

Oct. 15, 1963

L. LE GOFF

3,106,794

DEVICES FOR DISPLAYING INFORMATION

Filed Aug. 1, 1961

4 Sheets-Sheet 1

FIG. 1

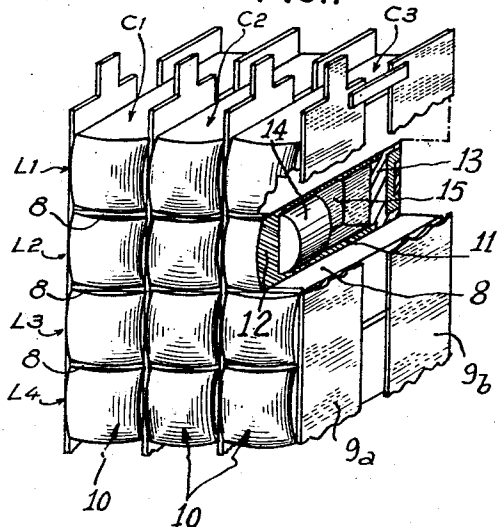


FIG. 3

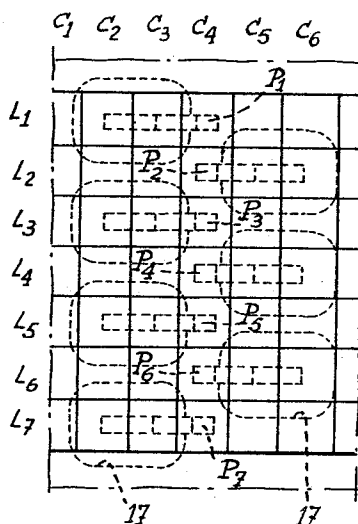
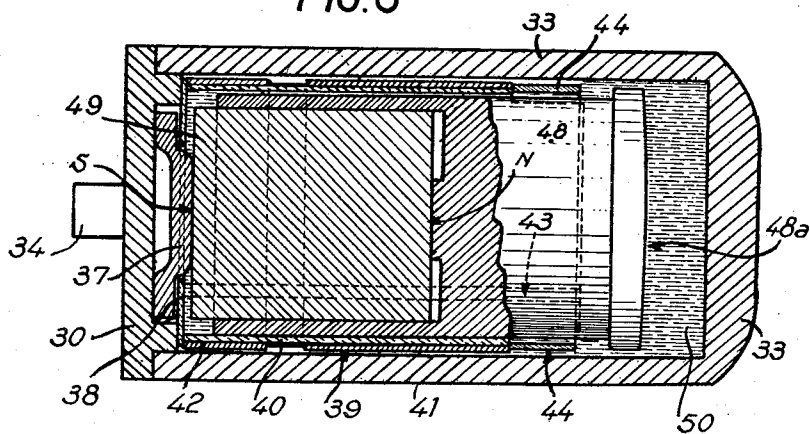


FIG. 6



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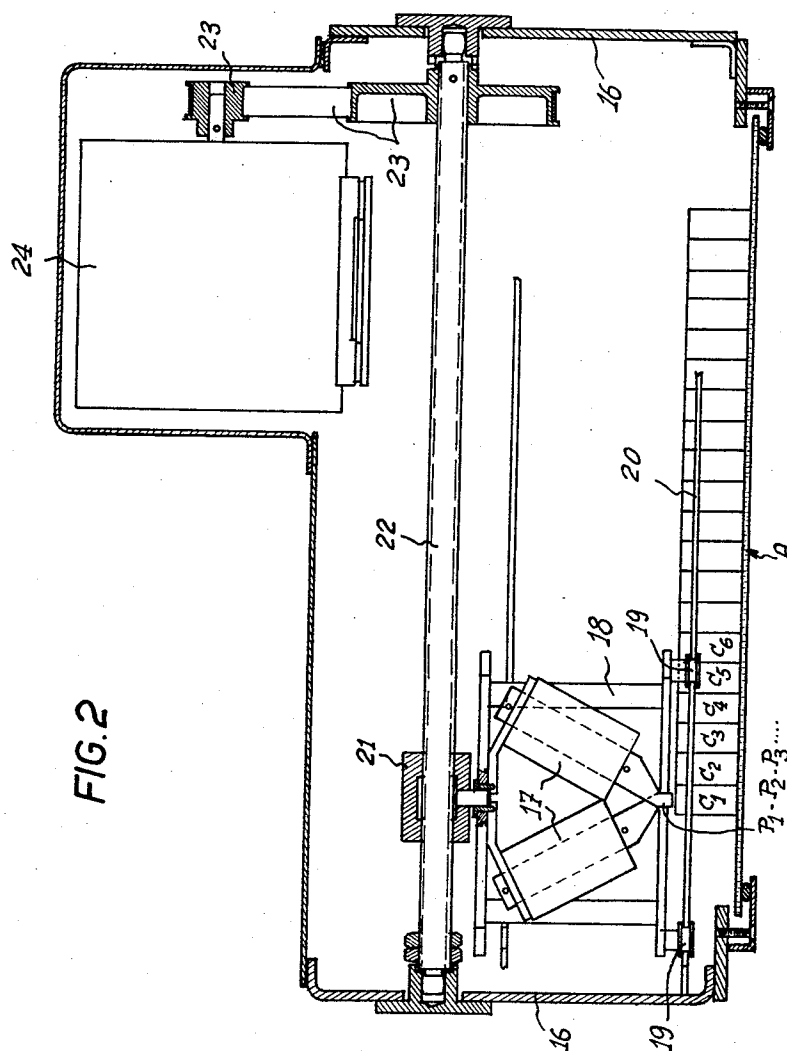


FIG. 2

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FIG. 4

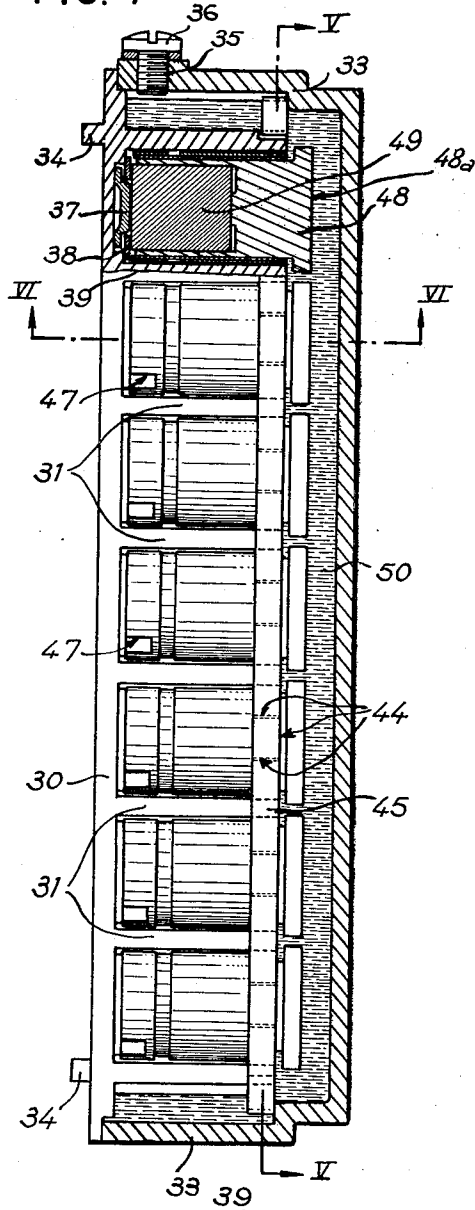


FIG. 5

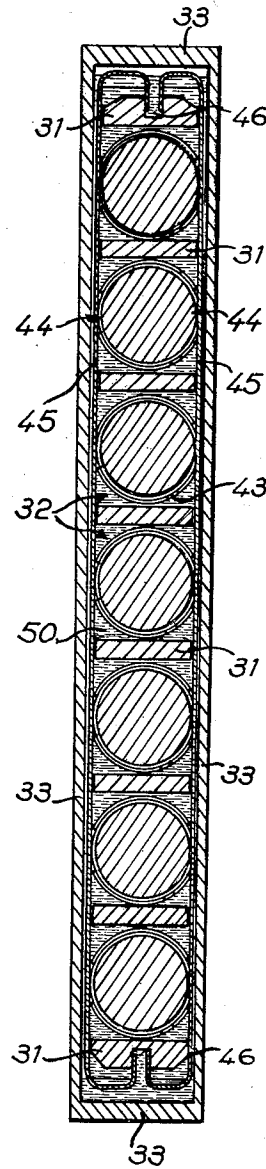
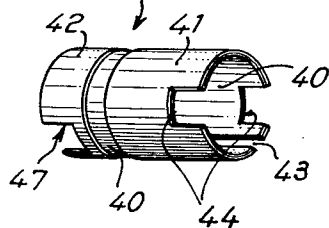


FIG. 7



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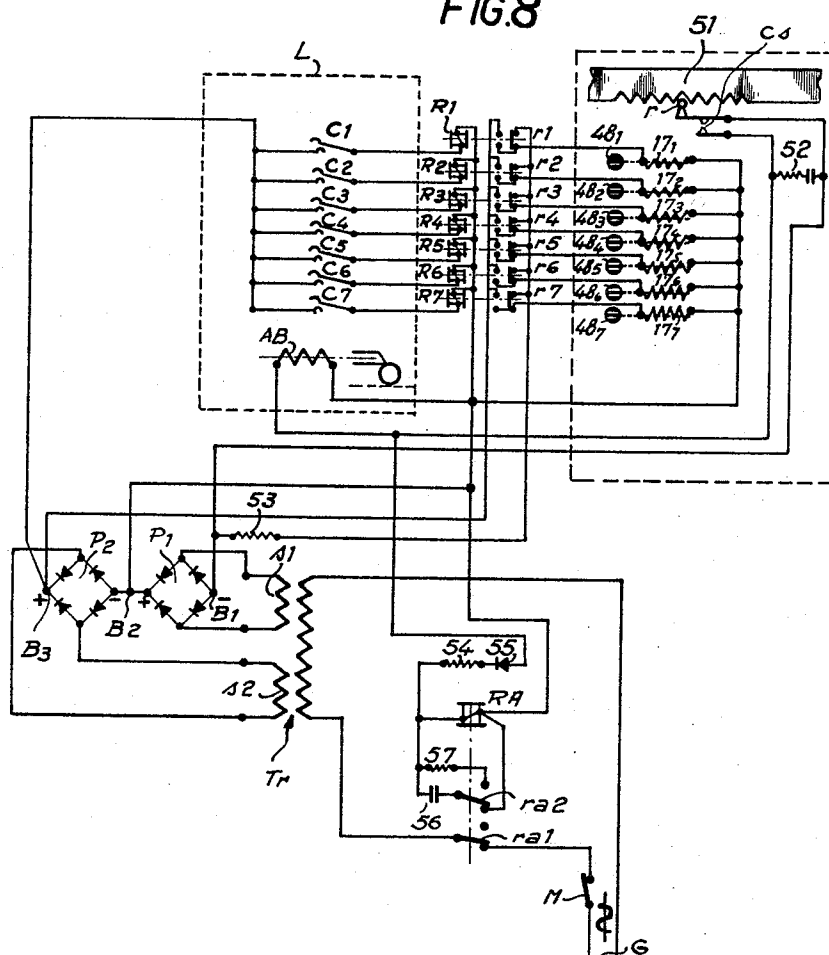
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FIG. 8



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DEVICES FOR DISPLAYING INFORMATION

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9 Claims. (Cl. 40-28)

The present invention relates to devices for displaying information and particularly to those enabling information to be displayed and easily read in lighted areas, such as stations, airports, racecourses, etc.

In such lighted areas, it is necessary that the inscriptions constituting the information be shown in a light colour on a dark background.

Different types of display devices fulfilling the above mentioned condition are already known. For example, certain devices use interchangeable placards but it is then necessary to have at one's disposal a large number of placards and to provide an auxiliary device in order to put them in place. Or again, devices are known comprising drums on the circumference of which there are painted, for example, the numbers from 0 to 9 or the letters of the alphabet, one single figure or one single letter appearing at a given moment in a window of an indicator board behind which a drum is located. It is rarely possible to use such letter devices by reason of the great bulk of the drums.

It has also previously been proposed to use display devices in which the display surface is formed by the juxtaposition of elementary surfaces capable of assuming one of at least two colours, e.g. a bright colour and a dark colour, each elementary surface being that of a member comprising a magnetically polarised movable member capable of occupying one of at least two positions according as to whether an external control member gives it a magnetic polarity in one direction or the other.

Display devices of this latter type, however, have not up to now formed the object of a practical application because of the technological difficulties encountered in industrially manufacturing the display elements which, in juxtaposition, form the display surface.

The present invention relates to the last-mentioned form of display device, and has for an object to provide a display element of a new type which may be economically manufactured and which ensures absolute operational security.

A display element according to the invention comprises an elementary cylindrical casing with a geometrical cross section allowing, by juxtaposition, the formation of a mosaic, (that is to say they may be triangular, square, rectangular or hexagonal), the front observation face of which is transparent, two magnetic stabilisation rings, one arranged on the side of the observation face and the other on the side away from this face, a piston in which is located a magnet, the magnetic moment of which is arranged parallel to the axis of the piston and which has a coloured face directed towards the observation face of the casing, this piston being mounted so as to be capable of being displaced inside the cylindrical casing, and a liquid of a different colour from that of the coloured face of the piston and filling the space inside the casing which is vacated by the piston, means being provided to allow the free circulation of the liquid during the movements of the piston.

The invention also relates to other characteristics relating both to the construction of the display element itself and to the control of display devices formed by the juxtaposition of display elements.

In order that the invention may be more clearly under-

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stood, various embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is an isometric projection of a particular embodiment of a display element according to the invention;

FIGURE 2 is a sectioned plan of a display device according to the invention;

FIGURE 3 is a diagrammatic plan view of the arrangement of the magnetic control members of the magnetically polarised movable elements;

FIGURE 4 is a longitudinal section of a group of seven display elements of a more elaborate embodiment forming a column;

FIGURE 5 is a section along the line V-V of the group of elements shown in FIGURE 4;

FIGURE 6 is a section along the line VI-VI of FIGURE 4, on an enlarged scale, of one of the elements of the group of elements;

FIGURE 7 is an isometric projection of a particular member used for mounting each member of the group and

FIGURE 8 is a circuit diagram of the cancelling and inscribing circuits for the information on a display device according to the invention.

Referring to FIGURE 1, the display device comprises a display surface formed by the juxtaposition, in a matrix comprising rows $L_1, L_2, L_3, L_4 \dots$ and columns $C_1, C_2, C_3 \dots$, of elementary square-shaped surfaces.

According to this example, the cells of the matrix are bounded by horizontal magnetic plates 8 held together by two assemblies of vertical magnetic plates 9a and 9b, one arranged towards the front of and the other towards the rear of the display surface.

Each cell encloses a display element 10 comprising a hollow body 11 of transparent material with a square cross section, terminating at the front in a lens 12 and at the rear in stopper 13.

A magnet 14 forming a piston with a circular section can move freely to and fro inside the square-section bore of the body 11. The front face of the piston 14, constituting the north pole N of the magnet for example, is painted white and is the same shape as the inner face of the lens 12. The remaining free volume inside the body 11 is filled with a black liquid 15.

The function of this embodiment may easily be understood; according as to whether a north or south pole is applied to the rear of a cell, the corresponding piston 14 will be pushed forward against the lens 12 which will then appear white, or drawn back towards the rear against the back 13 and then the lens 12 will appear black by reason of the black liquid which will then mask the remote white face of the piston 14.

By combining in any suitable manner the two different possible colorations of the elementary display surfaces, it may be seen that any desired information may be caused to appear on the observation surface.

The vertical metal plates 9a and 9b serve to stabilise the two possible positions of the pistons 14.

In the case of the previous example, in which the cells are arranged in a matrix in orthogonal columns and rows, it may be seen that this arrangement allows the display surface to be set to zero and to record in a very simple manner.

FIGURE 2 shows the assembly of a display surface manufactured according to the invention and of an associated device for setting the apparatus to zero and for recording information.

The display surface A, such as that formed by the juxtaposition of parallel surfaces as shown in FIGURE 1, is mounted at the front of a casing 16. In FIGURE 2 may be seen, in plan, the successive columns $C_1, C_2,$

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C₃, C₄ etc., each formed by the assembly of several vertically arranged display elements.

Behind the rear face of the display surface 2 a plurality of electro-magnets 17 may be displaced, said magnets being vertically arranged so that their poles P₁, P₂, P₃, P₄, etc., are located on the same column and spaced out in accordance with the rows such as L₁, L₂, L₃, L₄, (FIGURE 1) etc., of the display surface as shown in FIGURE 3.

The electro magnets 17 are mounted on a carriage 18 which can be displaced parallel to the rear face of the display surface A. To this end, the carriage 18 is guided by rollers 19 rolling along the rails 20 and is integral with a nut 21 in which a screw 22, driven by a belt and pulley transmission 23 from a motor 24, is rotatable.

A suitable electrical control circuit controls the rotation of the motor 24, detects the position of the carriage 18, reads a registration support upon which is recorded the information to be displayed, and consequently sends successively, column by column, pulses with suitable polarities to the electro magnets 17 in order to display the desired message.

FIGURES 4 to 7 show a more elaborate embodiment of a group of elements according to the invention. These elements are of a similar type to those shown in FIGURE 1.

It has been considered that, for the majority of the uses of a display surface, it is sufficient to provide symbols, figures and letters, the indication of which is contained with the aid of juxtaposed columns of groups of seven display elements.

Thus, there has been shown in FIGURES 4 to 7 such a group of seven elements, it being understood that a horizontal strip of a display device intended to receive a line of writing will be formed by the juxtaposition of a large number of vertical groups of seven elements.

The group is contained in a casing, comprising a base 30 provided with partitions 31 forming seven cells 32, and a cover 33 which encloses the partitions 31 and the base 30 and is made of a transparent material. The base 30 has lugs 34 allowing the groups to be fixed upon a common support. The cover 33 is stuck or welded on to the base 30. It is provided with a filler opening 35 which may be closed by a threaded plug 36. The front face of the cover 33 forms an optical lens, as shown in FIGURE 6.

Each square cross section cell 32 of the group corresponds to a display element. The bottom of each cell has a circular reinforcement in which is located a magnetic disc or plate 37 held in place by a non-magnetic perforated plate 38. The plate 38 is itself held in place by the base of a jacket 39 shown in perspective in FIGURE 7.

The jacket 39 comprises an inner jacket 40 which is non-magnetic and is, for example, made of copper, on which are secured a front or forward stabilising magnetic ring 41, and a rear stabilising magnetic ring 42. By "front" or "forward" is meant that side of the observation surface of the cover 33 located on the right in FIGURE 4, and by "rear" the opposite side located on the left in FIGURE 4. The assembly of the jacket 40 and the rings 41 and 42 has a longitudinal slot 43, the function of which will hereinafter be described. Two diametrically opposed retainer slots 44 are located towards the front of the jacket 39 and co-operate with two vertical strips 45 the curved ends of which are retained in securing recesses 46 formed respectively in the upper and lower surfaces of the two end partitions 31 of a group. Finally the jacket 39 has at its base two diametrically opposed recesses 47 each arranged opposite the corners of the square cross-section cell and the function of which will be hereinafter described.

The piston 48 is capable of being displaced inside the jacket 39. The piston 48 encloses a cylindrical magnet 49, the north pole N of which is directed forwards and

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the south pole S backwards for example. The front face 48a of the piston 48 is a light colour, for example white, and has a very small radius of curvature, as has been shown in FIGURE 6, so that it cannot stick against the flat inner surface of the cover 33. Generally the front face 48a of the piston 48 will be given a shape and dimensions suitable clearly to show the outline of the letters or symbols. The shape of this forward face could, according to requirements, be triangular, square, rectangular, with or without the corners cut off, or hexagonal.

In the case in which it is required to make use of letters or symbols of large size, a display device will be used in which the axes of the magnets such as 49 actuating the pistons such as 48 will form a network with larger meshes than in the example shown. It would then only be necessary sufficiently to enlarge the front faces 48a of the pistons 48 to re-establish the continuity of the outline.

Finally, a coloured liquid 50, for example a black liquid, fills the inside of the casing formed by the base 30 and the cover 33. A small space is left free of liquid above the group of elements adjacent the filler opening 35 in order to allow thermal expansion of the liquid. The nature of this liquid is selected so that its different characteristics of expansion, freezing, evaporation, chemical behaviour with regard to materials used, etc., are acceptable in relation to the conditions imposed.

The method of operation of this embodiment of a display element is easily understood. According to whether a south or north pole is applied to the rear of a cell 32, the corresponding piston 38 is pushed forward against the inner surface of the cover 33 forming a lens, which then allows the white colour of the front face 48a of the piston to be seen, or it is drawn back against the base 30 and the face visible at this place of the cover 33 then appears black by reason of the black liquid 50 which masks the remote white face 48a of the piston 48.

The front magnetic rings 41 on the one hand, and the rear rings 42 co-operating with the magnetic disc 37 on the other hand, ensure the stability of the two possible positions of the piston 48 by magnetic coupling with the magnet 49 enclosed by the piston. The longitudinal slot 43 in the jacket 39 avoids any short circuit of the magnetic flux.

The recesses 47 allow the coloured liquid 50 to be admitted or to circulate into or out of the interior of the jacket 39 according as to whether the piston 48 is travelling towards the cover 33 or away from it. It is clear that, as the cell is of square cross section and the piston 48 is of circular cross section, the colored liquid can freely circulate in the free spaces between the piston and the walls of the cell along the four edges of the cell 32; these free spaces communicate by the recesses 47 with the volume which is limited between the base 30 and the rear face of the piston 48.

Of course, it is possible to use a jacket 39 which is of square section. The piston 48 would then be guided in this jacket only by four generatrices. In this case, it would no longer be necessary to provide recesses 47 since the coloured liquid could freely circulate along the four angles or edges of the square jacket.

As for the possibility of the free movement of the piston within the coloured liquid in which it is immersed, this is obtained either, as shown above, by leaving sufficient clearance between the piston and the inner walls of the casing along which it is guided, or by providing one or more longitudinal channels in the piston itself through which the liquid may circulate, or again by providing such channels in the walls of the casing. In brief, it is only necessary to provide channels ensuring communication between the above defined volume which is limited between the base 30 and the rear face of pistons 48 and the volume between the forward face of pistons 48 and the cover 33.

With the aid of several vertical groups of display ele-

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ments of the type described above, it is possible to form columns C₁, C₂, C₃, C₄, etc., on an indicator board such as that shown in FIGURE 2.

As has been stated above with regard to FIGURE 2, behind the rear face of the display surface A a plurality of electro-magnets 17 may be displaced, said magnets being vertically arranged so that their poles P₁, P₂, P₃, P₄, etc., are located on the same column and have a spacing between them corresponding to that of the rows such as L₁, L₂, L₃, L₄, etc., of the display surface, as shown in FIGURE 2.

As has been described above, the electro-magnets 17 are mounted on a carriage 18 which may be displaced parallel to the rear face of the display surface A. The carriage 18 is driven by a motor 24.

Referring to FIGURE 8, an embodiment of an electrical control circuit will now be described, said circuit serving to control the rotation of the motor 24, to detect the position of the carriage 18, to read a recording support upon which the message to be displayed is recorded, and consequently to send pulses successively, column by column, with suitable polarities, to the electro-magnets 17 so as to display the required message.

The circuit is fed from an A.C. supply source G which is connected by means of a conventional starter switch M and a supply contact *ra*¹ to the primary winding of transformer Tr.

Secondary windings *s*₁ and *s*₂ of this transformer respectively feed two full-wave rectifier bridges, P₁ and P₂, which deliver direct voltages with different values to the terminals B₁, B₂ and B₃.

The messages intended to be displayed on the indicator board are previously recorded in the form of perforations on a tape of conventional type which is not shown in FIGURE 8. This tape is read in a conventional reading device diagrammatically indicated in FIGURE 8 by the rectangle L drawn in broken lines. Inside this rectangle is shown the winding AB of the electro-magnet effecting the step-by-step advancement of the tape. Reading contacts *c*₁, *c*₂, *c*₃ . . . *c*₇ have been shown corresponding to the seven possible positions of the perforations in a column arranged transversely of the tape. It will thus be understood that for a given position of the tape in the reading device, the reading contacts *c*₁ to *c*₇ are closed or open according as to whether they are at that moment respectively scanning a perforated or unperforated position on the tape. Then, when the winding AB is excited the tape advances by one step, and the subsequent recording column is read.

The advancement of the record tape, column by column, must be synchronised with the displacement of the column of electro-magnets 17 (FIGURE 2) successively in front of the different columns (C₁, C₂, C₃, etc.) of display elements. To this end, the winding AB is fed by the following circuit: Terminal B₁; synchronisation contact *cs*, which is closed each time that the column of the electro magnets 17 is mid-way between two successive columns of display elements; winding AB; and terminal B₂. The contact *cs* is actuated, for example, in the following manner: The movable portion of the contact *cs* is connected to move with a roller *r* (FIGURE 8) which moves longitudinally with the carriage 18 (FIGURE 2) and is flexibly forced to roll over a saw-toothed member 51 (FIGURE 8) secured to the structure 16 (FIGURE 2) of the apparatus. The contact *cs* is shunted by a series-connected resistance and condenser circuit 52 constituting a spark-suppressor. Thus, upon each excitation of the winding AB, brought about by the closure of the contact *cs*, the record tape is advanced by one column in the reading device L. Each trough of the saw-toothed member corresponds with a column of display elements.

At the moment when a given column of the record tape is read, or after a predetermined delay to allow for the excitation of the electro magnets and to compensate for the mechanical and electrical inertia of the apparatus

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and the circuits, certain of the contacts *c*₁ to *c*₇, corresponding to the perforations in the tape, are closed whilst the others, corresponding to non-perforated parts of the tape, remain open.

The contacts *c*₁ to *c*₇ are each connected in series with the winding of a corresponding relay R₁ to R₇; and the seven circuits: contact *c*₁ winding R₁; contact *c*₂ winding R₂; etc., contact *c*₇ winding R₇, are connected in parallel between the terminals B₂ and B₃.

The relays R₁ to R₇ respectively control the contacts *r*₁ to *r*₇. In the position of rest, as shown in FIGURE 8, the contacts *r*₁ to *r*₇ connect one end of the display electro magnets 17.1 to 17.7 to the terminal B₁ via a resistance 53. In the operative position, the contacts *r*₁ to *r*₇ connect this end of the electro magnets 17.1 to 17.7 to the terminal B₃. The other ends of the electro magnets 17.1 to 17.7 are connected in common to the terminal B₂.

FIGURE 8 diagrammatically shows the magnetically polarised movable members 48.1 to 48.7 which are capable of occupying one or other of two stable positions according to the direction in which current is flowing in the corresponding electro-magnet 17.1 to 17.7.

The method of operation of this circuit is simple to understand: when a perforation is read, it closes one of the contacts *c*₁ to *c*₇, e.g. contact *c*₁. The corresponding relay R₁ is then excited and operates its contact *r*₁. The display electro-magnet 17.1 is then connected between the terminals B₂ and B₃ and puts the element 48.1 in a suitable position e.g. that which causes its white surface to appear.

On the other hand, if there is no perforation the corresponding contact e.g. the contact *c*₂ remains open. The relay R₂ is thus not excited and leaves its contact *r*₂ in the rest position. The electro-magnet 17.2 is thus connected between the terminals B₂ and B₁ and leaves the element 48.2 in its second stable position, i.e. that it causes an elementary black surface to appear.

Reading of the tape and the inscription of its message upon the display elements is thus carried out successively column by column.

It is convenient if the display electro-magnets 17.1 to 17.7 are energised at the moment at which they are located substantially facing the display elements and are de-energised when they occupy intermediate positions between these display elements. To this end, a series circuit comprising a supply relay RA, a resistance 54 and a rectifier 55 is connected in parallel with the tape moving winding AB. Moreover, a series circuit comprising a condenser 56 and one of the contacts *ra*₂ controlled by the relay RA is connected in parallel with the relay RA. A resistance 57 is provided and is connected across the condenser 56 when the contact *ra*₂ operates.

The circuits described above operate in the following manner: when the carriage carrying the cancelling and inscribing electro magnets 17.1 to 17.7 are moved in front of the saw-toothed member 51, one column of the record tape is read and the corresponding message is displayed upon a column of display elements when the roller *r* which is moved with said carriage is located in a trough in the saw-toothed outline and when, therefore, the contact *cs* is open. After one column has been inscribed, the carriage and the roller *r* continuing to move, the roller *r* rises up an inclined edge of one tooth of the saw-toothed profile and ensures the closing of the contact *cs* which thus takes place when the display electro magnets 17.1 to 17.7, which are always excited as a function of the perforations of the column of the recording tape being read at this moment, are located in an intermediate position between two columns of display elements, but, however, nearer the column of elements upon which a notice is to be displayed. The contact *cs*, being closed, causes the excitation of the winding AB, as explained above, and thus causes the advancement by one step of the record tape in order that the following column may be read. This is not, however, carried out at this moment for, at the same

time, as the winding AB is excited, the relay RA is also excited with a delay determined by the resistance 54 and the condenser 56; in practice, the relay RA is excited immediately after the tape has been moved on by one step. The contact *ra1* then opens and cuts the connection between the alternating supply source G and the transformer Tr. The direct voltages at the terminals B1, B2 and B3 thus cease, and the rest of the circuits are, therefore, inoperative. The operation of the contact *ra2* allows the condenser 56 to be discharged into the resistance 57 which has the effect of keeping the relay RA momentarily excited. In practice, the relay RA is de-energised and thus allows its contact *ra1* to fall back effectively giving rise to the reading of the following column of the tape and the corresponding registration of the subsequent column of the display elements when the column of display electro-magnets 17.1 to 17.7 occupies an intermediate position between two successive columns of display elements but always nearer the column upon which a message is to be displayed.

I claim:

1. Display device comprising a casing, a plurality of juxtaposed display elements in said casing, each display element comprising a magnetically polarised movable member in the casing for sliding movement in a direction parallel to the magnetic axis of the member the casing being filled with a liquid and being provided with a transparent viewing surface opposite a first end of said movable member, said first end having a color different from that of the liquid, said movable member being movable between a first position in which said first end is adjacent said viewing surface to be visible therethrough and a second position in which said first end is spaced from said surface and is not visible through said liquid, magnetic control means for selectively causing said movable member to move between said positions, and passages permitting circulation of the liquid upon movement of said movable member.

2. Device as claimed in claim 1 comprising two magnetic stabilising members arranged respectively to stabilise the movable member in the position to which it is moved.

3. Device as claimed in claim 2, wherein the two magnetic stabilisation members are rings each having a longitudinal slot, the device further comprising a cylindrical jacket of non-magnetic material supporting the rings within which the movable member slides.

4. Device as claimed in claim 3, wherein the cylindrical jacket with the two magnetic rings is provided with recesses arranged to allow the colored liquid to circulate during the movement of the piston.

5. Device as claimed in claim 4 comprising magnetic plates, one for each display element located in the casing opposite the end of the respective movable member which is remote from the viewing surface, the plates co-operating with the adjacent magnetic stabilisation ring.

6. Display device as claimed in claim 1, wherein the movable members slide in separate elementary compartments in the casing with the first ends of the members disposed behind a transparent wall of the casing, each compartment being of angular cross section and having disposed therein a cylindrical jacket of non-magnetic

material carrying two magnetic stabilisation rings adjacent opposite ends thereof, and wherein each of the movable members comprises a piston slidable in said jacket, said jacket being provided with openings to allow the liquid to circulate into and out of the jacket during movement of the piston.

7. Display device as claimed in claim 1, wherein the display elements are arranged in orthogonally disposed columns and rows, the magnetic control means being a column of magnetic control members, equal in number to the number of display elements in one column, the column of magnetic control members being arranged behind the display elements and mounted for movement along the back of the display device so as to pass behind successive columns of display elements in turn, means for displacing the magnetic members stepwise to be positioned behind each column of display elements in turn, a record support adapted for recording in a series of columns the indications given by the various display elements, means for advancing said record support in step with the movement of the column of magnetic control members, means for successively reading the columns of the record support, and means for correspondingly energising the magnetic control members in accordance with said readings, the device further including an electrical synchronizing circuit comprising a contact, means for commencing an opening and closing cycle of said contact when the magnetic control members are located substantially midway between two successive columns of display elements, and means responsive to the opening and closing of said contacts for effecting advancement of the record support and for energizing a circuit for transferring the readings of a column on the record support to the magnetic control members when the column of magnetic control members is opposite a column of display elements.

8. Device as claimed in claim 7 comprising a roller which moves with the column of magnetic control members and rolls upon a fixed member with a saw-toothed outline for synchronizing said contact, the teeth on said fixed member having a pitch equal to the spacing of the columns of display elements.

9. A display element comprising a casing, a magnetically polarised movable member having a magnetic axis and mounted for sliding movement in a direction parallel to the magnetic axis in the casing, said casing being filled with a liquid and provided with a transparent viewing surface opposite a first end of said movable member, said end having a color different from that of the liquid, said member being movable between a first position in which said first end is adjacent said surface and a second position in which said end is spaced from said surface, two magnetic stabilising rings respectively arranged to stabilise the movable member in the position to which the movable member is moved, and passages permitting circulation of the liquid when said movable member is moved.

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