Feb. 7, 1933. L. W. CHUBB 1,896,768

PHOTOGRAPHIC SOUND RECORDING

Filed July 31, 1929

Fig. 1.

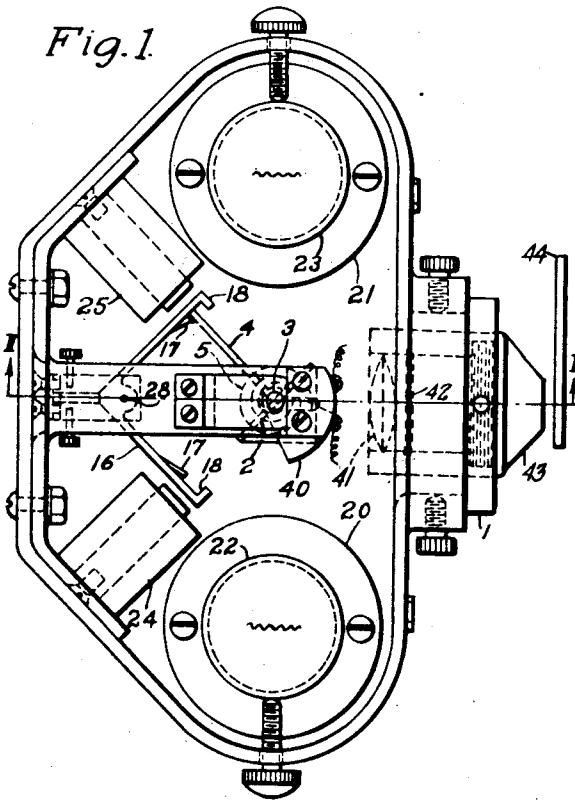


Fig. 2.

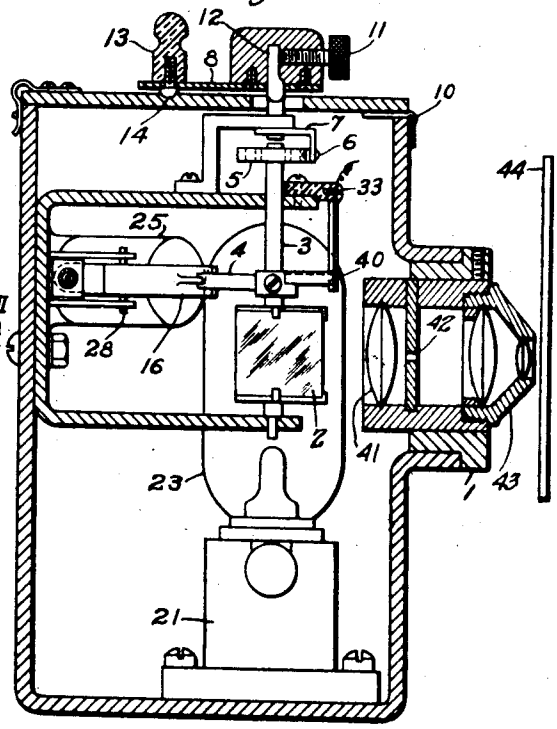
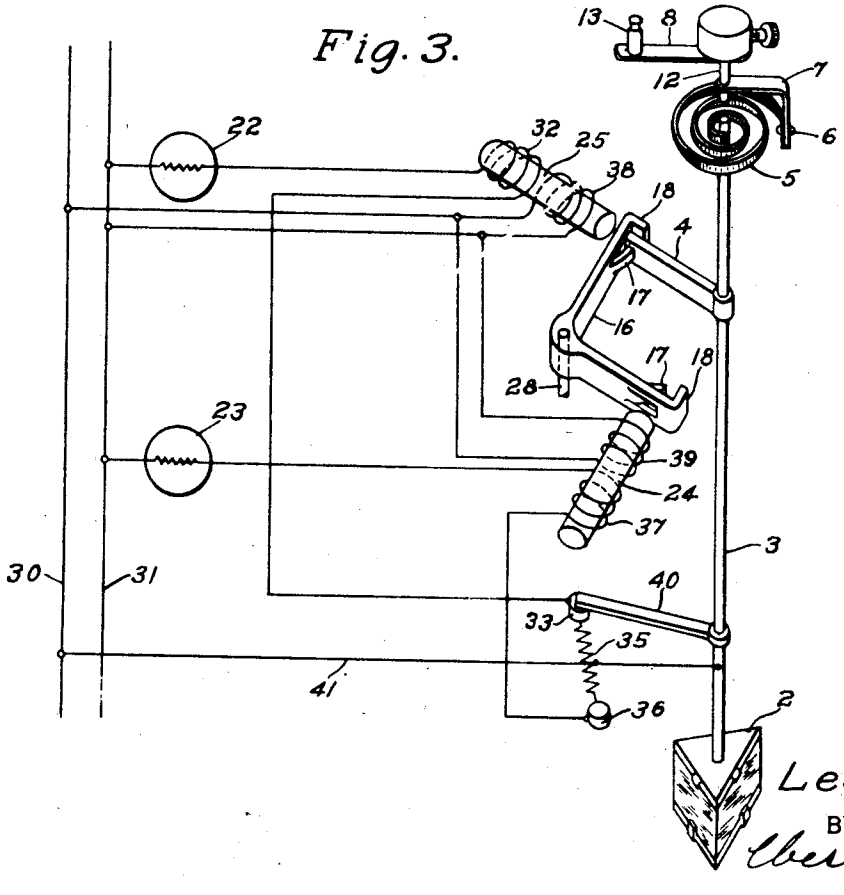


Fig. 3.



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1,896,768

UNITED STATES PATENT OFFICE

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PHOTOGRAPHIC SOUND RECORDING

Application filed July 31, 1929. Serial No. 382,573.

My invention relates to optical apparatus, and particularly to apparatus for the photographic recording or reproduction of sound.

Methods for photographically recording sound require a source of light, together with means for varying the intensity of the light which reaches the photographically sensitive surface from said source. Methods for reproducing sound from the photographic record require a light source which illuminates the record. The area or the density of the blackened portion of the record determines what intensity of light shall be delivered to the photo-electric cell or other light sensitive devices controlled by the record. In both of these methods an interruption of the supply of light from the light source results in a break in the reproduced sound which must be avoided if the record is to be used for entertainment purposes.

It is an object of my invention to provide a means whereby failure of a lamp will result in so brief an interruption that it will not be noticeable in the reproduced sound.

It is a further object of my invention to provide a device which will substitute a brightly shining lamp for a lamp which has failed and will make the substitution so quickly that no perceptible interruption will be present in the reproduced sound.

It is a further object of my invention to maintain a lamp with its filament heated to a temperature which, while not producing full brilliancy, will permit the filament to be heated to full brilliancy in a very short time and to arrange for substituting this lamp for the lamp which fails and increasing the brilliancy of its filament at the time of said substitution.

It is a further object of my invention to provide two lamps and a reflector whereby either of them may be used as the source of light for the optical system of a sound-recording or sound reproducing apparatus, the reflector being moved when a substitution of one lamp for the other is desired.

It is a further object of my invention to so arrange a circuit that the current through the lamp which serves as a light source will control the movement of the reflector, whereby, when the filament of the lamp breaks, the reflector will be moved.

It is a further object of my invention to provide a circuit, as just described, with supplemental means which will prevent movement of the reflector upon intentional extinguishing of the lamp, such as occurs when the apparatus is not in use.

Other objects of my invention and details of the construction will be apparent from the following description and the accompanying drawing, in which

Figure 1 is a top plan view of the apparatus with the cover of the casing removed,

Fig. 2 is a vertical central section taken along line II—II of Fig. 1, and

Fig. 3 is a diagram of the circuits and apparatus.

The optical system which is to be supplied with light is represented in the drawing by the tube 1 and in general comprises a condensing lens 41, a slot 42 of suitable dimensions, which is illuminated by light transmitted through the condensing lens, and a microscope objective 43 whereby an image of the slot 42 is imaged on a film strip 44. The film strip 44 is advanced through a machine of any well known type in a manner which is well known in the art, and a sound record may be impressed thereon or it may be so combined with the usual elements of a reproducing system that a record impressed thereon is reproduced. In the former case the light impinging on the film strip will be suitably modulated by any well known light valve, while in the latter case, the record on the film-strip will modulate the light transmitted therethrough and after being so modulated the light will be projected on a suitable photo-sensitive device. A reflecting device is illustrated at 2. This device may be an internally-reflecting prism or a plane mirror. It is mounted for rotation by a vertical shaft 3 with which a restraining arm 4 is rigidly connected.

A spring 5 is provided for moving the shaft 3. One end of this spring is attached to the shaft 3 and the other end is attached to an anchorage 6, carried upon an arm 7, which is mechanically connected with an

arm 8 on the outside of the casing. The top of the casing is shown in Fig. 2 as being hinged at 10. When the casing is to be opened, the set screw 11 must be loosened in order that the projecting end of the shaft 12, which is part of the connection between the arms 7 and 8, may be released. The arm 8 is provided with a handle 13. The head of the machine screw which fastens this handle to the arm is received, in one position, in a recess 14 in the top of the casing. When the handle is moved to impart a different adjustment to the spring 5, the screw is received in another, properly located, similar recess not illustrated.

The restraining arm 4 cooperates with an escapement or two-armed lever 16, each end of which is provided with a pair of latching projections 17 and 18, providing between them a recess for the reception of the arm 4. The casing is provided with a pair of lamp sockets 20 and 21 which receive the lamps 22 and 23 in the usual detachable way. A pair of magnets 24 and 25 are properly located to act upon the two ends of the lever 16. The pivot for this lever being mounted between them, as shown at 28.

The circuit connections, including the lamps and the windings on the magnets, are illustrated in Fig. 3. The main source of supply, which is ordinarily direct current at a potential of 10 volts, is illustrated by the mains 30 and 31. The main 31 is connected to one terminal of the lamp 22, the other terminal of this lamp is connected to a winding 32 upon the magnet 25, the other terminal of this winding is connected to a contact 33 at one end of a resistor 35. The midpoint of this resistor is connected both to the shaft 3 and to the other main 30.

The other end of the resistor 35 is connected to a conductor 36 which is connected to one terminal of a winding 37 upon the magnet 24 and the other end of the winding 37 is connected through the lamp 23 to the main 31. Additional coils 38 upon the magnet 25, and 39 upon the magnet 24, are provided and connected in parallel to the mains 30 and 31. The direction of winding of the coils 38 and 39 and their connection to the mains are so chosen that the magnetomotive forces produced by the pair of coils on either magnet are in opposition. The shaft 3 carries a switch arm 40 which in one position of the shaft connects the shaft to the contact 33 and in the other position connects it to the contact 36.

In the operation of the device, when a lamp is energized which, as the illustration has been chosen, is the lamp 22, it is illuminated to full brilliancy over a circuit including the lamp 22, the coil 32, the contact 33, switch arm 40, shaft 3 and conductor 41 to the main 30. At the same time, the other lamp 23 is energized over a circuit from the main 31 through the lamp 23, the coil 37, on the magnet 24, the contact 36, one-half of the resistor 35 and the conductor 41 to the main 30. Because this circuit includes a resistor, the current therethrough is not sufficient to bring the lamp 23 to full brilliancy, but the filament of this lamp is heated by the current through it to a temperature which will enable the lamp to be brought to full brilliancy in a much smaller time than would be necessary if the filament were cold.

The coil 32 receives full current through the lamp 22 and, therefore, exerts full magnetomotive force which is sufficient to completely neutralize the magnetomotive force exerted by the coil 38, with the result that the magnet 25 exerts no attraction upon the adjacent end of the lever 16. At this time, the coil 37 produces a magnetomotive force which is less than the full amount and is insufficient to completely neutralize the magnetomotive force exerted by the coil 39. This results in a differential effect producing flux in the magnet 24 and causing it to attract the adjacent end of the lever 16. The lever 16 is thus biased toward the position in which it holds the arm 4 in the position illustrated in Fig. 3.

If the magnetomotive forces were as described at the moment when the arm 4 arrives in this position, the cam action of the end of the arm 4 against the beveled projection 17 overcame the pull of the magnet 24 upon the other end of the lever 16. The arm 4 then contacted with the end projection 18 adjacent the magnet 25 and was held from further rotation while the magnet 24 moved the lever 16 sufficiently to cause the recess adjacent to the magnet 25 to embrace the end of the arm 4. The shaft 3 was then locked from further movement.

After this had occurred, the operator moved the arm 8 by means of a handle 13 to such a position that the spring 5 biased the shaft 3 away from the position illustrated in Fig. 3 and toward the position in which the arm 4 would engage the opposite end of the lever 16. The head of the screw by which the handle 13 is attached to the arm 8 entered the recess similar to recess 14 and by thus restraining the arm 8 from movement enabled the spring 5 to exert the bias upon the shaft 3 in the direction stated.

If, with the apparatus in this condition, the lamp 22 should burn out, current through coil 32 would cease, but current through the coil 38 would persist. The whole effect of the coil 38 is then available and produces a strong pull by the magnet 25 upon the adjacent end of the lever 16, with the result that the lever moves and releases the arm 4. The spring 5 then turns the shaft 3, causing the arm 4 to act upon the beveled surface of the projection 17 adjacent the magnet 24 and

enter the recess between this projection and the projection 18.

At the same time, the shaft 3 moved the switch arm 40 into engagement with the contact 36 thereby shunting the half of the resistor 35 which was formerly included in the circuit through the lamp 23. Although a circuit through this resistor may still be traced through the lamp 23, the resistance of this resistor is no longer effective in said circuit because of the shunting action of the switch arm 40 and the conductor 41. Consequently, the lamp 23 now receives full current and its filament quickly arrives at full brilliancy.

The increase of current through the lamp 23 is accompanied by an increase of current in the coil 37. This is now sufficient to counteract the current in the coil 39, and the magnet 24, therefore, now exerts no pull upon the lever 16. The magnet 25, however, at this time exerts a pull upon the other end of the lever and consequently, the lever is biased toward a position in which the arm 4 is firmly held in the recess adjacent the magnet 24.

When the operator observes that the lamp 22 is burned out, he replaces it with a fresh lamp. Current through the new lamp flows through the coil 32 and the one-half of the resistor 35 adjacent the contact 33. The new lamp is thus brought to a temperature which will enable it to quickly reach full brilliancy if the lamp 23 should fail. Also, the current through the coil 32 partially neutralizes the effect of current in the coil 38 and the pull of the magnet 25 upon the lever 16 is diminished. The operator then moves the arm 8 to its opposite position whereby the bias exerted by the spring 5 upon the shaft 3 is reversed in direction and the apparatus is then in condition to substitute the new lamp for the lamp 23, if the lamp 23 should burn out.

In one position of the shaft 3, the reflecting prism 2 is in correct position to associate the lamp 22 with the optical system. When the lamp 22 burns out and, consequently, the shaft 3 moves, the new position of the prism 2 is correct for establishing the lamp 23 in operative relation with the optical system.

The time used for the movement of the prism and for the arrival of the newly substituted lamp at full brilliancy is so short that the effect upon the record, in the case of recording, or upon the reproduction, in the case of a reproducing device, is not productive of any undesirable interruption.

Many other variations will occur to those skilled in the art and the specific mention of only a few modifications is not to be construed as a limitation. The only intended limitations are those required by prior art or indicated by the claims.

I claim as my invention:

1. In combination, an optical system, a plurality of lamps, means for operatively associating said lamps in turn with said optical system, means for causing the lamp thus associated to be brilliant and means for so preparing the lamp which has the next turn for said association that it may be made brilliant in a shorter time than an unprepared lamp.

2. In combination, a plurality of lamps, an optical system, said lamps being fixed and stationary in position, means for operatively associating any one of said lamps with said optical system, and means controlled by the life of the lamp thus associated and controlling said associating means, whereby, upon the failure of the associated lamp, another lamp of said plurality will be operatively associated with said optical system.

3. In combination, an optical system, a pair of lamps, light-directing means for operatively associating one or the other of said lamps with said optical system in accordance with the position of said means, means having an adjustable bias and tending to move said light-directing means to one or the other of said positions according to said adjustment, restraining means normally preventing said movement, and means controlled by the life of said lamps for rendering said restraining means ineffective upon failure of the operatively associated lamp, whereby, upon said failure the other lamp will automatically be operatively associated with said optical system.

4. In combination, an optical system, a pair of electric lamps, light-directing means for operatively associating one or the other of said lamps with said optical system in accordance with the position of said means, and for maintainng full current through the associated lamp and partial current through the other lamp, means having an adjustable bias and tending to move said light-directing means to one or the other of said positions according to said adjustment, restraining means normally preventing said movement and means controlled by the life of said lamps for rendering said restraining means ineffective upon failure of the operatively associated lamp, whereby upon said failure the other lamp will automatically be operatively associated with said optical system and will receive full current.

5. In combination with an optical system, a replicable light source comprising an electric lamp, said lamp being rigidly fixed, a magnetic coil in series therewith, a latch and means tending to move said latch to release position, said magnetic coil being located to counteract said means when energized, and means restrained by said latch and acting upon movement of said latch to release position, for substituting a second electric lamp for said first lamp, said second lamp being rigidly fixed, whereby, upon failure of said

electric lamp, said latch will move to release position and said substitution will occur.

6. In a replacement device for a light source, a source of current, an electric lamp supplied therefrom, said lamp being rigidly fixed, a coil in series with said lamp, a coil supplied from said source independently of said lamp, a latch subject to the differential action of said coils and light substituting mechanism controlled by said latch, whereby, upon failure of said current source, the latch will be unaffected but upon failure of current through said lamp and continued effectiveness of said current source, said latch will be moved causing said light-substituting mechanism to operate.

7. In combination with an optical system and a pair of stationary light sources, a movable optical device for operatively associating one or the other of said light sources with said optical system, means for biasing said optical device to cause it to tend to substitute one of said associations for the other and means for reversing the direction of said bias.

8. In combination with an optical system, a reflecting device, a plurality of light sources, means for positioning said reflecting device to operatively associate one of said light sources with said system and means acting automatically upon failure of said light source to position said reflecting device to operatively associate another of said light sources with said system.

9. In combination with an optical system, a reflecting device, a plurality of light sources, means for positioning said reflecting device to operatively associate one of said light sources with said system, means acting automatically upon failure of said light source to position said reflecting device to operatively associate another of said light sources with said system, and means for preventing such movement of said reflecting device upon simultaneous failure of all the light sources.

10. In combination, two electric lamps, a resistor in series with one of said lamps, a switch and connection, whereby in one position said switch establishes a circuit for said last-named lamp effectively free from the resistance of said resistor and means operable upon failure of the other of said lamps for moving the switch to said position.

11. In combination, a pair of light sources, an optical system, a movable optical device for operatively associating said system with one or the other of said light sources, spring means for moving said optical device, manual means for adjusting said spring means to control the sense of said movement and restraining means controlled by failure of a light source for controlling the occurrence of said movement.

12. In combination, a pair of light sources, an optical system, a casing, a movable optical device within said casing, spring means for moving said optical device, manual means for adjusting said spring means to control the sense of said movement and restraining means controlled by failure of a light source for controlling the occurrence of said movement.

13. In apparatus of the character described including an optical system for directing a light beam on a moving film, a plurality of light sources, means for directing light selectively from one or the other of said sources on said optical system, and means operative in response to a failure of one of said sources for operating said means to cause light from another of said sources to be directed on said system.

14. In apparatus of the character described including an optical system for directing a light beam on a moving film, a plurality of light sources, a movable reflector having limiting positions in which light from the respective sources is reflected toward said optical system and means responsive to the failure of one of said sources for shifting the reflector from one position to another.

15. In apparatus of the character described including an optical system for focusing a light beam on a moving film, a plurality of light sources, a pivotally mounted reflector having limiting positions in which light from the respective sources is reflected toward said optical system, and means operative in response to a failure of the source whose light is being reflected toward the optical system for moving the reflector from the corresponding position to another position.

16. In apparatus of the character described including an optical system for focusing a light beam on a moving film, two similar light sources, a pivotally mounted reflector for reflecting the light from said sources into said optical system, means for limiting the movement of the reflector betweeen two predetermined positions, and means responsive to a failure of one of said sources for shifting the reflector from one position to the other.

17. In apparatus of the character described including an optical system for focusing a light beam on a moving film, two similar light sources, a pivotally mounted reflector for reflecting the light from either of said sources into said optical system, a spring for shifting the reflector from position reflecting light from one source to the optical system to a position reflecting light thereto from the other source, an electromagnetic device for normally retaining the reflector in said first position and for releasing the reflector in response to a failure of said one source.

18. In apparatus of the character de-

scribed including an optical system for focusing a light beam on a moving film, two similar light sources, a pivotally mounted reflector for reflecting the light from either of said sources into said optical system, a spring for shifting the reflector from a position reflecting light from one source to the optical system to a position reflecting light thereto from the other source, and an electromagnetic device for retaining the reflector in said first position while said one source is energized and for releasing the reflector and closing the circuit of the other source in response to the burning out of said one source.

In testimony whereof, I have hereunto subscribed my name this 24th day of July, 1929.

LEWIS WARRINGTON CHUBB.