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DISPLAY DEVICE

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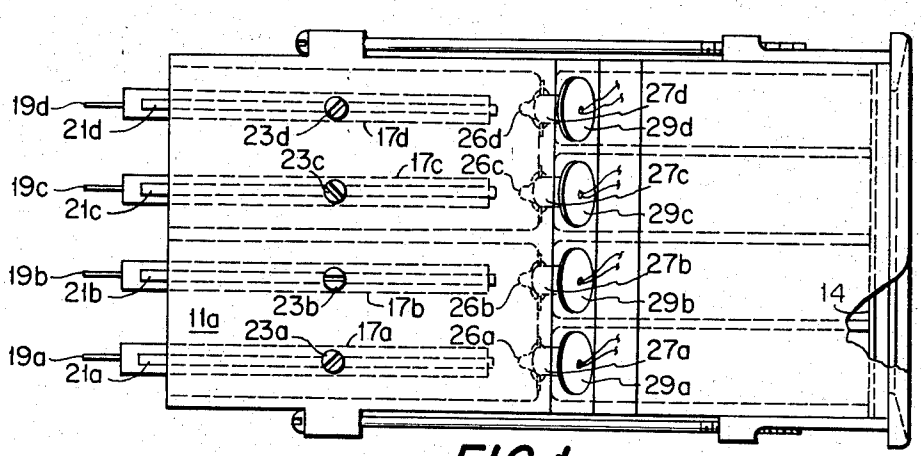


FIG. 1

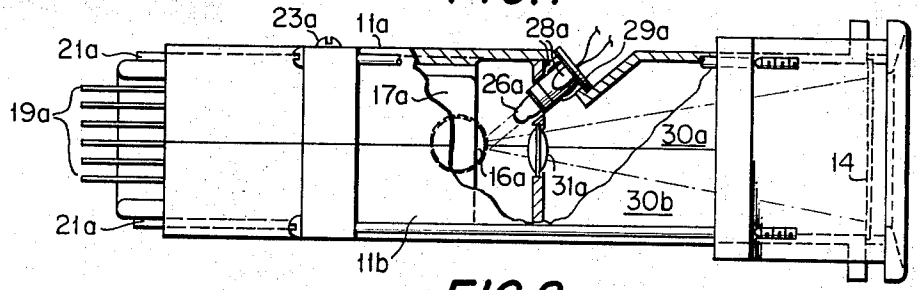


FIG. 2

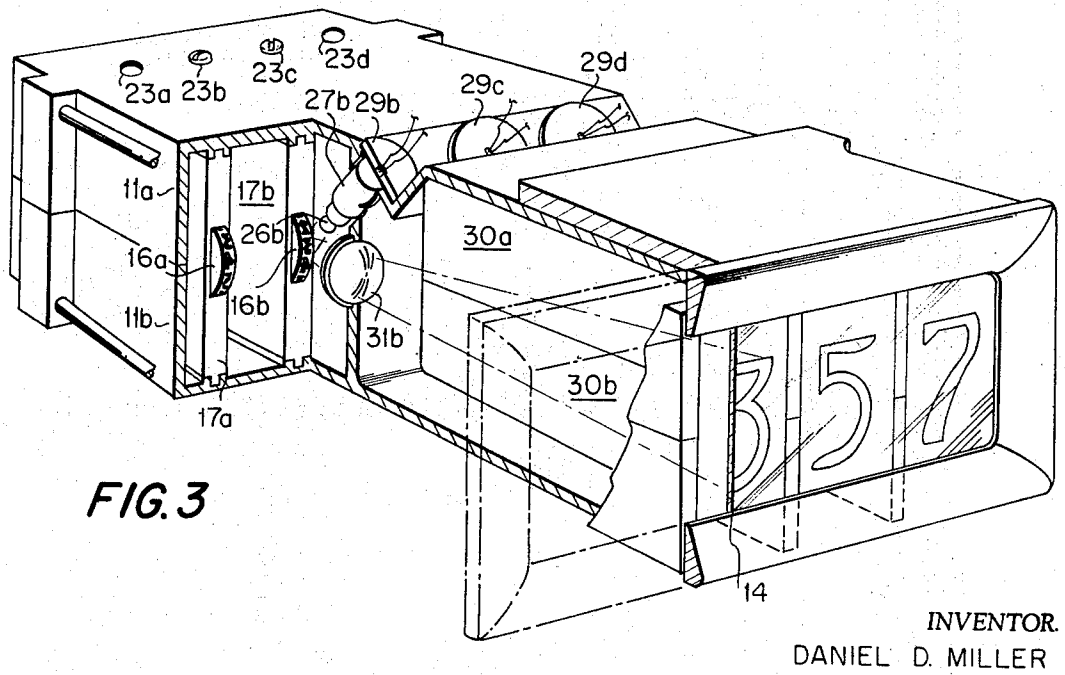


FIG. 3

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DISPLAY DEVICE

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U.S. Cl. 353—36 3 Claims

ABSTRACT OF THE DISCLOSURE

A display device employs light which is reflected from a representation of a character to be displayed and passed through a focusing lens to the back of a rear projection screen. The light source illuminating the character provides a shaped light pattern to produce maximum utilization of the light. The display may be focused by adjusting the position of the device carrying the characters to be displayed relative to the lens.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates in general to display devices, and relates more particularly to illuminated displays for displaying different alpha-numeric or other characters.

Description of the prior art

There is a significant demand for a display device which is capable of providing an illuminated display of a number of different alpha-numeric characters and which is reliable and inexpensive. One prior art approach to such a display device involves the use of a plurality of light sources and lenses associated with masks having transparent areas corresponding to the characters to be displayed. One light source and lens are associated with each character, and a given character is displayed on a common screen by energizing the associated light source to project light through the mask and associated lens. These devices are capable of providing a good quality display, but the requirement of an extensive logic or memory system and a separate lens and light source for each character to be displayed renders them relatively expensive, particularly where a large number of characters are involved. Additionally, the problem of producing the proper focus of all of the images of the different characters on a common screen necessitates the use of relatively expensive lens elements, thus further increasing the cost of the device and requiring a critical adjustment of the optical path for each character to be displayed.

An additional prior art approach to display devices is the so-called "Nixie" tube in which individual light elements having configurations corresponding to different characters are selectively energized to produce illuminated representations of the different characters. While these devices are capable of producing satisfactory displays, they are relatively expensive because of the large number of required individual light elements and energizing controls therefor.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a display device utilizing light reflected from a representation of the characters to be displayed. The light pattern from a light source is shaped or focused so as to form a confined pattern, preferably elliptical, which is projected toward a character which is in position for display. The light reflected from the face of the character is passed through a lens to the back of a rear projection screen to produce the desired display on the face of the screen.

In the preferred embodiment of the invention, the representations of the characters to be displayed are disposed around the periphery of a character member in the form of an indexable wheel which is selectively movable to position different ones of the characters thereon at a display position. As one particularly valuable feature of the invention, the position of this wheel may be readily adjusted relative to the light source and lens to provide for proper focus of the character on the display screen, thus permitting the use of relatively inexpensive lenses which may not have the optical uniformity found in more expensive lenses and required in display devices in which the positions of the optics and the character to be displayed are fixed.

The present display device requires only a single light source and lens for each display screen, since the same source and lens are used to form the display for all of the different characters on a given wheel. This eliminates the need for separate light sources and lenses for each character to be displayed in a given screen, thus considerably reducing the cost and reliability of the device. Further, by positioning the light source so that it may be easily removed for inspection or replacement, the maintenance costs of the present device are greatly reduced. The use of a shaped light pattern results in maximum utilization of the light, thus producing a readily visible display by reflected light with a minimum light input.

It is therefore an object of the present invention to provide an improved device for displaying different characters.

It is an additional object of this invention to provide a display device in which light is reflected from a representation of a character to be displayed, and the reflected light is projected onto a display member.

It is a further object of the present invention to provide a display device which is inexpensive to manufacture, easy to adjust, and reliable in operation.

Objects and advantages other than those set forth above will be apparent from the following description when read in connection with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view, partly in cross-section, illustrating a display device according to this invention for simultaneously displaying four characters;

FIG. 2 is an elevation view, partly in cross-section, of the device of FIG. 1; and

FIG. 3 is a perspective view of the device shown in FIGS. 1 and 2, with portions thereof broken away.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, the display device includes a housing **11** which includes an upper housing member **11***a* and a mating lower housing member **11***b*. A single rear projection screen **14** is provided for the assembly shown, and the different displays are produced in different sections or portions along the length thereof. Screen **14** may be of any suitable material, such as plastic or glass, which is capable or producing a display on the front thereof in response to illumination on the rear of the screen. Preferably, the material of screen **14** is frosted on the rear side and is provided with a special coating on the front thereof which reduces or eliminates light diffusion laterally so as to sharpen the images of the displayed characters. In the illustrated embodiment, it is assumed that four different displays are to be provided by the device, but it will be apparent that any other number may be employed as desired.

The indexable wheel which contains the different characters for each display on a given portion of the screen

is preferably in the form of a wheel of a counter module, such as wheel **16***a* of a counter module **17***a*, as best seen in FIGS. 2 and 3. Similar counter modules **17***b*, **17***c*, **17***d* are provided as shown in FIG. 1 to provide the required four sets of characters. Each counter module may be of the type manufactured by Presin Mfg. Co. under the designation #CM–10R. In such modules, the counter wheel carries around the periphery thereof representations of the different characters to be displayed, and these wheels are indexable by electrical signals or pulses supplied to the modules through electrical connecting pins **19***a*–**19***d* to position different ones of the characters on the wheel at the display position. Each of the characters formed on the wheels is of a highly light reflective material and color to maximize light reflection therefrom and may or may not be raised above the surface of the wheel. To further enhance the sharpness of the displayed image, the material of wheels **16***a*–**16***d* adjacent the characters thereon may be sandblasted or otherwise roughened to reduce light reflection therefrom.

The characters to be displayed may be of any suitable type, such as alpha-numeric or other, and in the illustrated embodiment it is assumed that the characters are the digits 0 through 9 for producing a numeric display on screen **14**. Such a display would be particularly useful in displaying the "team total" score in a bowling scoring machine such as described in copending application Ser. No. 648,863, assigned to the same assignee as the present application.

Each of counter modules **17***a*–**17***d* is provided with raised rib portions **21***a*–**21***d* extending the length of the modules on the top and bottom surfaces thereof. These ribs engage corresponding grooves in the top and bottom housing members **11***a*, **11***b* which serve to position the modules within the housing assembly. A plurality of set screws **23***a*–**23***d* are provided in upper housing **11***a* to bear against the upper ribs **21***a*–**21***d* of the modules. When these screws are adjusted to bear firmly against their corresponding ribs, the modules are firmly retained in position in the guide grooves. By loosening these screws, the corresponding modules may be moved longitudinally of the housing for purposes of providing proper focus of the displayed characters, as will be discussed more in detail below. Further, this ease of removability facilitates replacement of the module if required.

The light source for each character display may be of any suitable type, such as light bulbs **26***a*, **26***b*, **26***c*, **26***d*. Each of these bulbs is preferably of the type which produces an elliptical light pattern, such as the lens-end bulbs manufactured by the Chicago Miniature Lamp Co. under the type designation #253. This particular type of bulb has a double convex lens in the end thereof which is effective to produce the desired elliptical light pattern. Each of the bulbs is mounted in a corresponding socket or holder **27***a*–**27***d* which is turn extend through openings in upper housing **11***a*. The bulbs and holders are retained in these openings by spring fingers, such as fingers **28***a* shown for holder **27***a*, which cooperate with cover plates **29***a*–**29***d*. Plates **29***a*–**29***d* are of slightly larger diameter than the openings in upper housing **11***a* through which the bulbs and spring fingers extend so that the bulbs are firmly retained in the openings. The bulbs are rotatable by rotating plates **29***a*–**29***d* to adjust the position of the bulbs so that the elliptical light pattern therefrom is properly oriented relative to the characters in display position of each of counter wheels **16***a*–**16***d*.

Light from bulbs **26***a*–**26***d* is reflected from the characters in display position on wheels **16***a*–**16***d* and passes through lenses **31***a*–**31***d*. These lenses are of the double-convex or planal-convex type and serve to focus the reflected light on screen **14**. Lenses **31***a*–**31***d* may be made of any suitable material, such as plastic, and may be relatively inexpensive with some variation in lens thickness among the different lenses. The lenses are positioned in mating openings formed in the upper and lower housing members and may be retained in these openings by means of cement or the like around their edges.

Lenses **31***a*–**31***d* serve to focus the light reflected from the wheels **16***a*–**16***d* on screen **14** to provide a display thereon of the characters which are in display position on the wheels. To isolate the light from the different characters to be displayed, upper and lower housings **11***a*, **11***b* are provided with mating wall sections **30***a*, **30***b* which form light barriers between adjacent display channels. Thus, screen **14** receives light in a given area only from the character in that channel, and there is no interference between adjacent channels.

In operation, the proper focus for each channel may be determined by observing the image of a displayed character on screen **14** and adjusting the longitudinal position of the counter module, after loosening the appropriate one of set screw **23***a*–**23***d*, until the proper focus is achieved. The module may then be firmly fixed in position by tightening the set screw to bear firmly against the upper rib of the module. This adjustment feature permits the use of relatively inexpensive lens elements for lenses **31***a*–**31***d*, since variations in the lens focal length properties due to manufacturing tolerances or other causes can be simply compensated for by adjusting the position of the module.

Similarly, light bulbs **26***a*–**26***d* are adjusted by rotation so that the elliptical light pattern therefrom is properly oriented relative to the characters in display position on the wheels **16***a*–**16***d*. The proper orientation, of course. is with the long dimension of the elliptical pattern extending along the height of the character to be displayed, and this orientation may be adjusted by observing the displayed character on screen **14**. This orientation of the light pattern relative to the character results in maximum utilization of the light, thus producing a readily visible display by reflected light utilizing a minimum light input.

In operation, signals supplied to the electrical pins **19***a*–**19***d* of the modules serve to index wheels **16***a*–**16***d* to position different characters thereon at the display position, and light reflected from these characters in the display position passes through lenses **31***a*–**31***d* to the back of screen **14** to provide the desired display on the face of the screen. If desired, each wheel may have a non-reflecting portion on the periphery thereof which may be positioned in the display position when no display is desired in that channel. This situation might occur, for example, when no display is desired for a "0" in a numeric display, or when a non-display or blank portion is to be provided in a non-numeric display.

From the foregoing description, it will be seen that the present invention provides a display device which is inexpensive to manufacture, rugged and easy to maintain. In this connection, it will be apparent that light bulbs **26***a*–**26***d* may be easily replaced, without dismantling the device, merely by removing the desired one of covers **29***a*–**29***d* and the attached bulb. Further, the color of the display may be varied by varying the color of the character representations or by interposing different color filters between the character representation and the screen. Additionally, the use of the counter modules provides a memory function and permits a rapid reset to zero for a new display.

Although the illustrated embodiment discloses the use of lens-end light bulbs as light sources, it will be apparent that other sources which provide the desired shape of light pattern may be employed. For example, light fibers may be used, with one end of a bundle of such fibers positioned adjacent a single light source and the other end of the fiber bundle divided into smaller bundles to provide separate sources for each channel or position of display. These smaller, separate ends of the fiber bundle would be ground and shaped to produce the desired elliptical light for projection onto the characters in display position on the counter wheels.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in the form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A display device comprising:
(a) a housing;
(b) a plurality of counter modules disposed in said housing, each of said modules having an indexable wheel bearing representations of a plurality of different characters to be displayed, each of said wheels being rotatable to position different character representations thereon in a display position;
(c) a plurality of light sources, each of said light sources producing a light pattern directed at the associated one of said character representations on said wheels which is in said display position;
(d) a rear projection screen member;
(e) optical means positioned in said housing between said wheels and said screen member for focusing the light which is reflected off said character representations from said light sources onto the rear of said screen member to produce a display of said characters on the front of said screen member;
(f) means for enabling independent removal of said modules from said housing; and
(g) means for locking each of said modules in position in said housing.

2. A display device in accordance with claim 1 wherein each of said modules have raised rib portions extending along their upper and lower surfaces, said rib portions cooperating with grooves in said housing to provide sliding contact between each module and said housing and to maintain said modules in proper alignment within said housing.

3. A display device comprising:
(a) a housing;
(b) a counter module disposed in said housing, said module having an indexable member bearing representations of a plurality of different characters to be displayed, said member being indexable to position different character representations thereon in a display position;
(c) a light source, said light source producing a light pattern directed at the character representation on said indexable member which is in said display position;
(d) a rear projection screen member;
(e) optical means positioned in said housing between said indexable member and said screen member for focusing the light which is reflected off said character representation from said light source onto the rear of said screen member to produce a display of said character on the front of said screen member;
(f) means for enabling removal of said module from said housing; and
(g) means for locking said module in position in said said housing.

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HARRY N. HAROIAN, Primary Examiner

U.S. Cl. X.R.

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