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LUMINESCENT DISPLAY WITH A MEMORY AND A HEAT-QUENCHING ELEMENT

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SOURCE OF ULTRA-VIOLET LIGHT

PULSE GENERATOR

HEAT-GENERATOR ELEMENT

LUMINESCENT SURFACE, HEAT-QUENCHABLE

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LUMINESCENT DISPLAY WITH A MEMORY AND A HEAT-QUENCHING ELEMENT

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4 Claims

ABSTRACT OF THE DISCLOSURE

A heat-quenchable layer, such as zinc-cadmium-sulfide, that is activated by nickel, is bathed in ultra-violet light to produce a fluorescent display surface. This display surface is placed adjacent to a heat-generating element. The heat-generating element is in heat-conducting relationship with the fluorescent display surface and is associated with a ferrite memory core which operates in a partial switching mode. A high-frequency A.C. signal applied to the ferrite memory core is coupled through the memory core to the heat-generating element with a large amplitude when the memory core is in one memory state and with a small amplitude when the memory core is in the other memory state. The state of the memory core is determined by a pulse-switching means which causes partial switching of the ferrite memory core. Therefore, when the memory core is in one memory state, the heat-generating element receives a large amount of energy, which is converted into heat that quenches the fluorescent state of the memory device in the vicinity of the heat-generating element. When the memory core is in the other memory state, however, the amount of energy received from the A.C. signal source is not sufficient to exceed the heat-quenching threshold of the fluorescent display surface.

CROSS-REFERENCES TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

U.S. patent application Ser. No. 503,989, entitled “Luminous Display System” and filed Oct. 23, 1965, in the name of George T. Brown, Jr., discloses a visual display which employs a display panel in which the presence of ultra-violet light becomes a light source, emitting a color characteristic of the fluorescent material that is coated on the surface of the display panel. When a selected heat pattern is placed adjacent to the display panel, the fluorescent material in the vicinity of the heat pattern is quenched from its characteristic light-emitting state, and a data pattern is displayed when the display panel is exposed to ultra-violet light. The display panel disclosed in the above-cited Brown U.S. patent application, Ser. No. 503,989, can be selectively employed in a number of different display systems. However, this display panel does not have an inherent memory directly associated with it. Therefore, when a decoding matrix is employed to select the desired heat pattern, it is necessary to insure that the elements in the decoding matrix are continually held at some fixed level during display of this desired pattern. The present invention provides a display panel which has its own memory; therefore, once a display pattern is conveyed to the display panel of the present invention, the display panel remembers the pattern until a new pattern is to be displayed.

U.S. patent application Ser. No. 598,038, filed Nov. 30, 1966, in the name of Raymond J. Hansen, discloses a heat-quenchable luminescent display system that operates in combination with a magnetic memory selection network. In this application, it is the hysteresis energy loss of a magnetic memory core which quenches the fluorescent state of the luminescent display panel. Therefore, it is essential in this application that the magnetic memory element be positioned in close proximity to the luminescent display panel. The present invention, however, provides a magnetic memory core which utilizes a heating element that may be located at a position which is remote from the magnetic memory core, thereby greatly simplifying the construction of a luminescent display panel with a memory.

SUMMARY OF THE INVENTION

A readout surface of fluorescent material in a heat-quenchable fluorescent state is placed in proximity to a heat-generating element. The heat-generating element is associated with a magnetic memory core which operates in a partial switching mode. A high-frequency A.C. generator is coupled to the magnetic memory core, whereby, when the magnetic memory core is in one memory state, a large A.C. signal is coupled through the memory core to the heat-generating element, thereby creating a large amount of heat, which quenches the fluorescent state of the fluorescent material in the vicinity of the heat-generating element. When the magnetic memory core is in the other state, however, only a very small amount of A.C. signal is coupled through the memory core to the heat-generating element and, as a result, the heat generated in the heat-generating element is insufficient to quench the fluorescent state of the adjacent fluorescent material.

BRIEF DESCRIPTION OF THE DRAWING

The figure shows the luminescent display and memory system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The figure represents an element of a display employing the present invention, which utilizes the heat-generating element 10, which is placed adjacent to a surface 18, which is coated with a suitable fluorescent material. For example, at room temperature, a superior material of fluorescent properties for use in practicing the present invention is zinc-cadmium-sulfide, which is actuated by silver and "poisoned" by nickel, as set forth in the published article "Fluorescent Thermograph" by W. H. Byler and F. P. Hays, appearing in the May-June 1961 issue of "Non-Destructive Testing"; and in U.S. Pats. Nos. 2,551,650, and 2,642,538, issued May 8, 1951, and June 16, 1953, respectively, on applications of Franz Urbach.

A magnetic memory core, such as the core 12 of the figure, which operates in a mode of operation similar to
the mode of operation of the memory core in the present invention, is disclosed in U.S. Pat. No. 3,281,802, issued Oct. 25, 1966, on the application of Robert E. McMahon. However, the McMahon magnetic memory core was employed in an entirely different arrangement in that it was employed to generate a conventional memory output signal and not to generate heat for locally heat-quenching a luminescent display panel, to form a visual display pattern.

If the magnetic core 12 has an original flux state, as shown by the arrow 20, then a pulse of current through the winding 24 produced by the pulse generator 14 in the direction indicated by the arrow on the winding 24, will tend to reverse the magnetic flux state of the magnetic core 12. This reversal of magnetic flux state begins at the inner surface 26 of the magnetic core 12 and progresses to the outer surface 28. Therefore, termination of the current pulse in the winding 24 before the flux state has reached the outer surface 28 will result in a reversal of magnetic state only in the area 30.

The described partial switching phenomenon makes it possible to construct a sine wave non-destructive magnetic circuit. The A.C. sine wave current generator 32, which is coupled to the magnetic core 12 by the winding 36, will produce a large A.C. signal on the winding 36 whenever the areas 30 and 40 are in the opposite flux states, as indicated in the figure by the arrows 20 and 22. If, however, the areas 30 and 40 are in the same flux states—that is, if the arrows 20 and 22 are in the same direction—only a small A.C. signal will appear on the winding 36. Thus, when the core 12 has been switched to a partially reversed magnetic state, the heat-generating element 10, which may be any resistive heat-conducting element (for example, a Nichrome or a tantalum film or wire may be used), will produce sufficient heat to quench the luminescent surface 18, which is bathed in ultra-violet light emitted by a source of ultra-violet light 34 to achieve a characteristic luminosity, in the vicinity of the heat-generating element 10. When the magnetic memory core 12 is in the other memory state, the heat-generating element 10 does not receive sufficient energy from the winding 38 to exceed the heat-quenching threshold of the luminescent surface 18. The magnetic memory core 12 may be reset into the state where the areas 30 and 40 have the same magnetic flux direction simply by supplying a reset current to the winding 24, in the direction opposite to the arrow on the winding 24, from the pulse generator 14. It is not necessary to apply a continuous sine wave signal to the memory core to maintain the magnetic state of the memory core. Magnetic memory devices of this type may expect a zero to one output signal ratio of greater than twenty to one.

Although a particular configuration for obtaining a display is disclosed, it is apparent that the present invention may also be practiced by a number of methods that are apparent to those skilled in the art. In particular, it is apparent that a display pattern on the fluorescent surface of the present invention may be formed of rectangular areas which correspond in area to the area of a rectangular heat-generating element, or, alternately, they may be formed by placing heat-conducting surfaces which are formed into character shapes close to the heat-generating elements of the present invention, between the heat-generating elements and the fluorescent surface. Therefore, limitation of the invention in this respect to the described embodiment is not intended.

The present invention may be used to produce a luminous display against a dark background, and a number of other prior-art schemes may also be employed to achieve variations of the present invention which are obvious to those skilled in the art and are intended, therefore, to be included within the scope of this invention. In particular, the principles of this display are not limited to the display of numerals, and modifications of this display include other symbols and patterns that will be obvious to those skilled in the art. Furthermore, a number of fluorescent materials are known which produce different characteristic colors, and those skilled in the art may therefore employ the teachings of this invention in display systems which employ multi-color luminosity.

Typical values for the present circuit may be a ferrite core of from 30-mil inside diameter to 80-mil outside diameter, an alternating current ampere-turns value of 700, an output winding of 15 turns, a set current of 1 ampere-turn with a 1.0-microsecond width, and a reset current of 1 ampere-turn at 0.2-microsecond width and an A.C. sine wave current source with a frequency of 10 megacycles.

What is claimed is:

1. A display system comprising:
   (A) A readout area of thermally sensitive material which inhibits an optically detectable heat-produced change of state when sufficient heat is supplied to the readout area, and
   (B) An electrically resistive heat-generating element positioned adjacent to the readout surface, and
   (C) A magnetic memory core, and
   (D) An alternating current source coupled to the magnetic memory core,
   (E) An output winding coupled to the magnetic memory core and to the electrically resistive heat-generating element, and
   (F) Means coupled to the core to magnetically switch a portion of the core, a relatively large amount of energy being coupled from the alternating current source to the electrically resistive heat-generating element through the output winding whenever the portion of the core is switched, thereby supplying heat to the readout area, a relatively small amount of energy being coupled from the alternating current source to the electrically-resistive heat-generating element through the output winding whenever the portion of the magnetic memory core is not switched, so that the thermally sensitive material is unheated in this condition.

2. A display system as in claim 1 wherein the electrically resistive heat-generating element is shaped into a pattern to be displayed.

3. A display system as in claim 2 wherein the thermally sensitive material is a fluorescent material that is in a heat-quenchable fluorescent state when unheated and bleached in ultra-violet light.

4. A display system comprising:
   (A) A readout area of fluorescent material which has a heat-quenchable fluorescent state when bathed in ultra-violet light, and
   (B) A source of ultra-violet light located with respect to the readout area so that it is bathed in ultra-violet light, and
   (C) An electrically resistive heat-generating element positioned adjacent to the readout area, and
   (D) A magnetic memory core having a single aperture therein, and
   (E) An alternating current source coupled to a first input winding on the magnetic memory core, and
   (F) An output winding on the magnetic memory core coupled to the electrically resistive heat-generating element, and
   (G) A pulse generator coupled to a second input winding on the magnetic memory core to magnetically switch a portion of the magnetic memory core, a relatively large amount of energy being coupled from the alternating current source to the electrically resistive heat-generating element through the output winding whenever the portion of the magnetic memory core is switched, thereby supplying heat to the readout area and heat-quenching the fluorescent state of the fluorescent material in the vicinity of the electrically resistive heat-generating element,
a relatively small amount of energy being coupled from the alternating current source to the electrically resistive heat-generating element through the output winding whenever the portion of the magnetic memory core is not switched, so that the fluorescing state of the fluorescing material in the vicinity of the electrically resistive heat-generating element is not quenched in this condition.