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Edmonson et al.

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[54] **LIQUID CRYSTAL PROJECTOR**

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Related U.S. Application Data

[63] Continuation of Ser. No. 736,246, Jul. 26, 1991, abandoned.

[51] **Int. Cl.**[5] **G03B 21/16**

[52] **U.S. Cl.** **353/61**; 353/57

[58] **Field of Search** ..... 353/52, 54, 55-56, 353/60-61, 119-122, DIG. 3; 359/66, 79

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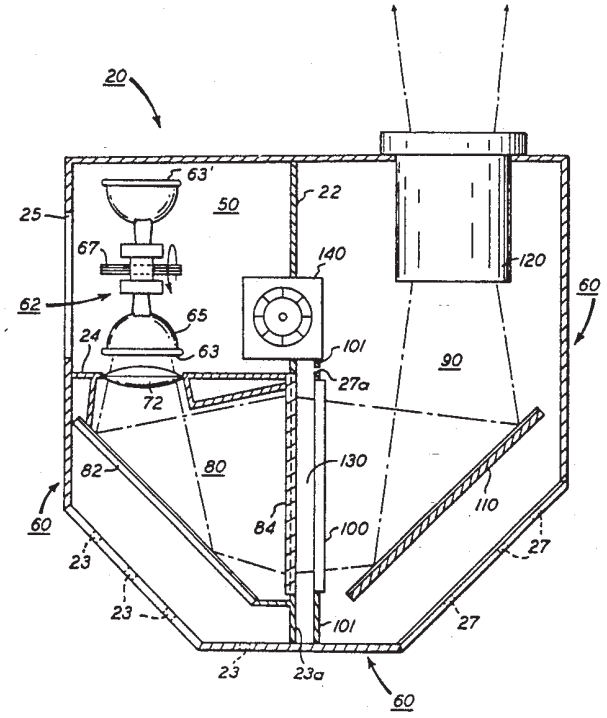
[57] **ABSTRACT**

A liquid crystal display panel projector including a housing having a thermally isolated hot compartment which has an illumination source and a cold compartment which retains liquid crystal display panel. The housing includes individual cooling fluid paths for the hot and cold compartments. The display panel is disposed in the cold compartment where it is isolated from the thermal energy of the illumination source to provide a substantially stable thermal environment.

7 Claims, 3 Drawing Sheets



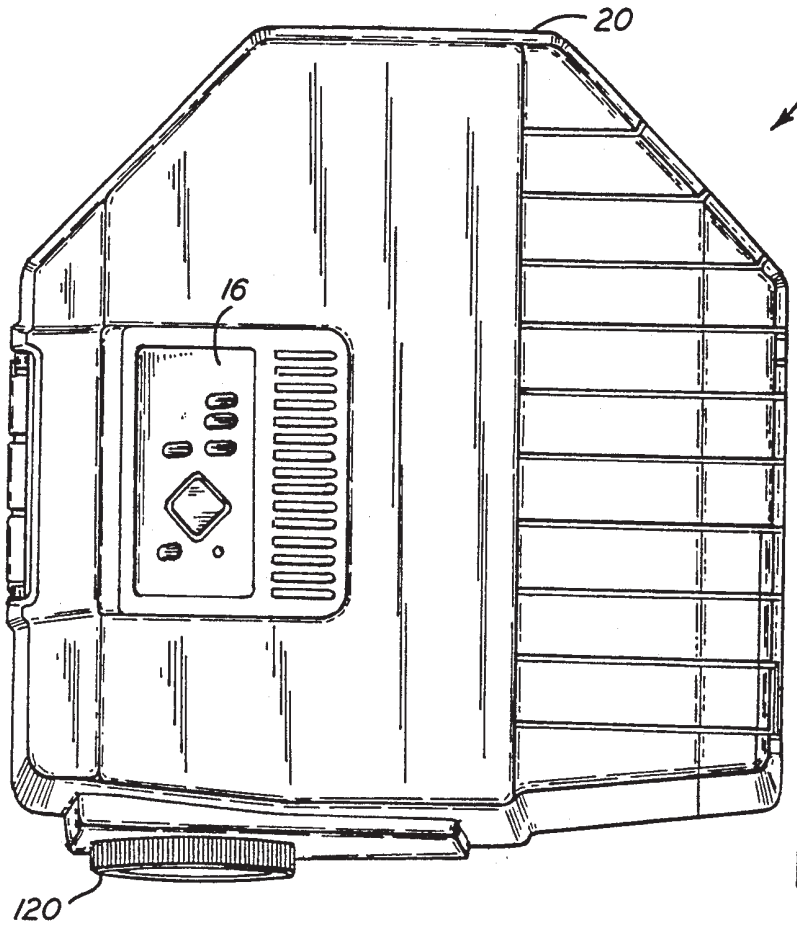


FIG. 1

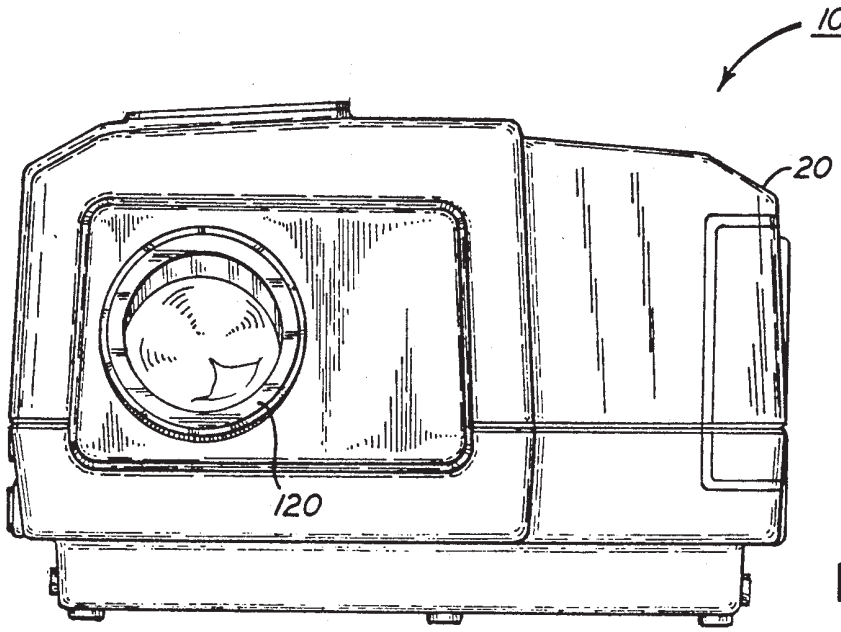


FIG. 2

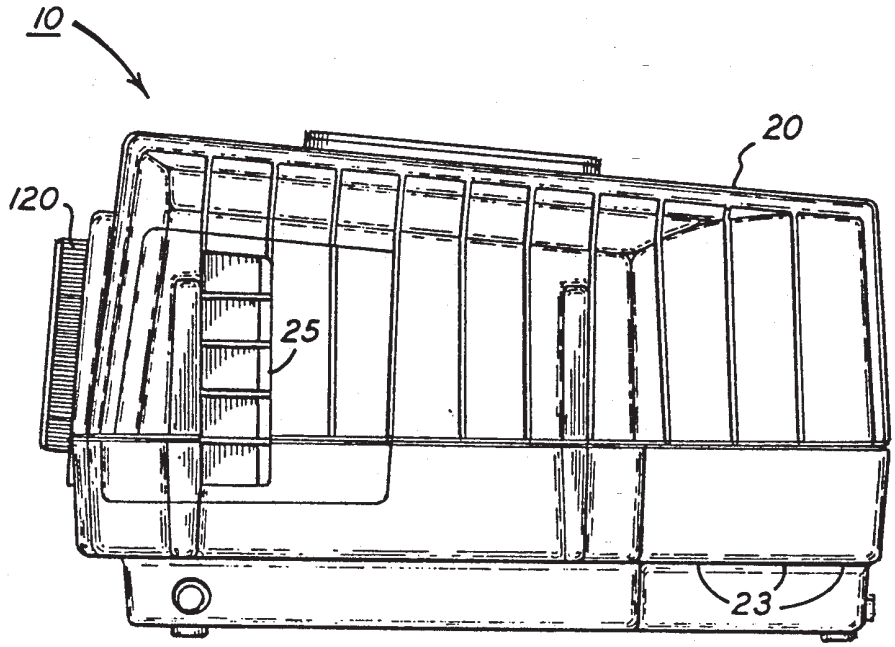


FIG. 3

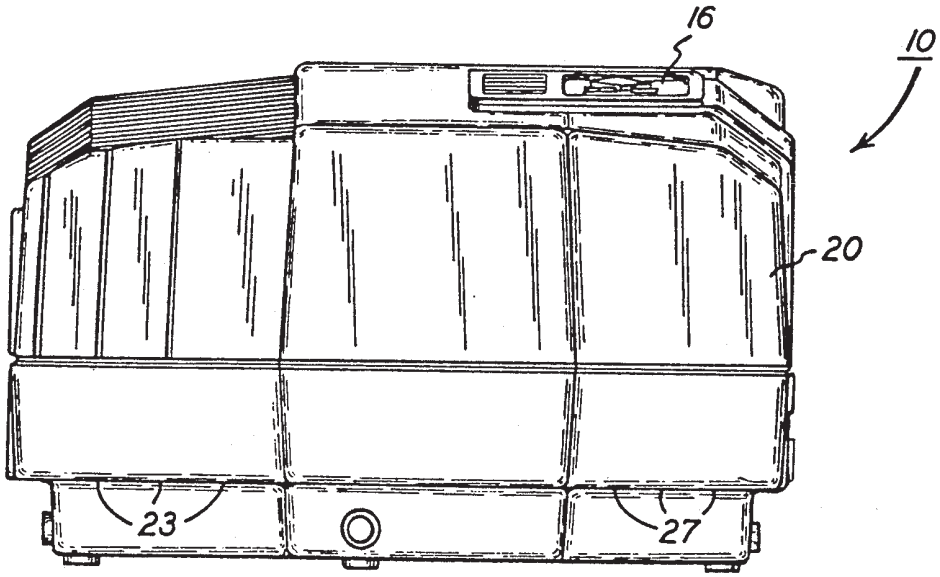


FIG. 4

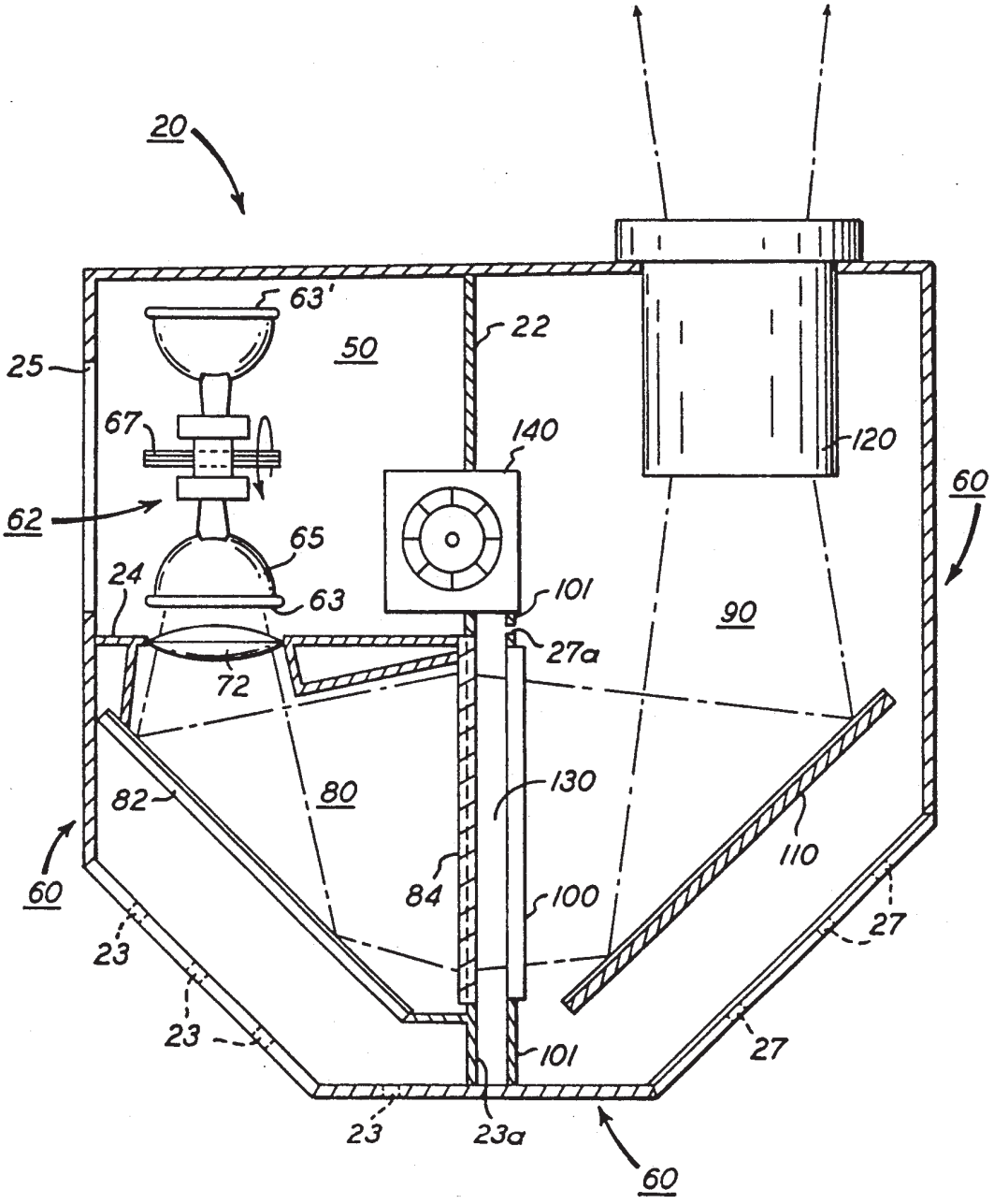


FIG. 5

LIQUID CRYSTAL PROJECTOR

This is a continuation of copending application Ser. No. 07/736,246 filed Jul. 26, 1991 now abandoned.

The present invention relates to liquid crystal projectors, and more particularly, to a liquid crystal projector having thermally isolated optically transparent compartments within the projector for providing a thermally stable environment for a liquid crystal display panel.

BACKGROUND OF THE INVENTION

Liquid crystal projectors employ a liquid crystal display panel positionable between a projector lamp and a lens. An illumination beam from the lamp passes through the liquid crystal display panel to form an image beam. The image beam is enlarged by a projection lens system and focused to cast an enlarged picture on a display screen.

To provide maximum contrast of the displayed image, liquid crystal display panels must be maintained at a cool and uniform temperature. The exposure of the display panel to heat from the projection lamp substantially degrades the quality of the projected image.

A prior projector employing a liquid crystal display panel is disclosed in U.S. Pat. No. 4,875,064 to Umeda. In the Umeda projector, the illumination beam passes through ultraviolet reflectors and absorbers to remove thermal energy from the beam. A reflective mirror redirects the illumination beam so that the beam is perpendicular to the lamp. A condenser lens directs the illumination beam to the liquid crystal display panel. The display panel forms an image beam which passes through a fresnel lens, and is redirected by a mirror. The image beam then passes through a projection lens, off a projection mirror, and on to a projection screen. While the Umeda device provides a relatively compact projector and employs ultraviolet reflectors and absorbers, the liquid crystal display panel is located in the same thermal environment as the illumination source, and is therefore subject to substantial heat and temperature fluctuations which degrade the quality of the image and contribute to premature failure of the panel.

A need exists for a liquid crystal display panel projector which provides a cool, thermally stable environment for the display panel. There is also a need for a compact projector having a reduced volume to permit integration with control equipment.

SUMMARY OF THE INVENTION

A liquid crystal display panel projector having a thermally isolated liquid crystal display panel and illumination source is disclosed. The thermal isolation of the display panel and the illumination source is achieved by housing each within a thermally separate compartment in the projector and circulating a cooling liquid through the compartments.

The projector of the present invention includes a housing having a hot compartment and a thermally isolated cold compartment, wherein the illumination source is disposed in the hot compartment and the liquid crystal display panel is disposed in the cold compartment. The cold compartment provides a relatively cool and substantially uniform temperature environment for the liquid crystal display panel. The stability of the environment in the cold compartment improves the contrast of the image produced by the display panel.

The hot and cold compartments are thermally isolated by removing the thermal energy from the illuminating beam while it is in the hot compartment, and preventing fluid communication from the hot compartment to the cold compartment.

The present invention may be used with liquid crystal display panels including color filter TFT, black and white double twisted, STN, and TFT panels. In addition, the present invention employs double folded optics to reduce the size of the projector, The compact design of the projector allows for the incorporation of a computer including a mother board, a disk drive and a backup system to provide a stand alone computer image projection system.

Specifically, the present invention includes a liquid crystal display panel projector comprising:

(a) a housing including a cold compartment having a fluid inlet and a hot compartment having a fluid outlet, wherein the hot compartment is at least partially thermally isolated from the cold compartment;

(b) a display panel substantially disposed within the cold compartment such that the cold compartment, the display panel having a first side and a second side;

(c) illumination means in the hot compartment for producing an illumination beam;

(d) single pass optics means for directing the illumination beam from the illumination means through the display panel in a single pass to produce an image beam;

(e) focusing means for projecting the image beam upon the screen; and

(f) fluid communication means extending between the inlet and the outlet for providing a fluid flow from the inlet into cold compartment in direct thermal contact with the first and the second side of the display panel such that the fluid flow then passes through the hot compartment in thermal contact with the illumination means and exits the housing through the outlet.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of the projector of the present invention;

FIG. **2** is a front elevational view of the projector;

FIG. **3** is a side elevational view of the projector housing;

FIG. **4** is a rear elevational view of the projector; and

FIG. **5** is a schematic cross-sectional view taken along lines **5—5** of FIG. **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1–3**, the projector **10** of the present invention includes a housing **20**. A projector lens **120** is retained by the housing **20**. As shown in FIGS. **1** and **4**, the housing **20** may include a control panel **16** including on/off, and focusing controls.

Referring to FIG. **5**, the housing **20** includes a hot compartment **50** and a cold compartment **60**. The hot compartment **50** is separated from the cold compartment **60** by a thermally insulating interior housing walls **22** and **24**. The insulating walls **22**, **24** may be formed of a variety of materials, such as insulated aluminum. The cold compartment **60** includes an illumination optics chamber **80** and an imaging optics chamber **90**. As shown in FIG. **5**, a light path whose boundaries are shown by broken arrows, extends from the hot compartment **50** through the illumination optics chamber **80** and imaging optics chamber **90** to exit the housing **20** through the projection lens **120**.

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