May 21, 1968 R. D. SMITH 3,384,147

ELECTRICALLY ADJUSTABLE VENETIAN BLIND STRUCTURE

Filed April 13, 1966 2 Sheets-Sheet 1

Fig. 1

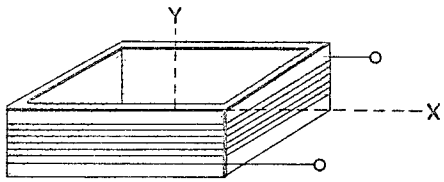
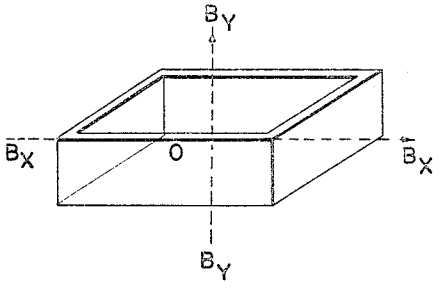


Fig. 2



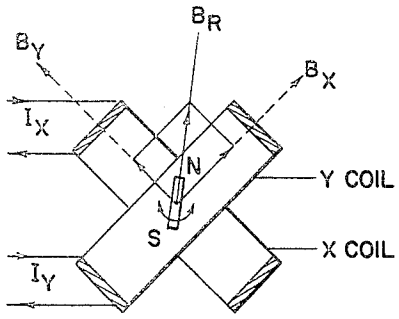


Fig. 3

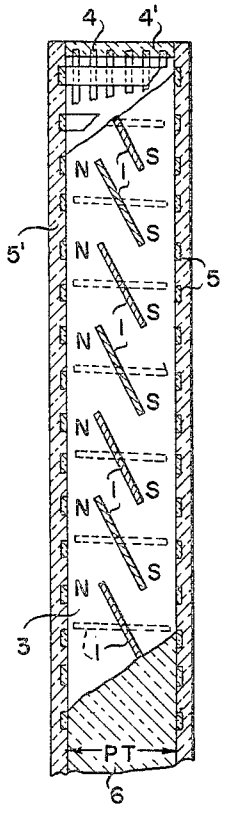
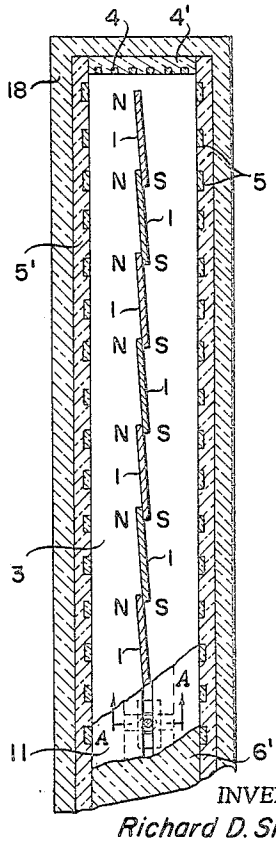


Fig. 4

Fig. 5



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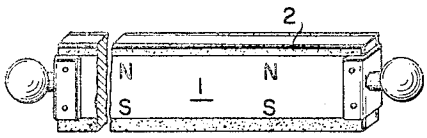


Fig. 6

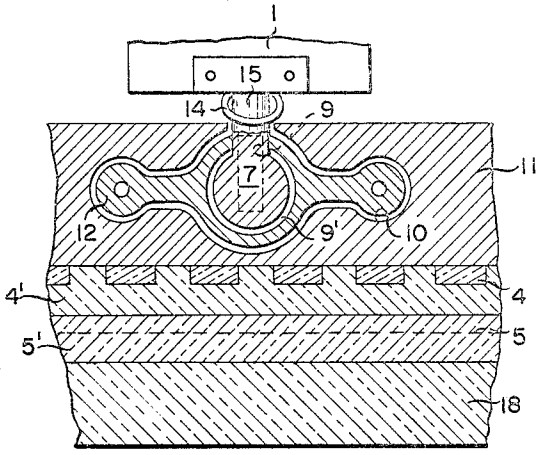


Fig. 7

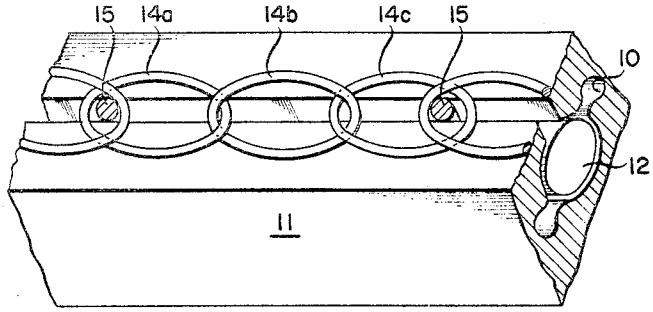


Fig. 8

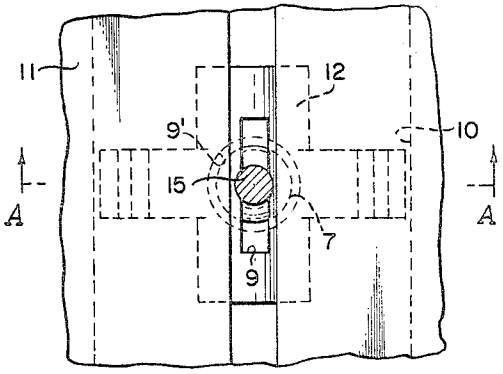
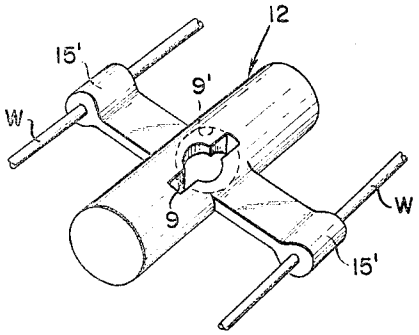


Fig. 9

Fig. 10



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ELECTRICALLY ADJUSTABLE VENETIAN BLIND STRUCTURE

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14 Claims. (Cl. 160—107)

The subject invention relates generally to an electrically adjustable Venetian blind and/or shutter-like structure characterized by a movement which can be controlled in two-dimensions from a remote position. The subject device is particularly useful in connection with enclosures, partitions, walls and the like provided with an aperture or equivalent portion through which a visual passageway is desired or required on a selective basis, the more notable advantages of the subject invention over similar devices presently employed being as follows: the subject device can be permanently installed in an aperture or equivalent portion as above in substantially the same fashion as, and as a substitute for, the transparent window conventionally employed, while simultaneously fulfilling the need normally provided by separate and distinct drapes, curtains and Venetian blind or the like type privacy means; it is readily adjustable by finger manipulative or like controls through a near infinite number of positions as is the conventional Venetian blind structure, and without the slat-misalignment and out-of-parallel problems inherent with the latter; it is substantially free from that universally deplorable of tasks, slat cleaning, inasmuch as the slats of the subject structure are never purposely in contact with the atmosphere; it is readily adapted for use as a basic interior decorating accessory inasmuch as mirror and color scheme effects are conveniently realizable therefrom; it may be comprised almost entirely of component parts which are somewhat flexible and therefore compressible to an extent when impacted to thereby provided an element of safety in the event of accidental collisions; and it is readily amenable to mass production techniques.

In order that the invention may be clearly understood, reference is made to the following description taken in conjunction with the appended drawings wherein:

FIGURES 1 to 3 are schematic illustrations useful in promoting understanding as to the operation of the subject device;

FIGURE 4 shows a sectional top view of the subject Venetian blind structure with a hypothetical visual obstructing medium filling the enclosed volume indicated generally by the numeral **3** and with volumes of this hypothetical medium at the ends of the figure being removed to enable one to distinguish the various component parts, the dotted line N-S slat elements illustrating their shutter-open position and the solid line N-S slat elements illustrating the slats when selectively moved by intentionally applied electric field forces to a position intermediate their shutter-open and shutter-closed positions;

FIGURE 5 is a sectional top view as in FIGURE 4, but with the slat elements illustrated in their shutter-closed position, with a portion of the slat guiding track added, and with the entire structure enveloped by a transparent incasement;

FIGURE 6 is a perspective view of a single slat element;

FIGURE 7 is a cross-section of the subject structure as viewed from line A—A of FIGURE 5;

FIGURE 8 is a sectional perspective view of the plastic link configuration used to regulate the distance between slats;

FIGURE 9 is an exploded view of the slat supporting and retaining means of FIGURE 5; and

FIGURE 10 is a persepctive view of the lateral slide and gathered slats spacing element.

The Venetian blind and/or shutter-like structure of this invention to be described in more detail hereinafter operates in accord with the well known principles of vector force summation. As shown schematically in FIG. 1, the electrical energization of two coils (of which only one is shown for the sake of clarity) positioned about the respective axes of a two orthogonal axis coordinate system X, Y, is characterized by the generation of respective force field components B_x and B_y generally in line with the respective axes as shown in FIG. 2. While the force field vectors of FIG. 2 have been assigned prescribed directions as denoted by the arrowheads, and magnitudes as denoted by the lengths from the origin 0 to the arrowhead tips, a reversal in the direction of current flow and variation as to the amperage thereof in a given coil is all that is required to modify, respectively, the direction and magnitude of the force field established by that coil.

With reference to FIG. 3 which schematically shows the general coil configuration employed in the subject structure, it is readily seen that the individual force field components are resolvable into a single resultant force field vector B_r. By a judicious selection of coil design and by the use in conjunction therewith of suitable current control circuitry which permits selective control of the current values supplied to the individual coils (e.g. I_x and I_y), the resultant field B_r may be confined to a substantially planar pattern which is selectively positionable in two dimensions. If now a relatively sturdy bar-type permanent magnet characterized by north and south poles N-S is substantially freely suspended interiorly of the two orthogonal coil configuration as schematically shown in FIG. 3, the magnet will tend to align itself with the resultant force field component and thereby itself be adjustably positionable in two dimensions. The structure of this invention relates to just such an arrangement.

Reference is now made to FIGURES 4 and 5 which show the preferred embodiment of the Venetian blind structure constructed in accord with the teachings of this invention. A plurality of long, thin, although physically sturdy, and rectangular-shaped permanent magnet N-S slat elements **1** are shown as being mounted for pivotal and rectilinear movement within the confines of a volume **3** the dimensions of which are established substantially by the size of the box-like coil configurations **4**, **4'** and **5**, **5'**. The elements are physically supported and/or suspended in substantially parallel relationship by means of ball-shaped ears **7** provided at each breadth end of the slats by way of connecting neck portions **15**. The ears are formed either integrally with the slats or by way of distinct but effectively integral U-shaped ear-carrying elements riveted or otherwise attached to the slats as shown in FIG. 6, the ears being restricted for travel within the complementary central circular-section portion of outrigger-shaped channels **10** of a pair of substantially rigid plastic slat guide track elements **11** of which only one is shown. As shown in FIG. 7, the ears are maintained out of direct contact with the side walls of the channel **10**, a relatively rigid and non-elastic plastic intermediate member **12** serving this purpose and having the general form of an outrigger provided with a slot **9** through which entry is gained to a cavity **9'** which is used to nestle the ears, the nestling being on a one member per ear basis. Note that the cavity **9'** is about the same size and shape as the ear which it nestles, that slot **9** extends to a depth of only about two-thirds of the depth of spherical cavity **9'**, and that the slot **9** as shown in FIG. 9 is somewhat longer than the cavity diameter to permit limited flexing of the narrow-section cavity wall portions to afford relatively easy entry of the ear into the cavity. Inasmuch as the members **12** are limited to rectilinear movement within a respective chan-

nel **10**, and the ears of the slat elements are pivotally mounted within the members, the ears are substantially permanently retained within the channels and are capable of both rotational and rectilinear movement with a nominal amount of friction. The width dimension of the slat elements is less than the internal dimension PT of the structure, and the other related dimensions are selected such that normal movement of the elements is restricted to a volume of space which is slightly remote from the internal surface boundaries of the coil configurations. The permanent magnet elements suspended as described are thus free to rotate and/or move rectilinearly.

At least one surface of each of the elements may be highly polished, or alternatively, polished and coated with a very thin metallic coating; in any event, and by any other known practical techniques, the N-S elements may be caused to function as mirrors whereby radiation incident on the referenced surfaces is substantially 100% reflected. In cases where a mirror effect is neither desired nor required, the mirror function may be dispensed with as by the spraying or otherwise coating of the mirror surface alone, or of the entire slat element, with a thin film of paint or the like. Alternatively, the slat elements can be manufactured without the mirror surfaces and the paint or the like coating applied subsequently as desired. The particular coating material employed and/or the thickness thereof must of course be of a nature which does not materially interfere with the movement of the elements in response to the applied force fields. The color or patterns of color of the coating may be any desired, a feature which is quite useful from an interior decorating point of view. The elements **1** are also preferably covered at the length-wise terminal portions thereof as the last step in their manufacture with a magnetic attractive inhibiting coating **2** of any of the known non or otherwise weakly magnetically attractable materials, such as copper, the purpose being to hold to a minimum the magnetic interattraction of each slat for the others.

Movement of the N-S elements in accordance with this invention is by way of two orthogonally oriented coil configurations selectively and variably energized under the control of any known finger manipulated variable coil current control means (not shown) essentially as above described. FIG. 4 shows portions only of such coils **4** and **5**. The coils are positioned about the slat elements as shown and are preferably of the printed circuit type in which electrically conducting material is sprayed or otherwise deposited upon a dielectric backing sheet as is well known, the backing sheets integrally associated with coils **4** and **5** being respectively indicated by **4'** and **5'**. In accordance with this invention, the coils and their respectively associated backing sheets form bottomless and topless box-like configurations similar to the schematic arrangement of FIG. 1 which configurations are optically transparent; transparent materials of this type are commonly employed in the electroluminescent display art and as such do not comprise the subject invention. The areas of FIGURES 4 and 5 which are referenced by the respective numerals **6** and **6'** serve the purpose of indicating the total transparency of coil configurations **4, 4'** and **5, 5'** when viewed as a single laminated entity. Although FIG. 4 shows each coil as comprising but a single layer of conducting paths, as many layers may be employed as are necessary to the generation of the required force fields. Note particularly at this point that slat mis-alignment and/or out-of-parallel problems inherent with conventional Venetian blind devices are non-existent in the case of the subject structure, owing to its operation in accord with the principles of the magnetic compass. The operation is such that the permanent magnet slats invariably assume alignment with the controllable resultant magnetic field derived from the coils regardless of their initial spatial position. Upon movement of the slats into a selected aligned position in response to the influence of the applied electric force fields, the current to the coils and thus the fields themselves may be turned-off, the slats tending to remain stationary in the position to which they were moved by the frictional forces inherent in the structure.

In addition to their slat element moving function, the printed coils in conjunction with their respective dielectric backing sheets serve as an enclosure for the elements to thereby confine the same to a predeterminable volume and prevent the intrusion of foreign matter which might tend to reduce the optical transparency characteristic of the subject device. A further assist in this direction is provided by the use of a molded transparent plastic, glass, or the like incasement for the structure as thus far described and as indicated in FIGURES 5 by 18. Inasmuch as coil configurations of the nature disclosed are equivalent electrical antenna structures and therefore susceptible to external electromagnetic effects, electrical shielding means (not shown) may be employed as necessary; shielding means of the referenced type are well known.

The volume **3** enclosed by the coil configurations **4, 4'** and **5, 5'** is preferably devoid of air so as to enhance the thermal properties of the device, properties which are especially significant in cases where the device is employed in an environment where opposing walls of the device are subjected to different temperatures. In such instances, the volume **3** may be evacuated to an extent or filled with a reduced pressure gaseous medium characterized by low heat conductivity.

The means employed for gathering all or a portion of the aligned slats of the subject structure in one location are best shown in FIGURES 8, 9, and 10, and consists primarily of elements already described. The key elements are the outrigger member **12** and the series of inter-looped links **14***a*, **14***b*, **14***c* associated with each pair of immediately adjacent slats. The outer extremity portions **15'**, **15'** of member **12** are fixedly connected by any known technique to respective synthetic or the like plastic wires W of a guy system which wires are reciprocated in unison by manual or electrically operated driving means of any known type not shown to effect similar reciprocation of the slat elements. The center portion of the member **12** is of a length which determines the interslat spacing during and subsequent to the gathering operation, while the links insure that all the slats are returned to a substantially equidistant relationship even in the unlikely although possible situation where a wire has become unattached from an associated member extremity **15'**, **15'**.

Having thus described my invention, and taking cognizance of the fact that the term—electric force field—as used in this specification is intended to encompass both magnetic field systems as specifically disclosed and the substantially equivalent and analogous electrostatic systems, that the subject device can be readily attached to or detached from an existing transparent viewing means such as a glass window or other supporting structure by any known transparent or opaque adhesive to yield a non-permanent configuration especially helpful when a need for replacement arises, and that various modifications of the invention are possible without departing from scope and spirit of the appended claims.

I claim:

1. An electrically adjustable shutter-like structure comprising a plurality of slat elements, substantially rigid means for mounting said elements for movement, and means for applying an electrical force field directly to said elements for selectively positioning said elements, said last named means comprising two orthogonally oriented box-like coil configurations which together completely surround said slat elements and said substantially rigid means.

2. A structure as in claim **1** wherein the slat elements comprise magnets.

3. A structure as in claim **2** wherein said permanent magnet slat elements are provided with a magnetic attraction inhibiting coating at the length-wise terminal portions thereof.

4. A structure as in claim 3 wherein the means for applying the electrical force field directly to said elements are in the form of printed circuit coil means.

5. A structure as in claim 4 wherein said means for mounting said elements includes nestling and guide track means which permit pivotal and rectilinear movement of said elements.

6. An electrically adjustable Venetian blind structure comprising a plurality of permanent magnet slat elements provided with a magnetic attraction inhibiting coating at their length-wise terminal portions, substantially rigid means for mounting said elements for movement, and optically transparent printed circuit coil means for applying an electrical force field directly to said elements for selectively positioning said elements, said last named means enclosing said slat elements and said substantially rigid means, whereby the position of said elements is observable directly through said printed circuit coil means.

7. A structure as in claim 6 wherein said means for mounting said elements includes element nestling means and element guide track means which respectively permit pivotal and rectilinear movement of said elements.

8. A structure as in claim 7 wherein said elements include ears at the breadth-wise terminal ends thereof, said ears being nestled in said nestling means for pivotal movement under the influence of said electrical force field means.

9. A structure as in claim 8 wherein said nestling means has the general form of an outrigger and said element guide track means includes an outrigger-shaped channel, said nestling means being slideable in said channel to effect a gathering of said slat elements.

10. A structure as in claim 9 wherein said outrigger-shaped nestling means includes a circular cavity for receiving the ear of an associated slat element and a slot somewhat longer than the cavity diameter to afford entry of the ear into the cavity with relative ease.

11. A structure as in claim 10 wherein said outrigger-shaped nestling means is characterized by a physical dimension which determines the inter-slat spacing during and subsequent to the gathering of said slat elements.

12. A structure as in claim 11 including link means operatively associated with said slat elements for insuring that all the slats are returned to a substantially equidistant relationship so desired.

13. A structure as in claim 12 wherein said outrigger-shaped nestling means includes outer extremity portions which are fixedly connected to the wires of an associated slat-gathering guy system.

14. A structure as in claim 13 including a transparent incasement for enveloping substantially the entire structure.

References Cited

UNITED STATES PATENTS

2,957,520	8/1958	Howard	160—113
2,983,316	5/1961	Croxen.	
3,201,661	8/1965	Koutnik.	
3,206,160	9/1965	Bennett.	
3,211,264	10/1965	Streeter	49—67

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