March 22, 1966 Y. W. GRACEY 3,241,419

AUDIO FREQUENCY-RESPONSIVE LIGHTING DISPLAY

Filed Jan. 6, 1964 2 Sheets-Sheet 1

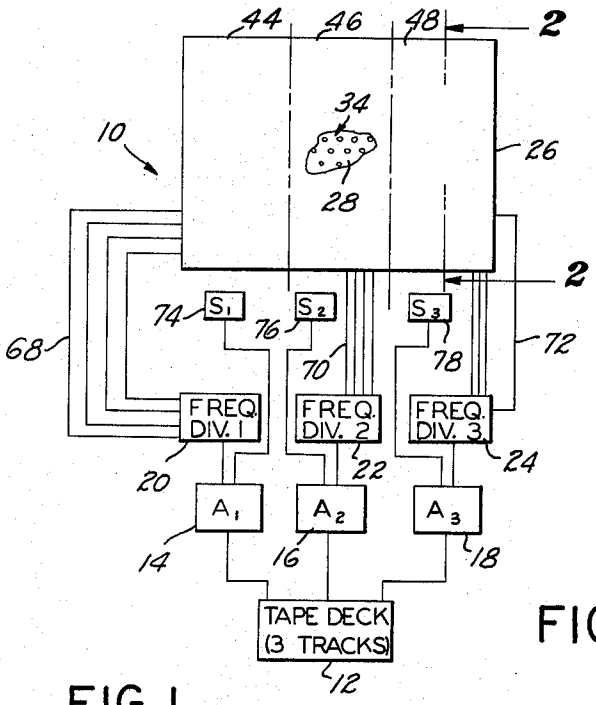


FIG. 1

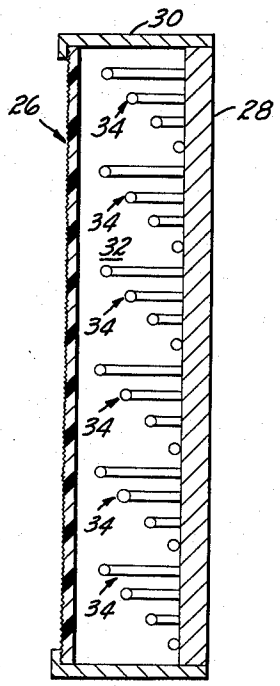


FIG. 2

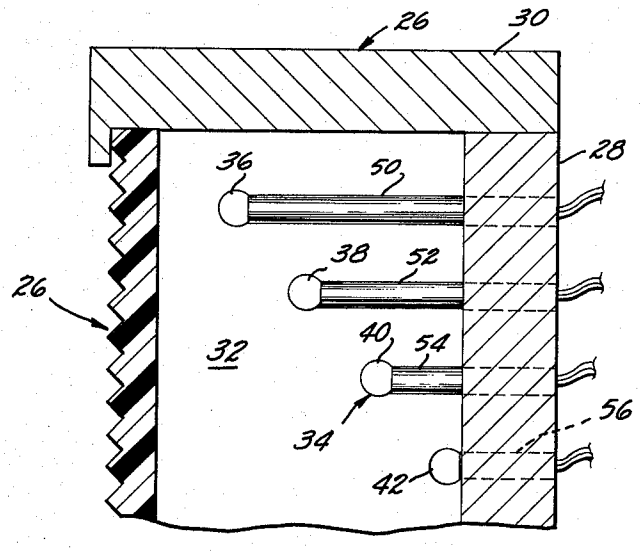


FIG. 3

INVENTOR.
YALE W. GRACEY

BY Fulwider Patton Rieber Lee & Utecht

ATTORNEYS

March 22, 1966 Y. W. GRACEY 3,241,419

AUDIO FREQUENCY-RESPONSIVE LIGHTING DISPLAY

Filed Jan. 6, 1964 2 Sheets-Sheet 2

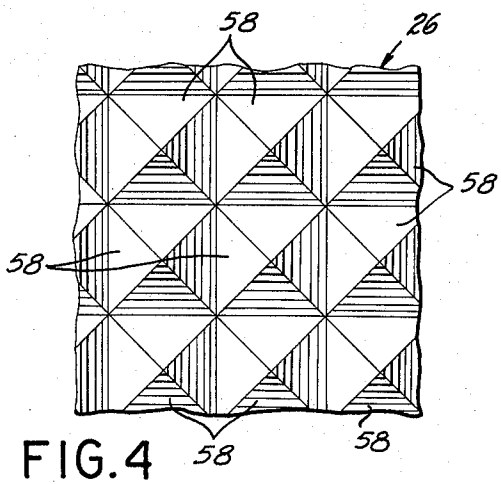


FIG.4

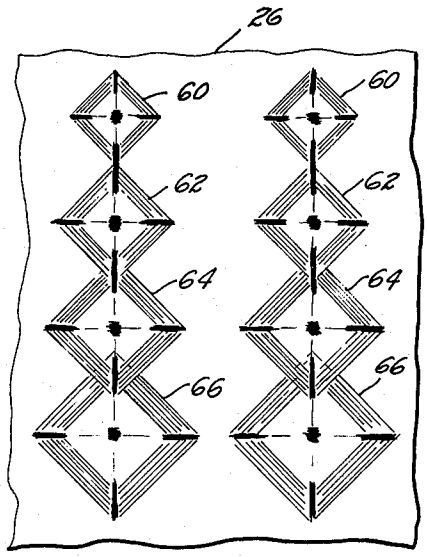


FIG.5

FIG.6

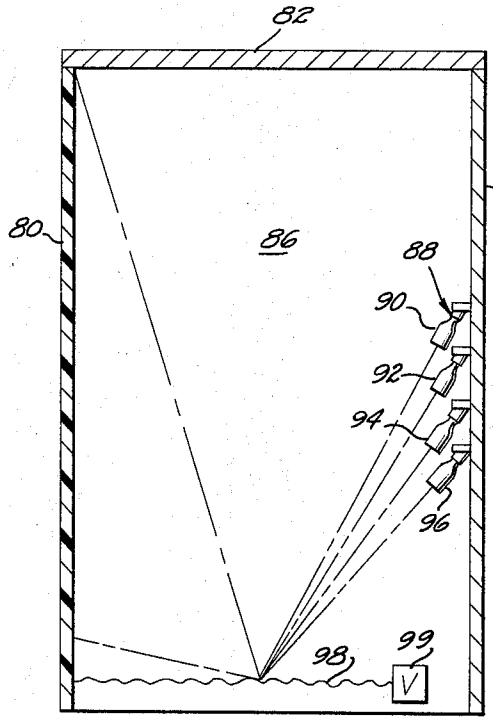
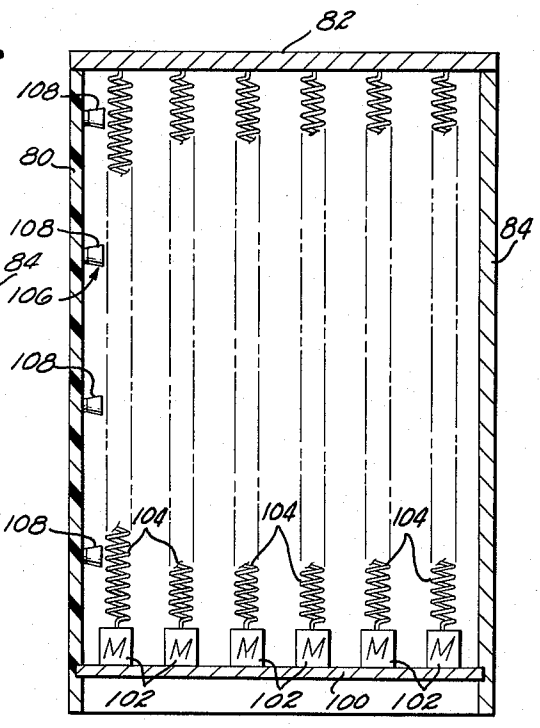


FIG.7



INVENTOR.
YALE W. GRACEY

BY Fulwider Patton
Rieber Lee & Utecht

ATTORNEYS

United States Patent Office 3,241,419
Patented Mar. 22, 1966

3,241,419

AUDIO FREQUENCY-RESPONSIVE LIGHTING DISPLAY

Yale W. Gracey, Beverly Hills, Calif., assignor, by mesne assignments, to Wed Enterprises, Inc., a corporation of California

Filed Jan. 6, 1964, Ser. No. 335,826
3 Claims. (Cl. 84—464)

The present invention relates to an audio frequency lighting display, and more particularly to an audio frequency lighting display in which a commingled display of relatively sharp and relatively diffuse light images is projected upon a display panel.

There are many systems in the prior art for varying the intensity of a plurality of lights in accordance with an audio frequency signal emanating from a signal source such as a record player, tuner, tape deck, or the like. In such systems the output of the signal source is suitably amplified and fed to a frequency divider network, the separated plurality of frequencies then being amplified and fed to the plurality of lights so that the various lights brighten and dim as their associated frequencies occur, for example, in a musical program. Certain of the lights brighten when bass notes are played, other lights brighten with the middle frequencies, and still other lights brighten with the high frequencies, the intensities of the various lights varying with the intensity of the signals associated with the various frequencies.

However, the visual effects provided by such prior art systems have been largely confined to a display of successively or contemporaneously winking lights and the dominant pervasiveness of a bass note, for example, is visually indistinguishable from the sharper, piercing high notes. Moreover, previous systems have not fully exploited the interesting visual effects which can be achieved by producing light images which not only vary in intensity in accordance with the audio frequency signal, but which also are characterized by an apparent movement.

Accordingly, it is an object of the present invention to provide a light image display adapted for association with a system for varying the intensity of a plurality of lights in accordance with audio frequency signals, which display visually simulates, for example, the mood of an orchestral composition by displaying a plurality of commingled light images, those corresponding to the lower bass notes being relatively diffuse and those corresponding to the high or treble notes being relatively sharp. Thus, for example, if the lights corresponding to the bass frequencies are red and those corresponding to the treble frequencies are white, the light image pattern is characterized by relatively sharp and distinct white images and a background of larger, more pervasive red images, it being apparent that various colors of lights for the intermediate frequencies may be provided to lend texture and composition to the overall display. In this manner, the viewer experiences a visual display which is correlated with the character of the musical program, the sometimes subtle gradation between the sharp and diffuse and the intermediately sharp and diffuse images producing a pleasing visual effect at once related but radically different from corresponding display systems of the prior art.

Another object of the present invention is to provide a visual display of the aforementioned character in which a diffuser panel is utilized which is characterized by a regular pattern of embossed, pyramidal diffuser sections which are productive of diamond-shape images, the images underlying and overlying one another according to the positioning of the sources of the light images.

A further object of the invention is the provision of a display of the aforementioned character in which a plurality of banks of lights are utilized, each of the

banks being responsive to a separate channel of a plural channel audio frequency source, each of the banks including a plurality of lights responsive to different frequencies of an associated one of the channels of the source. With this arrangement, the light image display is not only stereophonic but three-channel so that the display or diffuser panel is adapted to display, for example, the light images associated with one channel at one side of the panel, the light images associated with another channel at the opposite side of the panel, and the light images associated with the third channel in the central portion of the panel. Assuming that three loudspeakers are positioned adjacent the three sections of the panel, the listener-viewer is not only apparently hearing the musical instruments from directions corresponding to their location in the orchestra, but also experiences a visual effect correlated to the multi-directional sound program.

Another object of the invention is the provision of a display of the aforementioned character in which the plurality of lights are mounted at differential distances from the diffuser panel by means of a corresponding plurality of mounting elements, certain of the mounting elements being elongated and of different lengths so that certain of the lights are located adjacent the diffuser panel, certain of the lights are mounted farther away from the panel, and the remaining lights are mounted still farther away from the panel. The resultant light image pattern is characterized by commingled relatively sharp and relatively diffuse images for the purposes above adverted to.

A further object of the invention is the provision of a display of the aforementioned character in which the plurality of lights are arranged to direct their light beams up a sheet of flexible, reflective material such as metal foil, and a vibrator is coupled to the foil to vibrate the foil in an undulating pattern whereby the resultant light image pattern reflected upon the display panel is characterized by moving, commingled relatively sharp and relatively diffuse images.

A further object of the invention is the provision of a display of the aforementioned character wherein a plurality of elongated coils of light-conducting plastic material are arranged behind the diffuser panel and the plurality of audio frequency-responsive lights are directed upon the coils of plastic material, with means being employed to rotate the coils of plastic material so that the resultant light image pattern is characterized by commingled relatively sharp and relatively diffuse images which apparently move in the plane of the display panel.

Other objects and features of the invention will become apparent from consideration of the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatic showing of the display according to the present invention and in association with a system for varying the intensity of a plurality of lights in accordance with audio frequency signals;

FIG. 2 is an enlarged view taken along the line 2—2 of FIG. 1;

FIG. 3 is a further enlarged, detail view of a portion of the display shown in FIG. 2;

FIG. 4 is an enlarged, detail elevational view of a portion of the diffuser panel;

FIG. 5 is a view of a portion of the diffuser panel illustrating the character of the light images produced by the diffuser panel pyramidal pattern shown in FIG. 4;

FIG. 6 is an elevational, cross-sectional view of another embodiment of the display according to the present invention; and

FIG. 7 is an elevational, cross-sectional view of a third embodiment of a display according to the present invention.

Referring to the drawings, and particularly to FIGS. 1 through 5, there is illustrated a display **10** operatively associated with a system for varying the intensity of a plurality of lights in accordance with audio frequency signals. The audio frequency signals are provided by a signal source constituted, in the present case, by a tape recorder or tape deck **12** characterized by three channels or three playback heads (not shown). Although the three-channel tape deck **12** is illustrated, any suitable source of audio frequency signals such as a record player or tuner may alternatively be employed if desired.

The three-channel output of the tape deck **12** is amplified by three suitable amplifiers **14**, **16**, and **18**, whose outputs are applied to three frequency dividers **20**, **22**, and **24**. Each frequency divider is operative to separate the audio frequency signal applied to it into four separate frequencies, herein conveniently referred to as a low frequency, high frequency, first intermediate frequency, and second intermediate frequency. The particular construction of the frequency dividers does not form part of the present invention, and a number of frequency dividers are commercially available to accomplish the purpose above adverted to.

The display **10** includes a planar, vertically oriented rectangular display or diffuser panel **26** which is secured at its perimeter to a rectangular, box-like mounting structure comprising a mounting panel **28** and a rectangular frame **30** secured to the top, bottom, and sides of the mounting panel **28**, thereby defining an interior space **32** between the panels **26** and **28**.

A plurality of light sets **34** are regularly spaced in vertical and horizontal rows within the space **32**, each light set **34** including light sources constituted by a white light **36**, a blue light **38**, a green light **40**, and a red light **42**. In addition, the light sets **34** are divided into three banks extending vertically in coextensive relationship with the diffuser panel **26**, and located, respectively, behind different portions of the diffuser panel **26**, these portions conveniently being represented by the dash-dot lines in FIG. 1 and referred to herein as panel portions **44**, **46**, and **48**.

The mounting structure for the lights of each light set **34** includes, as best illustrated in FIG. 3, mounting elements **50**, **52**, **54**, and **56** which are of differential lengths. The mounting element **50** is preferably constituted by an elongated rod which mounts the white light **36** at one end and is fixed to the mounting panel **28** at the other end, thereby orienting the white light **36** substantially immediately adjacent the rearward surface of the diffuser panel **26**. The mounting elements **52** and **54** are of successively lesser lengths, with the mounting element **56** being substantially flush with the mounting panel **28**. Thus, the lights **36**, **38**, **40** and **42** are located at differential distances from the rearward surface of the diffuser panel **26**. One arrangement which has operated satisfactorily spaces the diffuser panel **26** from the mounting panel **28** a distance of 24 inches, the lengths of the mounting elements **50**, **52**, **54**, and **56** being such that the white light **36** is located 6 inches behind the diffuser panel **26**, the blue light **38** is located 12 inches behind the diffuser panel **26**, the green light **40** is located 18 inches behind the diffuser panel **26**, and the red light **42** is located substantially flush with the forward face of the mounting panel **28** approximately 24 inches behind the diffuser panel **26**.

As best illustrated in FIGS. 4 and 5, the diffuser panel **26** preferably is translucent and characterized by a regular pattern of embossed pyramidal diffuser sections **58** arranged in vertical and horizontal rows. With this pattern, illumination of the lights **36**, **38**, **40**, and **42** produces a plurality of commingled relatively sharp and relatively diffuse, diamond-like light images **60**, **62**, **64**, and **66** upon the diffuser panel **26**, the images being progressively larger and more diffuse as the distance of the respective lights from the diffuser panel **26** increases, with the commingled images underlying and overlying one another, according to their particular spacing.

It will be apparent that the panel **26** need not be characterized by the pyramidal configuration above-described, but may employ other configurations.

The various light sets **34** are electrically coupled to a frequency divider, each light set **34** of the panel portion **44** being coupled by a set of four leads **68** to the frequency divider **20**, each light set **34** of the panel portion **46** being connected to the frequency divider **22** by a set of four leads **70**, and each light set **34** of the panel portion **48** being connected to the frequency divider **24** by a set of four leads **72**. In this manner, the light sets **34** of each panel portion are individually responsive to all of the frequencies of a separate channel or track of the three-channel tape deck **12**. Each panel portion thus displays a visual counterpart of one channel of the three-channel signal source.

The visual display is correlated with a sound system comprising three speakers **74**, **76**, and **78** which are coupled, respectively, to the amplifiers **14**, **16**, and **18** so that the audio outputs of the speakers **74**, **76** and **78** correspond to the visual displays upon the panel portions **44**, **46**, and **48**, respectively.

The showing of the sets of leads at **68**, **70**, and **72** is partially diagrammatic in that a set of each of these leads is connected to each light set **34**, as will be obvious, and the showing of the multiplicity of sets of leads is omitted for clarity.

Referring now to FIG. 6, there is illustrated another system for varying the intensity of a plurality of lights in accordance with a plural-channel audio frequency signal source. This system includes a rectangular, vertically oriented and planar diffuser panel **80** made of light-diffusing plastic material or the like, and connected by a three-sided perimetrical frame **82** to a vertically oriented mounting panel **84**. The frame **82** extends between the top and both sides of the panels **80** and **84** to define a hollow interior space **86**, and a plurality of light sets **88** are suitably secured to the mounting panel **84** as illustrated. Only one representative light set **88** is illustrated for brevity, each light set including a number of different colored lights. Thus, the arrangement illustrated in FIG. 6 includes a white light **90**, a blue light **92**, a green light **94**, and a red light **96**, each of the lights including a light hood or shield to substantially prevent the light source from being seen by viewers located on the outside of the diffuser panel **80**.

The lights of the light sets **88** are aimed or directed downwardly upon a flexible reflective element, which is preferably constituted by a sheet of thin metallic foil **98**, it being noted that the lights of each set **88** are preferably located at different distances from the foil **98**. One edge of the foil **98** is preferably fixed, as by securement to the interior side of the diffuser panel **80**, and the opposite edge of the foil **98** is secured in any suitable fashion to a conventional vibrator **99** which is operative to vibrate and introduce undulations in the foil **98**. These undulations are more-or-less random in nature and reflect the light from the light sets **88** upon the diffuser screen **80**, giving the effect of a shimmering, multi-colored water surface.

Moreover, the light sets **88** are responsive to the plural-channel audio frequency source **12** in the same manner as the arrangement previously described, the light sets **88** preferably being divided into three banks adjacent three side-by-side portions of the panel **80** in an arrangement similar to the embodiment of FIG. 1. The three banks are also electrically coupled to different channels of the tape deck **12** to provide a three-channel visual display.

The undulating pattern of the foil **98** provides a light image pattern upon the diffuser panel **80** characterized by moving, commingled relatively sharp and relatively

diffuse images of different colors, the images brightening and dimming in accordance with the program provided by the signal source or tape deck **12**.

In FIG. 7 there is illustrated yet another embodiment of the present invention. This embodiment includes a diffuser panel, frame, and mounting panel substantially identical to the embodiment of FIG. 6 and therefore like reference numerals are employed to designate these components.

A floor **100** at the base of the structure supports a plurality of electric motors **102** which are each drivingly connected to one extremity of a helical coil **104** made of light-conducting plastic material, such as the material known in the trade as "Plexiglas." The opposite extremities of the coils **104** are each rotatably supported in a bearing (not shown) mounted to the underside of the upper wall or roof of the frame **82**.

Although six coils **104** are illustrated at different distances from and inwardly of the diffuser panel, a number of additional coils are preferably arranged on either side of the illustrated coils behind the diffuser panel in an arrangement substantially coextensive with the panel.

The coils **104** are illuminated by a plurality of light sets **106**, only one of which is illustrated in FIG. 7, which each include lights **108** of different colors, each light **108** being provided with a light shield or hood to shield the viewer on the opposite side of the diffuser panel **80** from the glare of the lights. The light sets **106** are preferably divided into three banks, and a separate bank is connected to each of the three channels of the signal source **12**, as in the embodiment of FIG. 1, to give a three-channel visual display upon the diffuser panel **80**.

The light sets **106** brighten and dim in response to the audio frequency signals of the tape deck signal source **12**, and the light therefrom is projected upon the plurality of coils **104** which are simultaneously being rotated by the motors **102**. Thus, the arrangement provides an entertaining visual display varied by the character of the audio program and heightened by apparent vertical movements of columns of differently colored lights.

From the foregoing it will be seen that the present display is adapted for use in conjunction with a system for varying the intensity of a plurality of lights in accordance with audio frequency signals, and that the display provides a plurality of commingled relatively sharp and relatively diffuse light images varying according to the character of the audio frequency signals and affording a three-dimensional lighting effect. The desired character of light images is produced in one case by predetermined spacing of the light sources from the diffuser panel, in another embodiment by spacing lights at different distances from a vibrated reflective element or foil, and in another embodiment by illuminating a plurality of moving, light-conductive elements located at different distances from a diffuser panel.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. In a system for varying the intensity of a plurality of lights in accordance with plural channel audio frequency signals, a display comprising:

a diffuser panel made of translucent material;

a plurality of banks of lights, each of said banks being responsive to a separate one of the channels of the audio frequency signals, each of said banks including a plurality of lights responsive, respectively, to different frequencies of the associated channel of said audio frequency signals;

a mounting structure behind said panel;

and means mounting said banks of lights on said mounting structure adjacent separate portions of said panel, the lights of each said plurality of lights being mounted at different distances from said panel whereby the resultant light image pattern on each of said separate portions of said panel is characterized by commingled relatively sharp and relatively diffuse images.

2. In a system for varying the intensity of a plurality of lights in accordance with audio frequency signals, a display comprising:

a plurality of lights responsive, respectively, to different frequencies of said audio frequency signals;

a diffuser panel made of translucent material;

and a mounting structure behind said panel including a plurality of mounting elements mounting said plurality of lights, certain of said elements being elongated and those of said elements which are elongated being of different lengths thereby to orient said plurality of lights at different distances from said panel whereby the resultant light image pattern is characterized by commingled relatively sharp and relatively diffuse images.

3. In a system for varying the intensity of a plurality of lights in accordance with audio frequency signals, a display comprising:

a plurality of lights, including red, blue, and white lights responsive, respectively, to the low, intermediate, and high frequencies of said audio frequency signals;

a diffuser panel made of translucent material;

and a mounting structure behind said panel including a plurality of mounting elements, certain of said elements being elongated and of at least two different lengths, the shortest of said elements mounting said red lights, the longer ones of said elements mounting said white lights, and the intermediate length ones of said elements mounting said blue lights thereby to orient said plurality of lights at different distances from said panel whereby the resultant light image pattern is characterized by commingled relatively sharp white images, relatively diffuse red images, and blue images intermediate a sharp and a diffuse character.

References Cited by the Examiner

UNITED STATES PATENTS

1,351,562	8/1920	Foster	84—464
1,690,279	11/1928	Craft	84—464
1,946,026	2/1934	Lewis et al.	84—464
1,977,997	10/1934	Patterson	84—464
2,131,934	10/1938	Burchfield	84—464
2,275,283	3/1942	Burchfield	84—464
2,665,609	1/1954	Gilluly	88—24
3,038,061	6/1962	O'Reilly	84—464
3,048,075	8/1962	Wright	84—464
3,062,085	11/1962	Smith	84—464
3,111,057	11/1963	Cramer	84—464
3,140,347	7/1964	Cohen	84—464 X

LEO SMILOW, *Primary Examiner.*