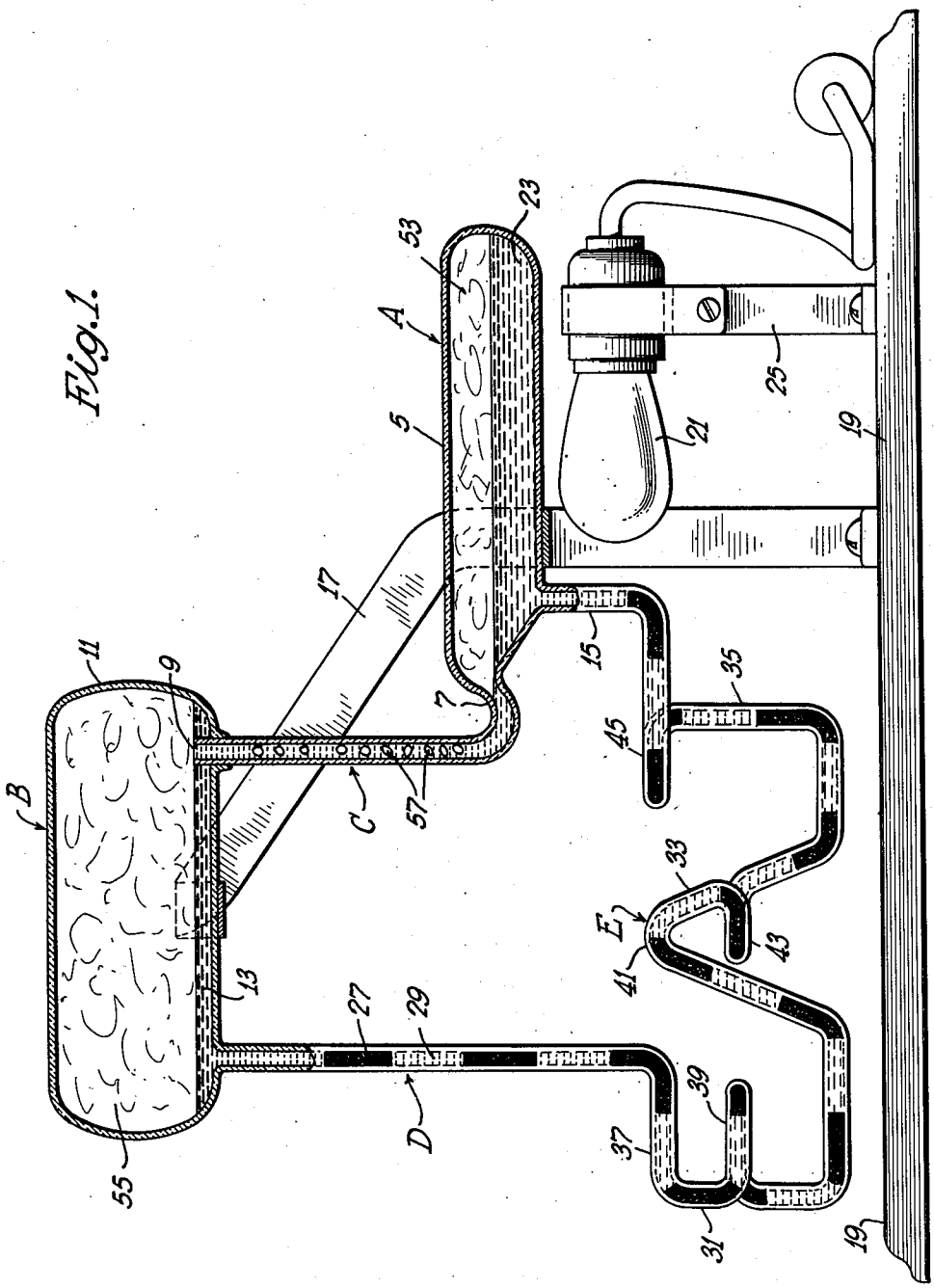
Dec. 5, 1939. P. ROSENBLATT 2,182,570

DISPLAY DEVICE

Original Filed Feb. 8, 1937 3 Sheets-Sheet 1

Fig. 1.



INVENTOR.

Philip Rosenblatt

BY

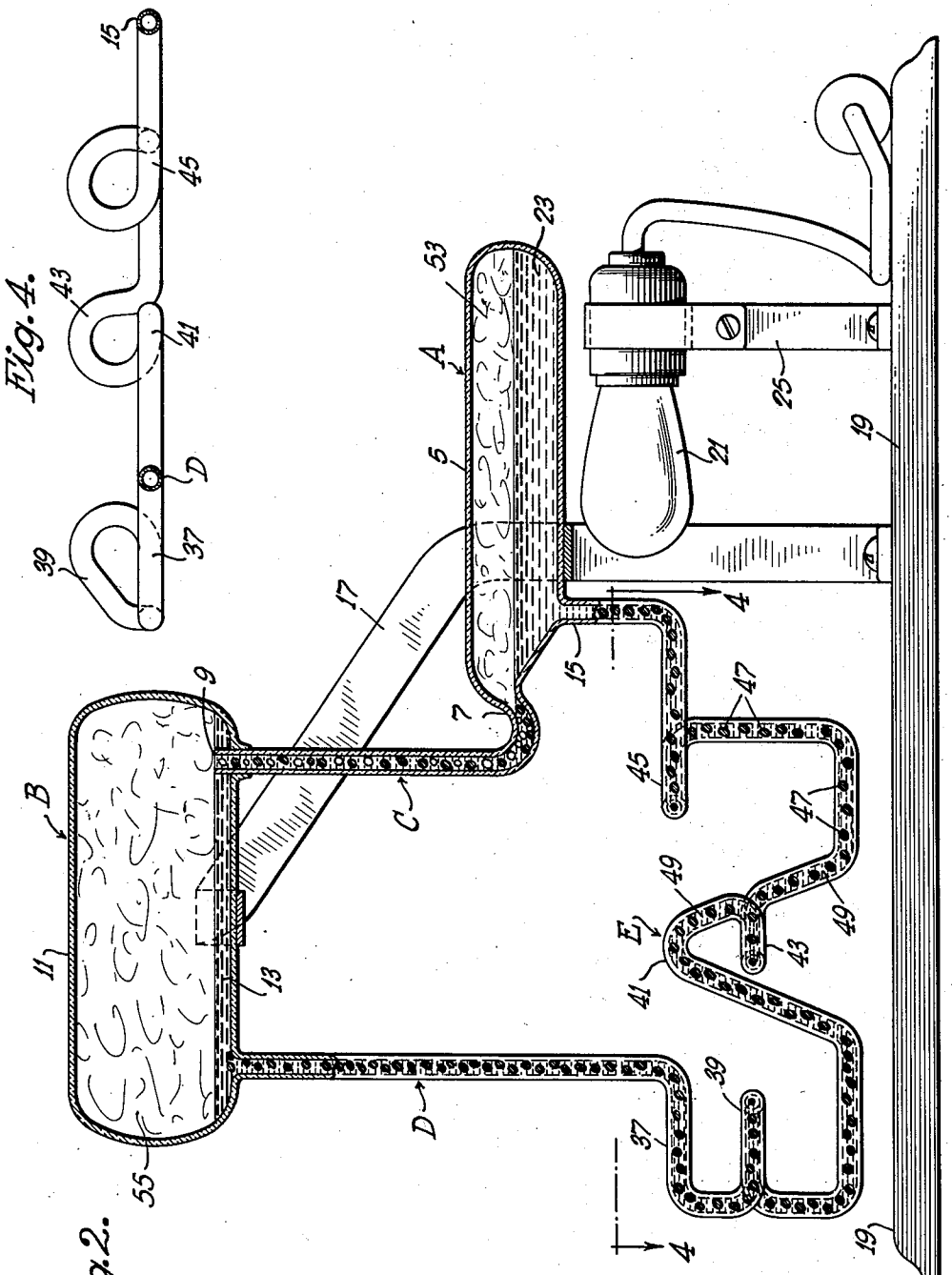
Fredric P. Warfield

ATTORNEYS.

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DISPLAY DEVICE

Original Filed Feb. 8, 1937 3 Sheets-Sheet 2



INVENTOR.

Philip Rosenblatt

BY

Frederic P. Vranjes

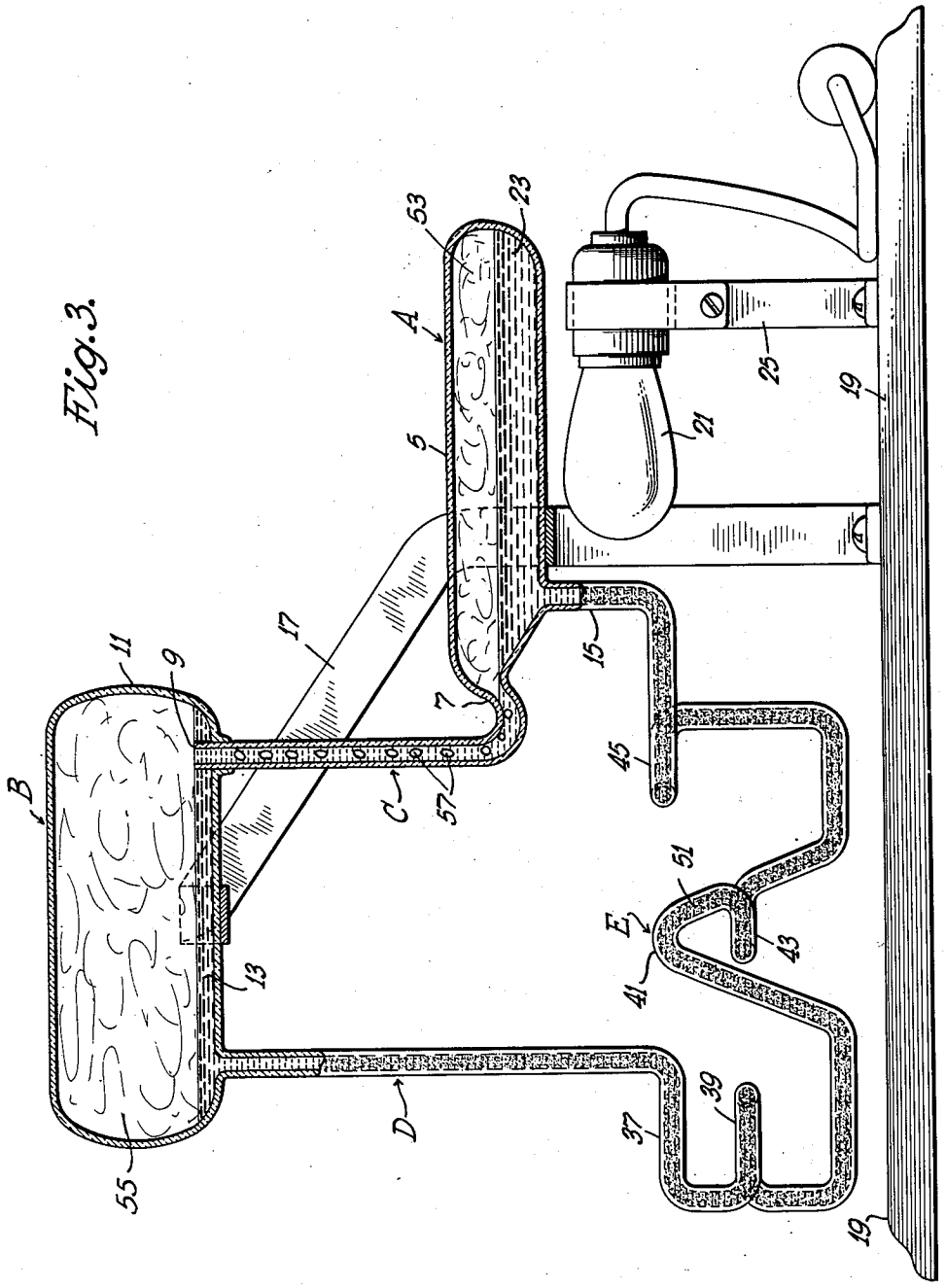
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DISPLAY DEVICE

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Fig. 3.



INVENTOR.

Philip Rosenblatt

BY

Frederic P. Warfield

ATTORNEYS.

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UNITED STATES PATENT OFFICE

2,182,570

DISPLAY DEVICE

Philip Rosenblatt, Brooklyn, N. Y., assignor to Biolite Incorporated, New York, N. Y., a corporation of New York

Application February 8, 1937, Serial No. 124,624
Renewed May 2, 1939

12 Claims. (Cl. 40—130)

In accordance with the present invention, there is produced a novel form of a display device wherein the attractiveness of the display is enhanced to a very substantial degree by a continuous circulation of fluid through a closed transparent system including indicia which may be numbers, letters, or other characters, or a combination thereof, and preferably wherein the said transparent system is illuminated by a suitable source of light, at least a substantial portion of which is transmitted through the system to the eye of an observer; and the invention provides, accordingly, display or exhibit devices and more especially animated advertising devices in which moving liquids flow through light-transmitting (transparent or translucent) forms arranged as indicia, which indicia may be of any kind and in any grouping as may be desired, as, for example, where the display characters are in the shape of letters, legend, figures, or slogan.

The present invention is an adaptation or expansion of the animated or bubbling displays of the prior art, wherein the illuminated display indicia are made up of an assembly of individual tubes, suitably bent and assembled to simulate letters, and wherein the display effect is procured to a considerable extent by movement of liquid contained in each tube induced by ebullition of the liquid produced by energizing a suitable source of heat. In the present adaptation the display effect is produced by a circulation of liquid through a closed system comprising a plurality of interconnected units forming a closed cycle which includes the characters forming the display.

This circulation is produced and sustained by a source of heat which vaporizes the liquid in a vaporizing chamber, the resulting vapors passing to a condensing chamber where they are condensed to liquid, which circulates through the indicia back to the vaporizing chamber, the action involving a thermo-syphonic circulation of the liquid.

However, the display effect in the present case is not dependent upon the appearance of ebullition caused by the generation of bubbles in the liquid, but rather to a continuous thermo-syphonic circulation of the liquid through the tube, differences in appearance in the circulating fluid being produced by differences in indices of refraction in the liquid circulating in the tube or by different and distinct colors in the liquid.

Thus, the different light effects may be produced in different ways, such as, for example, circulating a liquid stream which is made up of a plurality of relatively immiscible liquids, which may be in continuous phase, or in disperse phase, and which, in either phase, may be differently colored by the presence of suitable coloring matter dissolved in the respective liquids, each coloring material being soluble, in its own liquid, but insoluble in the remaining components of the circulating liquid stream, thereby maintaining distinct layers of different colored liquid which circulates continuously through the indicia defining the display.

The apparatus of the present invention presents a closed circulatory system for the liquid, including elements wherein the liquid may be at least partially vaporized and condensed as it circulates. For this purpose the tube system should be exhausted of air as completely as possible, and it is also desirable to utilize liquids in the tubes which are readily volatile and which will boil at low temperatures under the degree of evacuation of the apparatus.

To this end, and to assure the continuance of the thermo-syphonic circulation of the liquid, a suitable source of heat must be supplied, whereby vaporization of the liquid will occur in order to produce the necessary pressure in the system to initiate and to sustain the circulation.

This source of heat may be conveniently an electric light bulb of low power consumption, which serves as a source of light for illuminating the display, as well as the source of heat.

It will be seen, therefore, that the principal object of the invention is to improve the art of sign exhibits.

Further general objects of the invention will become apparent from the above general description, and still further objects and advantages of the present invention will become apparent as the description proceeds, and the features of novelty will be pointed out in particularity in the appended claims; and the invention accordingly comprises the sequence of steps of the operation, the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

The invention will be understood more readily by reference to the accompanying drawings, in which:

Fig. 1 is a sectional elevation of one form of a display device constructed in accordance with the present invention, and illustrating a form of display in which the circulating liquid is composed of two dissimilarly colored, relatively mu-

tually immiscible liquids both of which are in continuous phase;

Fig. 2 is a view similar to Fig. 1, but showing one of the liquids in disperse phase in the other liquid, the liquids being dissimilarly colored;

Fig. 3 is a view similar to Figs. 1 and 2, but in which one of the liquids is in disperse phase in the remainder, all of the liquids in the system being colorless, the dispersed liquid component of Fig. 3 being also in a more highly dispersed condition than is the showing in Fig. 2, producing a cloudiness or opalescence in the circulating liquids; and

Fig. 4 is a sectional plan view taken on the line 4—4 of Fig. 2, showing details of the formation of the indicia of the display.

While the drawings show only two separate components, it will be understood, of course, that the circulatory liquid body may be composed of as many different relatively immiscible components as may be desired, all, or any thereof, being contrastingly colored, or having no additional color imparted thereto, as may be preferred.

The liquid components may be of any desired character which are relatively immiscible in each other, such as, for example, benzol and a water solution of ethyl or methyl alcohol which may be adjusted with respect to their densities so that either the benzol or the alcohol will be of less specific gravity, and also so that either one of these components will be in disperse phase in the remainder.

Referring now more particularly to the drawings, it will be observed that the apparatus comprises a sealed, exhausted circulatory system including a vaporizing chamber A, a condensing chamber B, a tube C interconnecting the same for delivering liquid and vapor from the chamber A to the chamber B, and a return tube D for returning liquid from the condensing chamber B to the vaporizing chamber A, the said return tube D including a display sign E. These elements are all sealed together to form a continuous circulatory system for the liquid flowing through the apparatus.

It will be seen from the drawings that the chamber A comprises, suitably, a glass receptacle 5, which is drawn into a somewhat restricted U-shaped bend 7 to which the tube C is sealed, the open end 9 of which projects into the receptacle 11, which forms the chamber B, sufficiently far to prevent condensate 13 which forms in the chamber B, together with mechanically carried over liquid, from refluxing back through the tube C into the receptacle 5.

The receptacle 11 has suitably sealed to it the tube D which is suitably bent to form the indicia characters E, the end character being sealed to the receptacle 5 by way of a side arm tube 15.

A suitable support 17, mounted on a base 19, suitably carries the apparatus, a source of heat 21 such as an incandescent electric lamp being positioned adjacent to the receptacle 5 for warming the receptacle 5 for vaporizing liquid 23 therein, and also for illuminating the indicia characters E. Accordingly, the lamp 21 is shown as being mounted on a bracket 25.

The liquid 23 is illustrated as being composed of two components 27 and 29, which are mutually substantially immiscible and which are capable of absorbing and retaining a dye or coloring matter. The liquid components should also retain the coloring matter during frequent intermingling and separating of the liquids and should not stain or discolor the transparent display E.

The transparent display E is preferably arranged at a level below the condensing chamber B so that the liquids will flow from the receptacle 11 defining the chamber B through the conduit D and through the display tube E back into the vaporizing chamber A by reason of the hydrostatic head of liquid in the chamber B.

The display tube E is composed of a suitable number of selected letters or characters spelling out the desired legend. These characters, indicated individually by reference characters 31, 33, 35 being formed by bending the glass tube into loops, as shown in Fig. 4, wherein 37 represents the top of the "E", 39 representing the horizontal branch thereof, 41 the top of the "A", 43 the horizontal arm and 45 the top of the "T".

In Fig. 2, the same system is shown as in Fig. 1, but one of the components of the circulating liquid is shown in disperse phase in the other component, as is indicated at 47, the dispersed component being in the form of separate individual globules suspended in the continuous-phase component, designated at 49.

In Fig. 3, there is illustrated the same system as is shown in Figs. 1 and 2, the disperse-phase component being more or less homogenized or emulsified in the other component, to produce a generally cloudy or opalescent appearance, indicated at 51.

It will be understood that the system is exhausted of air and the circulatory liquid is introduced into the sytem while the vacuum is still applied, so that the liquid will be under reduced pressure when the system is sealed. After introducing the liquid, the apparatus is sealed directly, thus maintaining the vacuum therein.

A quantity of the liquid is introduced into the apparatus 5 so that the vaporizing receptacle 5 will be substantially filled with liquid, which will rise in the tube C, there being present in the liquid sufficient of the various components thereof so that the respective components will be clearly visible in the receptacle 5.

As the liquid contents of the receptacle 5 are heated, by the application of heat from the heat source 21, vapors will be given off by the liquid, and these vapors will collect in the upper portion of the receptacle 5, as indicated at 53, for example, forcing thereby liquid from the receptacle 5 up through the tube C and into the receptacle 11 of the chamber B, where the liquid collects, and the vapors designated 55, which pass over into the chamber B become partially condensed. The open end 9 of the tube C projects upwardly into the condensing chamber B so as to prevent refluxing of the liquid, indicated at 13 in the chamber B.

The chamber B is positioned at a level above that of the vaporizing chamber A and the indicia E. Therefore, the liquid which passes into the chamber B being unable to reflux through the tube C back to the vapor chamber A, flows into the conduit D, through the indicia E and back into the receiver 5, where it is partially vaporized. The vacuum in the apparatus is such that the boiling point of the liquid is reduced to such a point that only a slight amount of heat will boil the liquid in the reservoir receptacle 5, and the resulting vapors will be condensed to liquid in the cooler portions of the apparatus, including the tube C, and condensing chamber B. This condensate in the tube C is kept in continuous agitation by vapor bubbles 57 rising therethrough, any liquid returning into the receptacle 5 being pushed back into B by more vapor from A. The

constriction 7 acts as a valve, maintaining a constant flow of vapors and liquid through the tube C, and preventing liquid collecting in the tube C from running back into the receptacle 5, there being, however, a continuous interchange of liquid and vapor between the remainder of the system and the vapor chamber A, there being a continuous vaporization, condensation and circulation of the liquid, these actions of vaporization, condensation, and circulation, continuing as long as the light bulb 21 is operated. The condensation chamber B is air-cooled and a sufficient temperature gradient between the chambers A and B is maintained thereby so that condensation and vaporization rates are substantially equal. The condensation chamber B serves also to allow the immiscible compounds of the liquid to separate by gravity as the vapors thereof condense so that the liquid will enter the conduit D as distinctly different layers or other definite divisions therebetween as is described herein.

To achieve the effect illustrated in Fig. 1 two liquids are chosen which have relatively high surface tension and relatively different boiling points and specific gravities. Therefore the liquids will be separated throughout the circulation and will be maintained separated throughout the circuit of the apparatus. When liquid is transferred from chamber A to chamber B the transfer is not accomplished principally by evaporation in A and condensation in B but by the forcing of "slugs" of liquid from A to B by the rising vapors. The separate layers of circulating liquid, together with the different colors thereof, form a very effective and pleasing display, being very attractive to the eye of any observer.

If it is desired, of course, such of the parts of the construction as may be desired may be rendered invisible to an observer by mounting all parts except the indicia portion in a suitable frame, or cabinet, so that only the indicia will be visible to the observer who sees the indicia illuminated from the light bulb 21 with the different colored liquids circulating continuously through the indicia, the light 21 being itself concealed from the direct view of the observer.

As has been said above, Fig. 2 represents a similar system with the exception that the circulating liquid is made up of a plurality of liquid components, such as has been described above, which may be differently colored, and in which one of the components is in a disperse phase in the remainder and is maintained in suspension in individual globules, as indicated by reference character 47, the remaining component 49 of the liquid being circulated being shown to be in a continuous phase. This effect is achieved by regulating the two liquids more closely together with respect to boiling point and specific gravity. The result obtained is not due to mechanical but to physical and physical-chemical effects so that the initial condition of dispersion after a period of circulation, is stable.

In Fig. 3, the liquid components are of substantially the same specific gravity and the dispersed liquid is uniformly distributed through the circulating system, producing an opalescent appearance in the circulating liquid as indicated at 51, although the liquids may not be colored, in which event the optical effects are produced by differences in the refractive indices of the liquid components. In this arrangement the liquids must be so nearly alike in specific gravity that they form a relatively homogeneous and stable mixture.

Where the immiscible components of the circulating liquid are in continuous phase, and contrastingly colored, the optical effect produced by the display is that of a succession of bands of contrasting colors moving continuously through the indicia tube E, while in Figs. 2 and 3, wherein at least one of the components is in disperse phase, the effect is that of a substantially continuous distribution of different colors in the indicia tube as the liquid circulates therethrough, the effect being more uniform in Fig. 3 than in the case shown in Fig. 2, owing to the more complete dispersion and more homogeneous distribution of the components in the condition illustrated in Fig. 3.

The display device of the present invention comprises, therefore, a closed system through which the visible display fluid circulates in a closed cycle principally as liquid from the condensing chamber B, through the conduit D and indicia tube E to the vaporizing chamber A, thence partially as vapor through the tube C into the chamber B. The heating means 21 creates a sufficient differential in temperature between the chambers A and B to produce the above-described circulation which produces and maintains the continuous flow of the fluid through the system. Attention is called to the fact that the condensation of vapors in the chamber B will maintain the pressure in this chamber lower than that in chamber A thereby causing a suction on the chamber A thus drawing up of the vapors through the tube C.

While the drawings illustrate the use of a plurality of relatively immiscible liquids as the circulating medium, it will be apparent of course that there may be employed only a single liquid as the circulating medium, which liquid may be colored suitably in order to increase its visibility, or it may be found desirable to increase the visibility of the circulation by the inclusion of solid particles of suitable material of sufficiently low specific gravity to be maintained in suspension in the circulating liquid.

The illustrated letters 31, 33, 35 forming the indicia portion of the tube obviously may be replaced by any character, letter or combination thereof, forming any desired word or slogan, or any other desired indicia display. They are interconnected with themselves and with the remainder of the system so that the liquid may circulate continuously therethrough. They may be made in a manner similar to the procedure employed in the production of "neon" signs, with the illuminated circulating stream of liquid replacing the glowing discharge of the "neon" displays.

The liquids employed for the circulatory medium may be, for example, benzol and alcohol, as aforesaid, the latter being preferably intermixed with water to maintain sharp interfacial surfaces between the benzol and the alcohol; although any other low-boiling liquids may be used. Where the liquids are colored, a coloring material which is soluble in the alcoholic solution, but insoluble in benzol, is dissolved in the alcohol, and a second coloring material, preferably of a color which contrasts sharply to that of the previously mentioned color, and which is soluble in benzol, but not in the alcohol, is dissolved in the benzol. The trade offers a wide variety of materials which are suitable for use as the coloring agents, dyes of various compositions and colors being used for the alcoholic solution, for example, while dye-

stuffs which are soluble in benzol or oil may be used as the solute in the benzol.

It will be understood of course that the supports for the display apparatus as illustrated at 17 and 25 may be of any kind and shape that may be found suitable for any given installation. These supports are shown as being secured to, or resting on, a base 19, and it will be understood that these supports and the incandescent lamp 21 may be enclosed in a suitable housing or cabinet, not shown, which may be provided with transparent advertising cuts, legends, or the like, which will be lighted up by the lamp 21 simultaneously with the circulation of the liquid through the system.

In the case where one of the components is not volatile at the operating temperature, the vapors of the volatile components carry the liquid through the tube C, and into the chamber B where the vapors condense and the components of the liquid separate by gravity. Obviously the height of the vertical column of liquid in the tube D must be so related to the vapor pressure in the chamber A and the pressure in the chamber B so as to lift liquid from the chamber A against the pressure of the vapor therein through the U-bend 7 and up into the chamber B, this lifting action being aided by vapors generated in the chamber A and the lessened pressure in chamber B produced by vapor condensation therein.

It will be understood that the invention is not limited necessarily, to the specific details of the process and construction as are herein specifically described, but it will be apparent that such details are subject to various modifications which will become apparent readily to one skilled in the art, without departing from the spirit of the invention; and it will be understood, therefore, that it is intended and desired to include within the scope of the invention such modifications and changes as may be necessary to adapt it to varying conditions and uses. It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. A display device comprising conduit means defining a single complete circuit and including vaporizing and condensing chambers for a liquid, connecting means extending between the said chambers for conducting vapors and liquid from the vaporizing chamber to the condensing chamber, and a light transmitting tube connecting the condensing chamber to the vaporizing chamber, means for heating the vaporizing chamber, and a low boiling liquid within the circuit adapted to be circulated continuously thermo-syphonically by the heating means through the said circuit upon application of vaporizing heat to the vaporizing chamber.

2. A display device comprising, in combination, conduit means defining a single complete circuit and including a vaporizing chamber and a condensing chamber for a liquid, means interconnecting the chambers for passage of fluid from the vaporizing chamber to the condensing chamber, and an indicia tube also connecting the condensing chamber and the vaporizing chamber and completing the said circuit, a low boiling liquid in the circuit, the condensing chamber being positioned at an elevation above the vaporizing chamber and the indicia tube for maintaining a sufficient hydrostatic pressure on the indicia tube and the vaporizing chamber for effecting a continuous circulation of liquid from the condensing chamber through the indicia tube to the vaporizing chamber, and means for continuously transmitting fluid from the vaporizing chamber to the condensing chamber as liquid is returned to the vaporizing chamber through the said indicia tube.

3. A display device comprising, in combination, a vaporizing chamber and a condensing chamber, fluid-transferring means interconnecting the chambers, and a light-transmitting tube also connecting the chambers and forming therewith a complete, closed circuit, a visible, low boiling fluid within the circuit, and means for continuously effecting a thermo-syphonic circulation of the fluid in a closed cycle through the circuit.

4. A display device, comprising, in combination, conduit means defining a single complete circuit, and including a vaporizing chamber, a condensing chamber, a conduit connecting the said chambers, and a light-transmitting tube connecting the chambers and completing the circuit therewith, a low boiling liquid within the device, the said liquid comprising a plurality of distinct and substantially immiscible components, and thermal means for continuously circulating by thermo-syphonic action the said liquid in a closed cycle through the said circuit.

5. A display device comprising, in combination, conduit means defining a single complete circuit and including a vaporizing chamber, a condensing chamber positioned at an elevation above the vaporizing chamber, a conduit connecting the said chambers and extending from the vaporizing chamber to within the condensing chamber vertically sufficiently far to prevent refluxing of liquid from the condensing chamber into the vaporizing chamber, a light-transmitting indicia tube positioned below the vaporizing chamber and the condensing chamber, conduit means connecting the indicia tube with the said chambers and forming the said single closed circuit therewith, a low boiling liquid within the device, the said liquid comprising a plurality of distinct substantially immiscible components, and thermal means for effecting continuous circulation of the liquid in a closed cycle through the said circuit.

6. A display device comprising, in combination, conduit means defining a single complete circuit, and including a vaporizing chamber and a condensing chamber, fluid-transferring means interconnecting the chambers, and a light-transmitting tube also connecting the chambers and completing therewith the said single closed circuit, a visible fluid contained within the said circuit, the said fluid comprising distinct, substantially immiscible components which are contrastingly colored, and thermal means for effecting continuous circulation of the fluid in a closed cycle through the said circuit.

7. A display device as claimed in claim 4, wherein the fluid components are all in continuous phase.

8. A display device as claimed in claim 4, wherein at least one of the fluid components is in disperse phase in the remaining fluid.

9. A display device comprising, in combination, conduit means defining a single complete circuit and including a vaporizing chamber, a condensing chamber, fluid-transferring means interconnecting the chambers, and a light-transmitting indicia tube comprising continuously formed and uninterruptedly interconnected indicia charac-

ters also connecting the said chambers and completing the said single complete circuit therewith, a visible circulatory fluid within the circuit, the said fluid comprising distinct, substantially immiscible components which are contrastingly colored and in continuous phase, and thermal means for effecting unbalanced pressures within the circuit to produce a continuous circulation of the fluid in a closed cycle through the said circuit, thereby presenting a continuous succession of bands of color in the indicia tube as the fluid flows therethrough.

10. A display device comprising, in combination, conduit means defining a single complete circuit and including a vaporizing chamber, a condensing chamber, fluid-transferring means interconnecting the chambers and a light-transmitting indicia tube comprising uninterruptedly interconnected indicia characters interconnected to the said chambers and completing the said single closed circuit therewith, a visible circulatory fluid within the circuit, the said fluid comprising distinct, substantially immiscible components which are contrastingly colored, at least one of which components is in disperse phase in the remaining fluid, and means for effecting a continuous thermo-syphonic circulation of the said fluid in a closed cycle through the said circuit, thereby presenting a substantially continuous distribution of different colors in the indicia tube as the fluid flows therethrough.

11. A display device comprising a pair of closed chambers, a conduit connecting the same located to permit flow of liquid and vapor between the chambers, a low boiling liquid contained therein, and a light-transmitting indicia tube also connecting the chambers and defining a single closed circuit therewith, and means for creating temperature and pressure differentials in the said closed circuit for effecting a continuous flow of the liquid in a closed cycle through the said circuit, at least a portion of the said liquid being vaporized in one of the chambers and transmitted to the other of the said chambers where it is condensed to liquid, which is returned to the vaporizing chamber through the said indicia tube as a continuous flow incident to the operation of the said temperature and pressure differential-creating means.

12. A display device comprising, in combination, a fluid body comprising a plurality of contrasting liquids each immiscible in any other of the said liquids, each liquid being of a density different from that of any other of the said liquids, conduit means providing a single complete circuit and including a light-transmitting tube portion forming indicia, a vaporizing chamber for vaporizing the liquids, a condensing chamber for condensing the vapors, means connecting the vaporizing chamber and the condensing chamber, and means connecting the condensing chamber and indicia, and thermal means for continuously effecting flow of the contrasting liquids through the said indicia.

PHILIP ROSENBLATT.