
- Fig.4 is a schematic sectional view of a device for rotating elements of fig.1 apparatus;
- Fig. 5 is a diagram of a drive circuitry unit for fig. 4 device;
- Fig. 6 is a diagram of a drive circuitry of a matrix area having the basic circuitry unit of fig. 5;
- Fig. 7 is a diagram of an alternative drive circuitry of a matrix area having the basic circuitry unit of fig.5;
- Fig. 8 is a perspective view of an alternative device for rotating elements of fig 1 apparatus;
- Figures 9 to 13 are sectional views of alternative embodiments of fig.8 device; and

- Figures 14 and 15 are diagrams of drive circuitries in a matrix area for controlling devices of figures 9 to 13.

In fig. 1 is shown a portion of a possible embodiment of the invention apparatus 1, consisting of four pixels in a matrix arrangement. As previously stated, the apparatus 1 comprises a plurality of axially symmetric elements 2 which in fig. 1 are cylinders, but may be any other suitable element axially symmetric. Each cylinder is provided with a plurality of coloured surface areas, e.g. 3,4 and 5, and with means (not shown) to rotate them around their simmetry axis 12 in a controlled way in order to alternatively display said coloured areas in correspondence to a visualizing plane which is the ideal plane defined by areas 5 and 3 of upper elements 2 in fig. 1 and by all the other apparatus surface areas aligned with them. As shown in fig. 1, said elements 2 are coaxially aligned by rows, and parallel to each other by columns: i.e. the symmetry axes of the elements are coaxial in each row and parallel in each column. While this is the preferred embodiment, it is possible to have the elements 2 coaxially aligned per columns and parallel by rows.

In front and adjacent to this plurality of cylinders 2, there is positioned a grid structure 6 which is coplanar with said visualizing plane and consists of a plurality of prismatic cells or funnels 7. Each prismatic funnel 7 is corresponding to at least one rotatable element 2 and to at least one pixel of the apparatus. Each funnel 7 is hollow and it is provided with a first opening 8 positioned adjacent to one or more rotatable elements 2 in an interfacing position with the displayed coloured surface area of at least one of said coaxial elements of the same row and with a second opening 9 opposed to the first one.

The walls of the funnel 7 are internally reflecting walls. Thus, the coloured surface areas are reflected by said internal walls from element 2 surface to opening 9. The funnels 7 have a quadrangular section which may be square or rectangular depending on their required dimensions. Actually, while the apparatus can provide one funnel for each element, as shown in the lower part of fig. 1, it is preferred to have one funnel for two or more coaxial elements, as the upper funnel of fig. 1. In fact, the latter embodiment will provide a much more luminous signal, even if slightly less well defined than in the first embodiment. In any case, however, the funnel walls 10, i.e. those perpendicular to the rotation axis 12, are substantially parallel to each other, while the remaining walls 11 are raking, diverging from first opening 8 to second opening 9. More particularly, first opening 8 defines onto each corresponding element 2 surface an area that is substantially equal to any coloured area on that cylinder, and sides 13 of second opening 9, corresponding to walls 10, are substantially as long as, or longer than, the diameter of element 2, where "diameter" means the diameter of the circle circumscribed to the cross section of the rotating element 2 if said section is polygonal, or the actual cylinder diameter 14 if said element is a cylinder as shown in fig.2.

It is preferred to have sides 13 of opening 9 which are slightly greater than said diameter 14, in order to have elements 2 spaced enough to avoid any contact and to be housed by relevant supporting means. In any case said sides 13 can not be much longer than diameter 14 : a much greater length would prevent the sight of the reflected colour from certain angles with respect to the visualizing plane.

Also, in order to obtain a good reflection of the coloured areas the ratio of the funnel depth A, i.e. the value of distance between the two openings 8 and 9 versus the value of side 13, is within 0.5 and 2.0, and most preferably within 0.7 and 1.5.

As shown in the preferred embodiment of figs. 1 to 3, the element rotation axes coincide with symmetry ares 12; the elements 2 are positioned horizontally and are provided with six different colours in the form of longitudinal surface bands of identical extension. In a preferred embodiment (fig.3) said bands are positioned on an interchangeable sheath 15; in this embodiment the rotatable element 2 is provided with suitable means 16 to exactly position sheath 15. The preferred number of bands is six, which is also the preferred number of coloured faces when the rotating element 2 has a poligonal cross section, but there obviously may be a different number of such colored areas.

As previously stated, the displayed coloured areas (i.e. the areas positioned in correspondence with first opening 8) are reflected by the internal reflecting walls and the whole pixel area will thus be seen as totally coloured in one or more discrete colours even at great observing angles; the apparatus has thus a representative efficiency (i.e.the ratio between representative surface versus total surface) higher than 90%.

Any suitable means may be used in order to controllably rotate elements 2.

A first preferred embodiment is shown in fig.4, and is essentially consisting of a multipolar stator 17 coaxial with axis 12 and provided with n/2 poles, where n is the number of the possible stop positions of the rotatable element 2, i.e. the number of coloured bands. In fig. 4 embodiment the stator has three poles 18,18' and 18"each having an angle amplitude of about 90 degrees. Externally to the stator 17 and integral with element 2 is provided a permanent magnet 19 which is also the rotor and has two poles 20 and 20', each having an

angular amplitude substantially equal to that of poles 18 - 18".

While this is the preferred embodiment, it is possible to have the rotor and the permanent magnet internally to the stator.

Poles 18-18" are preferably provided each with one coil 21, 21', 21", which is connected at one end to a common node 23 (fig. 5) and a relevant electrode 22 and at the other end to electrodes 24, 24' and 24". According to this preferred embodiment, electrode 22 is the output electrode, and electrodes 24-24" are feeding electrodes; rectifier elements 24a are provided between coils 21-21" and the relevant electrodes 24-24"in order to avoid undesired energizations. According to the invention, the feeding electrodes are connected to a source of unidirectional voltage: thus, when fed, coils 21-21" will always create the same kind of magnetic field e.g.forming a South pole. When it is necessary to change said pole sign from South to North, the method according to the invention provides to change the magnetic field previously created - e.g. on pole 18 when feeding its coil 21 with said unidirectional voltage - by stopping to feed said coil and feeding all the remaining coils 21' and 21"with the same unidirectional voltage. By induced magnetization pole 21 magnetic field will then change its sign. It is thus possible to obtain the same six possible positions for rotor 19 with an unidirectional voltage feeding as when inverting the voltage sign.

When the above disclosed circuitry unit is used for a plurality of the cited rotating appartuses in a matrix arrangement, also the circuitry is arranged in a similar matrix.

In fig.6 is disclosed a first embodiment of said circuitry matrix arrangement, where each optical row, i.e. each pixel row v, w, is provided with a common output electrode 22v and 22w, respectively, which parallel connects the outputs of all common nodes 23 of the same row, and each optical column i and k (i.e. each column of elements 2)is provided with three feeding electrodes 24i, 24'i,24"i and 24k, 24'k, 24"k respectively. Each feeding electrode parallel connects all the homologous coils in the same column: e.g. electrode 24i parallel connects 21iv and 21iw. Each electrode is provided with switching means.

In fig.6 each column has three feeding electrodes, but more generally the number of electrodes is the same of the coils, i.e. n/2, where n is the number of colours (stop positions) of the rotating element 2. A device provided with a circuitry as above disclosed is operated according to a method "by rows in parallel". More specifically this means that the rotation of elements 2 is controlled by rows: a first electrode, e.g. 22v is activated by closing its relevant switch only, and leaving all other row switches open; then one or more feeding electrodes are operated in each column (e.g.24'i and 24'k) depending on the chosen colour for each element of row v, which thus commutes in parallel with the other row elements. Electrode 22v is then deactivated and the above cited operations are repeated for each remaining row.

The time required to complete the message is:

n x t

where

n = number of rows

t = response time for each row

and the response time for each row is substantially the same as the response time of a rotation device.

In fig.7 is disclosed an alternative embodiment of a circuitry in a matrix arrangement that also enables the preferred parallel operation of the pixels as disclosed with reference to fig.6.

In this embodiment the circuitry units are the same as those shown in fig. 5, but the common node 23 is connected to a grounding electrode 23' through switching means 25.

All homologous coils in the whole matrix (e.g. all coils 21) are parallel connected to one feeding electrode (not shown): the total number of such feeding electrodes is therefore equal to the number of coils in the stator 17 - i.e. three in fig. 7 embodiment and n/2 more generally.

The control of the rotation of elements 2 is carried out by means of a matrix arrangement of the feeding and output electrodes of the switching means 25. More particularly, switching means 25 is a bistable relay provided with a set coil 26 and a reset coil 27. All reset coils 27 are parallel connected with a single feeding electrode 30 and are grounded in a known way. The set coils 26 of each optical column, i.e. columns i and k in fig. 7, are parallel connected to a feeding electrode 28i and 28k, respectively, and those of each optical row, i.e. rows v and w, are connected to the same output electrodes 29v and 29w, respectively. Most preferably, a rectifier element is provided between electrodes 28 and set coils 26. Each electrode has its relevant switching means.

The above disclosed matrix arrangement is operated according to a "by colour in parallel" method. More particularly, in the first step all reset coils 27 are simultaneously activated trough electrode 30 in order to open switching means 25, at this moment also the switches of set coil feeding electrodes are open.

Secondly, the electrode of a first row - e.g. electrode 29v of row v - is closed and also are closed some of the column feeding electrodes - e.g. electrode 28i - to actuate a first plurality of set coils 26 which thus close relevant switching means 25, the bistable relays being provided with a memory, electrode 28i can be closed only temporarily.

The above disclosed steps are repeated for each row to actuate all the matrix units which are going to have the same colour. At this point it is sufficient to actuate one or two of the cited n/2 feeding electrodes (according to the selected colour) to commute "in parallel" throughout the whole matrix all the elements corresponding to the previously actuated units, which will thus all display the same kind of colured area.

The time required for completing a message is:
n x t
where
n = number of coloured areas
t = response time of the unit device
and the relay response time is considered as negligeable. Figures 8 to 15 concern alternative embodiments of an apparatus to controllably rotate elements 2.

According to these embodiments, each element 2 is hollow and is idle with respect to its supporting axis 29, which is coaxial with symmetry axis 12 and usually coincides with it. The apparatus comprises engagement means provided at preselected positions internally to said element 2 and on axis 29, to reversibly engage axis 29 with element 2 and rotate said element by dragging it to a selected display position, and blocking means to stop element 2 in said display position. All engagement means on axis 29 are aligned between themselves and those an elements 2 are in corresponding positions with respect to the element coloured areas.

As shown in fig. 8 all elements 2 of the same row are mounted on one axis 29 which may be a single axis or may consist of several axes joined together.

Any suitable means according to above disclosed apparatus may be used : in fig. 9 is shown a cross section of a first embodiment where the engagement means comprises a leaf spring 31 or similar radial elastic element provided onto axis 29, and a tooth 32 internally projecting from element 2. It is also possible to have the spring 31 on element 2 and tooth 32 on the drive axis 29.

While this is the preferred embodiment, alternative engagement means can be envisaged, such as those of fig. 10, where said means are comprising a permanent magnet 34 positioned on axis 29 and a ferromagnetic element 33 onto element 2 (or viceversa).

In both the previously disclosed cases the engagement between the radial elements is strong enough to rotate element 2 but weak enough to allow a disengagement when the rotatable element 2 is blocked in the selected display positions by the cited blocking means.

Several possible blocking means are disclosed in figures 9 11 and 12.

In fig. 9 the reversible blocking means consist of a plurality of ferromagnetic plates 35 provided on rotating element 2 in preselected positions and of an external electromagnet 36 controllably actuated by a coil 37.

Fig. 11 discloses blocking means consisted of a plurality of slots 38 or similar depressions provided on selected positions on rotating element 2, which are engageable by a latch 39 operated by an electromagnetic actuator 40. In this embodiment latch 39 is not provided with a position memory, in that it is urged in a direction contrary to that of the actuator 40 by a spring 41 to release element 2. There is therefore provided further "memory" blocking means , as the leaf spring 43 that releasably blocks element 2 in the position previously selected through latch 39 when the latter is disactivated and disengages slots 38.

Fig. 12 embodiment provides a position memory latch which enables to avoid the use of leaf spring 43. In this case actuator 40' has two actuating coils 44 and 45 to set and reset said latch in and from an engagement position, respectively. A clutch element 42, by means of its friction value, avoid latch 39 moving from the position selected through coil 44 or 45.

In this case also, a plurality of apparatuses as above disclosed with reference to figures 9 to 12 in a device according to the invention, will be operated through a matrix arranged circuitry. This circuitry will control the actuation of the electromagnetic blocking means, as shown in figs. 14 and 15.

In fig. 14 a circuitry for controllably operate a matrix of apparatuses without position memory as those disclosed in fig.11 is shown. According to the invention, all the actuator coils 49 of each optical column - e.g. column i - are parallel connected to a feeding electrode - e.g. electrode 46i - most preferably through a rectifier element, and all actuator coils of each row - e.g. row v - are parallel connected to one output electrode - e.g. electrode 47v - each electrode being provided with switching means.

The alternative arrangement shown in fig. 15 is used with actuators provided with set and reset coils as those disclosed with reference to fig. 12.

According to this embodiment all the set coils 44 are connected to a matrix arrangement identical to that above disclosed, the only difference being that reset coils 45 are all parallel connected with one single feeding electrode (not shown) and grounded in a known way. Each electrode has its switching means.

When operating a matrix with mechanical rotation apparatuses, the first step is to turn the rotation axis 29 for a whole revolution to "collect" all elements 2 which it supports in order to "time"

them and obtain the alignement of the some coloured areas for all the elements on the same axis. The rotation of the axis is stopped after every 360/n degrees - where n is the number of coloured areas - i.e. for every coloured area of element 2, to allow the blocking means block some of said row elements in a selected display position, according to the required message, and then continued until all the message is formed.

Similarly to methods previously disclosed, it is possible to form a complete message for each row, successively; or to form a partial message for all pixels, sequentially moving the elements according to the message colours.

If a matrix arrangement according to fig. 14 is used, the blocking step is effected according to a method "by rows in parallel" which is hereinafter exemplified with reference to row v : initially all blocking means are desactivated, i.e. the switches of electrode 47v and of all column electrodes are open. Axis 29 is then rotated and the coloured areas of elements 2 in row v are aligned as previously disclosed. The rotation of axis 29 is then stopped in a first position in which all elements 2 are displaying a first colour; the switch of electrode 47v is closed and then are closed the switches of all the column electrodes corresponding to pixels which have to display said first colour in row v, thus actuating in parallel the blocking means of the correponding elements. Axis 29 is then rotated of 60 degrees (360/n; n = 6) and while the blocked elements retain the first colour, all other elements 2 will now display a second colour. The same steps are then repeated for all remaining pixels (i.e. elements) of row v, until all row v elements are positioned as required.

Column switches may be open after each blocking step or after the whole row has been "written", positioning elements 2 as required.

Electrode 47v switch is then open and the above disclosed step is repeated for all remaining rows. The time required to create the whole image is essentially :

n x R x t

where

n = number of colours

R = number of rows

t = time to rotate the axis for 360/n degrees

the response time of blocking means is considered almost negligible.

If a matrix arrangement according to fig. 15 is used, the above disclosed method is modified to provide a "by colour in parallel" operation, as hereinafter exemplified.

As previously described, in fig. 15 circuitry the set coils 44 are connected as the actuator coils 49 in fig. 14, and reset coils 45 are all parallel connected.

Therefore, after having temporarily actuated reset coils 45, all axes 29 are rotated for a whole revolution to align all the matrix elements which will thus all display the same first colour in the visualization plane. Then all elements which have to diplay this first colour in the plane are blocked actuating relevant blocking means, operating them by rows as previously disclosed with reference to fig. 14. The position memory of blocking means will block elements 2 in the selected position even when set coils of a first row are disactivated to allow to operate the next row.

At this point all axes 29 are rotated 60 degrees to have all non-blocked elements 2 display the next colour, and the blocking operation is repeated. These steps are repeated for each colour, forming a one-colour part of the message each time, until the whole message is completed. The time required to create the message according to this method is:

n x t

where n and t have the previously disclosed meanings and the response time of blocking means is considered almost negligible.

Fig. 13 shows an alternative embodiment of a rotating device according to the invention.

In this device internal engagement means comprise an engaging element 50, which rotates with axis 29 but can freely move along it inside rotating element 2 from an engagement position to a disengagement position. At one end element 50 is provided with a tooth 51 which cooperates with a similar tooth 52 integral to element 2 when element 50 is in said engagement position.

Element 50 is advantageously moved along axis 29 by means of an electromagnetic actuator 53, and is therefore made of ferromagnetic material. Actuator 53 is provided with two coils, set and reset coil respectively, and their matrix arrangement and operating method is much the same as that disclosed with reference to fig.15.

It is obvious that also in this case the physical requirements of alignement of teeth 51 and teeth 52 are the same as previously disclosed for the other engagement means.

Claims

1. An information display apparatus of the kind having a plurality of axially symmetric elements (2) coaxially aligned by rows or columns in a matrix arrangement, and provided with differently coloured surface areas (3,4,5) and with means for their controllable rotation around their axis of symmetry (12) in order to alternatively display said coloured areas in correspondence with a visualizing plane, characterized in that it is provided with a grill

structure (6) coplanar and adjacent to said visualizing plane and consisting of a plurality of prismatic cells, or funnels (7), each positioned adjacent and in correspondence to at least one of said rotatable elements, and each being provided with a first opening (8) positioned in interfacing relationship with the displayed surface area of at least one of said coaxial rotatable elements (2), a second opening (9) opposed to the first one and reflecting walls (10,11).

2. An apparatus according to claim 1, characterized in that said prismatic funnels (7) have a quadrangular section, two walls (10) of which are substantially parallel to each other and perpendicular to the element symmetry axis (12), while the remaining walls (11) are diverging from first opening (8) to second opening (9).

3. An apparatus according to claim 2, characterized in that said first opening (8) defines onto each rotatable element (2) surface an area that is substantially the same as any of said coloured areas (3, 4, 5); the sides (13) of said second opening (9) which are normal to symmetry axis (12) substantially corresponding to said rotatable element diameter (14) and the ratio of the funnel depth (A) versus each of said sides (13) being within 0.7 and 1.5.

4. An apparatus according to claim 3, characterized in that there is provided one funnel (7) for each rotatable element (2), each opening (8) corresponding to one coloured area.

5. An apparatus according to claim 3, characterized in that there is provided one funnel (7) for two or more coaxially aligned rotatable elements (2), each opening (8) corresponding to two or more coloured areas.

6. An apparatus according to claim 3, characterized in that said axes (12) are positioned horizontally.

7. An apparatus according to any preceding claim, characterized in that said rotatable elements (2) are cylinders and said coloured areas are longitudinal surface bands.

8. An apparatus according to any preceding claim, characterized in that said coloured areas are interchangeably and adjustably provided on a sheath (15) housed on said rotatable element (2).

9. An apparatus according to any claim from 1 to 8, characterized in that said rotatable elements (2) have six different coloured surface areas corresponding to six different stop positions of said elements.

10. A device for controllably rotate an axial symmetry element (2) in an apparatus according to claim 1, of the kind comprising a multipolar stator (17) coaxial to said element (2) symmetry axis (12) and provided with n/2 poles - n being the number of the coloured areas - and a rotor integral with said rotatable element (2) and provided with a permanent magnet (19), characterized in that said permanent magnet has two-poles (20, 20') having an angular amplitude substantially equal to that of said stator poles (18 - 18") and of about 90 degrees, said stator pole coils (21 - 21") being connected at one end to an output electrode (22) and at the other and to rectifier elements (25) and to a source of unidirectional voltage.

11. A control circuitry for a plurality of devices according to claim 10 in a matrix arrangement, characterized in that it comprises a common output electrode (22 v, 22 w) for each pixel row and n/2 feeding electrodes (24i - 24"i) - n being the number of coloured areas - for each optical column; said common output electrode parallel connecting all common nodes (23) of the same row and said feeding electrodes parallel connecting all homologous coils of the same column, each electrode having switching means.

12. A control circuitry for a plurality of devices according to claim 10 in a matrix arrangement, characterized in that each device common node (23) is grounded through switching means (25) and all homologous coils in the matrix are parallel connected to one feeding electrode, the total number of said feeding electrodes being n/2 - n being the number of coloured areas.

13. A control circuitry according to claim 12, characterized in that said switching means (25) comprises a bistable relay consisting of a set coil (26) and a reset coil (27), all reset coils (27) being parallel connected to one feeding electrode (30) while set coils (26) of each column (i, k) are parallel connected to one feeding electrode per column (28i, 28k) and set coils of each row (v, w) are parallel connected to one output electrode per row (29v, 29w), all electrodes being provided with switching means.

14. A method for electromagnetically controlling the rotation of an axial symmetry element (2) in a device according to claim 7, characterized in feeding said device circuitry with constant unidirectional voltage, and in inverting the sign of a first magnetic field previously created on a first pole (18) through feeding of said pole coil, by stopping said feeding to said first pole and by feeding the remaining pole (18', 18") coils.

15. A method according to claim 14, which uses a circuit according to claim 11, characterized in comprising a plurality of "by rows in parallel" steps.

16. A method according to claim 14, which uses a circuit according to claim 12 or 13, characterized in comprising a plurality of "by colour in parallel" steps.

17. A device for controllably rotate an axial symmetry element (2) in an apparatus according to claim 1, characterized in that said rotatable element (2) is hollow and idle mounted on a drive axis (29) coaxial to said element symmetry axis (12), and in that it is provided with internal engagement means (31, 32; 33, 34; 50, 51, 52) at preselected positions, to reversibly engage said axis (29) with said element (2) and draggingly rotate said element (2) to a selected display position, and with reversible blocking means (35, 36; 39) to block the rotated element (2) in the selected display position; the engagement means mounted on each axis (29) for said axis rotating elements (2) being aligned to each other.

18. A device according to claim 17, characterized in that said engagement means comprises a leaf spring (31) or similar elastic means, and a rigid tooth (32) radially projecting from said drive axis (29) and said element (2), respectively, or viceversa.

19. A device according to claim 17, characterized in that said engagement means are magnetic means comprising a permanent magnet (34) and a ferromagnetic element (33) respectively projecting from said drive axis (29) and said element (2), or viceversa.

20. A device according to claim 17, characterized in that said engagement means are mechanical means comprising an engagement element (50) rotating with said axis (29) and freely moving along it inside said rotatable element (2) from an engagement position to a disengagement position, a tooth (52) integral to said rotatable element (2) to be engaged by said engagement element (50) for rotatiing said rotatable element (2), and means (53) to move said engagement element (50).

21. A device according to claim 20, characterized in that said engagement element (50) is made of ferromagnetic material and said moving means (53) is an electromagnetic actuator.

22. A device according to any claim from 17 to 21, characterized in that said blocking means are electromagnetic means comprising a plurality of ferromagnetic plates (35) in preselected positions on said rotating element (2), and an external electromagnet (36).

23. A device according to any claim from 17 to 21 characterized in that said blocking means are mechanical means comprising a plurality of slots (38) or similar depressions, provided at preselected positions on said rotating element (2) and engageable by a latch (39) operated by an electromagnetic actuator (40; 40').

24. A control circuitry for a plurality of matrix arranged devices according to any claim from 17 to 21, wherein said electromagnet (36) or actuator (40) is provided with one coil (49), characterized in that it comprises feeding electrodes (46i, 46k) parallel connecting all coils (49) in each column (i, k) and output electrodes (47v, 47w) parallel connecting all coils (49) in each row (v, w).

25. A control circuit for a plurality of matrix arranged devices according to any of claims 17 to 21, wherein said actuator (40'; 53) is provided with two coils (44, 45), a set coil and a reset coil, characterized in that all reset coils (45) are parallel connected to one single feeding electrode and the set coils (44) are connected by a circuitry according to claim 24.

26. A method to controllably operate a device according to claim 17, characterized in that it comprises the steps of: turning one or more drive axis (29) for a whole revolution to engage all rotatable elements (2) on said axis or axes (29) and align their corresponding coloured areas:
stopping said axes (29) rotation in a first display position of a first coloured area;
blocking a preselected number of rotatable elements (2) in said first position;
turn said drive axis (29) for 360/n degrees or a multiple thereof- n being the number of coloured areas - to display a second coloured

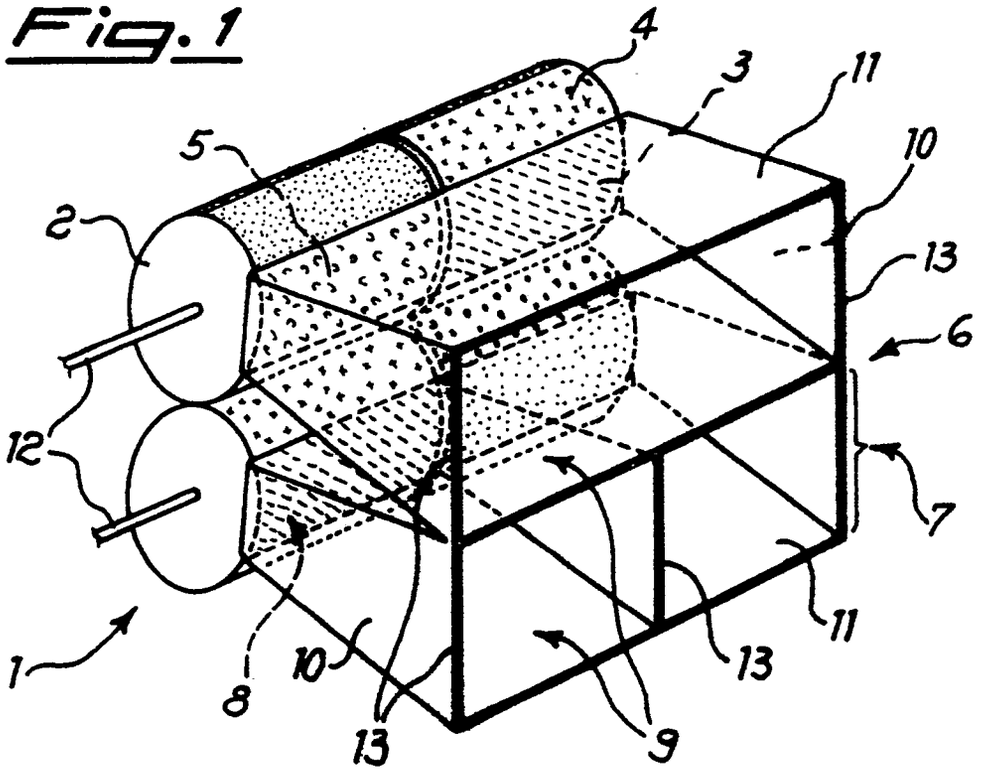
area; and
repeating the blocking and turning steps until all elements (2) are positioned as required.

27. A method according to claim 26, by which a circuitry according to claim 24 is used, characterized in actuating said electromagnet (36) or actuator (40) coils in a "by rows in parallel" way.

28. A method according to claim 26, by which a circuitry according to claim 25 is used, characterized in actuating said actuator (40') coils in a "by colour in parallel" way.

29. A method for controllably rotate an axial symmetry element (2) in a device according to claim 20, characterized in moving said engagement element (50) in an engagement position and in carrying out a plurality of steps according to claim 24.

Fig. 1



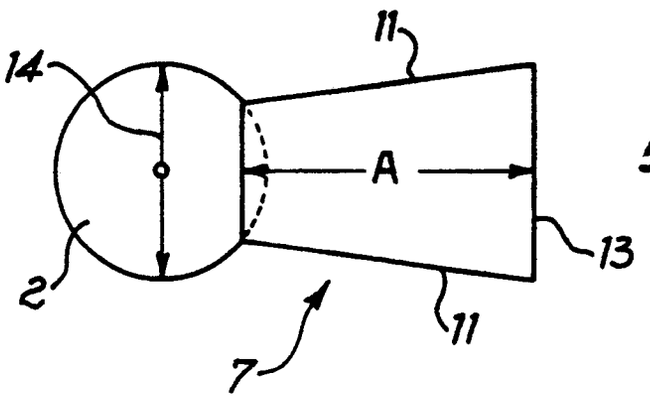


Fig. 2

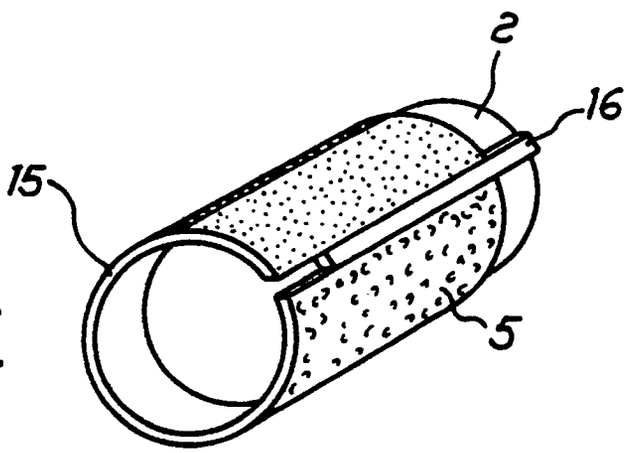


Fig. 3

Fig.4

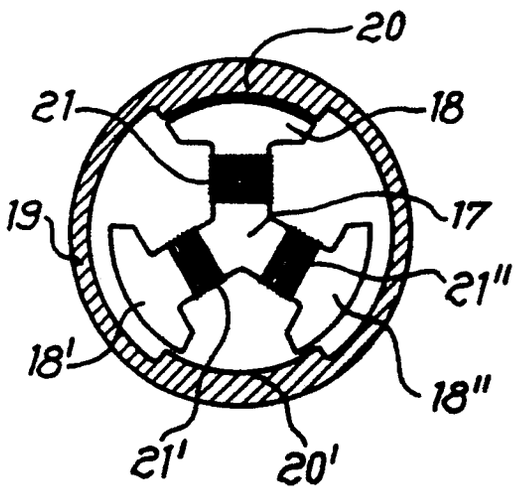


Fig.5

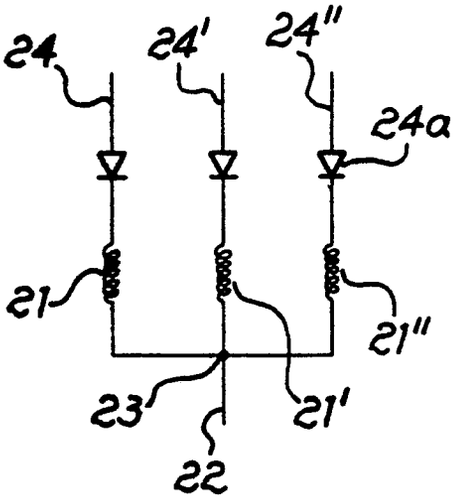


Fig.6

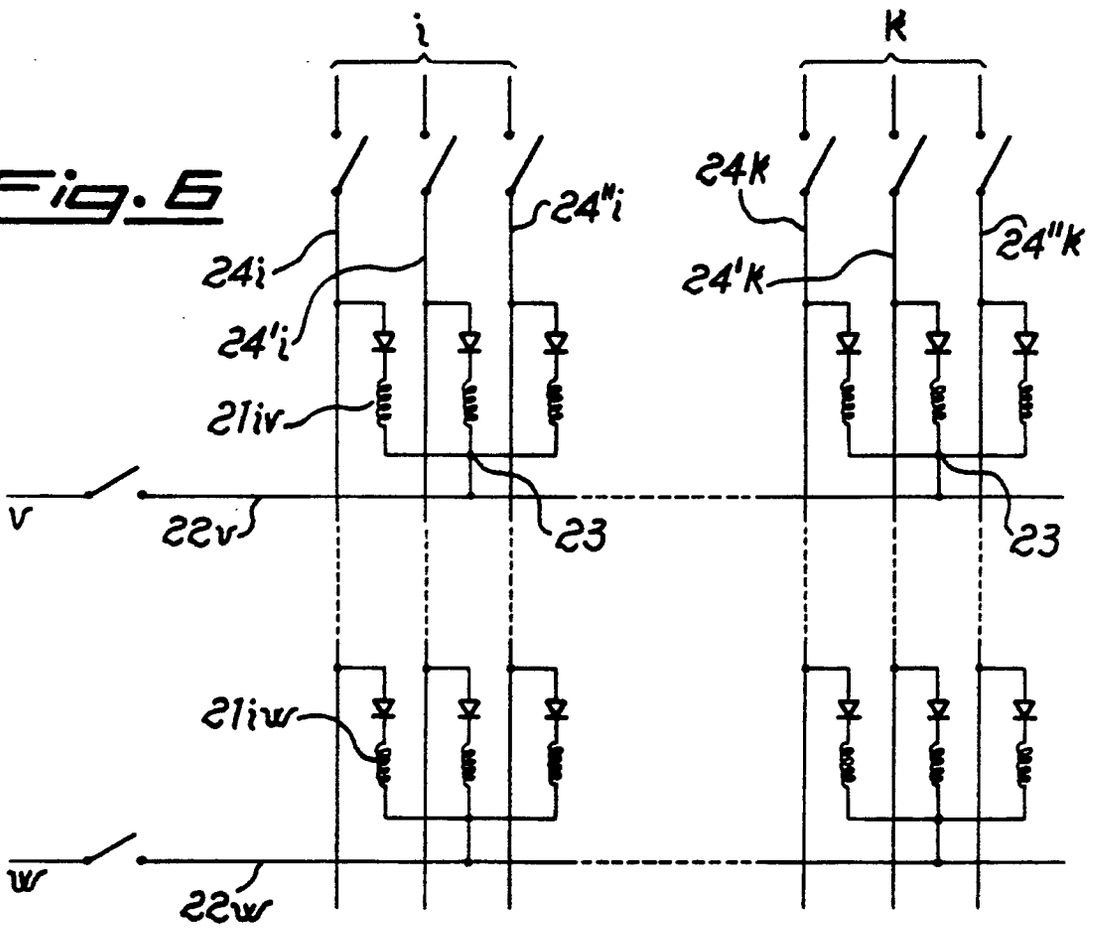


Fig.7

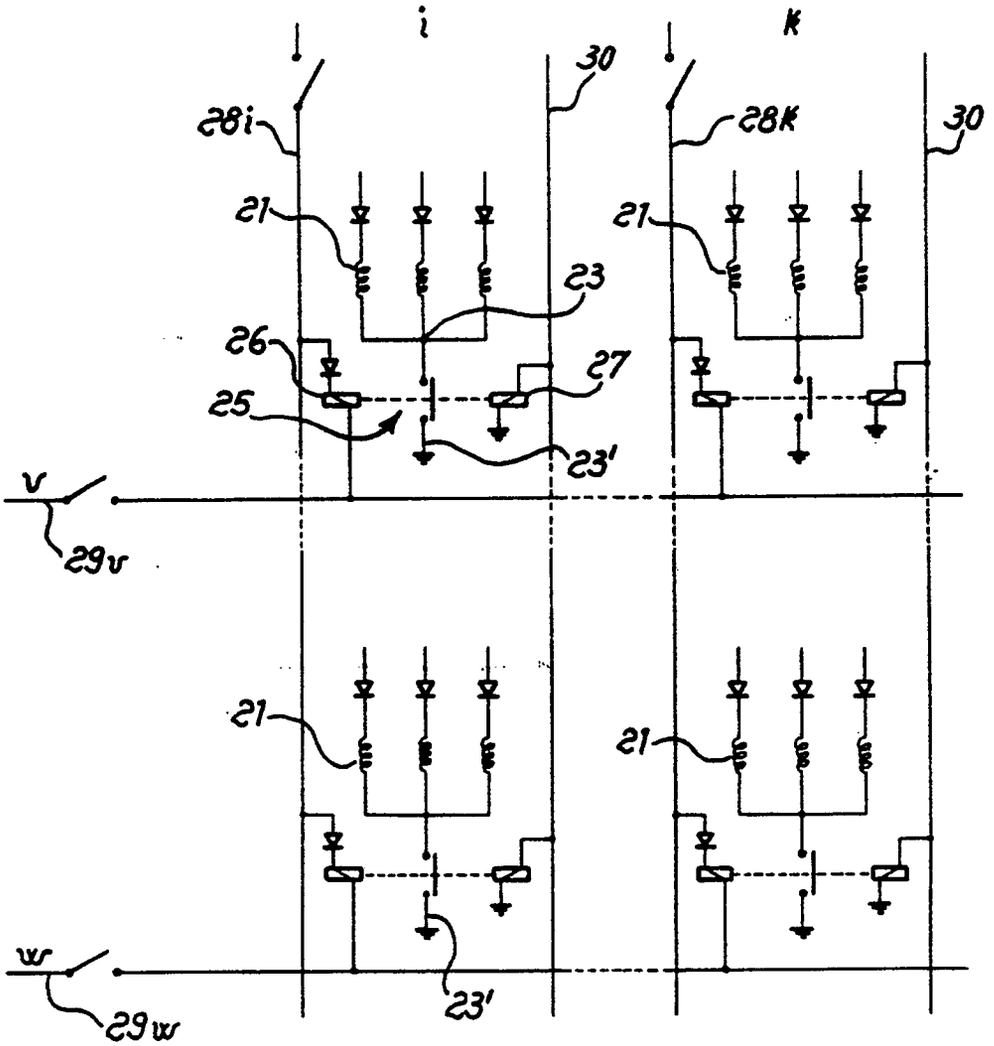


Fig.8

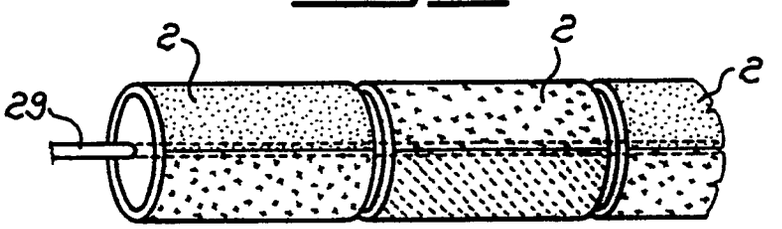


Fig.9

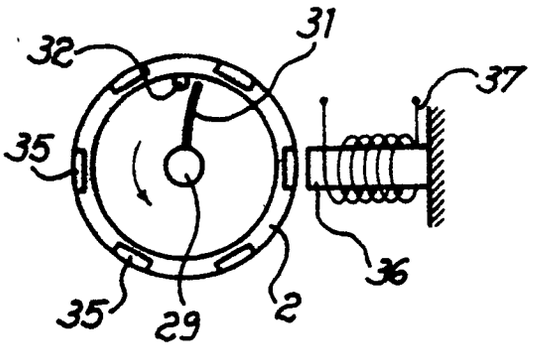
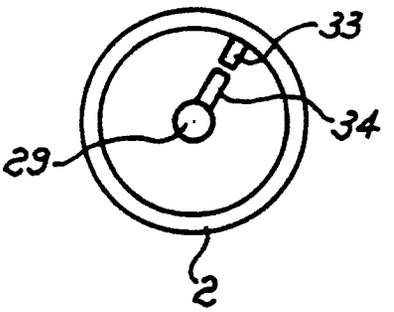


Fig.10



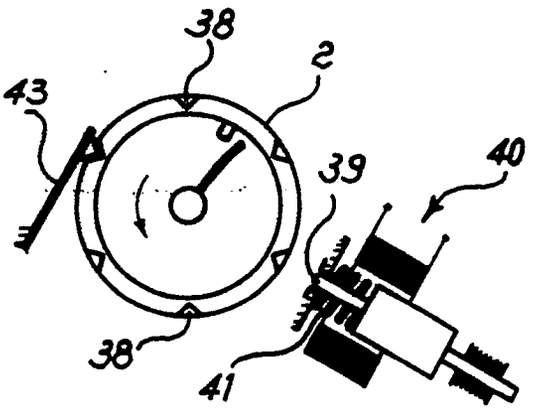


Fig.11

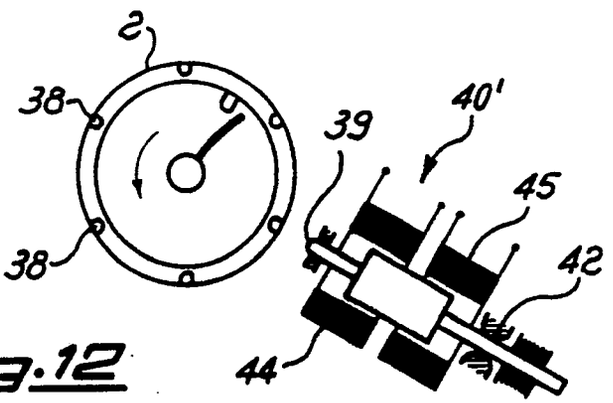


Fig.12

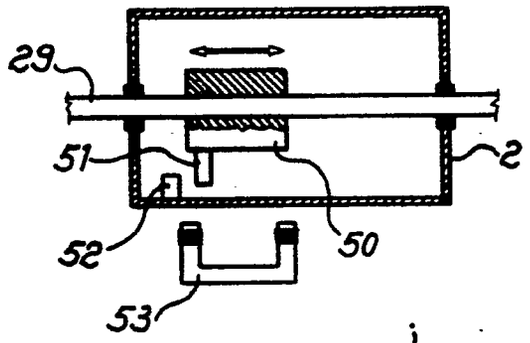


Fig.13

Fig.14

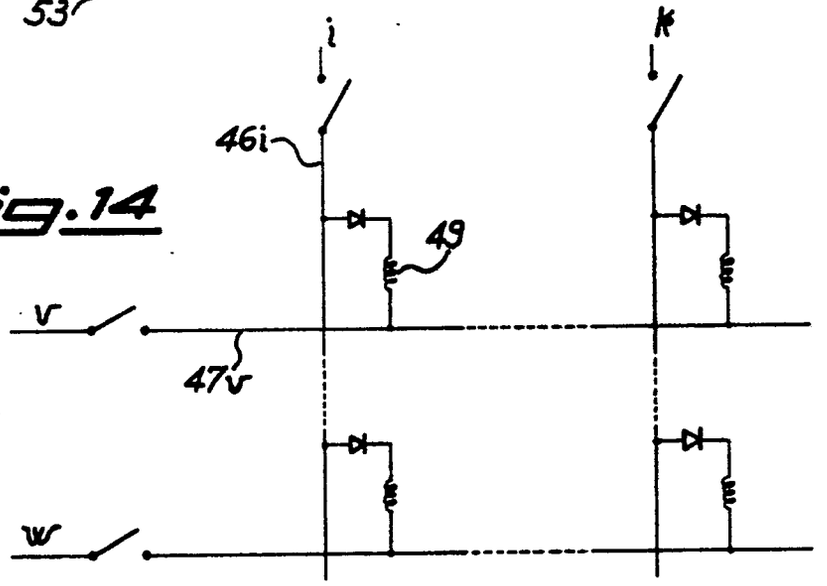
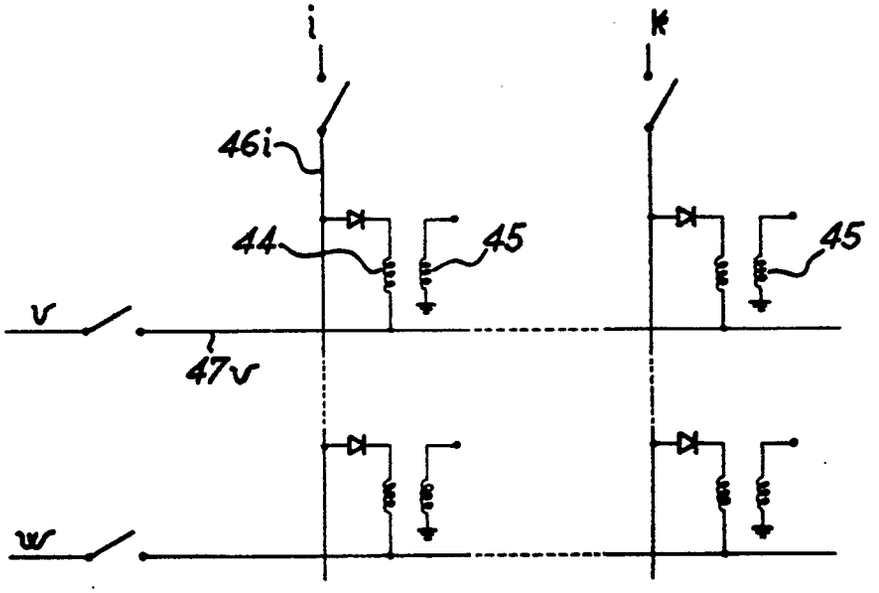


Fig.15



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 10 1275

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.5)
Y	US-A-3 963 326 (C. BUCHERT) * Column 2, line 59 - column 3, line 25; figures 1,13 *	1-4,6,7	G 09 F 9/37
Y	FR-A-1 272 078 (SOC. D'ELECTRICITE MORS) * Page 2, left-hand column; figures 1,2 *	1-4,6,7	
A	FR-A-2 294 500 (C. BUCHERT) * Page 2, line 15 - page 3, line 16; figures 1-3 *	1-4,6,7	
A	US-A-4 779 082 (H. SALAM) * Claims; figures 1-6 *	10,14	
A	EP-A-0 167 445 (SOC. D'ETUDES POUR LE DEVELOPPEMENT DES PRODUCTIONS ELECTRONIQUES) * Page 3, line 29 - page 6, line 9; figures 1-2 *	10,14	
A	US-A-4 069 480 (C. HELWIG)		TECHNICAL FIELDS SEARCHED (Int. Cl.5) G 09 F G 08 B G 09 G
A	DE-A-1 965 150 (FOK-GYEM)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16-11-1990	GALLO G.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)

European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,

namely:

1. Claims 1-9: Grill structure consisting of prismatic funnels positioned adjacent the rotatable display elements.

2. Claims 10-29: Devices and method for controllably rotating the rotatable display elements.

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,

namely claims:

☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

namely claims: