United States Patent

Winslow et al.

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[54] DISPLAY APPARATUS

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[52] **U.S. Cl.** **40/106.21**

[51] **Int. Cl.** **G09f 13/24**

[58] **Field of Search** 40/106.21

[56] **References Cited**

UNITED STATES PATENTS

1,190,459	7/1916	Le Moine	40/106.21
1,887,285	11/1932	Burrell et al.	40/106.21
2,621,430	12/1952	Neville	40/106.21 X
3,058,245	10/1962	Pieters	40/106.21
3,321,857	5/1967	Scnroer	40/106.21 X
3,388,490	6/1968	Stechemesser	40/106.21
3,405,464	10/1968	Simson	40/106.21 X

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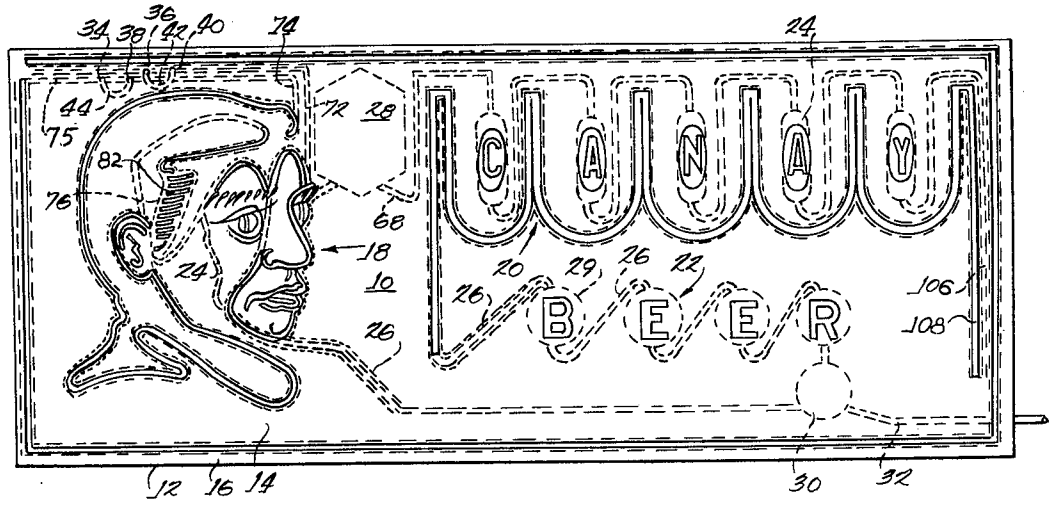
[57] **ABSTRACT**

A liquid that is opaque or translucent and colored is drawn out of passageways in one or several aligned transparent plastic vacuum-formed passageway panels from one or more than one outlet in each panel to uncover lines and areas on one or several design panes, which lines and areas overlie portions of the passageways to form a design of either of two types, which are: (1) formed of lines that are opaque on an opaque background of different color with the design being positioned behind a passageway panel so that the lines of the design are uncovered to daylight as the liquid is drained out of the passageway panel; and (2) with the lines forming the design being transparent or translucent with an opaque background and aligned with a lamp so that the passageways permit light to shine through the transparent or translucent lines and areas as the liquid is withdrawn. In each of the embodiments special display effects are obtainable through the use of bubbles, ultraviolet light and color mixing.

13 Claims, 5 Drawing Figures



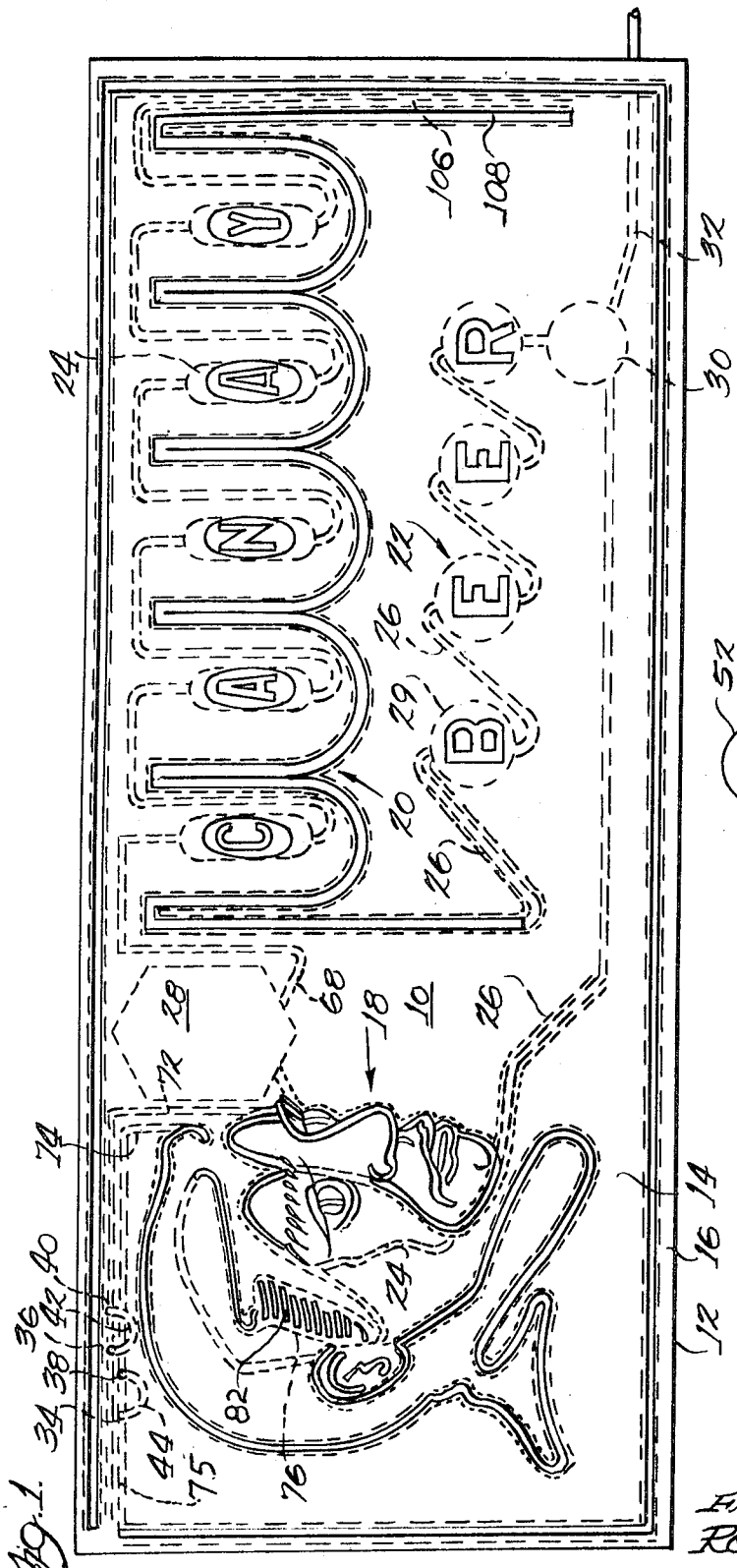


Fig. 1.

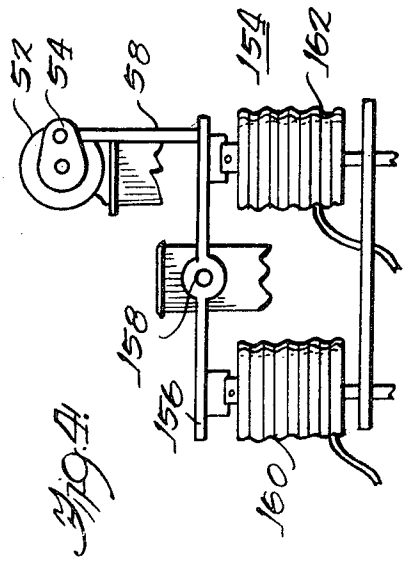


Fig. 4.

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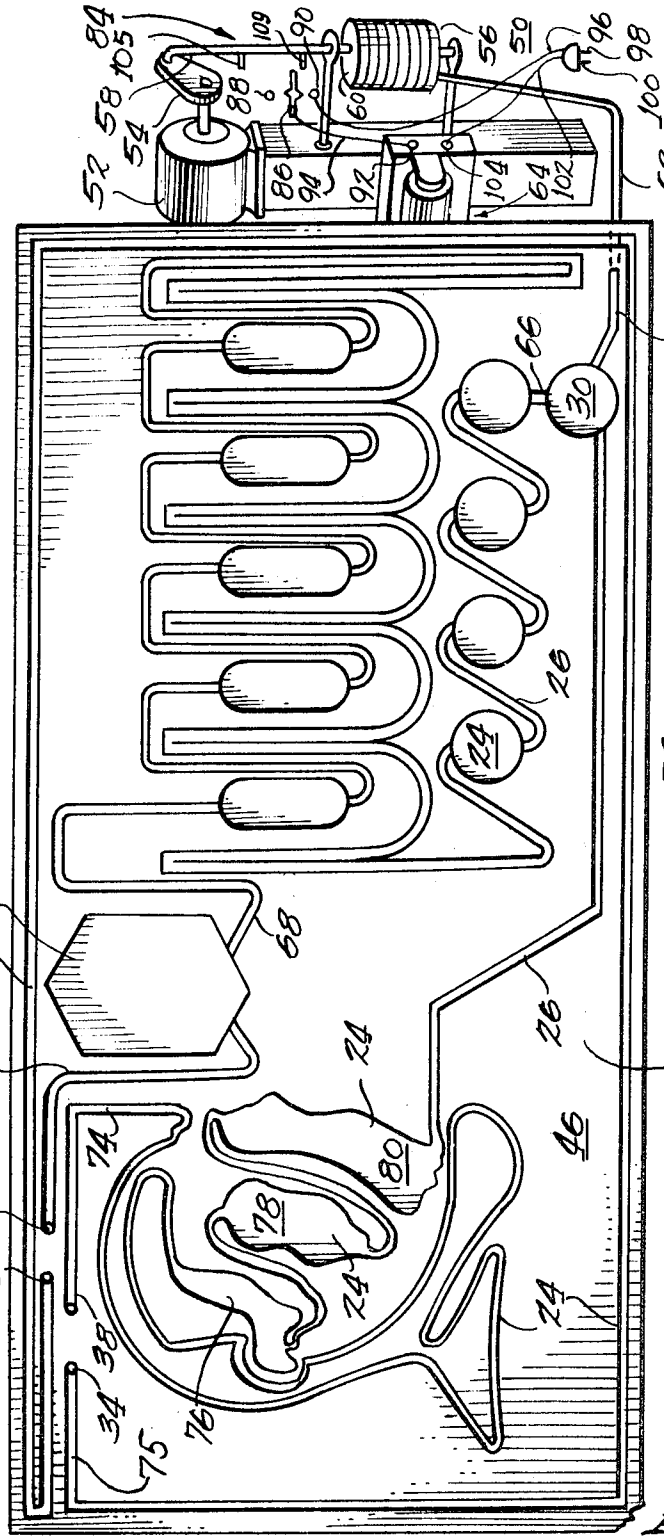

Fig. 2.

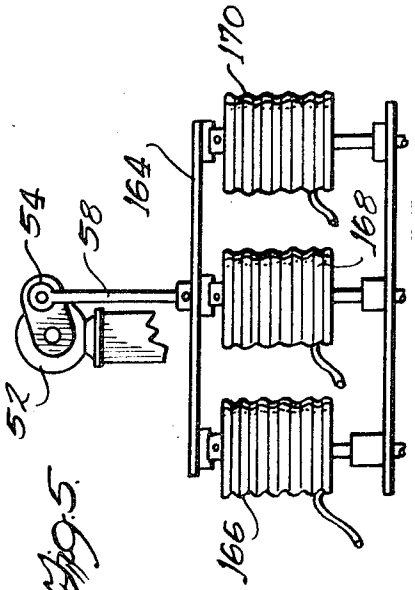

Fig. 5.

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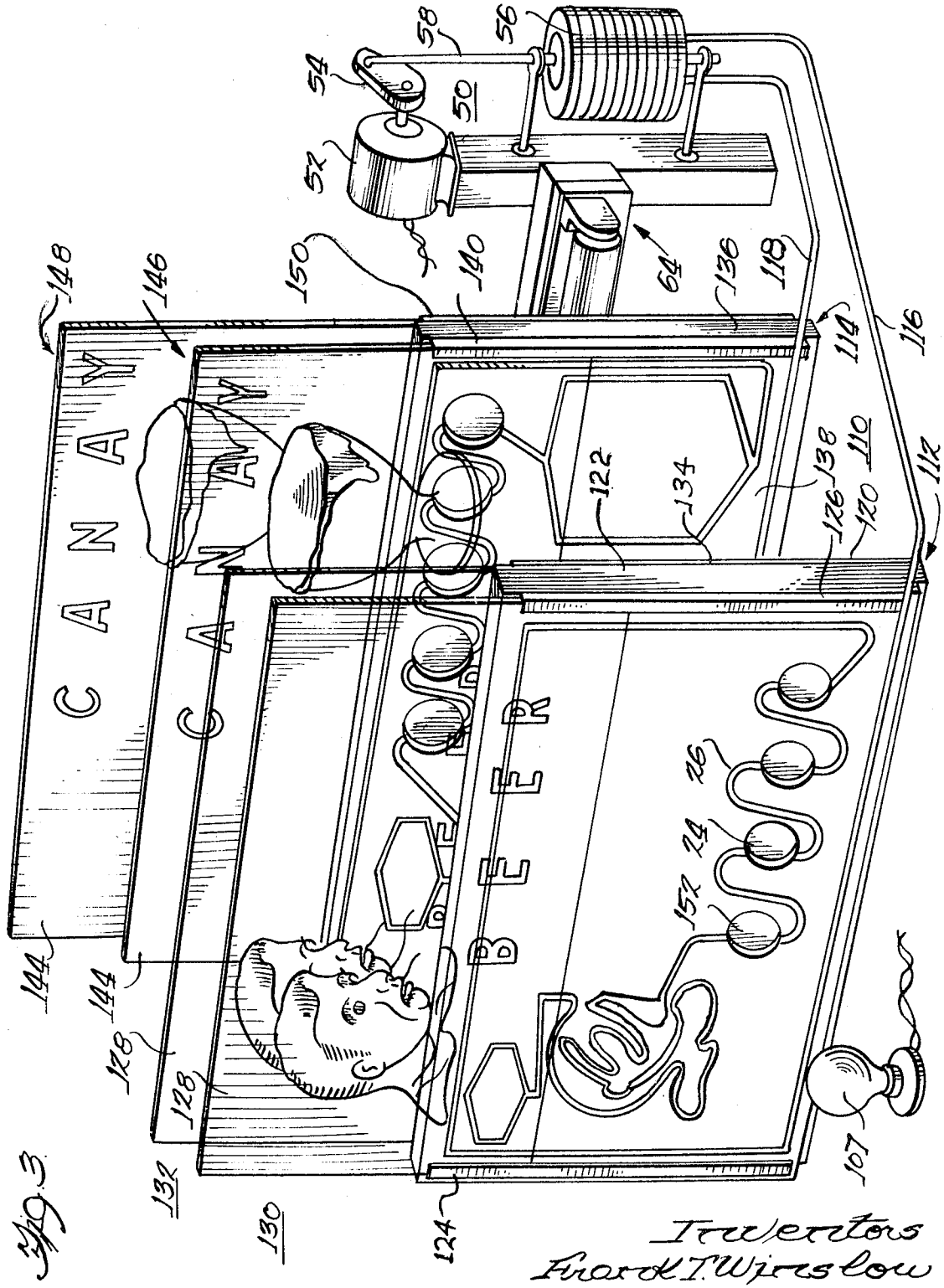

Fig. 3

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DISPLAY APPARATUS

This invention relates to display apparatuses and more particularly relates to display apparatuses and methods for using display apparatuses in which a design is uncovered and displayed as a liquid is removed from the display apparatus.

One type of display apparatus includes a front panel having translucent or transparent portions forming a design with a lamp behind the panel to illuminate the transparent or translucent portions. Liquids are pumped through passageways between the lamp and the translucent or transparent portions to block the light from the lamp and are drained from the passageways to cause the design to be slowly uncovered thus presenting the impression of lines being drawn to form the design.

In the prior art display apparatuses of this type, the transparent or translucent portions and the passageways are transparent or translucent tubes shaped to form letters or other simple designs. The tubes are located behind an opaque panel having openings aligned with the portions of the tubes that form part of the design.

The prior art display apparatuses have several disadvantages, which are: (1) they are expensive to make because the plastic tubes must be shaped into the design and attached to the display apparatus by hand; (2) they are limited to designs formed with lines having a width substantially the same as the diameter of the tubes and of a single color; (3) they are limited to relatively simple designs because tubes that are formed into complex shapes or are small in diameter offer too much resistance to the flow of the liquid; (4) the speed of drawing the lines must be constant or else relatively expensive equipment must be used to vary the flow rate of the liquids; (5) the simultaneous drawing of different lines at different locations on the display apparatuses is relatively expensive and difficult to achieve; (6) they are not able to display lines drawn at overlapping locations; and (7) they cannot provide more than two colors at any one location, one during the display of the design and the other when no design is displayed, without relying upon the radiation of the liquid or panel with ultraviolet light.

Accordingly, it is an object of this invention to provide a novel display apparatus.

It is a further object of this invention to provide an inexpensive display apparatus which is capable of displaying moving indicia.

It is a still further object of this invention to provide display apparatus operated by the flow of a liquid and presenting a moving display including art work having lines of different sizes and colors forming complex designs.

It is a still further object of this invention to provide a display apparatus in which a moving display of art work formed on a replaceable sheet is animated under the control of the flow of a liquid.

It is a still further object of this invention to provide a display apparatus that permits simultaneous sequences at spaced-apart locations on the display apparatus.

It is a still further object of this invention to provide a display apparatus under the control of a liquid which permits lines to be drawn at overlapping locations.

It is a still further object of this invention to provide a display apparatus under the control of the flow of liquid which permits more than two different colors to be displayed at different times without the use of ultraviolet light.

In accordance with the above and further objects of the invention, the display apparatus includes a transparent plastic passageway panel, a lamp, and a design pane having an opaque background with translucent or transparent lines and areas of different colors, shapes and sizes forming a design. The transparent plastic passageway panel is formed from a transparent plastic sheet by any process such as vacuum forming to provide a panel containing integrally formed channels covered by another transparent sheet sealing the edges of the channels to form a plurality of liquid control passageways, light control passageways, and reservoirs.

The passageways and reservoirs communicate with a source of a translucent colored liquid or an opaque liquid. In some embodiments of the invention, the liquids include a dye that emits visible light when irradiated by ultraviolet light. The design pane, which may also be plastic, is positioned over the passageway panel with the translucent and transparent lines and areas overlying the light control passageways and the lamp is positioned on the opposite side of the passageway panel so that the passageway panel is between the lamp and the design pane.

To provide a moving display, a liquid is pumped into the passageways of the passageway panel and then the lamp is illuminated. While the lamp is illuminated the liquid is withdrawn from the light control passageways to permit light from the lamp to shine through the translucent and transparent lines and areas providing the impression that the design is being drawn. In some arrangements the liquid is withdrawn from the passageways from a plurality of different locations to create different sequences of lines at spaced-apart locations at the same time. Moreover, in some embodiments colored liquids are combined with the colors of the translucent areas of the design so that when passageways are full of liquid, the colored liquid and the colored translucent areas combine to provide a darkened area or an area of the same color as the background but when the liquid is withdrawn the light shines through the translucent area to provide a line or area of a color brighter and different than the background.

The design pane may include a plurality of both narrow and broad lines of any color and the lines may overlie wide light control passageways or narrow light control passageways. With this arrangement several effects are obtainable such as: (1) a line inclined in a horizontal direction over a wide light control passageway is uncovered more rapidly than a line inclined in a vertical direction as the liquid is withdrawn; (2) the liquid is withdrawn more slowly from wide passageways than narrow passageways so that the speed of exposing lines and the delay between exposing different portions of a design is controlled by the width of the passageways; (3) the lines over a wide passageway may be complex, composed of many parts and of any width although the passageway is not complex; and (4) several separate lines on the design pane may be located horizontally to each other over the same passageway to be drawn simultaneously.

To provide another visible display while the passageways of one display are being filled with a liquid in one embodiment of display apparatus, the lamp to the rear of the display device is extinguished and the display surface of the display apparatus is irradiated with ultraviolet light. A design of material that emits visible light under ultraviolet radiation is on the design pane to provide a design while the passageways are being filled. In another embodiment of display apparatus, two designs under the control of the liquid are positioned side by side so that one design is drawn while liquid is evacuated from the passageways overlying it and liquid is pumped into the passageways overlying the other. The process is then reversed so that the other design is drawn while liquid fills the passageways for the first design.

In another embodiment of display apparatus, the design pane is positioned behind the passageway panel with the passageway panel being between the design pane and the front viewing surface of the display apparatus. With this arrangement, a lamp is not necessary and the design pane is entirely opaque with a colored design covered by the light control passageways in the passageway panel. The light control passageways are filled with a liquid that matches the background of the design pane so that when they are full the design is not shown and when the liquid is withdrawn the design is drawn on the viewing surface.

In still another embodiment, two passageway panels and two design panes have aligned portions which aid in forming a design common to both panels and panes. Some light control passageways on one panel are aligned with light control passageways on another panel and some are not aligned. How-

ever, there are translucent or transparent areas in both design panes that are aligned with the light control passageways on at least one of the passageway panels.

In one mode of operation, as the liquids are evacuated from the passageway panels, overlapping lines and images are drawn by the light control passageways in the two different panels, which lines and designs change color by color mixing to provide several color changes for the same area of the design and to add portions of an image at a delayed time in the same area. In another mode of operation, one passageway panel has liquid withdrawn from it while the other one has liquid applied to it so that some lines are being drawn on the display while others are being erased. Ultraviolet light may also be used to obtain additional effects similar to those described as part of other embodiments.

The above-noted and other features of the invention will be understood more fully from the following detailed description when considered in connection with the accompanying drawings, in which:

FIG. 1 is a plan view of a display apparatus in accordance with an embodiment of the invention;

FIG. 2 is an elevational sectional view of the display apparatus of FIG. 1;

FIG. 3 is an exploded perspective view of another embodiment of the invention;

FIG. 4 is a schematic diagram of a motor and pump arrangement which may be used in an embodiment of the invention; and

FIG. 5 is another schematic diagram of a motor and pump arrangement which may be used in still another embodiment of the invention.

GENERAL CONSTRUCTION OF FIRST EMBODIMENT

In FIG. 1 an elevational view of a display apparatus **10** is shown having a casing **12** and a design pane **14**. The design pane **14** includes four designs, which are: (1) a border **16**; (2) the head of a man **18**; (3) five letters **20** spelling the word CANAY; and (4) four letters, **22** spelling the word BEER.

The design pane **14** has an opaque background and the designs **16**, **18**, **20**, and **22** are formed of translucent or transparent lines and areas on the opaque background of the design pane **14** although these lines are shown as black lines in the drawings for clarity.

Behind the transparent or translucent lines in the designs **16**, **18**, **20**, and **22** are light control passageways **24** interconnected by a plurality of liquid control passageways **26** shown in hidden lines. At one location, there is an air reservoir **28** to which one end of each of the liquid control passageways **26** is connected and at another location there is a liquid reservoir **30** shown in hidden lines and communicating with the other ends of the liquid control passageways **26** near the inlet-outlet orifice for the passageway panel. An inlet-outlet passageway section **32** is shown in hidden lines and communicates between the liquid reservoir **30** and a source of liquid. In the preferred embodiment the air reservoir is vented to the atmosphere.

At one or more locations along the liquid control passageways **26** are inlet-outlet orifices such as the four orifices at **34**, **36**, **38**, and **40**, which orifices are adapted to receive tubular conduits such as the plastic tubes **42** and **44** shown in hidden lines in FIG. 1. The conduits that enter the orifices may be directly connected to a source of liquid or may be connected between different orifices in the liquid control passageways **26** as jumper conduits. For example, the tubes **42** and **44** shown in FIG. 1 provide continuous passages along the liquid control passageways **26**, but could be repositioned to supply liquid to the passageways from an external source of liquid or to cross-connect different sections of the passageways **26**.

In FIG. 2, a passageway panel **46** is shown having a flat raised background area **48** and a plurality of depressed areas forming channels for the liquid control passageways **26**, the light control passageways **24**, the air reservoir **28**, and the liquid reservoir **30**. The four orifices **34**, **36**, **38** and **40** are holes in the liquid passageway panel **48** to permit the passageways to communicate with tubing such as **42** and **44** (FIG. 1) behind the panel.

The passageway panel **46** is located behind the design pane **14** (FIG. 1) with the liquid control passageways **26** being covered by opaque portions of the design pane **14** and with the transparent and translucent lines and areas of the design **16**, **18**, **20** and **22** on the design pane **14** overlying and being smaller than the light control passageways **24**.

The passageway panel **46** may be formed in any convenient manner but is economically formed by vacuum-forming a transparent plastic sheet to form channels and covering its surface having the channels with a flat transparent plastic sheet attached to the background area **48** to seal the liquid control passageways **26**, the light control passageways **24**, the air reservoir **28**, and the liquid reservoir **30**. After the passageways and reservoirs are sealed by a transparent or translucent sheet, different design panes **14** are positioned in front of the passageway panel **46** each of which may be replaced by another. In the alternative, a design pane such as **14** may itself be attached to the background area **48** of the liquid passageway panel **46** to seal the passageways **24** and **26** and reservoirs **28** and **30** instead of the flat transparent plastic sheet.

To supply liquid to the passageways **24** and **26** in the passageway panel **46**, a pump **50** is provided having a low horsepower pump motor **52** such as a synchronous motor or the like, an eccentric **54** driven by the shaft of the motor **52**, and an expandable bellows **56**. A rod **58** is pivotally attached to a top plate **60** of the expandable bellows **56** at one end of the rod and pivotally attached to the eccentric **54** at its other end so that the expandable bellows **56** is collapsed and expanded by the motor **52** as the motor **52** drives the eccentric **54**.

To permit liquid to flow between the passageway panel **46** and the pump **50**, a conduit **62** communicates at one end with the interior of the expandable bellows **56** and at its other end with one of the passageways **26** that extends beyond the edge of the passageway panel **46** or to an orifice such as **34**, **36**, **38**, or **40** positioned at some location along a liquid control passageway **26**. A liquid is always present in some portion of the system that includes the passageways of the passageway panel **46**, the conduit **62**, and the expandable bellows **56**. This liquid is forced through the passageways **24** and **26** of the passageway panel **46** as the expandable bellows is collapsed by the motor **52** and withdrawn from the passageways **24** and **26** as the expandable bellows **56** is expanded by the motor **52**.

To illuminate the display panel **10**, a lamp **64**, is positioned behind the passageway panel **46** to shine light through it and onto the design pane **14**. Since the passageway pane **46** is of transparent or translucent material, the light impinges directly upon the reverse side of the design pane **14** except where it is blocked by an opaque liquid in the passageways **24** and **26** of the passageway panel **46**. A colored or translucent liquid in the passageways of the passageway panel **46** causes the light to impinge upon the reverse side of the design pane **14** in color by removing some frequencies of light as it passes through those passageways containing the liquid. Since the light control passageways **24** are wider than the translucent or transparent lines on the design pane **14**, the light from the lamp **64** passes through the translucent or transparent lines of the design pane **14** wherever it is not blocked by either liquid in the passageways of the passageway panel **46** or the opaque portions of the design pane **14**.

GENERAL OPERATION

For the purposes of explanation, one general mode in which the display apparatus **10** is operated will first be described and then other modes of operation will be described by explaining the variations in the steps from the general mode of operation.

In the general mode of operation, the design pane **14** is positioned in front of the passageway panel **46**. The liquid control passageway **26** is closed at **66** and **68** so that no liquid can enter the right side of the panel. With this arrangement, light from the lamp **64** always passes through the light control passageways **24** of the passageway panel **46** to cause the words CANAY and BEER to be illuminated. In this mode of operation the right side of the panel may be omitted entirely so that only the left-hand side design **18** of the head of a man is displayed.

In this general mode of operation, the panel on the left is completely blank at first and then the head of the man forming the design **18** is slowly traced in lines of light which are colored or white depending upon the color of the transparent or translucent lines forming the design **18**.

During the time that the panel is completely blank, the lamp **64** does not emit light and the motor **52** drives the eccentric **54** downward to collapse the bellows **56** forcing an opaque liquid to flow through the conduit **62** to the liquid reservoir **30** and from the reservoir **30** into the first section of the liquid control passageway **26** connecting the reservoir **30** to the light control passageway **24** that underlies the translucent or transparent lines forming the design **18** on the design panel **14**. The reservoir **30** always contains at least some liquid to compensate for the slight escape of liquid from the liquid system of the display apparatus.

When the bellows **56** is completely collapsed, the liquid has flowed from the first section of the liquid control passageway **26** into all of the light control and liquid control passageways **24** and **26** connecting and underlying the design **18**, into the light control and liquid control passageways underlying and connecting the border design **16** that passes around the outer edge of the design pane **14** and into the section **74** of liquid control passageway connecting the light control passageways of the head design **18** to the light control passageway of the border design **16** which section **74** is covered by an opaque portion of the design pane **14**. Once the border passageways have been filled, the liquid flows through another section **72** of liquid control passageway from the border passageways into the air reservoir **28**. Any bubbles in the system, are forced into the air reservoir **28** and flow to the top surface thereof where they leave the liquid so that it will thereafter be relatively free of bubbles as it is drained from the display apparatus.

To cause the border design **16** and the design **18** of the head of a man to be traced in white or colored light on the surface of the display apparatus **10**, the lamp **64** is illuminated and the motor **52** rotates the eccentric **54** to pull the rod **58** upwardly causing the expandable bellows **56** to expand and withdraw liquid from the passageway panel **46** through the conduit **62**. As liquid is withdrawn from the passageway panel **46**, the air reservoir **28** is emptied of the liquid, which drains through the section **72** of the liquid control passageway **26**. The interface between the liquid and the air then scans through the liquid control passageway **26** to the orifice **40** and through the tube **42** (FIG. **1**) to the orifice **36** of the liquid control passageway **26**. From there the interface enters the light control passageway **24** forming a portion of the border design **16** causing this passageway **24** to be slowly emptied towards the right along the top. As the top passageway is emptied, light shines through the translucent or transparent lines of the design **16** so that a white or colored line is traced along the top portion of the border.

The interface between the liquid and air continues around the entire border **16** to form a square borderline and then enters the horizontal section of the liquid control passageway **26**. The interface then flows through the following units in the order named, which are: (1) the orifice **34**; (2) the tube **44**; (3) the orifice **38**; (4) the section **74** of the liquid control passageway **26**; and (5) the light control passageways **24** forming the passageways underlying the design **18** of the head.

As the liquid drains through the liquid control passageways **26** underlying the design **18** of the head, the head is drawn in light just as the border **16** was previously drawn. After the liquid has been entirely drained from the light control passageways **24** of the head design **18**, it flows through the liquid control passages **26** back to the reservoir **30**. At this time the border design **16** and the head design **18** are fully visible to an observer. The lines and areas forming the designs assume the color of the translucent or transparent lines and areas of the design pane **14** which is white or colored. Moreover, some portions of the design may be of one color and others of a different color depending upon the color of the translucent portions of the design pane **14**.

Portions of the light control passageways **24** and liquid control passageways **26** are larger in area than others. For example, in the passageways underlying the design **18** of a head, the sections **76**, **78**, and **80** (FIG. **2**) of the light control passageways **24** are larger in area than most other passageways. In filling these passageways with a liquid, the liquid enters from the bottom of the larger area passageways and, when emptying these larger passageways, the liquid flows out of the bottom. This arrangement reduces turbulence in the liquid as it is entering or being withdrawn from the larger passageways.

While some of the light control passageways **24** are wider in areas than others, it is not always true that the translucent or transparent lines and areas of the design overlying larger areas are wider than other portions of the translucent or transparent design. The translucent or transparent portions of the design overlying the larger areas of the passageway are of any size narrower than the passageway itself.

The increased area of the light control passageways **24** and the liquid control passageways **26** enables four special effects to be displayed to the viewer of the display apparatus **10**, which are: (1) the speed with which a line is drawn varies in proportion to the size of the light control passageway underlying it since a larger passageway is emptied more slowly than a small passageway; (2) time delays before starting the drawing of a line are provided by interposing a large liquid control passageway **26** in the passageway system immediately before the light control passageway **24** that is to start the time delay; (3) horizontal lines are illuminated at the same time across their entire length and lines slightly at an angle from the horizontal are illuminated very rapidly because a single large area light control passageway **24** underlies the horizontal or substantially horizontal line such as shown at **82** in FIG. **1**; and (4) a plurality of individual small lines are drawn at the same time if they are in a horizontal line overlying a single wide light control passageway **24**.

Large area light control passageways also have the advantage of permitting different design panes **14**, each with a different design, to be used with the same passageway panel **46** at different times. This is possible because different designs may overlie the same wide light control passageways **24** so that different design panes **14** may be inserted over the passageways providing its translucent or transparent lines and areas overlie the light control passageways.

LAMP CONTROL

To turn the lamp **64** on and off automatically, the electric power source for the lamp is connected to the lamp through a single-pole, double-throw toggle switch **84** having a switch arm **86** that makes with either of the two contacts **88** or **90**. The lamp **64** is electrically connected to the source of power through the following elements in series in the order named, which are: (1) electrical input terminal **92** for the lamp **64**; (2) a conductor **94** connected at one end to the input terminal **92**; (3) the movable switch arm **86** electrically connected to the other end of the conductor **94**; (4) the contacts **90** with which the movable switch arm **86** makes in one of its two positions; (5) a conductor **96** electrically connected at one end to the contact **90**; (6) a plug prong or terminal **98** adapted to be connected to one side of the AC source of electrical power; (7) the source of electrical power; (8) the terminal or plug prong **100** adapted to be connected to the other input terminal of the

source of electrical power; (9) a conductor **102** electrically connected at one end to the prong or terminal **100**; and (10) a second input terminal **104** for the lamp **64**.

The rod **58** includes a first actuating arm **105** positioned on the rod at such a location that it contacts the switch arm **86** when the rod **58** is near its lowermost position, causing the switch arm **86** to make with the contact **90** and a second actuating arm **109** positioned lower on the rod **58** in such a position that it moves the switch arm **86** to break with the contract **90** and make with the contract **88** when the rod **58** is near its highest position.

In operation, the switch arm **86** of the switch **84** is closed to contact **88** interrupting the power to the lamp **64** while the eccentric **54** is moving the rod **58** downward. This causes the lamp **64** to be off while liquid is being forced through the conduit **62** to fill the liquid control passageways **26** and the light control passageways **24** of the passageway panel **46**.

When the eccentric moves the rod **58** downwardly at the bottom of its sweep just before starting in an upward direction, the actuating arm **105** contacts the switch arm **86** causing it to break with the contact **88** and make with the contact **90**. At this time a circuit is completed from the lamp **64** through the conductor **94**, the switch arm **86**, the contact **90**, the conductor **96**, the source of power and back to the lamp **64** through the conductor **102**. The lamp **64** is illuminated as the rod **58** begins its forward motion to withdraw liquid from the passageway panel **46** causing a line to be drawn on the display apparatus **10** as the liquid is withdrawn from the passageway panel **46**.

When the rod **58** nears its upper position, the actuating arm **108** contacts the switch arm **86** causing it to break with the contact **90** and make with the contact **88**. With this mechanization, the source of power to the lamp **64** is extinguished after the liquid has been withdrawn from the passageways **24** and **26** and remains extinguished until the passageways have been refilled with liquid.

SINGLE LANE PLURAL LINE PATHS

In another mode of operation of the display apparatus **10**, the liquid control passageways are not closed at **66** and **68** and all of the liquid control passageways and light control passageways shown in FIGS. **1** and **2** are able to receive liquid and to have liquid drained through them.

When the display apparatus **10** is operated in this mode, all of the passageways are open so that liquid is caused to flow in the refilling portion of the cycle through not only the border design passageways **16** and passageways underlying the design **18** but also through the passageways underlying the designs **20** and **22**. The liquid flows under the design **22** at the same time that it is under the design **18** and then continues from the passageways underlying the design **22** into the passageways underlying the design **20** to fill them. After the design **20** is filled, the liquid flows into the air reservoir **28**.

Although in the display apparatus shown in FIG. 2, the air reservoir **28** and the liquid reservoir **30** are shared for the passageways underlying each of the designs, separate reservoirs could also be used if desired.

When the bellows **56** is expanded by the rod **58** to remove liquid from the passageway panel **46**, the liquid is removed from the air reservoir **28** through both the sections **72** and **68** of the liquid control passageways **26** that are connected to the air reservoir **28** at the same time. When all of the liquid has been removed from the air reservoir **28**, the interface between the liquid and the air moves through both the sections of the liquid control passageway **72** to the passageway underlying the border design **16** and through the section **62** of the liquid control passageway to the passageway underlying the design **20**.

As further liquid is removed, the light from the lamp **64** begins to show through the border design **16** to cause a line to move to the right as shown in FIG. **1** and at the same time moves downwardly across the first letter, C, of the word CANAY in the design **20** causing the C to be written. As the line continues to move around the border, successive other letters of the word CANAY are exposed from top to bottom. The letters are exposed from top to bottom while the line drawing the border design **16** moves around in several different directions in succession so that at times it is moving downwardly in the same direction that the letters are being written and at other times at right angles or in an upwardly direction. Both the border and letter lines are written independently in this mode of operation and may move in the same direction or opposite directions or some transverse direction depending on the direction of the light control passageways **24** that underlie them.

Once the passageways of the border design **16** have been evacuated of liquid so that the border shows through in color or in white light, the interface between the liquid and the air begins to move through the light control passageways underlying the design **18** of the head of a man. Similarly, once the letters of the word CANAY have been written, the interface between the liquid and the air moves downwardly through the section **106** of the liquid control passageways **26** then upwardly through the section **108**, writing a long line from the right-hand bottom of the display apparatus **10** upwardly to a point above the letter Y. The interface then moves underneath each of the letters of the word CANAY to form a plurality of loops one under each letter.

After forming these loops the interface moves downwardly to draw a long line towards the bottom of the display apparatus **10** near the center and then proceeds to expose, one by one, the letters of the word BEER. After both the design **18** of the head of a man and the design **22** of the word BEER have been written, the liquid remains only in the reservoir **30**, the passageway **32**, the conduit **62**, and the expandable bellows **56** of the pump **50**. A new cycle is now ready to be started.

CHANGING THE DIRECTION OF WRITING

The direction, the starting points, and the ending points of the writing on the display apparatus **10** can be altered by inserting tubes into the passageways of the passageway panel **46** to cause the liquid to enter or to leave at different points. This is done by jumper tubes that connect one passageway to another or by tubes that connect passageways to the air reservoir **28** or to the pump **50**.

In FIG. **1** jumper tubes **42** and **44** are illustrated. In the previous mode of operation these jumper tubes **42** and **44** connected the orifice **36** to the orifice **40** and the orifice **34** to the orifice **38** so that the liquid flowed in a straight path through the liquid control passageways **26**. However, these jumpers may be changed in position so that the jumper **44** is connected between the orifice **34** and the orifice **40** and so that the jumper **42** is connected between the orifice **36** and the orifice **38**. With these connections, the direction of evacuation of the passageway **24** that underlies the border design **16** is opposite from the direction of evacuation with the jumper **42** connected between the orifice **36** and the orifice **40** and the jumper **44** connected between the orifice **34** and the orifice **38**. With the new arrangement the liquid from the air reservoir **28** drains through the section **72** to the orifice **40** and from the orifice **40** through the jumper **42** to the orifice **34**. It then proceeds to the section **75** and around the border until it reaches the orifice **36**. It then flows from the orifice **36** to the orifice **38** and then to the passageways underlying the design **18** of the head of a man.

BUBBLING EFFECTS

The display apparatus **10** is operated in either of two additional modes, each of which creates a different bubbling effect. In one of these bubbling effects a large number of bubbles of light suddenly flows through all of the translucent or transparent lines in the border design **16**, the design **18**, the design **20**, and the design **22** prior to the writing of these designs. In the other effect, a plurality of bubbles flow through the translucent or transparent lines as the writing is being ac-

complished and the bubbles are fewer in number than occur in the first bubbling effect.

The first bubbling effect is accomplished by reducing the amount of liquid in the system. The amount of liquid is reduced to such a low volume that there is an insufficient volume to fill the reservoir **30** at the end of the downward stroke of the rod **58**.

With this amount of liquid in the system, the last portion of the downward stroke of the rod **58** compresses the bellows **56** to force air through conduits **62**, the reservoir **30**, and through each of the liquid control and light control passageways **26** and **24**. The air flows as a plurality of bubbles through each of these lines providing an effervescent effect on the display. As the bubbles pass through the light control passageways **24**, the light from the lamp **64** passes through the bubbles to display the bubbles moving through the passageways. After the bubbles have been forced through the passageways, the rod **58** begins its upward stroke, draining the liquid from the passageways in the normal direction to write the designs into the display apparatus **10**.

The second bubbling effect is obtained by changing the timing between the portion of the cycle that fills the passageways of the passageway panel **46** and the portion of the cycle that withdraws liquid from the passageway of the passageway panel **46**. In normal operation there is a period of time after the passageways have been filled in which the bellows **56** continues to force liquid into the reservoir **28** even though all of the passageways in the passageway panel **46** are full. During this time bubbles that are trapped in the passageways by the liquid that is filling the passageways in the normal operation of the display apparatus **10** move upwardly into the air reservoir **28** where they rise to the surface. This causes the liquid to be bubble free by the time it is withdrawn. However, if the liquid is withdrawn immediately after the passageways have been filled, the bubbles that are normally trapped in these passageways remain so that, when the lamp **64** is illuminated they appear as bubbles of light that are slowly covered by the moving line that draws the design.

The time between the two portions of the cycle may be shortened by shortening the radius between the center of revolution of the eccentric **54** and the pivot pin or gudgeon that holds the rod **58** to the eccentric **54**.

STRUCTURE OF SECOND EMBODIMENT

In FIG. **3** an exploded perspective view is shown of another embodiment **110** of a display apparatus having a pump **50**, a lamp **64**, and a switch operated by the pump to control the lamp (not shown in FIG. **3**) that are substantially the same as the pump, lamp, and switch disclosed in the embodiment illustrated by FIGS. **1** and **2**. The embodiment shown in FIG. **3** also includes an ultraviolet lamp **107** positioned to radiate ultraviolet light upon the front of the display apparatus **110**, a front section **112** and a back section **114** of the display apparatus **110**, a conduit **116** communicating with the expandable bellows **56** and with the front section **112** of the display apparatus **110** and a conduit **118** communicating with the expandable bellows **56** and with the back section **114** of the display apparatus **110**.

The display apparatus **110**, like the display apparatus **10** shown in FIGS. **1** and **2**, is operated in several different modes. In some of these modes of operation only a portion of the apparatus shown in FIG. **3** is necessary. It is to be understood that the unnecessary apparatus may be entirely omitted for display apparatuses that are to operate in the modes not requiring some parts of the apparatus shown in FIG. **3**.

The front section **112** includes a casing **120** supporting a passageway panel **122**. The casing also supports two vertical front brackets **124** and **126** adapted to receive a design pane such as the design pane **128** shown at **130** in a position to slide between the brackets **124** and **126** and to be held thereby in front of and parallel to the passageway panel **122**. The same design pane **128** is shown at **132** in position to slide between similar brackets, one of which is shown at **134**, which brackets are supported by the casing **120** at a location behind the passageway panel **122**.

Similarly, the back section **114** includes a casing **136** supporting a second passageway panel **138** in a vertical position. The casing **136** also includes two vertical front brackets on opposite sides of the casing **136** one of which is shown at **140**, to receive a second design pane **144** shown at **146** being slid between the side brackets to a location parallel with and in front of the passageway panel **138**. The design pane **144** is also shown at **148** being slid between two back vertical brackets, one of which is shown at **150**, to receive and support the design pane **144** in back of and parallel to the passageway panel **138**.

DAYLIGHT OPERATION

The display apparatus **110** may be operated without the use of lamps such as **107** or **64** and using only the front section **112**. To use the display apparatus **110** without lamps relying only upon external light such as sunlight or store lamps, the design pane **128** is inserted in the rear brackets of the casing **120**, one rear bracket **134** being shown in FIG. **3**. The display apparatus is now operated in daylight, using only the pump **50**, the passageway panel **122**, and the design pane **128**.

For use in the daylight mode of operation, the design pane **128** must be a positive having lines and areas that are not translucent or transparent but are opaque and colored. The background of the design pane is the same color as the liquid used to fill the light control and liquid control passageways of the passageway panel **122**.

In operation, the design on the design pane **128** is visible from the front of the display apparatus **110** whenever there is no liquid within the light control passageways **24** of the passageway panel **122** because the passageway panel **122** if completely translucent or transparent. The liquid in the reservoirs matches the background of the design pane **128** and is not seen.

As the pump **50** fills the light control and liquid control passageways **24** and **26** with the liquid, the design on the design pane **128** is covered by the liquid and matches the background. When all of the light control passageways **24** have been filled with the liquid, the display apparatus **110** does not show the design on the design pane **128** at all.

When the pump **50** begins to withdraw liquid from the passageway panel **122**, the design on the design pane **128** is slowly uncovered to display the design. This design is clearly visible even when viewed only by the daylight or artificial light that is not emitted by the display apparatus **110**.

GENERAL OVERLAPPING SEQUENCES

By using more than one passageway panel, special effects can be obtained. With two passageway panels such as the front passageway panel **122** and the back passageway panel **138**, two sequences of moving designs which are independent in time but overlapping are drawn.

To obtain two overlapping sequences that are independent in time, a first design pane such as **128** is inserted through the front brackets **126** of the front passageway panel **122** and a second design pane such as **144** is inserted through the brackets such as **140** at **146** in front of the back passageway panel **138**. When the display apparatus **110** is operated in this mode, the design panes **128** and **144** are not completely opaque in those areas that are to overlie the background portion of the passageway panel against which they are held. Instead, transparent or translucent lines and areas are included in the front design pane **138** which do not overlie any light control passageway **24** in the passageway panel **122** but are aligned with a light control passageway **24** in the passageway panel **138** and conversely translucent or transparent areas are including in the design pane **144** which do not overlie light control passageways **24** in the passageway panel **138** but are instead aligned with light control passageways in the passageway panel **122**.

With this construction, a moving design is under the control of any of three arrangements of light control passageways which are: (1) only under the control of the light control passageway on the front passageway panel **122** because translucent or transparent lines and areas overlie or are aligned with these passageways on both the front design pane **128** and the rear design pane **144** but no light control passageways in the passageway panel **138** are aligned with the same translucent or transparent areas; (2) only under the control of the light control passageway in the back passageway panel **138** because there are transparent or translucent lines and areas aligned with these light control passageways on both the front design pane **128** and the design pane **144**, but no light control passageways in the passageway panel **122** aligned with the light control passageways in the panel **138**; and (3) under the control of aligned light control passageways in the front and back passageway panels **122** and **138** because there are translucent or transparent lines and areas aligned with these light control passageways in both design panes **128** and **144**.

This type of control with the passageways in both the passageway panel **122** and the passageway panel **144** being drained simultaneously is illustrated by the wide area passageway **152** in the passageway panel **122** with a design pane **128** inserted in the front brackets **124** and **126** having a B upon it in translucent lines of one color within a translucent disk of another color. At an aligned location in the passageway panel **138** there is a light control passageway shaped as a smaller disk (not shown) just larger than the B on the design pane **128**, and the design pane **144** is inserted in front of the passageway panel **138** with a disk-shaped transparent or translucent area the same size and aligned with the passageway **152**.

The passageways in the passageway panel **122** and the passageway panel **138** are arranged so that it takes longer to drain the passageway **138** to the light control passageway in the shape of a small disk than it does to drain the large area passageway **152** in the panel **122**. With this arrangement, the large area passageway **152** is drained first causing light to shine through from the lamp **64** around the filled light control passageway in the shape of a small disk in the passageway panel **138** to display a disk with a circle around it. Later as the light control passageway in the panel **138** is drained, the B on the design pane **128** shows through and the small disk disappears.

GENERAL OUT-OF-PHASE OPERATION OF TWO PASSAGEWAY PANELS

The two panels **112** and **114** may be operated so that the passageways in one panel are being drained at the same time that the passageways in the other panel are being filled. When the operation is in this mode, the lines and areas of a design are erased at the same time that other lines and areas of the same design or another design are written onto the display apparatus.

It is possible to use this mode of operation either with the lamp **64** or without the lamp **64** and relying only upon daylight.

If the lamp **64** is to be used, the design pane **128** is in front of the passageway panel **122** and the design pane **144** is not needed but may be included, and located in front of the passageway panel **138**. Both panels must have opaque backgrounds and designs in transparent or translucent areas and lines. The transparent or translucent lines and areas on the design pane **128** overlie light control passageways in the passageway panel **122** but only those portions of the design that are to be erased have aligned light control passageways on the passageway panel **138**.

In operation, while the lamp **64** is on, the liquid is drained through the conduit **116** causing the design to be written on the display apparatus **110** as the liquid is removed. To erase a portion of the design while the writing is still occurring, liquid is pumped into the passageway panel **138** through the conduit **118** so that the light from the lamp **64** is blocked from the aligned transparent or translucent portions of both the design pane **128** and the design pane **144** where the line is to be erased.

If the lamp **64** is not used, the design pane **128** is not needed but can be located behind or in front of the passageway panel **122**, if desired. The design pane **144** is located behind the passageway panel **138**. The design panes **128** and **144** have aligned designs if both are used but the design on the design pane **128** is in transparent or translucent lines and areas while the design on design pane **144** is in opaque lines. The portions of the design that are to be erased are covered by light control passageways of one of the passageway panels and portions of the design that are to be drawn are covered by the light control passageways of the other passageway panel. In operation, the liquid is drained from one passageway panel to uncover the design on design pane **144** while liquid is pumped into the other passageway panel to cover the portions of the design that are to be erased.

For the purpose of draining liquid from a panel through one conduit and pumping liquid into the other panel through another conduit, a special arrangement is necessary and this pumping arrangement is shown in FIG. **4** explained hereinafter.

SPECIAL PUMP STRUCTURES

In FIGS. **4** and **5** two different pumps are shown, which pumps are useful in particular modes of operation of the display apparatus. The pump shown in FIG. **4** is used when liquid is to be pumped into one passageway panel and withdrawn from the other at the same time. The pump shown in FIG. **5** is used when liquids of different colors are to be pumped into different passageways of several passageway panels or the same passageway panel at the same time.

The pumps shown in FIG. **4** and FIG. **5** each include a motor **52**, an eccentric **54**, and a rod **58** that are similar to the corresponding parts of the pumps shown in FIGS. **2** and **3**. However, each of these pumps is arranged to drive two or more expandable bellows.

In FIG. **4**, a pump **154** is shown having a pump lever **156** mounted to a frame by a pivot pin **158** near its center. At one end of the lever **156**, there is attached a first expandable bellows **160** and at the other end of the lever **156** there is attached a second expandable bellows **162** and a rod **58**. With this arrangement, the expandable bellows **162** is compressed as the rod **58** moves downward while the expandable bellows **160** is expanded, and as the rod **58** moves upward, the expandable bellows **160** is compressed while the expandable bellows **162** is expanded. The liquid is pumped through one conduit from the expandable bellows **162** while it is drawn into the other bellows **160** and is expelled from the bellows **160** while it is drawn into the bellows **162**. This pump is used in the embodiment of FIG. **3** when a portion of a design is written on the display apparatus while another portion of the design is being erased.

In FIG. **5**, the rod **58** is pivotally attached to a support plate **164**. Each of three expandable bellows **166**, **168**, and **170** is pivotally attached to the other side of the support plate **164** so that the expandable bellows **166**, **168**, and **170** are compressed as the rod **58** moves downwardly and are expanded as the rod **58** moves upwardly. This pump is used to supply a plurality of liquids of different colors to either different passageway panels or to the same passageway panel. The colors are used as explained hereinafter in embodiments of the invention that employ color mixing.

COLOR MIXING

In one of the embodiments illustrated by FIGS. **1** and **2**, the lines and areas of the designs such as **18** are translucent and colored and the liquid is not opaque nor of the same color as the opaque portion of the design pane **14** which forms the background of the design but has a color that, when mixed with the color of the translucent lines and areas of the design,

provides the same color as the opaque portion of the design pane **14** or is itself opaque.

In this embodiment, the lines and areas of the design appear in colors contrasting with that of the background as the liquid is drained from the passageway panel. This arrangement and choice of colors enables the background of the design to be colored and the lines and areas to be drawn in the design in a contrasting color.

This feature also permits the conversion of existing colored displays or signs to animated displays or signs. For such a conversion, the background of the display remains as it is but the lines of the design are cut away and replaced with a colored translucent plastic. A liquid is used having a color, that when combined with the color of the translucent plastic, matches the background of the design or is opaque, but when the liquid is removed results in colored lines forming a visible design.

In the embodiment disclosed in FIG. **3** having two separate display apparatus sections **112** and **114**, even greater variations are permitted in the color of the design through the use of color mixing. In portions of such a design in which the front design pane **128** and the rear design pane **144** have aligned translucent areas and lines with only one of the two passageway panels **122** and **138** having an aligned light control passageway, a variation of two colors is possible as in the display apparatus **10** illustrated in FIGS. **1** and **2** having only one display apparatus section. The two colors are formed by the combination of the colored liquid and the colors of the translucent design panes and the other color is formed only by the combination of colors in the aligned translucent portions of the two design panes.

In the portions of the design in which there are aligned light control passageways in both the passageway panels **122** and **138** and aligned translucent areas and lines in both the front design pane **128** and the rear design pane **144**, three colors are obtainable. The first color is obtained by a mixture of the colors of both colored liquids in the light control passageways with the colors of the design panes and this color matches the background. The second color is formed by the color of one of the liquids in one of the light control passageways and the colors of the translucent areas and lines on both of the design panes and this color is formed after one of the liquids has been drained from the display apparatus at that location. The third color is formed only by the combination of the colors in the translucent areas and lines of the design panes after both liquids have been withdrawn from the display apparatus at that location.

For example, the design pane **128** has a translucent disk area of one color with a B of another color in its center overlying the large area light control passageway **152** in the passageway panel **122** and the design pane **144** has a translucent disk-shaped area (not shown) of the same size and aligned with the light control passageway **152** which disk-shaped area overlies a B-shaped light control passageway in the panel **138**. The liquids are selected to pass light with little enough attenuation to permit the light to illuminate the front design pane after passing through both liquids and both design panes.

In operation, the light from the lamp shines through the liquid in the light control passageway **152** of the passageway panel **122**, through the liquid in the B-shaped light control passageway of the passageway panel **138**, and through both design panes to provide a colored B on a background of a different color. When the liquid is drained from the light control passageway **152**, the B is shown in another color and the background in still another because the B is still influenced in color by the colored liquid in the light control passageway of the passageway panel **138**. After the second liquid has been withdrawn, the B again changes color so that now it is influenced only by the color of the B on its design pane **128** and the color of the disk-shaped area on the design pane **144**.

ULTRAVIOLET LIGHT

In some embodiments, ultraviolet light provides a visible design while the liquids are being pumped into the passageway panels of the display apparatus.

In the embodiment shown in FIG. **3**, a design is included on the front design pane **128** using material that emits light upon being irradiated with ultraviolet light and another design is formed of translucent or transparent lines and areas. While the liquids are draining from the display apparatus **110**, the design formed in translucent or transparent lines and areas provides a design to the viewer. While the light control passageways are being filled, the lamp **64** is extinguished and the ultraviolet lamp **107** is energized. With the lamp **107** energized the design formed in luminescent materials shows while the light control passageways are being filled. Once the light control passageways are filled the ultraviolet lamp **107** is extinguished and the lamp **64** illuminated to start another display cycle.

Ultraviolet light is also used in other embodiments in which the design pane **128** when located at **132** has a fluorescent coating over the regular design.

In operation, the regular design is formed as the liquid drains through the passageway panel **122**. In one embodiment this design is seen only with the aid of daylight and in another embodiment the lamp **64** is used. Once the liquid has been drained from the passageway panel **122** revealing the full visible design, the lamp **64** is extinguished if it has been on and the lamp **107** is illuminated. Now the same design appears from the fluorescent materials activated by the ultraviolet light. This design is cancelled as the liquid is again pumped into the light control passageways of the passageway panel **122** or a fluorescent dye is included in the liquid, in which case the liquid also glows from the ultraviolet radiation as it fills the light control passageways. With this dye in the liquid the design remains visible as the passageways are filled. The glow of the liquid is of the same color as the design behind or of a different color, in which case, the display shows one color slowly erasing another color.

In the embodiments using ultraviolet light another effect is obtainable. As the ultraviolet light moves upwardly and emits light, a strong edge glow occurs above the advancing liquid. This glow results from the channeling of light upward towards the narrow edge of the liquid. The edge glow provides a pronounced visual effect that, in some instances, improves the display.

OPERATION WITHOUT A PUMP

In each of FIGS. **2** and **3**, a single display apparatus is shown operated by a pump. However, it is possible to arrange a plurality of the display apparatuses, and in doing so, permit operation without a pump. In such an arrangement, each of the display apparatuses are attached to the periphery of a cylinder that has a horizontal axis of revolution so that one display apparatus is vertical and faces the viewer at a time with the apparatus facing the viewer being periodically moved upward and a new display apparatus moved from the bottom of the cylinder to face the viewer. The passageways in the passageway panels of each of the display apparatuses communicate with one another and a sufficient amount of liquid is in this system to fill at least one display apparatus.

At first the display apparatus at the bottom of the cylinder has passageways completely filled with liquid. When it is moved upwardly to face the viewer, the liquid begins to drain from the passageways to cause the design to slowly appear to the viewer. While the liquid is drained from the passageways of the display apparatus facing a viewer, the passageways of the bottom display apparatus are being filled with liquid. When the bottom display apparatus has its passageways filled, the vertical passageway panel being viewed has a completed design upon it. The cylinder may now be rotated to raise the next display apparatus into viewing position to begin the process again.

Although several embodiments of the invention have been described with some particularity, many modifications and variations in the invention other than those specifically described may be made within the light of the above teachings.

What is claimed is:

1. Display apparatus comprising:
a passageway panel having a first wide side and a second wide side substantially parallel to and oppositely disposed from each other, said passageway panel being adapted to be illuminated by a source of light;
said passageway panel including at least one continuous channel extending substantially parallel to said first wide side and second wide side;
at least one section of said continuous channel being capable of passing light;
a fluid in said continuous channel; said fluid being capable of blocking at least some frequencies of light;
a design pane having a first wide surface and a second wide surface substantially parallel to and oppositely disposed from each other and including at least one design on said wide surfaces;
said design pane having one of its first and second wide surfaces positioned against one of the first and second wide sides of the passageway panel with said one design being opposite to said one section of said continuous channel, whereby light passing through said one section of continuous channel illuminates said design; and
means for causing the fluid to move into and from the one section of the continuous channel, whereby the one design is darkened as the fluid moves into the section and is illuminated as the fluid leaves the section of continuous channel;
said design pane including at least one solid portion; said one design including a plurality of spaced-apart lines and areas on said solid portion positioned opposite to said section of continuous channel so that light rays perpendicular to said design pane and passing through the lines and areas also pass through said one section of continuous channel, with some of said lines extending in directions independent of the direction of the continuous channel and some of said lines and areas having sizes smaller than the continuous channel, whereby an artistic design is animated under the control of a passageway panel having a relatively simple continuous channel.

2. Display apparatus according to claim 1 in which:
said one section of said channel includes two sidewalls defining between them a channel width substantially parallel to said passageway panel and to said design pane;
said passageway panel being adapted for fluid flow in a first direction within said one section to darken the one design and in a second direction to illuminate the one design;
the lines of said one design being arranged with some of said lines being generally parallel to the second direction whereby they are illuminated rapidly and other of said lines being generally transverse to the second direction whereby they are illuminated slowly as said fluid flows from said one section of said channel; and
a plurality of said lines being positioned side by side over said channel width so as to be crossed by the projection of an imaginary horizontal line which is substantially parallel to said wide sides of the passageway panel and between said sidewalls of said one section, whereby said plurality of lines are illuminated at substantially the same time.

3. Display apparatus according to claim 1 in which at least some of the lines and areas are of a different color than others of the lines and areas opposite to the same continuous channel.

4. Display apparatus according to claim 1 in which said fluid is of a different color from said design and is capable of passing some frequencies of light.

5. Display apparatus according to claim 1 in which:
said continuous channel includes a second section communicating with said one section;
said display apparatus further comprising means for blocking light from passing through said second section to prevent illumination of said design pane opposite said second section, whereby said second section provides a reservoir for fluid to control the time of illumination of said one design.

6. Display apparatus according to claim 5 in which:
said continuous channel includes a third section, said third section being capable of passing light;
said design pane includes a second design opposite to said third section; and
said third section communicates with said second section and said second section is above said one and third sections, whereby fluid flows between said second section and both said one and said third sections to darken and illuminate said one design and said second design at substantially the same time.

7. Display apparatus according to claim 1 in which:
said passageway panel comprises two sheets of light-passing material;
one of said sheets includes a groove, the other of said sheets closing said groove to form said continuous channel, whereby said first and second wide sides of said passageway panel are solid continuous surfaces.

8. Display apparatus according to claim 1 in which:
said design pane includes a second design; said means for causing the fluid to move into and from the section of the continuous channel includes an external conduit, orifice means in said passageway panel through which the external conduit communicates with the continuous channel and pump means communicating with the conduit for withdrawing fluid from and forcing fluid into the continuous channel;
said one section includes at least two subsections extending in different directions with respect to said orifice means, a portion of one of said two subsections being behind said one design and the other subsection being behind the second design, whereby said one and second designs are illuminated at substantially the same time as fluid is withdrawn from said channel; and
said display apparatus further includes means for blocking light from at least a portion of one of said subsections that is between the one and second designs, whereby said one and second designs are spaced apart.

9. Display apparatus according to claim 8 in which:
said pump means includes a source of fluid; said orifice means includes a plurality of openings communicating with said channel, said channel being continuous between said openings; and
said display apparatus further includes means for enabling any of said openings selectively to communicate with the source of fluid, to be closed, and to communicate with another opening, whereby said fluid may be caused to flow between said source of fluid and said channel and flow in a selected direction through said channel to control the sequence in which different portions of the design are illuminated.

10. Display apparatus according to claim 1 in which:
said design pane includes opaque portions and portions capable of passing light, at least one portion of said design being on said portions capable of passing light;
said display apparatus further including a source of light;
said passageway panel being between said source of light and said design pane, whereby light from said source of light passes through said one section of continuous channel to illuminate said one portion of said design when said fluid is not in said one section; and
said passageway panel includes a second section of said continuous channel, said second section being opposite to an opaque portion of said design pane.

11. Display apparatus according to claim 1 in which:
said display apparatus has a viewing surface with a background area and an animated design area;

said design pane is entirely opaque; said passageway panel is located between said viewing surface and said design pane;

said fluid being of a color to match the background area of said viewing surface;

said design being of a different color from said background area, whereby said design is covered by a fluid matching the background area of said viewing surface as said fluid flows into said one section of channel and is uncovered as said fluid flows from said one section.

12. Display apparatus according to claim 1 further including:

a second design formed of a phosphor that emits visible light when irradiated by ultraviolet light;

an ultraviolet lamp positioned adjacent to the design pane and passageway panel: and

means for periodically illuminating said ultraviolet lamp to illuminate the second design at different times than the first design is illuminated.

Display apparatus according to claim 1 further including:

a second passageway panel having a first wide side and a second wide side substantially parallel to and oppositely disposed from each other;

a second design pane having a first wide surface and a second wide surface substantially parallel to and oppositely disposed from each other and including at least one design on said wide surfaces;

said second passageway panel including at least one continuous channel extending parallel to said first wide side and second wide side;

at least one section of said continuous channel of the second passageway panel being capable of passing light;

a fluid in said continuous channel of said second passageway panel;

said fluid being capable of blocking at least some frequencies of light;

said first-mentioned design pane including opaque portions and portions capable of passing light, with said design being positioned over said portions capable of passing light;

said first-mentioned passageway panel being positioned between said first-mentioned design pane and said second design pane with the one section of continuous channel of the first-mentioned passageway panel being opposite to the designs on said first-mentioned and second design panes;

said second passageway panel being positioned against the second design pane with the one section of continuous channel of the second passageway panel being opposite to the design on the second design pane;

said design on said second design pane including a plurality of spaced-apart lines and areas opposite to sections of said first-mentioned design pane that are capable of passing light and free of lines and areas, said lines extending in directions independent of the direction of the channel in the second passageway panel and said lines and areas on said second design pane having sizes smaller than the channel in the second passageway panel;

said means for causing the fluid of the first-mentioned passageway panel to move into and from the one section of the continuous channel of the first-mentioned passageway panel including a means for moving the fluid of the second passageway panel into and from the one section of continuous channel of the second passageway panel at a time overlapping with the time that the fluid of the first-mentioned passageway panel is moved into the corresponding position, whereby the first-mentioned design and the second design are illuminated in overlapping sequences.

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