

Dec. 15, 1931.

R. J. SHERMAN

1,836,558

LIGHT VALVE

Filed Aug. 17, 1929

2 Sheets-Sheet 1

FIG. 1.

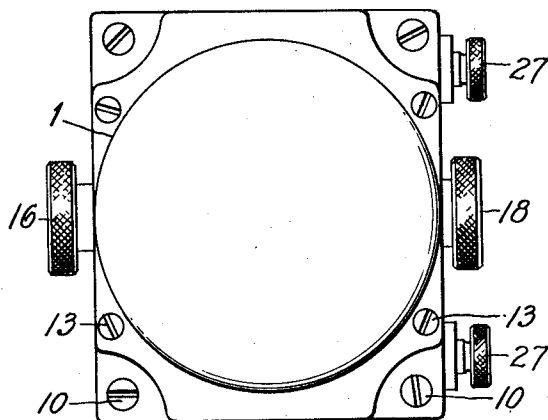


FIG. 4.

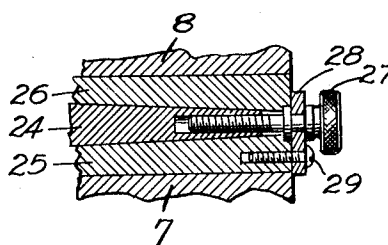


FIG. 2.

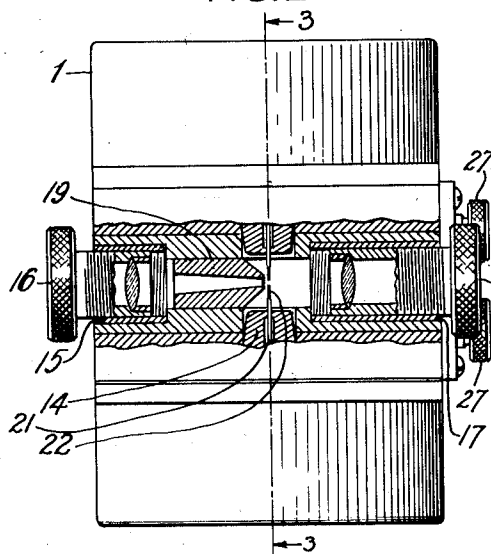


FIG. 3.

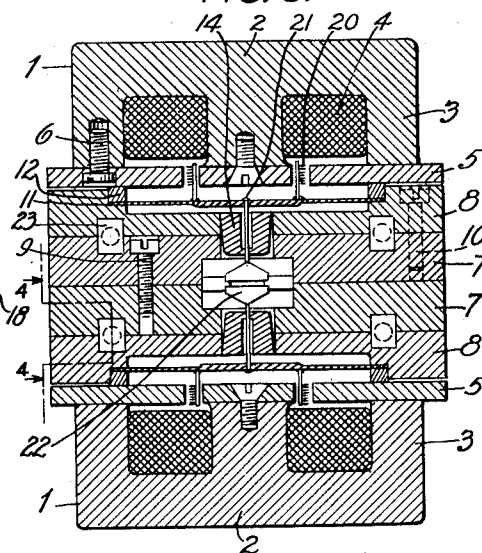
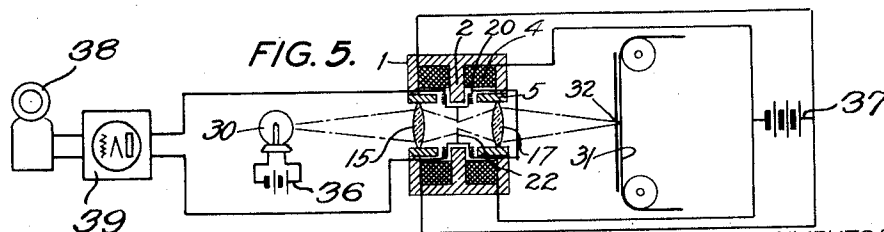


FIG. 5.



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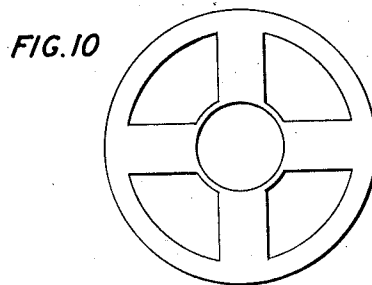
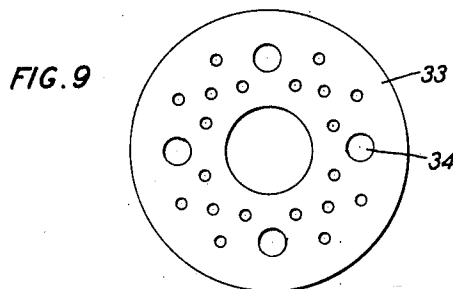
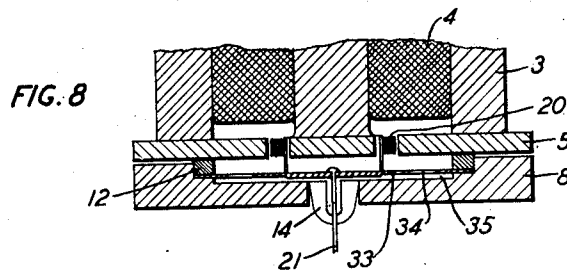
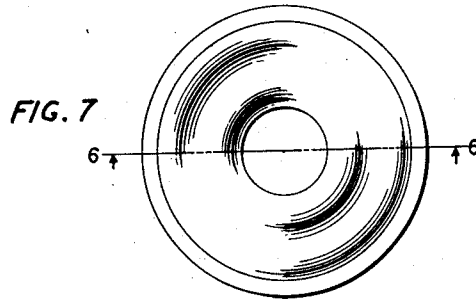
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LIGHT VALVE

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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LIGHT VALVE

Application filed August 17, 1929. Serial No. 386,604.

This invention relates to light valves and particularly to devices which vary the amount of light transmitted through an orifice in response to variations in an electric current.

The object of this invention is the provision of an improved light valve.

Many light valves which have been proposed heretofore are constructed of parts so small and light that difficulty is experienced in keeping the valve in adjustment. Others are inefficient in converting electrical power into motion or are not uniformly efficient throughout the frequency range to be recorded. Many are so constructed that acoustic shocks transmitted through the air can affect the moving parts and cause the recording of an undesired disturbance.

A feature of the present invention is the use of moving parts actuated by current carrying coils immersed in a constant magnetic field. The high efficiency of a coil driven system permits the use of strong, rugged parts with good efficiency over a wide frequency range. By properly proportioning the moving elements, the range of uniform efficiency may be shifted from low frequency to high frequency. If a very broad range of response with uniform efficiency is required, the drive for one shutter is proportioned to be efficient over the lower range of frequencies, the drive for the other shutter being proportioned to be efficient over the higher range of frequencies, and the combined movements will then be efficient over the whole range.

Another feature of this invention is the inclusion of the optical system in a unitary structure with the light valve. Thus, when the optical system is properly focussed, the whole structure may be removed without disturbing the accuracy of the focussing. Due to the complete enclosure of the moving parts, the slot formed by the shutters is protected from dust and moisture, and the moving parts are protected from acoustic shock due to undesired pulses.

In the drawings:

Fig. 1 is a plan view of a light valve constructed in accordance with this invention;

Fig. 2 is an elevation in part section of the light valve;

Fig. 3 is a section on line 3—3 of Fig. 2;

Fig. 4 is a section on line 4—4 of Fig. 3;

Fig. 5 is a diagrammatic view of the application of the light valve to the recording of sound on a photographic film.

Fig. 6 is a section of a corrugated diaphragm;

Fig. 7 is a plan view of the diaphragm of Fig. 6;

Fig. 8 is a fragmentary section on line 3—3 of Fig. 2;

Fig. 9 is a plan view of a perforated diaphragm;

Fig. 10 is a plan view of a resilient spider.

This light valve, in general, comprises a central portion with an electromagnet affixed to each of two opposed faces. These electromagnets 1, 1 are composed of a body of magnetic material having a central pole 2 and an annular exterior pole 3, surrounding an exciting winding 4. A flat annular pole piece 5 reduces the air gap to a small annular space and is secured to the pole 3 by screws 6.

The central portion of the body comprises two symmetrical parts each composed of a central member 7 and an outer member 8. The two central members 7, 7 are secured together by screws 9. The outer members 8, 8 are secured to their respective central members by screws 10.

The outer face of each member 8 is recessed to form a shoulder supporting a resilient member 11. A resilient ring 12 is placed on the outer edge of the resilient member 11 and is retained in place by the pole piece 5 which is secured to the member 8 by screws 13. The recessed face of the member 8 is centrally pierced by a hole retaining a bushing 14.

Centrally located on the junction of the two members 7, 7, a threaded tube 15 is inserted, supporting a condensing lens system 16. Also centrally located on the junction of the two members 7, 7, and axially in line with the tube 15 is a similar tube 17 supporting a projecting lens system 18. Inserted in an axial orifice running from the tube 15 to the

tube 17 is an opaque plug 19 extending nearly to the center of the members 7, 7 and pierced by an orifice of uniform width but tapering in height to form a small rectangular slot at the inner end.

Affixed to each resilient member 11 is a conducting coil 20 centrally located in the air gap between the central pole 2 and the pole piece 5 and encircling the pole 2. The coils 20 are connected to suitable terminals (not shown) by which varying currents may be conducted to them.

Centrally attached to each resilient member 11 and extending through the bushing 14 are pins 21 terminating in shutters 22 which define a small slot in the center of the valve. The bushings 14 may be of material such as quartz so as to reduce the friction on the pin 21. The orifice in the bushing through which the pin extends may be counterbored to reduce the area in contact with the pin.

Two adjusting devices 23, shown in detail in Fig. 4, are located on each junction between members 8 and 7. These adjusting devices comprise a central wedge 24 adapted to be drawn between two inclined planes 25 and 26 by the screw 27. The screw 27 is rotatably retained by the washer 28 which is secured to the member 25 by screw 29. Rotating the screw 27 will cause the wedge 24 to force the members 25 and 26 apart causing member 8 to be moved outward parallel to member 7 and giving a fine adjustment of the size and location of the slot defined by the opposed ends of the shutters 22.

The resilient members 11 may be in the form of a diaphragm, either flat as shown in Fig. 3 or with annular corrugations as shown in Figs. 6 and 7. This invention contemplates also the use of a diaphragm 33, Fig. 9 pierced by orifices 34 of such size as to cause the motion of the diaphragm to be damped by the air enclosed in the space 35, Fig. 8 passing through the orifices 34. As shown in Fig. 10 the orifices may on occasion be made so large that the member is in the form of a spider having a circular central area. The invention contemplates also the use of resilient members so proportioned that the natural frequency of vibration of the two members is different, one member responding most freely to frequencies in the lower end of the range to be recorded and the other member responding most freely to frequencies in the upper end of the range. The central area of the resilient support may be made thicker than the remainder to lower the natural frequency of vibration of the support and to stiffen the support where the coil is attached.

Referring now to Fig. 5, the condensing lens 15 forms an image of a light source 30 energized by a battery 36 on the slot formed by the shutters 22. The opaque plug 19,

shown in Fig. 2, reduces the diffusion of the light transmitted through the lens 15 and defines the area through which the image of the source 30 is focussed on the shutters. The projecting lens 17 forms an image of the slot on the surface of a photosensitive film 31 moved in a well-known manner at uniform speed past an aperture 32 in an opaque plate. A constant electric current from a suitable source 37 flows in the coils 4 and forms a powerful, steady and practically uniform magnetic field in the gap between the central pole 2 and the pole piece 5. Sound waves are detected by the known type of microphone 38 and the resulting currents may be amplified in a conventional type of amplifier 39 and applied to the windings of the coils 20. Varying electric currents flowing in the coils 20 will cause the shutters 22 to move to and fro varying the quantity of light reaching the film and forming a photographic record of the variation in the current.

What is claimed is:

1. In a light valve, a body comprising a central portion pierced by an orifice and two exterior portions, resilient supports respectively mounted between said exterior portions and said central portions a pair of shutters respectively attached to said supports and so disposed as to define a light controlling slot in said orifice between the opposed free ends of said shutters, means affixed to said supports to cause said supports to vibrate in response to electrical variations, and means to adjust the size and location of said slot comprising inclined surfaces in operative relation to said central portion, inclined surfaces in operative relation to said exterior portions, and manually operative wedges co-operating with said inclined surfaces to change the space location of said portions.

2. In a light valve, in combination, a vibratile member, means attached to said member and responsive to electrical variations to cause said member to vibrate, the combined mass of said member and said means and the stiffness of said member being such that the natural frequency of the combination is in the lower range of sound frequencies, a second vibratile member, oppositely disposed to said first vibratile member, other means attached to said second member and responsive to electrical variations to cause said second member to vibrate, the combined mass of said second member and said other means, and the stiffness of said second member being such that the natural frequency of the combination is in the upper range of sound frequencies and a pair of shutter members respectively attached to said vibratile members and so disposed as to define a light controlling slot between the opposed free ends of said shutter members.

3. In a light valve, in combination, a body comprising a central portion pierced by an

orifice and two oppositely disposed exterior portions, a diaphragm pierced by a plurality of small holes and retained between said central portion and one of said exterior portions
5 close to the exterior of said central portion, a resilient spider retained between said central portion and the other of said exterior portions, electromagnetic actuators respectively attached to said diaphragm and said
10 spider for imparting vibrations in accordance with sound modulated currents, and a pair of shutters respectively attached to said diaphragm and said spider and so disposed as to define a light controlling slot in said
15 orifice between the opposed free ends of said shutters.

4. In a light valve, a body comprising a central portion pierced by an orifice and two oppositely disposed exterior portions, a pair
20 of resilient supports respectively mounted between said exterior portions and said central portion and completely enclosed within said body, a pair of shutters respectively attached to said supports and so disposed as to
25 define a light controlling slot in said orifice between the opposed free ends of said shutters, electromagnetic actuators respectively attached to said supports for imparting vibrations in accordance with sound modulated
30 currents, a condensing lens system mounted in one end of said orifice for focusing light onto said slot, and a projecting lens system mounted in the other end of said orifice for forming an image of said slot exteriorly of
35 said valve, said lens systems substantially completely closing said orifice and preventing the transmission of acoustic disturbances to said shutters.

In witness whereof, I hereunto subscribe
40 my name this 8th day of August, 1929.

RUSSEL J. SHERMAN.

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