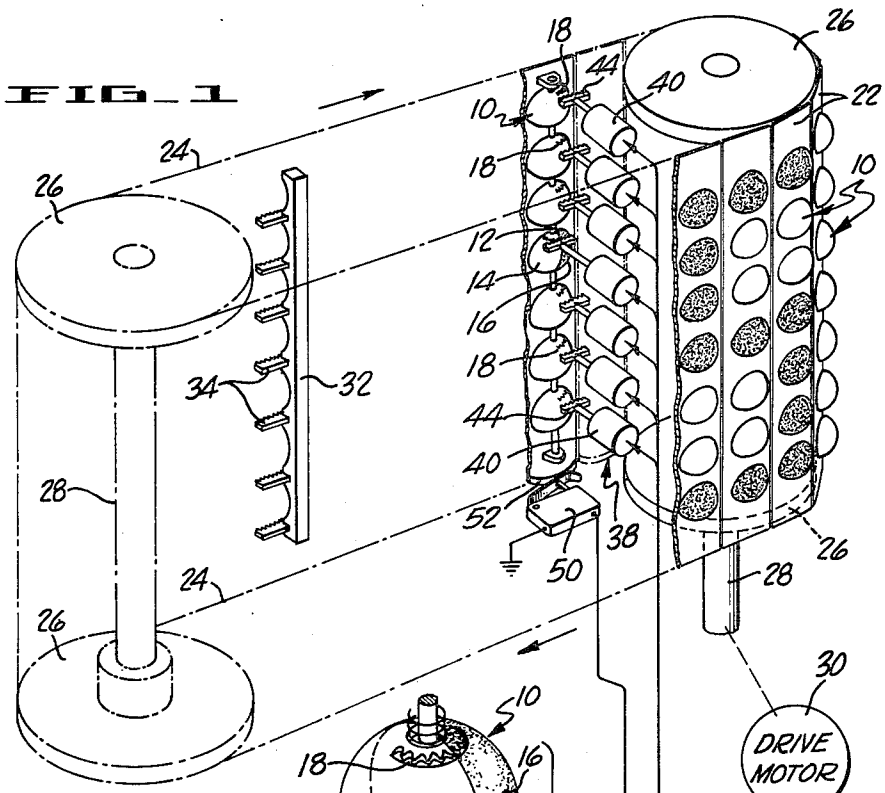
Aug. 3, 1965 S. A. SCHWARTZ 3,199,098

DISPLAY APPARATUS HAVING SPHERES MOUNTED ON RODS

Filed Feb. 14, 1963 2 Sheets-Sheet 1

FIG_1



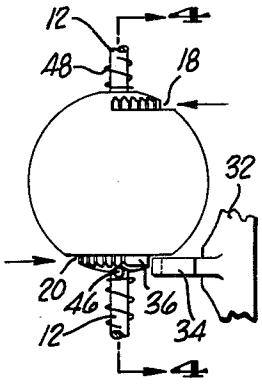


FIG_3

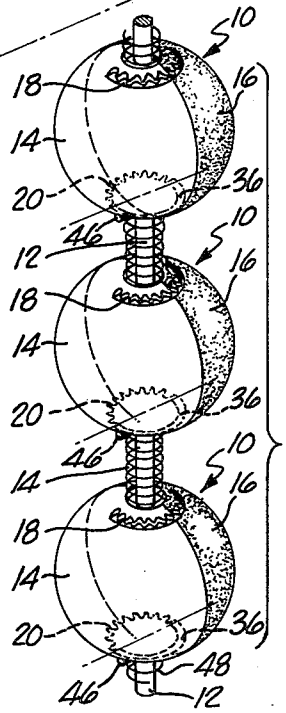


FIG_2

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DISPLAY APPARATUS HAVING SPHERES MOUNTED ON RODS

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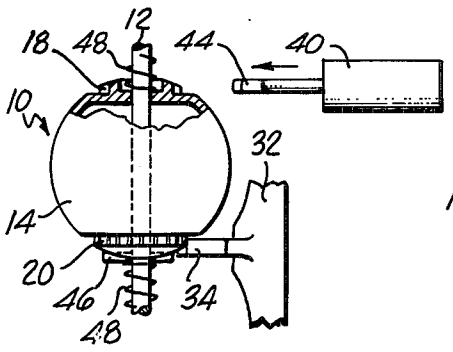


FIG_4

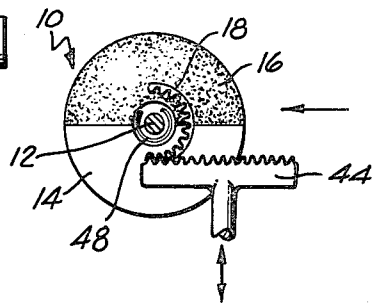


FIG_5

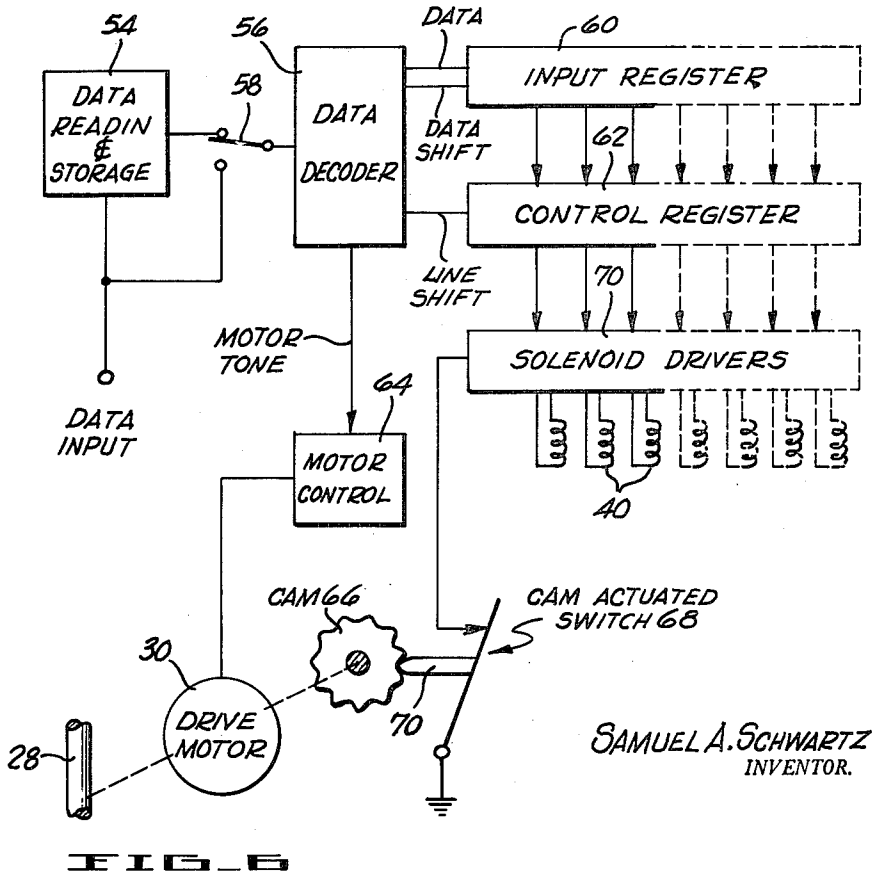


FIG_6

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United States Patent Office 3,199,098 Patented Aug. 3, 1965

3,199,098

DISPLAY APPARATUS HAVING SPHERES MOUNTED ON RODS

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Filed Feb. 14, 1963, Ser. No. 258,444
11 Claims. (Cl. 340—324)

This invention relates to a novel and improved display system, and in particular to a display system having a multiplicity of discrete information indicating elements that may be varied to display animated images or changing characters.

Presently known display boards may be of the fixed image type whereby the composite image is immobile and unchangeable, such as painted billboards and the like. Other known displays are composed of many elements formed as characters, letters, and numbers that may be manually interchanged. This type of display may be found at lunch counters and cafeterias, for example.

There are many display systems that employ a large number of fixed indicating elements for presenting binary type information. The elements may be varied to achieve animated images or to present a changing message. Generally, these display systems require separate switching circuits and/or actuating devices for each fixed element to vary the information. One example is the New York Times news display that utilizes hundreds of incandescent bulbs that are selectively lighted to flash news bulletins. However, it is necessary to provide individual circuits for each bulb to achieve the binary type "ON"–"OFF" switching operation. Such a system becomes complex, costly, and requires extensive maintenance and repair. Large amounts of electrical power are utilized for lighting and relighting the bulbs, and the switching elements often require replacement. Furthermore, the packing density or number of information bits per unit area is limited by the standard size of the bulbs used.

Other schemes propose the use of fluorescent bulbs, or phosphorescent elements such as electroluminescent cells and light amplifiers. However, presently known display apparatus are subject to many limitations, generally found with the switching arrangement.

One known means for displaying binary type information comprises spherical elements having hemispherical portions with contrasting colors, such as black and white. Rotation of the sphere or ball presents a discrete bit of information, and a composite of the binary bits represents an image or character, or a plurality or combination of these. Such type of display device is set forth in U.S. Patents 3,025,512 and 3,036,300. This type of device which is inexpensive to manufacture, may be a plastic or other low cost material, of any desired size, and of low weight. Also, each element has a wide angle of discernability or large parallax. But such devices of the known prior art are also limited in that the indicating elements or spheres are fixed in position, and in addition require separate actuating devices associated with each indicating element. Such a display apparatus becomes cumbersome as the number of elements are increased, and experiences the difficulties of additional maintenance and repair, excessive power requirements, and other costly factors.

An object of this invention is to provide a novel and improved display system that is capable of displaying animated images and changing characters.

In accordance with this invention, a display apparatus comprises a multiplicity of information indicating elements that may be transported through a viewing plane to present varying information. The elements are preferably of the binary information type, having two stable conditions, one representing "zero" information, the other representing binary "one" information. The elements are mounted in rows or columns on individual supports or rods that are driven along the viewing plane, preferably at a substantially constant speed. Before appearing in the viewing plane, each rod passes a "writing" or selective energizing device that simultaneously activates selected elements on the rod so that information is "written" thereon, for presentation upon arrival of the rod in the viewing plane. After leaving the viewing plane, the elements are "erased" or reset by an erasing device.

In a particular embodiment of the invention, the indicating elements are spheres, with one face or hemisphere being black (binary 1) and the other face being white (binary 0). Initially, the spheres are mounted so that the white surfaces face the viewer. Each sphere is formed with two toothed or geared arcuate portions that are diametrically opposed. One geared portion that enables "writing," causes rotation of the sphere when meshed with a cooperating "write" rack so that the black hemisphere will be presented to the viewer. The other geared portion affords resetting of the spheres that were rotated to white or binary zero thereby providing the "erase" function.

The information or intelligence may be derived from a data storage or transmission system, and is applied to a data shift register apparatus that causes a row or line of spheres to be selectively actuated simultaneously. The shift register energizes solenoid drivers, for example, that project selected movable "write" racks for engagement with the writing geared portion.

The invention will be described in greater detail with reference to the drawing in which:

FIGURE 1 is a perspective view of the display apparatus of this invention, with portions removed for simplicity and convenience of explanation;

FIGURE 2 is an elevational view of a segment of a rod carrying the spheres or indicating elements, in accordance with this invention;

FIGURE 3 is a side elevational view of a single indicating element of this invention;

FIGURE 4 is a front elevational view, partly broken away, of an inventive indicating element;

FIGURE 5 is a top view of the indicating element; and

FIGURE 6 is a schematic and block diagram of a system used in conjunction with the display apparatus.

With reference to FIGURES 1 and 2, an embodiment of the invention comprises a multiplicity of information indicating elements **10** in the form of spheres (only a fractional number being shown), mounted coaxially and equally spaced on a supporting rod **12**. The spheres **10** may be made of a lightweight plastic material, such as nylon, that is easily produced by a mold. With further reference to FIGURES 3, 4 and 5, each sphere **10** has a white hemispheric face **14** and a black hemispheric face **16**, which may comprise a coating of pigment having phosphorescent material incorporated therein. The coating may be deposited by spraying, or other well known methods. Each sphere **10** has a toothed or geared portion **18** that defines a circumvolution or semicircular arcuate path at the upper portion of the sphere, and which encompasses a part of each hemisphere **14** and **16**. Diametrically opposed at the lower portion of the sphere is a second similar geared portion **20**. The first geared portion **18** serves as part of the writing mechanism; whereas the second geared portion **20** serves as part of the erasing mechanism, as described hereinafter.

Each rod **12** with its spheres **10** (seven spheres for each rod illustrated by way of example) is coupled to a rectangular strip **22**, such as aluminum or other sturdy metal having either a neutral shade or color that approximates the white hemisphere **14**, to provide a contrasting back-

ground for the black surfaces **16**. The strips **22** are aligned in tandem and closely adjacent to each other so that all adjacent spherical elements are spaced equidistantly, horizontally or vertically, to form a display matrix. The strips **22** with the associated rods **12** and spheres **10** are secured between a pair of endless belts **24** that are transported clockwise by pulleys **26** mounted on shafts **28** driven by a constant frequency motor **30**.

During operation, the belts **24** carrying the strips **22**, rods **12** and spheres **10** are transported clockwise so that the display pattern may be read from left to right. It is to be understood that the display of this invention may also be presented for vertical movement of the viewing plane, i.e., from top to bottom, or any other plane of orientation, if so desired. Each rod **12** that is leaving the viewing plane carries spheres **10** having a combination of white surfaces **14** and black surfaces **16** facing externally from the belt and pulley system. Before rewriting information along the rod, it is necessary to "erase" the prior information by resetting the spheres **10** so that the black surfaces **16** face inwardly and the white surfaces **14** face externally. This erase action is achieved by means of a rack bar **32** that carries the same number of toothed gears or racks **34** as the number of spheres on each rod **12**. (For purpose of convenience of explanation, the erase rack bar **32** is shown detached, but it is understood that the bar **32** is fixed securely in position within the confines of the belts **24**.)

As each rod **12** passes the erase rack bar **32**, those spheres **10** that have the white surfaces **14** facing inwardly to the rack bar **32** also have the lower toothed portion **20** facing the bar **32**. The lower toothed portion **20** engages the teeth of the associated rack **34**, and the continuous motion of the belt mounted strip **22** and rod **12** imparts a torque which causes the sphere to rotate 180° so that the white surface **14** now faces outward. In those cases where the sphere **10** has its white hemisphere facing out, the erase rack **34** associated with that sphere does not rotate the sphere, because only a toothless slot **36** continuous with the toothed portion **20** traverses the erase rack **34**.

After the erase process, the rod **12** then approaches a writing rack assembly **38**. The writing assembly **38** includes solenoids **40** that may be selectively actuated by a programmed switching device **42**. Each solenoid **40** serves to project and retract a spring-loaded write rack **44** in accordance with the information received from the switching device **42**. The number of write racks **44** and solenoids **40** is the same as the number of spheres **10** that are mounted on a rod **12**.

When a solenoid **40** has been energized by the switching device **42**, the rack **44** is extended to engage the upper toothed portion or write gear **18** of the sphere **10**. As the rod **12** progresses past the extended writing rack **44**, the sphere **10** is rotated 180° to show the black surface **16** externally relative to the display apparatus. If a rack **44** associated with a sphere **10** has not been projected by solenoid action, no rotation of the sphere occurs and the white surface **14** will face outwardly. All the spheres **10** on any one rod **12** may be set simultaneously, according to information received by the switching device **42**. After the writing process, the driven rod **12** carries the spheres **10** to the viewing plane for visual presentation. All the spheres **10** in the viewing plane form a composite image or character display in accordance with information received from the program device **42**.

When any sphere **10** is at rest, that is, not being rotated, the sphere **10** remains fixed by means of a tapered detent in the lower portion of the sphere that seats on a detent pin **46** secured through the rod **12**. When the sphere is being rotated, the frictional engagement of the toothed portion **18** or **20** causes the sphere to ride up along the taper of the detent to allow the 180° rotation. At the end of the rotation, resilient means **48**, such as compression springs, located along the rod **12** adjacent to each sphere snaps the sphere back into a detented position.

To ensure that the write racks **44** will be in proper alignment for engaging the write gears **18** of corresponding spheres **10** of any rod **12** at such time when the rod is in juxtaposition with the column of solenoids **40**, a switching device **50**, such as a microswitch, is located in the path of the rods **12** preceding and very close to the solenoids **40**. Each rectangular strip **22** mounted to a rod **12** has a projecting area or finger **52** that depresses or trips the microswitch **50** thereby closing the circuit, which includes the program device **42** and the solenoids **40**. Thus the bit information stored in the program device **42** actuates the line of solenoids **40**, so that the spring loaded write racks **44** are selectively projected in coincidence with the arrival of a sphere carrying rod **12** in the write position.

In order to provide the necessary intelligence to the write apparatus of the display system, a shift register may be employed, as illustrated in FIGURE 6. Data may be received from a transmission line, for example, and stored in a read-in or buffer stage **54**, which may be a tape apparatus. The data may be fed to a reader or decoder **56** through a switch **58**, when the display apparatus commences operation. Alternatively, the input data may be passed directly through the switch **58** to the decoder **56**.

The decoded composite information signal may include display information, shift data, and motor control signals. The display data is channeled from the decoder **56** to an input register **60** that stores the serial information bits that have been read out in sequence, in accordance with bit data shift signals that are also supplied by the decoder. The decoder **56** additionally feeds a line shift signal to a control register **62**, which provides parallel storage and simultaneously passes the stored bits of information as an information line. The registers **60** and **62** may be conventional, and may comprise memory core circuits well known in the art. The shift signals may be derived from a constant frequency or clock signal source. The discrete information signals are directed concurrently from the control register **62** to drive the line of solenoids **40**, each bit being passed to a corresponding solenoid.

The decoder **56** further provides a tone signal to a motor control **64** that serves to control the rotational velocity of the motor **30**, which drives the shaft **28** and transports the display elements through the viewing plane. In this manner, the display elements pass through the viewing plane at a substantially constant speed.

In the apparatus of FIGURE 6, a jumping cam **66** is coupled to the drive motor **30** to control the alignment of the write gears **18** with the write racks **44**, in the same manner as provided by the microswitch device **50** shown in FIGURE 1. The cam **66** causes a switch **68** to open and close periodically by virtue of a finger **70** that rides on the undulating periphery of the cam **66**. The switch controls the energization of the solenoid drive circuit **70** so that the solenoids **40** are actuated with the arrival of each rod **12** in write position. It is apparent that various alternatives are possible for aligning the write gears **18** properly with the line of solenoids **40** and the write racks **44**.

It is also noted that the scope of the invention is not limited to the embodiment set forth above. Thus, as an alternative, the spherical elements may be fixed in position, and the column of solenoids may be driven to achieve the write function. The erase rack may also be driven in conjunction with the solenoids.

Furthermore, the display elements may be elliptical or in another shape provided that the write and erase gears are made to mesh with the write and erase racks as necessary. Also, the colors may be other than black and white for contrast, and a number of colors could be utilized to achieve a color display. In this regard, a plural-

ity of colors could be used with each sphere, or triads consisting of separate display elements having different colors, e.g., blue, red and green, may be employed.

There has been described a variable display apparatus having the advantages of simplicity, economy of manufacture and maintenance, and low power requirements.

What is claimed is:

1. A variable display system comprising:
a multiplicity of rods fixed in seriatim in an endless loop that includes a viewing plane;
a number of spherical elements mounted on each rod, having hemispheres of contrasting colors, each element having a write gear;
means for transporting said rods and elements in such endless loop; and
means for engaging the write gears selectively to present the desired hemispheres for display in the viewing plane.

2. A variable display system comprising:
a multiplicity of rods fixed in series in a pulley driven belt system;
a number of spherical elements mounted on each rod, having colored hemispheres, each element having a write gear;
means for transporting said rods and elements in an endless loop that includes a viewing plane;
means for engaging the write gears to present the desired colored hemispheres for display; and
switching means for selecting such write gears for engagement with said engaging means.

3. A moving display system comprising:
a multiplicity of rods;
a number of spherical elements mounted on each rod, having colored hemispheres, each element having a toothed portion;
means for transporting said rods and elements in an endless loop that includes a viewing plane;
means for engaging the toothed portions to rotate the elements to a desired position, including racks controlled by solenoids; and
a switching device for selectively actuating such solenoids to form a display.

4. A moving display system comprising:
a multiplicity of rods;
a number of spherical elements mounted on each rod, having different faces, each element having a write gear;
means for transporting said rods and elements in an endless loop that includes a viewing plane, such transporting means including a constant frequency drive motor;
means for selectively engaging the write gears to present the desired faces for display, including write racks;
switching means for periodically selecting write racks for engagement with associated write gears; and
a swinging device correlated with the transporting means to ensure proper alignment of the write gears with the write racks when selected for engagement.

5. A moving display system comprising:
a multiplicity of rods;

a number of spherical elements mounted on each rod, having colored hemispheres, each element having a write gear;
means for transporting said rods and elements in an endless loop that includes a viewing plane;
means for engaging the write gears selectively to rotate the selected elements thereby presenting the desired colored hemispheres for display, including write racks;
switching means for selecting such write racks for engagement with the desired write gears; and
a shift register for supplying signals to said switching means for selective actuation of the write racks.

6. A moving display system comprising:
a multiplicity of rods;
a number of spherical elements mounted on each rod, each spherical element having two stable states represented by a white face and black face respectively, each element having a write gear;
means for transporting said rods and elements in an endless loop that includes a viewing plane; and
means for engaging the write gears selectively to present one of the faces of each element for display.

7. A moving display system as in claim 6 including an erase rack bar for setting the spherical elements in one of the stable states prior to selective engagement of the write gears with the engaging means.

8. A moving display system comprising:
a multiplicity of rods;
a number of spherical elements mounted on each rod, having hemispheres of contrasting colors, each element having a write gear, said spherical elements being spaced by resilient means along each rod, and being seated in a detent position;
means for transporting said rods and elements in an endless loop that includes a viewing plane; and
means for engaging the write gears selectively to present the desired hemispheres for display.

9. A variable display system as in claim 2, wherein each element has a toothed portion; and said engaging means includes solenoid controlled racks.

10. A variable display system as in claim 2, wherein said transporting means includes a constant frequency drive motor.

11. A variable display system as in claim 2, wherein a shift register is utilized for supplying said signals to said switching means.

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