June 13, 1933. E. C. WENTE 1,914,186

TRANSLATING DEVICE

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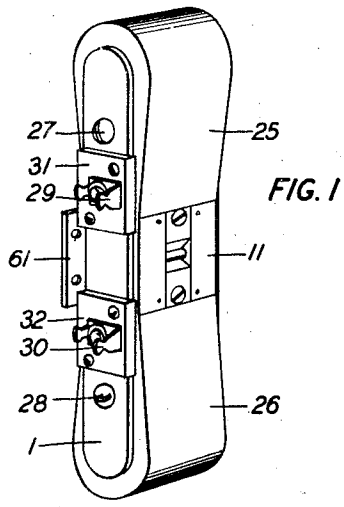



FIG. 1

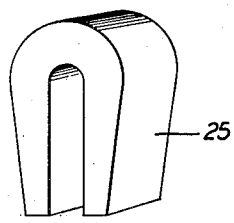
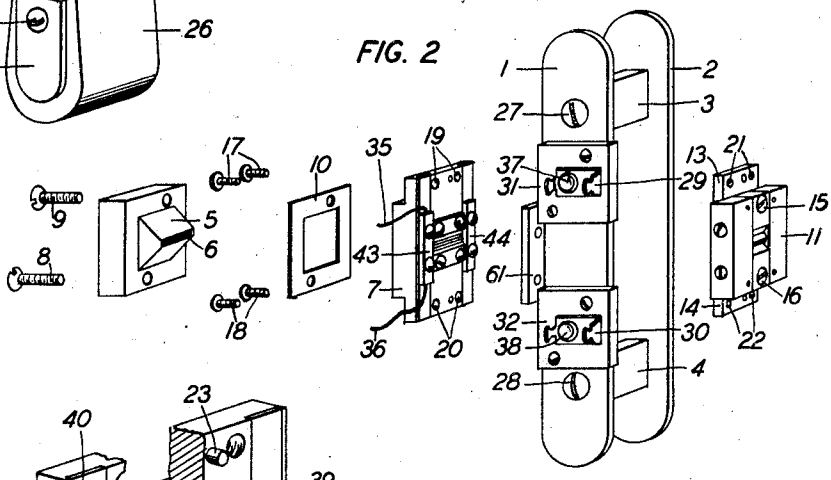



FIG. 2



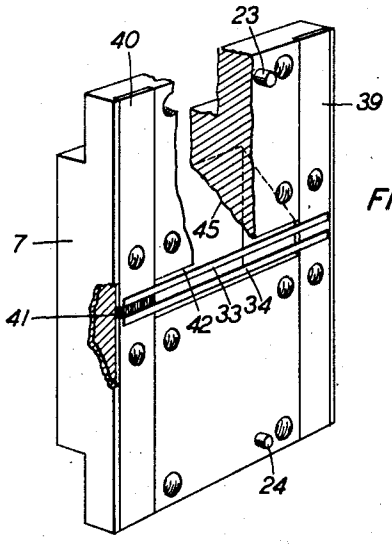
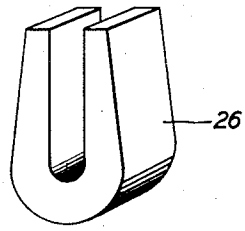




FIG. 3




INVENTOR
E. C. WENTE
BY
G. H. Heydt
ATTORNEY.

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FIG. 4

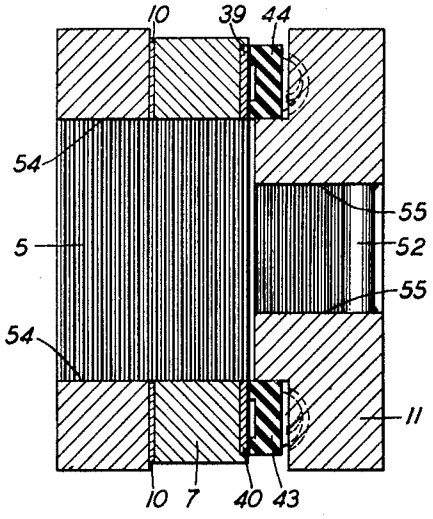
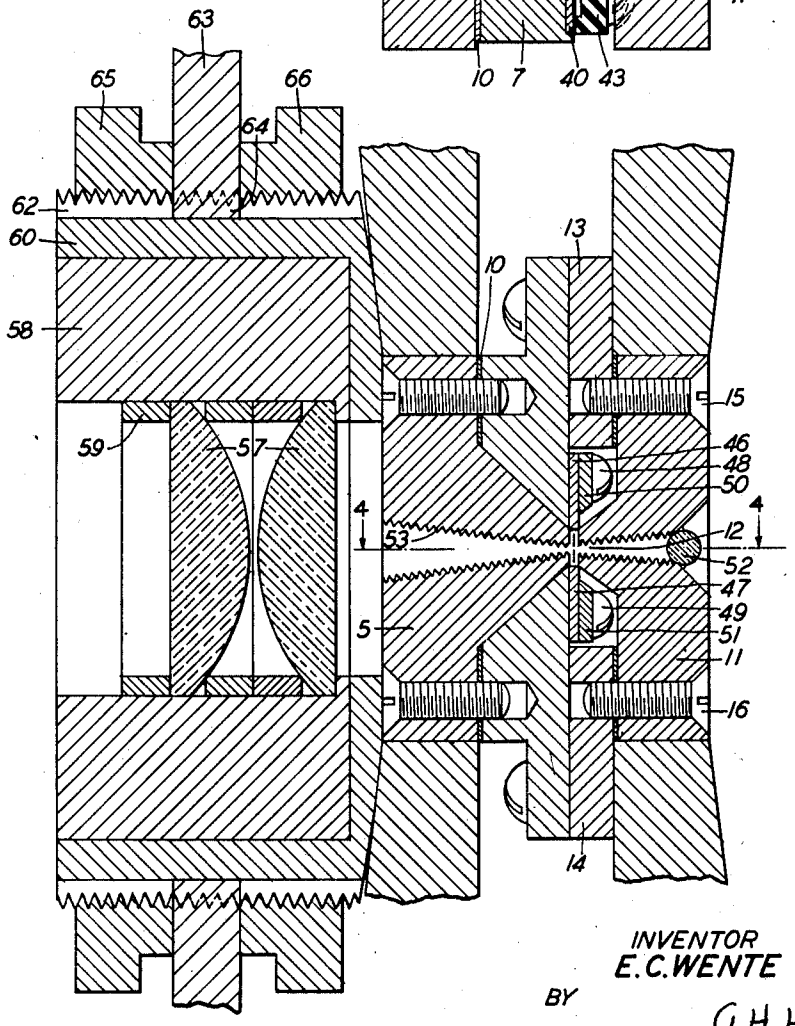



FIG. 5




INVENTOR
E. C. WENTE

BY G. H. Heydt

ATTORNEY

Patented June 13, 1933 1,914,186

# UNITED STATES PATENT OFFICE

EDWARD C. WENTE, OF NEW YORK, N. Y., ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

## TRANSLATING DEVICE

Application filed October 4, 1930. Serial No. 486,382.

This invention relates to translating devices, such as light valves, and more particularly to improvements in the construction and operation of such devices.

The principles of operation of light valves generally are disclosed in my U. S. Patent 1,638,555, issued August 9, 1927. In the light valve disclosed in this patent a pair of electrical conductors is arranged in a plane at right angles to a magnetic field so as to define a slot through which light is transmitted. Varying electrical current applied to these conductors causes them to move relative to each other, thus varying the width of the slot and the amount of light transmitted.

The improvements which are the subject of this invention have for an object the production of a light valve of compact construction having highly efficient operation.

Another object of the invention is to provide a light valve having a highly damped vibrating system and which requires a minimum amount of power for efficient operation.

A further object of the invention is the provision of a unitary structure for a light valve, said structure including a portion of a highly efficient optical system.

A feature of the invention lies in the manner of supporting and holding the light valve ribbons between the pole faces.

A light valve designed in accordance with the invention comprises two oppositely disposed pole pieces through which a magnetic field is established by two horse shoe type permanent magnets. All adjusting and tensioning devices are eliminated and the ribbons are placed and held in position between the faces of the oppositely disposed pole pieces and in front of the aperture therein by means of a ring member which surrounds and is secured to one of the pole pieces and on which the ribbons have been mounted before assembling the valve. The length of the ribbons is reduced to a length which barely exceeds the length of the apertures in the pole pieces thereby reducing the resistance of the operating portions of the ribbon and consequently the power required for their operation. The optical efficiency of the system in which the valve is employed is increased by providing in the aperture of one of the pole pieces a cylindrical lens in the form of a glass rod whose axis is parallel to the ribbons, which lens forms a line image of every point of the opening between the ribbons.

Fig. 1 is a perspective view in actual size of the assembled light valve;

Fig. 2 is an exploded view of the light valve shown in Fig. 1;

Fig. 3 is an enlarged view of a conductor supporting member shown in Fig. 2;

Fig. 4 is an enlarged section of the assembled valve taken through line 4—4 of Fig. 5; and

Fig. 5 is an enlarged sectional view of the assembled valve including the condensing lens holder and the valve mounting plate.

A light valve constructed in accordance with this invention comprises a frame made up from sides 1 and 2 and cross pieces 3 and 4. A pole piece 5 having an aperture 6 in the face thereof has mounted thereon a conductor supporting member 7 by means of screws 8 and 9. A shim 10 is inserted between the shoulders of the pole piece 5 and the supporting member 7. A more detailed description of the conductor supporting member will be given in connection with a discussion of Figs. 3 and 5. A second pole piece 11 having an aperture 12 (Fig. 5) therein, has secured thereto, by means of screws 15 and 16, spacing members 13 and 14. The apertures in the two pole pieces are kept in alignment when the valve is assembled by means of screws 17 and 18 which project through holes 19 and 20 respectively in the supporting member and terminate in the holes 21 and 22 in the spacing members 13 and 14. Projections 23 and 24 on member 7 fit into holes in the spacing members 13 and 14 to further insure the alignment of the apertures in the pole pieces. Two horse shoe type permanent magnets 25 and 26 are clamped between the sides 1 and 2 of the frame member by means of the screws 27 and 28 which carry the side 1 of the frame

and terminate in the cross pieces 3 and 4 of the frame respectively. Terminals 29 and 30 are attached to the frame by blocks 31 and 32 of some suitable insulating material. A source of acoustically modulated currents is electrically connected to the terminals and these modulated currents are fed to light valve ribbons 33 and 34 by means of conductors 35 and 36 which extend through openings 37 and 38 in the frame.

One improvement in operation produced by the construction of the light valve herein disclosed lies in a shortening of the total length of the vibrating system or "ribbons" of the valve. In any light valve the "working length" of the ribbons includes only that portion actually in front of the apertures in the pole pieces of the valve. In the light valves previously constructed, a surplus length of ribbon is provided to enable it to be properly tensioned and to be given the proper spacing by devices incorporated in the valve for these purposes.

The length of the ribbons in the present valve only slightly exceeds the length of the apertures in the pole pieces. The resistance of the vibrating system is thereby greatly reduced, as compared to the resistance of the vibrating system of light valves previously constructed, and consequently reduces the amount of power required for efficient operation and in addition provides a highly damped vibrating system.

A compact construction and decreased length of the vibrating system is made possible by the provision of a novel means for supporting the ribbons in their proper position between the pole pieces of the light valve. There is provided a supporting member 7 (Fig. 3) made of a non-magnetic material, on which the ribbons 33 and 34 are mounted before the valve is assembled. On the top surface of the supporting member 7 are cut channels about 10 mils in depth into which are fastened strips of gold 39 and 40 by means of an insulating compound. These strips form the connection between the ribbons and the source of acoustically modulated currents through the conductors 35 and 36. Although any suitable conducting material may be used for this purpose it has been found that gold is preferable due to the small contact resistance between it and the material making up the ribbons of the valve. One strip of gold 40 is broken by the insertion of an insulating material 41. The ribbons 33 and 34 are given their proper spacing and tensioning on a specially constructed device developed for this purpose.

It is desirable in light valves of this type to have uniform response of the movable elements or ribbons throughout the recording operation. To accomplish this result it is the usual practice to apply such a tension to the movable elements that their natural period of vibration is above the range of frequencies likely to be impressed thereon during recording. In accordance with this invention a novel method of adjusting and assembling the ribbons with the remaining elements of the valve is employed. The adjusting device mentioned above is made up of two separate parts, each part having means thereon for mounting one of the movable elements. Means are also provided on each of the parts for applying a tension to the movable element. While mounted on the adjusting devices the ribbons are separately tensioned and then tested in a magnetic field to determine their adjustment. In the testing operation the ribbon is placed in a magnetic field and a voltage of a frequency above any frequencies likely to be applied during recording is applied thereto. The applied tension is then increased until maximum deflection of the ribbon (at its resonance point) is noted. As each ribbon is tested separately from the other the same frequency is impressed on both so that their natural period of vibration will be uniform. In the adjusting operation the length of the ribbon mounted on the adjusting device is greater than the length finally secured to the supporting member 7. In the adjusting operation the frequency of the voltage impressed during testing is to the desired resonant frequency of the ribbons when secured to the supporting member inversely as the length of the ribbon during the testing operation and the length when finally secured to the supporting member. This may be shown by the equation

$$\frac{f_1}{f_2}=\frac{L_2}{L_1}$$

where $f_1$ is the frequency impressed on the ribbon during the testing operation;

$f_2$ the desired resonant frequency of the ribbon when finally mounted;

$L_1$ the length of ribbon on the adjusting device; and

$L_2$ the length of ribbon secured to the supporting member.

After the ribbons have been separately adjusted as to tension the two parts of the adjusting device are placed together and by means of adjusting screws one of the parts is moved relative to the other in such a manner that the ribbons mounted on each part are accurately spaced to define the aperture or light transmitting slot required. The supporting member 7 is then placed under the ribbons with the aperture 42 parallel thereto and the ribbons are secured to the member by means of small bars of insulating material 43 and 44. The ribbons, as mounted on the supporting member, are properly spaced, have the proper tension applied, and therefore require no further adjustment after

the supporting member is assembled with the remaining parts of the valve.

In assembling the device, pole piece 5 fits into the cut-out portion 45 of the supporting member 7. The shim 10 inserted between the shoulders of the pole piece 5 and the supporting member 7, is of a thickness such that the faces of the terminal strips 39 and 40 extend beyond the face of pole piece 5 a distance equal to that desired for clearance between the ribbons and the pole face (see Fig. 4).

To prevent excessive opening or movement of the ribbon and to provide additional damping, metal strips 46 and 47 (Fig. 5) having a thickness equal to the gap between the pole pieces 5 and 11, are secured to the supporting member 7 parallel to the ribbons by means of screws 48 and 49 and clamping bars 50 and 51.

It is the general practice in sound film recording systems to so locate the light valve in an optical system that it is between separate sets of lenses so that an image of the aperture formed by the ribbons is projected to the photographic film. Spherical lenses are usually employed for focusing on the film the aperture formed by the ribbons.

In accordance with this invention the valve is used in an improved optical system. A cylindrical lens is provided for focusing the aperture formed by the ribbons on the film. Referring to Figs. 4 and 5, a cylindrical lens 52, in the form of a glass rod, is mounted at the outer end of the aperture 12 of the pole piece 11, the axis of the lens being parallel to the ribbons 33 and 34. A preferred diameter for such a lens is about $\frac{1}{16}$ of an inch and the lens is preferably placed a distance from the ribbons such that an image ¼ as large as the opening between the ribbons is formed by the lens on the film. The optical efficiency of the system is further increased by the provision of transverse corrugations 53 in the lateral surfaces of the apertures 6 and 12 to reduce specular reflection of stray light. The sides 54 and 55 of the apertures 6 and 12 are made flat and parallel and are polished so that they reflect the light striking the walls to the ribbon and lens 52. In this manner the whole length of the ribbon is uniformly illuminated while undesirable stray light striking the lateral surfaces of the apertures is absorbed.

As the cylindrical lens forms a line image of every point of the opening between the ribbon, any irregularity in the opening, such as may be introduced by dust particles, does not result in striations in the film record as is the case when a spherical lens is used. Also a greater angle of light and consequently more intense light can be obtained at the image without sacrifice in the definition. Another improvement lies in the fact that a smaller number of glass surfaces are employed in this system than in former systems.

The cylindrical lens 52 is mounted in the aperture of the pole piece 11 in such a position that the ribbons 33 and 34 are properly focused and therefore require no further adjustment after assembly.

Referring to Fig. 5 a condensing lens system 57 of large aperture is employed to project light rays from a constant intensity light source to the ribbons 33 and 34. The lens system 57 is held in a circular mounting member 58 by any suitable means, such as a split metal ring 59. The member 58 fits into a circular holder 60 which is secured to projections on a frame member, one of which is shown at 61 (Fig. 1). The outer surface of the holder 60 is threaded and has a groove 62 therein. A plate member 63 is mounted on the member 60 by means of projection 64 which fits into the groove 62. Locking rings 65 and 66 hold the plate 63 in position and permit its adjustment to any position along the outer surface of the member 60. The member 63 is used to secure the whole assembly to apparatus on which it is to be used.

It can readily be seen that the light valve constructed in accordance with this invention possesses increased operation efficiency and is of compact construction which enables it to be used in cases where space is a limiting factor, as for example, in a news reel camera wherein the light valve is attached to the camera casing to enable the picture and sound to be recorded on a single film within the camera.

What is claimed is:

1. A light valve comprising a frame, oppositely disposed magnets carried by said frame, said magnets having aligned apertures, a pair of conducting elements interposed between the adjacent faces of said magnets to define a light transmitting slot, means to support said conducting elements between said magnets comprising a member surrounding the pole piece of one of said magnets and detachably secured thereto, and means on said member for securing the conducting elements thereto adjacent the apertures in said magnet.

2. The combination in a light valve having oppositely disposed pole pieces provided with aligned apertures and a pair of conducting elements arranged between said pole pieces to form a light transmitting slot, of means for supporting said conducting elements between said pole pieces comprising a member of nonmagnetic material surrounding one of said pole pieces, and means on said member for securing the conducing element thereto at a point above the face of the pole piece adjacent the aperture therein.

3. In a light valve having oppositely dis-

posed pole pieces for setting up a magnetic field and conductors supplied with modulated electrical currents suspended between said pole pieces to form a light transmitting slot, supporting means for said conductors attached to one of said pole pieces, and spacing members attached to the other of said pole pieces at opposite sides thereof.

4. A translating device comprising a frame, a pair of magnets carried by said frame, oppositely disposed pole pieces having aligned apertures disposed between said magnets, an electrical conductor suspended between said pole pieces, a supporting member for said conductor of non-magnetic material, and means for detachably securing said supporting member to one of said pole pieces.

5. A translating device comprising a frame, a pair of magnets mounted on said frame, and a unit assembly disposed between said magnets comprising a pair of oppositely disposed pole pieces and a supporting member for electrical conductors suspended between said pole pieces.

6. In combination, a light valve having a frame, a pair of magnets supported by said frame, and a unit assembly carried between the ends of said magnets comprising oppositely disposed pole pieces having aligned apertures, a supporting member for electrical conductors attached to one of said pole pieces, and a spacing member attached to the other of said pole pieces at opposite sides thereof.

7. A light valve comprising a frame, a pair of magnets supported by said frame, and a unit assembly disposed between the ends of said magnets, said assembly comprising oppositely disposed pole pieces having aligned apertures, a pair of conducting elements interposed between said pole pieces, to form a light transmitting slot, and means surrounding one of said pole pieces and detachably secured thereto for supporting said conducting elements adjacent the aperture in said pole piece.

8. In combination, a light valve having a frame, a pair of magnets supported by said frame, and a unit assembly carried between the ends of said magnets comprising oppositely disposed pole pieces having aligned apertures, a pair of conducting elements interposed between said pole pieces to form a light transmitting slot, and means detachably secured to one of said pole pieces for supporting said conducting elements adjacent the apertures in said pole piece.

9. The combination in a light valve having oppositely disposed pole pieces provided with aligned apertures and a pair of conducting elements arranged between said pole pieces to form a light transmitting slot, of means for supporting said conducting elements between said pole pieces comprising a member attached to one of said pole pieces, and means on said member for securing the conducting elements thereto at a point above the face of the pole piece adjacent the aperture therein.

In witness whereof, I hereunto subscribe my name this 2nd day of October, 1930.

EDWARD C. WENTE.