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DISPLAY DEVICES USING PIEZO-ELECTRIC TRANDUCERS

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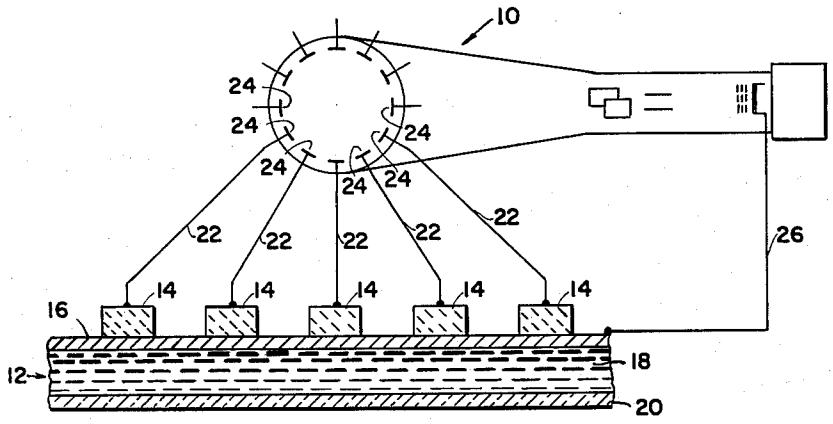


FIG. 1

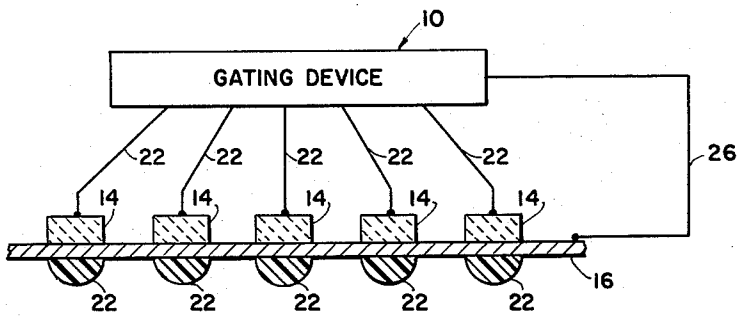


FIG. 2

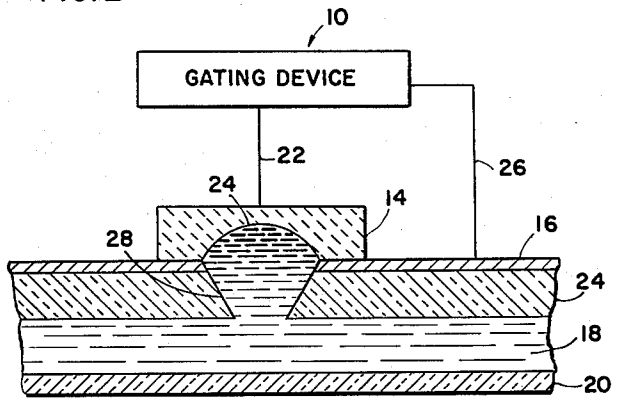


FIG. 3

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AGENTS

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DISPLAY DEVICES USING PIEZO-ELECTRIC TRANSDUCERS

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This invention relates to display devices and more particularly to a piezoelectric driven sonoluminescent display panel.

Sonoluminescence, as utilized in my device, may be defined as the luminescence produced in liquid and semi-liquid media when the media is excited by a sound field or by mechanical vibration.

The prior art luminescent devices have at least one thing in common, and that is the need for an electric field to sustain light. In one instance, when a potential of a suitable amplitude is placed across a phosphor material, the phosphor will glow. In another case, where a layer of phosphor or electroluminescent material is placed over a layer of photoconductive material a beam of light directed to a spot on the photoconductive material will cause it to lower its resistance and apply the electric field to that spot on the luminescent material in registry with the beam of light. In this manner the luminescent material will produce light as long as the electric field remains of sufficient amplitude.

These prior art devices, while being capable of producing a uniform light throughout the panel, suffer serious drawbacks when used, for example, as a gated display medium. To perform in this manner, it becomes necessary to gate sufficiently small increments in discreet rows. The major difficulty that is encountered resides in the fact that as soon as one area of phosphor is excited, the excitation spreads to its adjacent surrounding areas and very rapidly the whole panel becomes lighted. It therefore becomes necessary to devise complex systems to prevent this "spill over." More particularly in the case of the photoconductive electroluminescent device one is also faced with the problem of devising methods of light feedback within the given incremental areas while simultaneously preventing the light feedback from triggering the adjacent areas.

My device solves the problems of the prior art in that by utilizing discreet piezoelectric elements and sonoluminescent material in conjunction therewith, I am able to produce successive pinpoints of light throughout given incremental areas without affecting the adjacent areas.

It is, therefore, one of the primary objects of the present invention to provide an improved luminescent display panel.

Another important object of the present invention is to provide a luminescent display panel wherein there is no interaction between adjacent excited areas.

Still another important object of the present invention is to provide a display panel which does not depend on light feedback to produce a spot of light.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by referring to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 represents a partial schematic and sectional view of one embodiment of my invention utilizing a representative means for gating the piezoelectric elements.

FIG. 2 represents a partial schematic and sectional view of another embodiment of my invention utilizing sonoluminescent material in a semi-liquid, dot form; and

FIG. 3 represents a partial schematic and sectional view of still another embodiment of my invention wherein the piezoelectric elements are in direct contact with the sonoluminescent medium.

Referring now to FIG. 1, there is disclosed my novel luminescent panel **12** having a liquid sonoluminescent material **18** contained in a suitable container wherein the viewing side may be of transparent, glassy or plastic material **20**. On the other side of the panel there is a thin metallic, conducting plate **16** having piezoelectric elements **14** mounted thereon in the desired configuration. Where, for example, it is desired that this device be utilized as a display device in conjunction with a television receiver, elements **14** are arranged in rows and columns. Each element **14** has a wire **22** which connects it to a suitable gating device **10**. To present a completely operable device, I have depicted herewith a beam switching tube having the usual gun and cathode in the neck thereof and anode plates **24** at the face. Conductive plate **16** is connected through lead **26** to the cathode of the gating device and when the proper potentials are applied to the deflection plates, the generated beam will successively strike the plates **24**, thereby completing a circuit across the respective piezoelectric elements **14**. As soon as the circuit is completed and an element **14** is energized, it vibrates at its natural resonant frequency, causing material **18** to luminesce.

In this connection it has been found that materials such as glycerol, dimethyl-phthalate, nitrobenzol and ethylene glycol are particularly suitable as sonoluminescent media. While these materials have been found to work somewhat better than others, it will be understood that other materials may also work equally as well in different applications.

Referring now to FIG. 2, I have presented another embodiment of my device wherein instead of the liquid medium of FIG. 1, the sonoluminescent material is a semi-liquid medium. I have found that if the sonoluminescent material were embedded in a silica gel, for example, I would still be able to produce the same effect. In this embodiment, the gating device **10** is connected through lead **26** to plate **16**. Piezoelectric elements **14**, mounted on plate **16**, are connected through leads **22** to the gating device **10** in the same manner as previously described. The sonoluminescent material is embedded in a silica gel and deposited on the opposite side of plate **16** in the form of nodules or dots **22** which are in registry with corresponding elements **14**. In this manner, when an individual element **14** is energized, its energy is transmitted directly to the corresponding dot **22**, which luminesces. Any energy that may be transmitted to an adjacent dot will be so severely attenuated that no luminescence will be produced. While it has not been shown, it will be obvious to those skilled in the art that a suitable protective transparent covering may be placed over dots **22** to maintain them in a semi-liquid state.

Referring now to FIG. 3, there is disclosed a single element of the type described and it is to be understood that this is merely an enlarged, fragmentary cross-section of a panel. In this embodiment, the piezoelectric element **14** is provided with a concave curved surface **24**. This curved surface is placed in registry with an aperture, formed by wall **28**, in conducting plate **16**. As previously described, the piezoelectric element is connected to the gating device **10** by means of lead **22**, while lead **26** connects the common backing plate **16** to the gating device **10**. Transparent wall **20** forms the container for the sonoluminescent medium **18**. Thus, when the gating device **10** provides a triggering pulse to element **14**, the element will vibrate at its natural resonant frequency. However, the sound or vibrations will be focused at the focal point of curved portion **24** which is well within the media

18 to produce a spot of light. While it is realized that in some instances backing plate 16 may not provide sufficient rigidity, I have found that by using selectively etchable glass of the type known as "Fotoform" produced by the Corning Glass Works, an apertured mask 24, having good structural rigidity may be formed so as to have conically shaped apertures as shown.

While I have described what is presently considered the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from inventive concept contained therein, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

I claim:

1. A luminescent panel comprising a conductive layer, a plurality of piezoelectric elements mounted on one side thereof, a sonoluminescent medium on the other side of the layer, said medium being luminescent upon vibration, and means causing selective piezoelectric elements to vibrate at their natural frequency to produce luminescence in the medium in only those areas opposite the selected piezoelectric elements.

2. The device of claim 1 wherein the medium is a member of the group consisting of glycerol, dimethyl-phthalate, nitrobenzol, and ethylene glycol.

3. The device of claim 1 wherein the medium is glycerol.

4. The device of claim 1 wherein the medium is dimethyl-phthalate.

5. The device of claim 1 wherein the medium is nitrobenzol.

6. The device of claim 1 wherein the medium is ethylene glycol.

7. A luminescent panel comprising a conductive layer, a plurality of piezoelectric elements mounted on one side thereof, an equal plurality of dots of sonoluminescent material mounted on the other side of the layer and respectively corresponding to and in registry with the piezoelectric elements, said dots being luminescent upon vibration, and means causing selected piezoelectric elements to vibrate at their natural resonant frequencies to produce luminescence in the dots which are located opposite the selected piezoelectric elements.

8. The device of claim 7 wherein the sonoluminescent material is in a semi-liquid state.

9. The device of claim 8 wherein the sonoluminescent material is a member of the group consisting of glycerol, dimethyl-phthalate, nitrobenzol, and ethylene glycol.

10. The device of claim 8 wherein the sonoluminescent material is glycerol.

11. The device of claim 8 wherein the sonoluminescent material is dimethyl-phthalate.

12. The device of claim 8 wherein the sonoluminescent material is nitrobenzol.

13. The device of claim 8 wherein the sonoluminescent material is ethylene glycol.

14. A luminescent panel comprising a conductive layer, having a plurality of apertures therein, an equal plurality of piezoelectric elements each having indentations in one surface thereof, said indentations having given radii of curvature and focal points, said plurality of piezoelectric elements being mounted on the conductive layer with the indentations in registry with the apertures, a sonoluminescent medium on the other side of the layer and extending through said apertures into the indentations, and means causing selected piezoelectric elements to vibrate at their natural frequencies to produce a shaped wave front at the focal point of each selected piezoelectric element and thereby produce luminescence in the medium at the focal point thereof.

15. The device of claim 14 wherein the medium is a member of the group consisting of glycerol, dimethyl-phthalate, nitrobenzol and ethylene glycol.

16. The device of claim 14 wherein the medium is glycerol.

17. The device of claim 14 wherein the medium is dimethyl-phthalate.

18. The device of claim 14 wherein the medium is nitrobenzol.

19. The device of claim 14 wherein the medium is ethylene glycol.

20. The device of claim 14 further comprising an apertured support member, the wall of each of said apertures being sloped.

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