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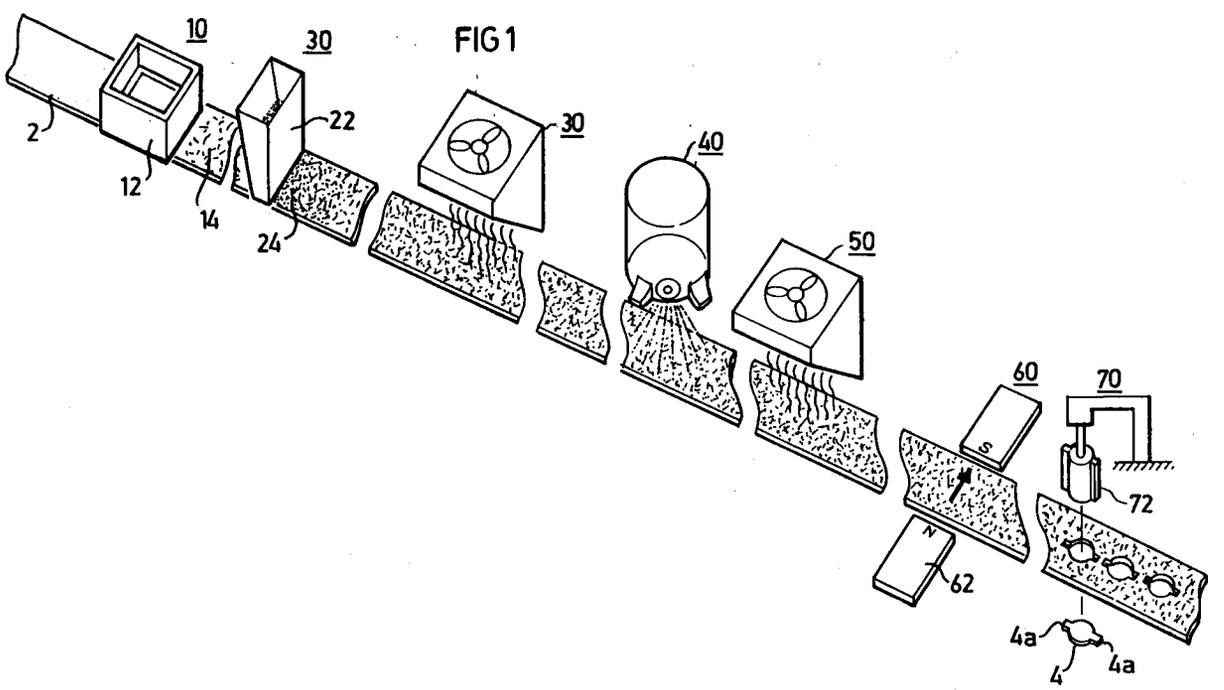
(54) Magnetically-actuated display elements and method of making same.

(57) A magnetically-actuated display element includes a non-magnetic substrate having a coating of magnetic particles and a plurality of surfaces of contrasting colour. The display element is mountable to permit it to assume a plurality of stable positions each displaying one of the surfaces of contrasting colour, and is cooperable with a fixed electromagnet for moving the display element to a selected one of its plurality of stable positions.

FIG 1



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The present invention relates to magnetically-actuated display elements, and also to a method of making such display elements. The invention is particularly applicable to making the disc-shape display elements as described, for example, in US Patents 3,871,945 and 3,942,274, and is therefore described below with respect to such an application, but it will be appreciated that the invention could advantageously be used in making display elements of other configurations, for example of spherical or cylindrical configuration.

Magnetically-actuated displays of the foregoing type comprise a plurality of display elements of disc configuration arranged in a rectangular matrix of horizontal rows and vertical columns, with each display element being coloured with contrasting colours on the its opposite sufaces. Each display element is pivotally mounted to a supporting member to permit it to be pivoted to two stable positions. Each element displays one of the surfaces of contrasting colour, and includes a magnet cooperable with fixed electromagnetic means on the supporting member for pivoting the display element to selected positions in order to produce variable displays among the plurality of display elements.

In the conventional construction, as described for example in the above patents, the magnet carried by each display element is a magnetic body occupying a relatively small area of the display element. This requires the magnetic body to be of appreciable thickness, and thereby requires the display element also to be of appreciable thickness. Such a construction increases the mass of the display element, and therefore the time and/or power required to change the displays. In addition, since each display requires a large number of display elements, displays using such a construction are relatively expensive to produce.

An object of the present invention is to provide a display element for magnetically-actuated displays having advantages in the above respects.

According to the present invention, there is provided a magnetically-actuated display element comprising a plurality of surfaces of contrasting colour, mounting means for movably mounting the display element to permit it to assume a plurality of stable positions each displaying one of said surfaces of one of contrasting colour, and a magnet carried by the display element and cooperable with fixed electromagnetic means for moving said display element to a selected one of its plurality of stable positions; characterized in that said display element comprises a non-magnetic substrate, and a coating thereover of magnetic particles bound to the non-magnetic substrate by an adhesive.

According to the preferred embodiment of the invention described below, the display element is of disc shape and is formed with a pair of diametrically-opposed ears constituting the mounting means and permitting pivoting the disc to one of two stable positions, one face of the disc being one of the colours, and the opposite face of the disc carrying the coating of magnetic particles and being of the other colour. The other colour is preferably in the form of a coating of colouring matter over the coating of magnetic particles bound to the substrate.

According to further features in the described preferred embodiment, the adhesive is preferably an epoxy resin; and the non-magnetic substrate is preferably of plastic material, such as Mylar plastic film. It is contemplated, however, that the non-magnetic substrate may also be of metal, such as copper or aluminum.

The present invention also provides a method of making the above-described display elements comprising: feeding a continuous strip of the non-magnetic substrate, having one face coloured with the one colour, through a plurality of stations; coating the opposite face of the strip with the adhesive at one station; coating the adhesive with a layer of the magnetic particles at a second station; drying the adhesive to bind the magnetic particles to the opposite face of the strip at a third station; coating the layer of magnetic particles with the other colour at a fourth station; and punching out the disc-shaped display elements from the strip at a fifth station.

As will be more apparent from the description below, relatively thin display elements may be constructed in accordance with the present invention in volume and at low cost.

Further features and advantages of the invention will be apparent from the description below.

The invention is herein described, by way of example only, with reference to the accompanying drawings wherein:

Fig. 1 illustrates one form of display element, and method of making it, in accordance with the invention; and

Fig. 2 illustrates a display including a plurality of elements as in Fig. 1.

As shown in the accompanying drawing, a continuous strip, generally designated 2, of a non-magnetic substrate is continuously fed through a plurality of stations at which various processes are formed on the continuous strip to produce a plurality of display elements 4 at the final station in the process. The continuous strip 2 may be of a plastic material, such as Mylar plastic film; alternatively, it could be of a metal, such as copper or aluminum. In either case, it is of one colour on one face (that hidden from view in the drawing), while the various operations are formed on the opposite face (that exposed to view).

Thus, the continuous strip 2 is first passed to

an adhesive station 10 wherein a coating of adhesive supplied from a reservoir 12 is applied, as by spraying, brushing or calendering, onto the exposed face of the strip to cover substantially the complete surface with the adhesive, as shown at 14.

Next, the strip is passed through station 20 at which magnetic particles, preferably in fine powder form, are applied from a reservoir 22 to coat substantially the complete surface of the adhesive coating 14, as shown at 24. The strip is then applied through a dryer station 30 wherein the adhesive is dried and thereby to bind the magnetic particles 24 to the respective face of strip 2.

Following the drying step, the continuous strip 2 is passed through a colour-coating station 40, in which colouring matter is applied, as by spraying, onto the dried coating of magnetic particles. The colour of the mattter applied at station 40 is of course of a contrasting colour from that carried by the hidden surface of the strip.

The continuous strip 2 is fed through another drying station 50, and then through a magnetizing station 60 in which an electromagnetic 62 magnetizes the coating of magnetic particles. The magnetic particles are of "hard" magnetic material, so that the particles are thereby permanently magnetized in a predetermined direction.

Finally, the continuous strip 2 is passed through a punching station 70, wherein a punch 72, in the shape of the display element 4 to be produced, punches out the display elements 4 from the continuous strip 2.

The display elements 4 so-produced are of disc shape and include ears 4a at diametrically-opposite sides so as to permit a plurality of such display elements to be pivotally mounted in the form of rectangular matrices in their respective housings, as shown at 80 in Fig. 2. Since such matrices and housings are well-known, for example as described in the above-cited patents, they are not illustrated in detail herein. It will be appreciated, however, that such housings include fixed electromagnets, shown schematically at 82, which are selectively energizable to pivot the display elements to a respective one of their two stable positions, i.e., exposing one or the other face, thereby to selectively expose one or the other of their colours according to the information to be displayed.

As indicated earlier, the continuous strip 2 may be of any suitable non-magnetic material, such as plastic or metal. Preferably, it should be sufficiently stiff so that the display element, produced by applying to it the various layers described above, retains its shape when such display elements are mounted in the display housing as shown in Fig. 2, but preferably should be sufficiently flexible to permit the display element to be manually flexed in order to snap its ears 4a into the openings provided in the display housing for pivotally mounting the display elements.

It will thus be seen that the invention enables the production of relatively thin display elements in a continuous, low-cost and high-volume manner.

While the invention has been described with respect to one preferred embodiment, it will be appreciated that many variations may be made. For example, the display element may be of cylindrical, spherical, or other shape. Also, the coating of magnetic particles could be applied to a substrate which is adhesively bonded to the display element. Many other variations, modifications and applications of the invention will be apparent.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A magnetically-actuated display element comprising a plurality of surfaces of contrasting colour, mounting means for movably mounting the display element to permit it to assume a plurality of stable positions each displaying one of said surfaces of one of contrasting colour, and a magnet carried by the display element and cooperable with fixed electromagnetic means for moving said display element to a selected one of its plurality of stable positions; characterized in that said display element comprises a non-magnetic substrate, and a coating thereover of magnetic particles bound to the non-magnetic substrate by an adhesive.

2. The display element according to Claim 1, wherein the display element is of disc shape and is formed with a pair of diametrically-opposed ears constituting said mounting means and permitting pivoting the disc to one of two stable positions, one face of said disc being one of said colours, and the opposite face of said disc carrying said coating of magnetic particles and being of an other of said colours.

3. The display element according to Claim 2, wherein said other of said colours is in the form of a coating of colouring matter over said coating of magnetic particles bound to said

substrate.

4. The display element according to any one of Claims 1-3, wherein said non-magnetic substrate is of plastic.

5. The display element according to any one of Claims 1-3, wherein said non-magnetic substrate is of copper.

6. The display element according to any one of Claims 1-3, wherein said non-magnetic substate is of aluminum.

7. A magnetically-actuated display comprising a plurality of display elements according to any one of Claims 1-6 arranged in horizontal rows and vertical columns on a supporting member, and electromagnetic means fixed to said supporting member for selectively moving said display elements.

8. A method making magnetically-actuated display elements each according to any one of Claims 2-7, comprising:

feeding a continuous strip of the non-magnetic substrate, having one face coloured with said one colour, through a plurality of stations;

coating the opposite face of the strip with said adhesive at one station;

coating the adhesive with a layer of said magnetic particles at a second station;

drying said adhesive to bind the magnetic particles to said opposite face of the strip at a third station;

coating said layer of magnetic particles with said other colour at a fourth station;

and punching out said disc-shaped display elements from said strip at a fifth station.

9. The method according to Claim 8, wherein said magnetic particles are particles of permanent magnetic material and said particles are permanently magnetized at a magnetizer station before the disc-shaped display elements are punched from the strip at said punching station.

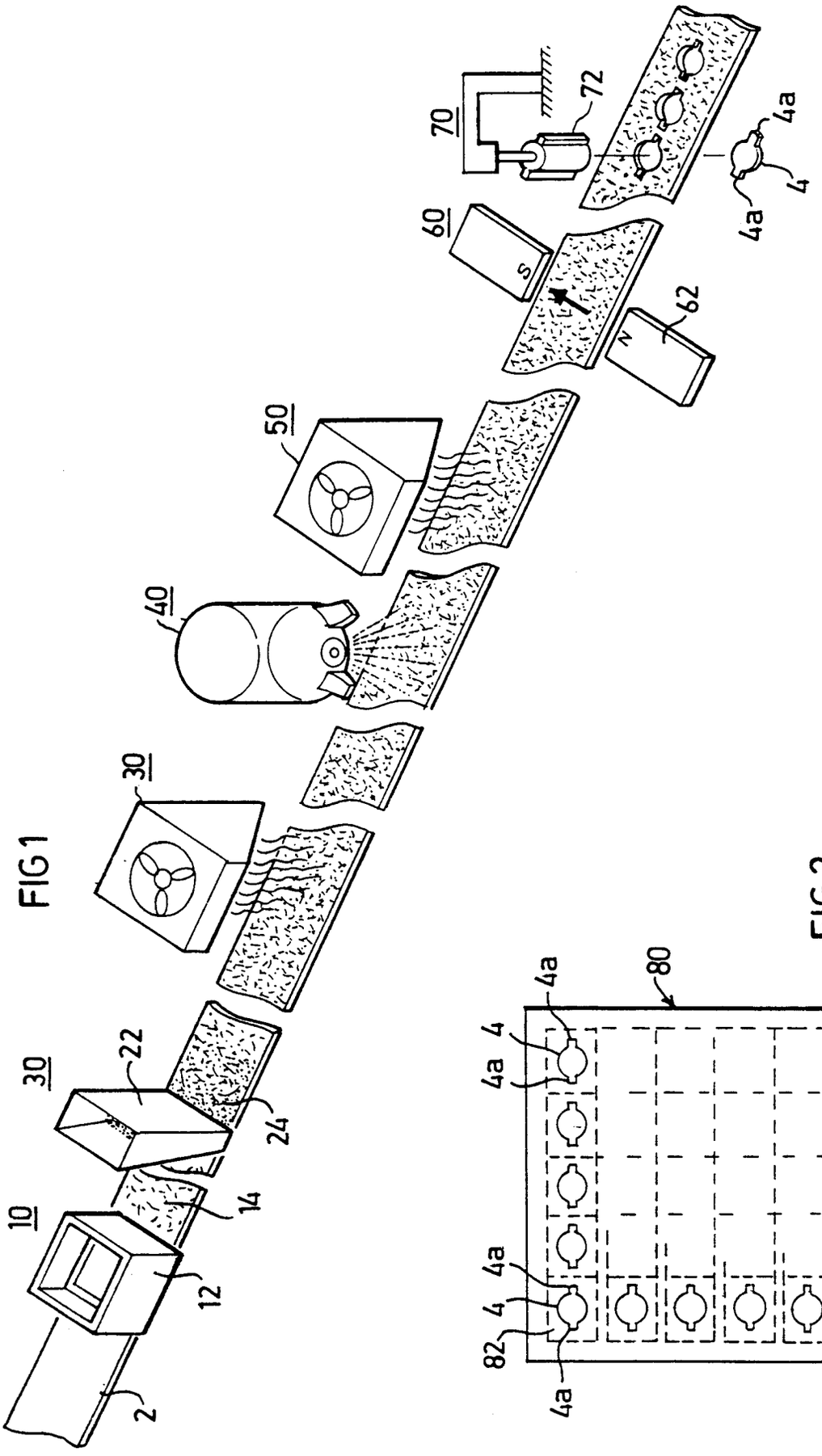

FIG 1

FIG 2