350-418 SR
OR 2,484,675
SEARCH ROOM

Oct. 11, 1949. C. BIDERMAN 2,484,675

FLUID LENS HAVING BUBBLE ELIMINATION MEANS

Filed Oct. 3, 1947

T 2014
X 2029

Fig. 1

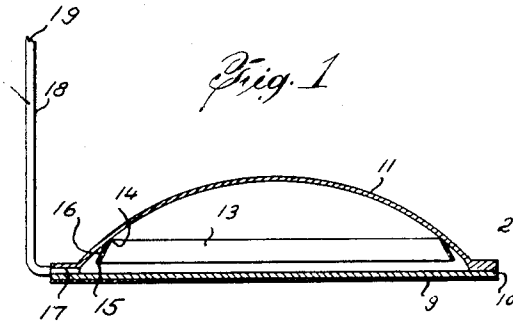


Fig. 2

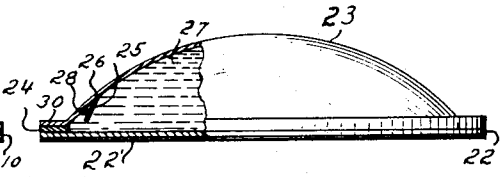


Fig. 4

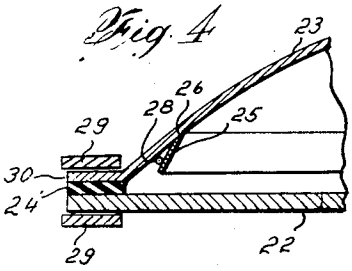


Fig. 3

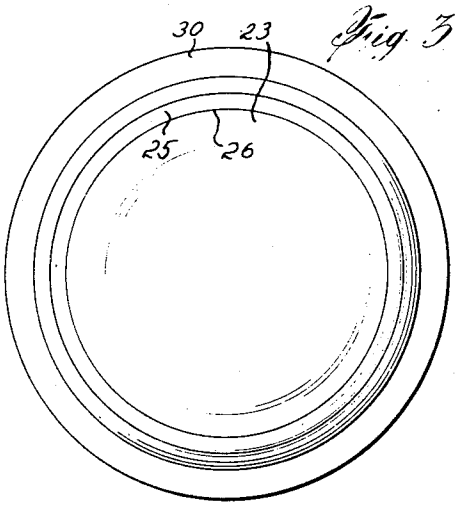


Fig. 5

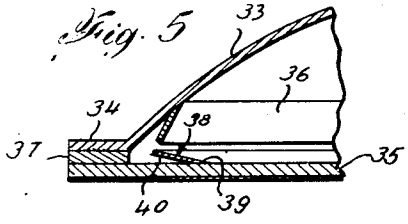
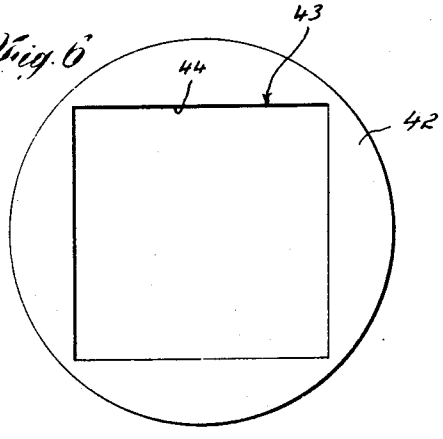


Fig. 6



INVENTOR.
Carl Biderman
BY
John P. Claudle
his attorney

SEARCH ROOM

Patented Oct. 11, 1949

2,484,675

UNITED STATES PATENT OFFICE

2,484,675

FLUID LENS HAVING BUBBLE ELIMINATION MEANS

Carl Biderman, Jamaica, N. Y.

Application October 3, 1947, Serial No. 777,699

6 Claims. (Cl. 88—57)

1

This invention relates to fluid lenses, and relates more particularly to an improved fluid lens of relatively large dimensions which is inexpensive to construct and which has novel means for filling the lens with the fluid and for eliminating a bubble when the lens is normally disposed horizontally with its spherical surface uppermost.

The fluid lens of the present invention has particular usefulness in connection with a television apparatus for enlarging the image produced thereby, but it also has general utility in a large number of instances wherein large-surface lenses are desirable but wherein the cost of the usual solid glass lens may be prohibitive.

Lenses of this general character are frequently formed with two transparent diaphragms, at least one of which has a curved contour, usually a spherical segment. The two diaphragms are suitably secured together around their marginal edges, and the closed chamber thus formed is filled with a highly transparent fluid. Generally a clear liquid is used, but in some instances a gas may be employed.

When a liquid lens is horizontally disposed it has been considered virtually impossible to eliminate the bubble which finds its level at the center of the spherical surface, the bubble greatly reducing the usefulness of the lens.

In accordance with the present invention there is provided a dished annulus or ring which is appropriately secured to the inner surface of one or both of the diaphragms. The dished ring, which externally is of the shape of a frustum of a cone, is so secured around its inner edge, and the outer edge is thus free. The outer surface of the ring, i. e., the surface lying adjacent the shell to which it is secured, is disposed at an acute angle to the inner surface of such diaphragm. A filling tube or filling opening is positioned at any point around the periphery, and after the hollow lens has been filled while in the usual vertical filling position any residual bubble which may remain is entrapped in the annular channel formed by the dished ring when the lens is moved to a horizontal position.

In the event that in the particular use for which the lens is intended it will normally occupy a horizontal position, only one of such dished rings is necessary, namely, that which is disposed on the upper diaphragm thereof. In the event, however, that the position of the lens may vary, a second dished ring may be disposed on the other diaphragm. Also, in connection with the television work earlier mentioned, it may be desirable to provide a mask of generally rectangular

2

inner contour to "frame" the image viewed by the user. This mask may be a similarly dished ring, or it may be largely rectangular in shape, both along its inner and outer edges, and its outer surface may be disposed at an acute angle relative to the diaphragm to which it is attached.

Another object of the invention is the provision of an improved filling means for lenses of this general character wherein the filling opening is provided with a filling tube, preferably formed of flexible material and being of such length as to be capable of being disposed at its outer terminal at a level above the highest level of the lens. Thus, the lens is filled while is occupies a generally vertical position with this filling tube uppermost. In the event that the lens is to normally occupy a horizontal position, the tube may be bent vertically with respect to the surface of the lens and always remain filled to a height above the highest liquid level in the lens.

A further object of the invention is to provide a liquid lens for a television apparatus wherein the image may be viewed at any desired angle without any substantial distortion of such image.

Yet another object of the invention is to provide an improved liquid lens comprising a pair of clear, transparent diaphragms wherein one has a curved contour and the other, a generally flat contour with a coating on its surface capable of rendering it useful as a projection screen.

In the drawings:

Fig. 1 is a horizontal section taken through a fluid lens embodying the present invention.

Fig. 2 is a side elevation, partially in section, of a slightly modified form of lens.

Fig. 3 is a plan view of the lens shown in Fig. 2.

Fig. 4 is an enlarged, broken section taken through the lens shown in Figs. 2 and 3.

Fig. 5 is an enlarged, broken section taken through another modified form of lens.

Fig. 6 is a bottom plan view of a lens of the present invention embodying a masking element.

The lens shown in Fig. 1 is horizontally disposed and comprises a lower, generally flat diaphragm **10**, and an upper diaphragm **11** formed with an upwardly curved contour. In some instances this may be a spherical segment, but more frequently it will be aspherical. The marginal edges **12** of the latter diaphragm are generally flat and lie on the same plane as lower wall **10**. The lower wall or diaphragm **10** is illustrated as having on its outer surface a protective layer **9**. Whereas both diaphragms **10** and **11** may be formed from glass or other transparent material, it is preferred to form them from clear,

transparent, synthetic resins, many of which are currently in use and which are readily molded to shape. These transparent, plastic materials offer a number of advantages over glass in that they are easily handled, are light in weight, are substantially unbreakable, have a higher degree of transparency than glass, and are easily secured together in a permanent fashion along their marginal edges.

The lens shown in Fig. 1 is provided with a dished ring 13 which is secured along its inner, marginal edge 14 to the inner surface of upper shell 11. Any suitable means may be employed for forming the dished ring of the desired shape. For instance, a split ring may be cut from a sheet of plastic, metal, or other material of a size larger than the ring occupies when disposed within the lens of the present invention. The spaced terminals are then joined together, which gives the ring its dished effect. The outer edge 15 is thus free, and the outer surface 16 occupies an acute angle relative to the surface of the upper diaphragm 11. The lens shown in Fig. 1 is further provided with a filling opening 17 to which is secured a flexible tube 18 of such length that its outer terminal 19 may occupy a position higher than the highest level of diaphragm 11.

The particular fluid used in connection with the lens is largely immaterial so far as the present invention is concerned, just so long as it is clear, highly transparent, incapable of reacting chemically with the diaphragms, and has a desired index of refraction. Gases as well as liquids may be used.

In the lens shown in Fig. 2 there is a lower, generally flat, circular diaphragm 22, an upper, circular diaphragm 23 having a spherical surface, and an annular ring 24 disposed between the walls around the marginal edges of the lens. The peripheral edge 30 of the upper diaphragm is plane with the surface of lower diaphragm 22. No particular filling means is shown in connection with the lens of Fig. 2.

The annular ring 24 may be of plastic material, and therefore relatively incompressible, or it may be formed of resilient, compressible material as shown at 24' in Fig. 4. In this latter figure the peripheral edges of the lens are mounted between annular frame elements 29. After the lens is filled with the fluid these frame elements may be compressed together to reduce the effective volume of the chamber. The dished ring 25 is secured along its inner, marginal edge 26 to the lower surface of the upper diaphragm, and the lens is filled with a fluid shown at 27. At 28 there is shown a bubble which is entrapped between the outer surface of the annular ring and the upper wall. It will be understood, of course, that if the bubble is too large to be suitably confined within this area, the lens may be filled to a higher level to eliminate this defect.

The lower diaphragm 22 of Fig. 2 is shown as being provided with a transparent, protective, lower surface covering 22', which element is absent in the showing in Fig. 4. It was earlier pointed out that an object of the present invention was to provide a fluid lens of this character having a coating on its lower surface forming a screen for projection purposes. The layer 9 of Fig. 1 or the layer 22' of Fig. 2 may be considered as such coating.

In Fig. 5 the upper diaphragm 33 is provided with the annular, peripheral edge 34 lying on a plane with lower diaphragm 35. The upper diaphragm is further provided with the dished ring

36. An annular spacer element 37 is disposed between the diaphragms. This figure further shows the use of a dished element 38 secured along its inner peripheral edge 39 to the lower diaphragm 35. Thus, the lower or outer surface 40 of such element is disposed at an acute angle to the diaphragm and acts to entrap bubbles in case diaphragm 35 is normally disposed uppermost.

In Fig. 6 the lower diaphragm 42 is shown as being provided with a mask 43 having a generally rectangular opening 44, the outer edge of which may be either spaced from the diaphragm, or the entire mask may be secured to the diaphragm in all-over surface engagement. The mask, of course, would be made from opaque material and serve to frame the image viewed through the lens.

By forming one or both diaphragms with an appropriately curved contour and of a size greater than that of the television tube in which the lens may be used, it is possible to get a relatively wide range of vision of the image in the tube. There is also less eye strain than in conventional lenses, and the lens of the present invention further gives a third-dimensional effect. When one of the diaphragms has a coating to enable it to function as a projection screen, there is also a marked absence of eye strain and the third-dimensional effect is furthermore pronounced.

Whereas the drawing shows a number of lenses, each of which has one flat diaphragm and one curved diaphragm, it is nevertheless within the scope of the invention to provide both diaphragms with a curved contour.

When it is desired to fill the lens with a liquid, it is supported in a vertical position with the filling opening uppermost. The liquid is then introduced into the lens through tube 18, or if the tube is omitted the liquid is introduced through a funnel or other suitable means through the filling opening 17. The diameter of this opening will be larger in a lens of larger proportions, for the reason that the diaphragms themselves will have an increased thickness as the size increases. Thus, in a relatively large lens the opening will similarly be quite large, and a greater quantity of the liquid may be introduced in a given time. In some instances, particularly in the case of smaller lenses, plural openings may be provided, one for the purpose of introducing the liquid and the other for the purpose of permitting air to escape.

After the filling has been completed there is generally the air bubble at the highest level, even if the opening is sealed. The lens may now be moved slowly from its vertical position to the horizontal position of Fig. 2 and any remaining air bubble is entrapped outside the ring, as shown at 28. It is not necessary to seal the opening in all instances if the tube 18 is employed. It is generally preferred, however, to effect the seal. In the event that the temperature in the surrounding area is reduced, an air bubble might appear in the viewing area even though it was not there originally. It is then only necessary to raise one edge upwardly to allow the bubble to move outside the ring, and then return the lens to the horizontal position. Thus, the viewing area is kept free from bubbles at all times.

While three forms or embodiments of the invention have been shown and described herein for illustrative purposes, and the construction and arrangement incidental to three specific applications thereof have been disclosed and discussed in detail, it is to be understood that the invention is limited neither to the mere details

SEARCH ROOM

or relative arrangement of parts, nor to its specific embodiments shown herein, but that extensive deviations from the illustrated forms or embodiments of the invention may be made without departing from the principles thereof.

What I claim is:

1. A fluid lens comprising a pair of generally circular diaphragms formed of clear, transparent, plastic material and having a curved contour, the diaphragms being secured together around their marginal edges to provide a closed chamber, a clear, transparent fluid filling said chamber, the chamber having an opening therein for such filling, a dished ring presenting an external contour of the general shape of a frustum of a cone secured along its inner edge to the inner surface of one of said diaphragms generally concentric therewith.

2. A fluid lens comprising a pair of diaphragms formed of clear, transparent material, at least one of such diaphragms having a curved contour, the diaphragms being secured together around their marginal edges to provide a closed chamber, a resilient, annular member interposed between such marginal edges and frame elements engaging the outer surfaces of such edges, a clear, transparent fluid filling said chamber, the chamber having an opening therein for such filling, a dished ring presenting an external contour of the general shape of a frustum of a cone secured along its inner edge to the inner surface of one of said diaphragms generally concentric therewith, the outer surface of such ring being disposed at an acute angle to the adjacent surface of such diaphragm.

3. A fluid lens comprising a pair of diaphragms formed of clear, transparent material, at least one of such diaphragms having a curved contour, the diaphragms being secured together around their marginal edges to provide a closed chamber, a clear, transparent fluid disposed within said chamber, filling the same, the chamber having an opening therein for such filling, a dished ring presenting an external contour of the general shape of a frustum of a cone secured along its inner edge to the inner surface of one of said diaphragms generally concentric therewith, the outer surface of such ring being disposed at an acute angle to the adjacent surface of such diaphragm and acting to entrap bubbles remaining in the chamber after the filling thereof.

4. A fluid lens comprising a pair of generally circular diaphragms formed of clear, transparent, plastic material, at least one of such diaphragms having a curved contour forming a spherical segment, the diaphragms being secured together around their marginal edges to provide a closed chamber, a clear, transparent fluid filling said chamber, the chamber having an opening therein for such filling, a tube leading to such opening and being of sufficient length to occupy a position at its outer end on a level higher than the highest level of the fluid in the chamber, and a dished ring presenting an external contour of the general shape of a frustum of a cone secured along its inner edge to the inner surface of one of said diaphragms.

5. A fluid lens comprising a pair of generally circular diaphragms formed of clear, transparent material, at least one of such diaphragms having a curved contour, the diaphragms being secured together around their marginal edges to provide a closed chamber, a clear, transparent fluid filling said chamber, the chamber having an opening therein for such filling, and a dished ring presenting an external contour of the general shape of a frustum of a cone secured along its inner edge to the inner surface of said diaphragms, the outer surface of such rings being disposed at an acute angle to the adjacent surface of such diaphragm.

6. A fluid lens comprising a pair of generally circular diaphragms formed of clear, transparent, moldable material, one of such diaphragms having a curved contour forming a spherical segment, the diaphragms being secured together around their marginal edges to provide a closed chamber, a clear, transparent fluid filling said chamber, and a dished ring presenting an external contour of the general shape of a frustrum of a cone secured along its inner edge to the inner surface of said diaphragm formed with the curved contour, the outer surface of such ring being disposed at an acute angle to the adjacent surface of such diaphragm, and an opaque frame having an opening secured to the other diaphragm.

CARL BIDERMAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
60,109	Woodward	Nov. 27, 1866
509,379	Ingram	Nov. 28, 1893
2,165,078	Toulon	July 4, 1939
2,300,251	Flint	Oct. 27, 1942

FOREIGN PATENTS

Number	Country	Date
6,534	Great Britain	1911
101,260	Great Britain	Aug. 31, 1916