Nov. 28, 1933. J. O. KLEBER 1,937,089

MACHINE FOR RECORDING AND REPRODUCING SOUND MOTION PICTURES

Filed Sept. 9, 1929 2 Sheets-Sheet 1

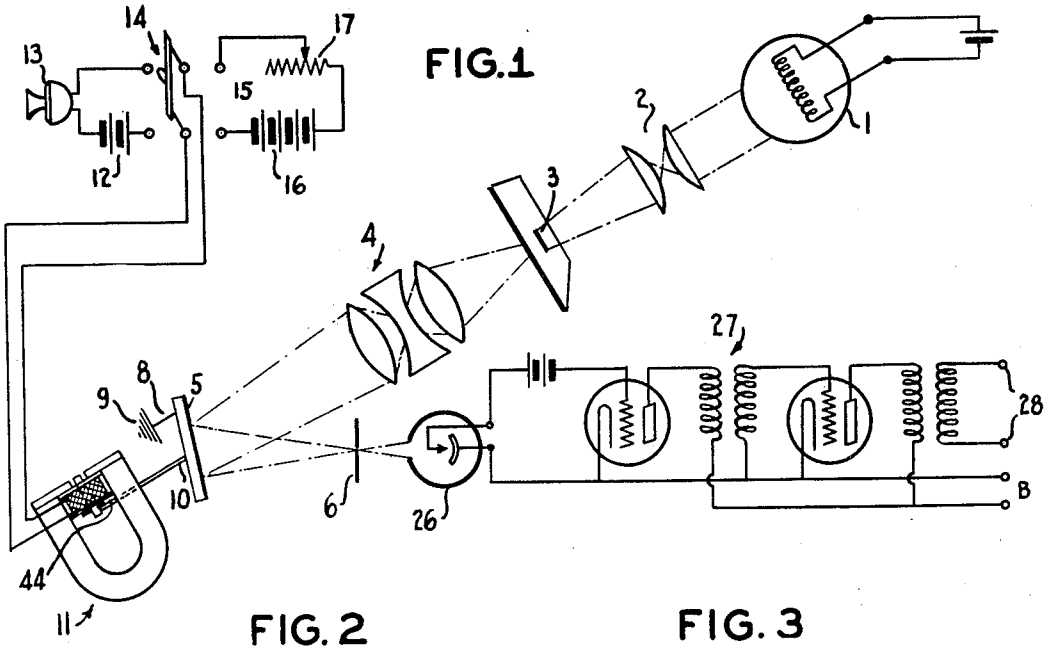
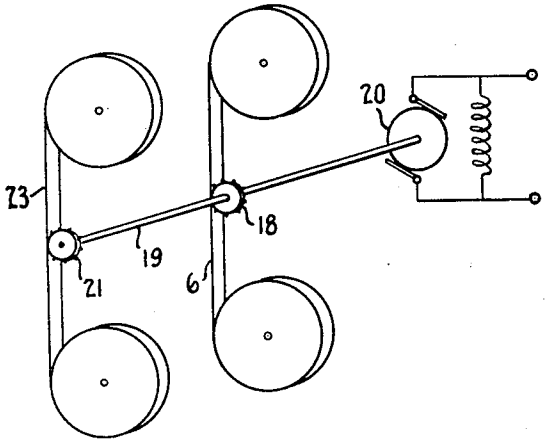


FIG. 1

FIG. 2

FIG. 3



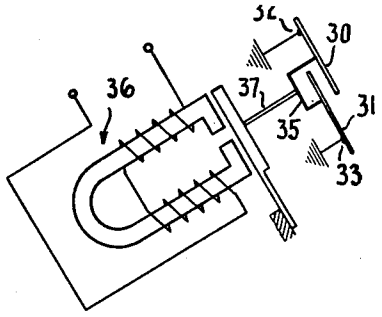


FIG. 5



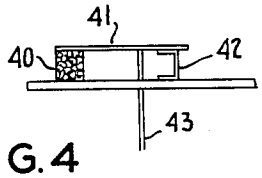


FIG. 4

INVENTOR
Jackson O. Kleber
BY
Edward W. Fearing
ATTORNEY

Nov. 28, 1933. J. O. KLEBER 1,937,089

MACHINE FOR RECORDING AND REPRODUCING SOUND MOTION PICTURES

Filed Sept. 9, 1929 2 Sheets-Sheet 2

FIG. 6

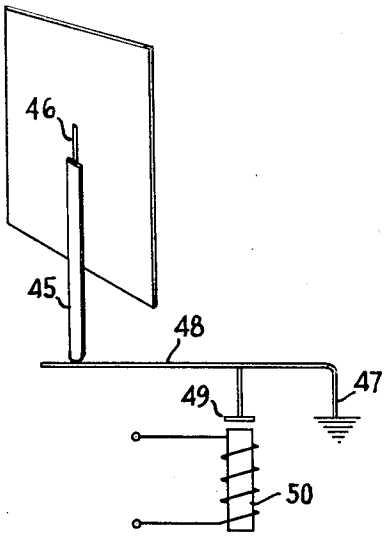


FIG. 7

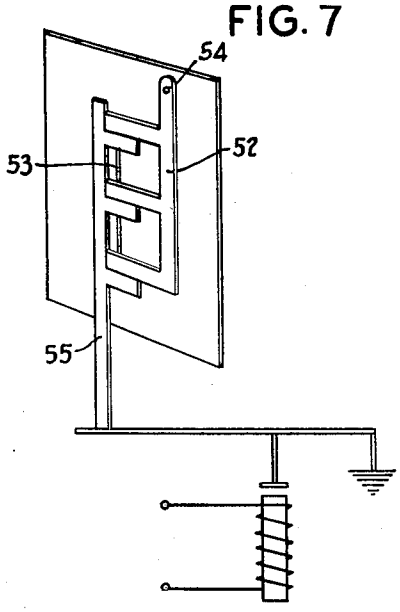


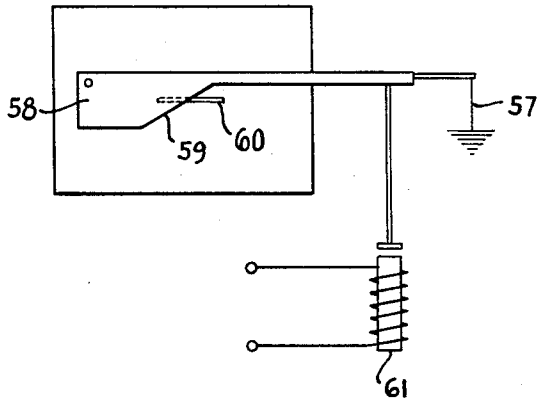
FIG. 8



FIG. 9



FIG. 10



INVENTOR
Jackson O. Kleber
BY
Edward W. Fearing
ATTORNEY

Patented Nov. 28, 1933 1,937,089

UNITED STATES PATENT OFFICE

1,937,089

MACHINE FOR RECORDING AND REPRODUCING SOUND MOTION PICTURES

Jackson O. Kleber, Jackson Heights, N. Y.

Application September 9, 1929. Serial No. 391,201

8 Claims. (Cl. 179—100.3)

This invention relates to light recording and reproducing apparatus, more particularly when used in connection with talking moving picture machines in which a light responsive or sensitized film moves in conjunction with or is a part of another film on which pictures are being exposed or are already developed. Such apparatus has been previously constructed and requires extremely fine manipulation and adjustment. Heretofore film has been exposed or sounds recorded thereon in one machine, adapted by carefully designed adjustable features, particularly applicable to this operation, and the sounds have been reproduced from the film after exposure and development in another machine having adjustable features governing this operation. The present invention relates to a machine which will accomplish both of these operations by means of substantially the same adjustment features except for those peculiar to the elements of the machine not common to both.

It is therefore an object of this invention to provide a machine which will be adapted upon proper adjustment to both record and reproduce sound onto and from a light film.

Another object is to improve the operation and simplify the construction of machines of this nature.

A further object is to provide a simple and efficient adjustment feature for rendering a recording device of this nature usable as a reproducer.

Another object is to improve the operation and minimize the number of adjustments necessary to the reproduction of a particular film by permitting such reproduction on the same machine on which the film was produced.

Another object is to improve the operation of light deflecting means used in connection with machines of this nature by rendering such means properly aperiodic in their movements.

A still further object is to improve the slit construction of machines for recording and reproducing sound by light methods, more particularly wherein separate light deflecting means may be dispensed with and special means for controlling the length of the slit is provided.

A further object is to adapt a recording machine for reproducing by properly arranging the light modifying, deflecting and recording elements.

Another object is to improve the operation of light recording and reproducing machines in which there is provided a slit for restricting the passage of light by focusing the reflected image of the slit upon the light recording element or film.

A further object is to provide apparatus for producing light films having more than one light track, each of which is made simultaneously with another and if desired may be made slightly out of phase therewith by deflecting the light beam to another portion of the film more remote from the portion on which the first light beam is directed or by staggering the individual sections of the slit.

Further and more definite objects will appear from the following specifications, claims and drawings, in which:

Figure 1 shows a diagrammatic view of the features embodying my invention;

Fig. 2 is a diagrammatic view of the arrangement of a sound machine and a moving picture machine according to the features of my invention;

Fig. 3 is a modified form of light deflecting device which may be used herein;

Fig. 4 shows the means for rendering the vibratory light deflecting element sufficiently aperiodic in its movement.

Fig. 5 is a section of a film produced by such a deflecting element.

Fig. 6 is a modified form of slit which may be used with the features indicated in connection with Fig. 1 or may be used without the separate light deflector, in which case the modulation circuit may be connected directly to the magnet of Fig. 6.

Fig. 7 is a still further modified form of slit arrangement to be used as stated in connection to the slit of Fig. 6.

Fig. 8 is a section of film made with the modified form of deflector shown in Fig. 3.

Fig. 9 is a section of film produced with the modified form of slit indicated in connection with Fig. 7.

Fig. 10 shows another modified form of slit to be used as indicated in connection with Fig. 6.

Referring now more particularly to the drawings, a source of light 1, shown as a lamp with helical filament but any other type filament might as well be used, is directed toward the light condenser 2. This condenser concentrates the light onto a slit 3 formed in a shield so that no other light may reach apparatus disposed beyond this point than that which passes through the slit. In lighting this slit it is desirable to illuminate the end which is focused on the mid-portion of the film, more brilliantly than elsewhere. This can be done by properly arranging the condenser

2. Also, by using a small prism adjacent one end of the slit or by purposely using a lens which produces a spectrum at one end, the sharpness of the sound outline may be improved.

The slit 3 being thus illuminated, the light is directed further through the set of light converging objective lenses 4 having any number of lenses, the only requisite being that an accurate image be cast thereby. The light passes through these lenses onto the mirror 5, which will be described more in detail hereinafter. From the mirror it passes onto a movable film 6 which may have light sensitive salts deposited thereon in a well known manner.

The slit 3, objective lenses 4, mirror 5 and film 6 are so placed as to produce an accurate image of the slit 3 upon the film 6. This is an important feature of the invention inasmuch as it prevents distortion of the sounds recorded, and lends itself to easy manipulation where it is desired to use the machine for both recording and reproducing of sound.

The mirror 5 is hingedly mounted for movement at 8 to a stationary part 9. A connection 10 adjacent the hinge 9 mechanically associates the mirror to the moving system of an electro-magnetic motor device 11 of any well known form, one type of which known as the Baldwin unit has given satisfactory results, although any suitable type could be used. The circuit of the unit is connected to a source of power 12 and to a microphone or output of an amplifier which is connected to a microphone 13 through a double throw switch 14. On the other side of the switch 14 is connected a circuit 15 having battery 16, the adjusting rheostat 17 which is of the proper size to vary the amount of current through the coils of the loud speaker unit 11 from practically no current at all to the maximum permissible energization thereof. This circuit could be permanently connected to the microphone if desired, omitting the switch 16.

If the film is moved at a suitable speed at the same time that sounds are impressed upon the microphone 13, it is obvious that a sound curve will be traced upon the film in accordance with the movements of the mirror, since in this operation the images of the slit will be moved longitudinally across the film, tracing as the film moves, an oscillograph of the sound curve with one end of the image. This is quite distinct from systems depending upon the variation of illumination of the slit.

The film 6 is held in a suitable guide to prevent lateral movement and is propelled by sprocket 18 connected to motor shaft 19 driven by motor 20. Another sprocket 21 on a suitable motion picture camera or projector propels the film 23 in a manner common to such devices. It may be necessary to provide a detachable coupling between the two sprockets so that any type of picture camera or projector may be utilized.

On the opposite side of the film from the direction from the source of light or on the opposite side from the light there is arranged within the structure of the machine a light responsive cell 26. This cell is connected with amplifying system 27 composed of vacuum tube amplifiers and sources of energizing potential. The output connections 28 may be in circuit with a loud speaker.

In any type of electro-magnetic unit there is a certain definite mechanical bias given to the moving armature to return it to its normal position as well as to prevent its sticking to the pole pieces. In the present instance this is supplemented by a normal bias of the mirror. This is ordinarily adjusted when the device is constructed to throw the image of the slit on the film so that the brilliantly illuminated tracing end will take a normal position in about the middle of the film.

The circuit 15 is arranged with its constants adjusted so that the image of the slit may be thrown entirely across the film by giving the mirror the proper bias electrically. This electrical bias might also be used in conjunction with the microphone to more accurately position the mirror and slit image on the film. This arrangement is more satisfactory than in attempting to mechanically change the bias on the mirror, particularly because of the delicacy of the parts and the trouble occasioned by refocusing the slit necessitated thereby. Such biasing may be done with the vibratory mirror adjacent the film because in this position the entire slit image can be shifted whereas elsewhere the position of the image is controlled by other elements which might need to be readjusted whenever the light is redirected through them. However, the use of a biasing means on a deflector might be used in other relations.

If instead of using the mirror shown in Fig. 1, a mirror suspension such as shown in Fig. 3, is used, a double modulation of the light band will result. Here there are two mirrors 30 and 31, hinged at separated points 32 and 33, respectively. Adjacent portions are connected to a common flexible yoke 35 and to the operating unit 36 by rod 37. This moves the mirrors in opposite directions, causing the corresponding beams of light to produce a double effect. It is necessary that the mirrors be adjusted so that they will be substantially parallel and that the end of one beam will not interfere with the other. If desired the mirrors may be operated by independent units of different natural frequency responses so that one having a natural resonance characteristic of low frequency and another of higher frequency independently connected to different mirrors and operated from the same electrical output may be used.

It is desirable that the mirrors or other light deflecting means used, be properly damped so as to be rendered substantially aperiodic in their movement throughout all of the frequencies impressed thereon. For this purpose it is necessary to apply the damper directly to the vibrating element, in this case the mirror, on account of the likelihood of independent vibration of the individual parts of the moving system. In doing this care must be taken not to damp too much, thereby preventing sufficiently free movement and also the damping must be sufficient to prevent distortion due to the pronounced resonance of the parts.

In overcoming these difficulties it has been found that with a mirror of small size the damping may be accomplished by applying a damper such as is shown at 40 in Fig. 4 under the edge of the mirror 41. This damper may be of any suitable material not too hard in texture. Sponge rubber has been found to be very satisfactory for this purpose. This damper should be placed at the point furthest away from the hinge 42 on which the mirror is suspended. In order to obtain the greatest effect of the unit it is desirable to position the hinge quite near to the operating connection 43 to the unit. These two connections are made as near as possible to the middle of the mirror so that there will be as little movement of the center of the mirror in a

line perpendicular to its plane as possible. This is to prevent throwing the image of the slit out of focus. The mirrors described in Figs. 1 and 3 should be supplied with such dampers. This damping action may also be supplemented by using a piece of sponge rubber under both edges of the mirror and also against the connection 10 or 43 to prevent resonant vibration. For instance a piece of damping material might be used in the space 44 between the rod 10 and the pole inside of the unit in Fig. 1.

With proper damping of the deflecting element a true oscillograph with as is shown in Fig. 5 will result. If improper damping is accomplished the wave form will not only be distorted but also the density of the film will be varied owing to uneven periods of exposure. With the double mirror an envelope or doubly modulated form will be effected as is shown in Fig. 8.

A slit such as shown in Fig. 6 may be used without a deflector. Here the shutter 45 is positioned to cover part of the slit 46 and is movably hinged to a stationary part 47 by the lever arm 48, carrying the armature 49 actuated by the electromagnet 50. This shutter could be modified as shown in Fig. 7 if desired giving a plurality of modulated tracks on the film shown in Fig. 9. In recording sound in this way the light beams may be deflected by prisms or by staggering the different parts of the slit as divided by the combs. Here the comb is permanently fixed to the slit 53 by the pin or rivet 54 and the comb 55 is secured to the moving system as previously described in connection with Fig. 6. A still further modified form of slit is shown in Fig. 10 wherein the fulcrum is at 57 and the shutter 58 has an inclined edge 59 cooperating with the slit 60. The shutter is operated by the magnet 61. The light cell should be so arranged that any light which passes through the film will affect the current in circuit with the cell.

After the film has been exposed and developed it may again be used in the same machine thereby insuring that no difficulty will be encountered with varying sizes of film or other adjustments. The only difference in the use of the machine which projects the image of the slit upon the film in its operation as a reproducer and a recorder is that in the first case the image of the slit must cover the whole film whereas in recording it must be movable and cover only a part of the film.

It has been found that the mirror 5, when the device is used as a recorder, must be so biased as to throw the image of the slit 3 so that the end of it will come in the middle of the sensitized portion of the film. However, when the apparatus is used as a reproducer, the entire slit must cover the film or at least that much of it as is affected by the exposure, to obtain the best results. The switch 14 and the rheostat 17 are therefore provided in the circuit 15 to permit easy change from one condition to the other. It is quite apparent that this is much simpler and more effective than attempting to readjust the entire light system as would be necessary with the arrangement of parts according to previous machines of this nature.

The apparatus may be operated as a recorder by using the microphone 13 on the location at which the moving pictures are being taken by synchronizing the sprocket shaft 19 with the camera. This may be done by coupling the shafts of the two machines. When the action is to be reproduced the switch 14 may be reversed and the proper bias given the mirror 5 to project the image of the slit entirely across the film. In this case the shaft 19 may be coupled with the motion picture projector, the proper synchronization having been determined. Now when the light cell 26 is energized together with its amplifying circuits the loudspeaker or other device connected to the output 28 will reproduce the sounds in accordance with the motion shown in the pictures. It is also apparent that the entire mechanism should be enclosed in a light proof casing so as to prevent interference with the operation by external sources at light.

The sound film may be printed on the same film with the pictures if desired, so that the reproducer may be mounted above or below the projector and the two reproductions then properly spaced in phase to compensate for the difference in time required to travel between the two machines.

Various other modifications and changes might be made both in the structure set forth and the operation indicated without departing from the intended spirit and scope of the invention. It is not intended to be limited to the exact structure shown but only to the extent specified in the appended claims.

What I desire to claim is:

1. An optical translating machine for selectively recording and reproducing sounds having, in combination, a source of light, a light condenser, a screen having a slit arranged in a concentrated beam of light from the condenser, an objective lens in the path of light from the slit, a film guided for movement in a plane passing through the rays of light directed from the objective lens at a position where the image of the slit is formed, a sound operated light controlling means arranged to vibrate the beam of light at right angles to the line of film movement and located along the light path between the slit and the film and a light responsive cell at the opposite side of the film from said light controlling means.

2. An optical sound translating apparatus for selectively recording or reproducing sounds having, in combination, a source of light, a light condenser, a screen having a slit arranged in a concentrated beam of light from the condenser, an objective lens in the path of light from the slit, a film guided for movement in a plane passing through the rays of light directed from the objective lens at a position where the image of the slit is formed, a light controlling means located along the light path between the slit and the film for vibrating the light path at right angles to the line of film movement, a sound operated device for operating the light controlling means, a light responsive cell at the opposite side of the film from said light controlling means and a manually shiftable apparatus for connecting and disconnecting the sound operated device from the light controlling means and at the same time for actuating the light controlling means to change the normal position of the slit image on the film when the sound operated device is disconnected from the light controlling means.

3. An optical sound translating apparatus for selectively recording or reproducing sounds having, in combination, a source of light, a light condenser, a screen having a slit arranged in a concentrated beam of light from the condenser, an objective lens in the path of light from the slit, a film guided for movement in a plane passing through the rays of light directed from the objective lens at a position where the image of the

slit is formed, an electrically operated light controlling means located along the light path between the slit and the film, a microphone for operating the light controlling means, a source of potential for producing a steady deflection of the light controlling means, a light responsive cell at the opposite side of the film from said light controlling means and a double throw switch operable at will to connect the source of potential to the light controlling means and at the same time to disconnect the microphone from the light controlling means.

4. An optical sound translating machine having, in combination, a source of light, a light condenser, a screen having a slit arranged in a concentrated beam of light from the condenser, an objective lens in the path of light from the slit, a film guided for movement in a plane passing through the rays of light directed from the objective lens and an electromagnetically operated mirror located along the light path between the slit and the film and provided with a sponge rubber vibration damper secured between the mirror and a stationary part to control the light projected on the film.

5. An optical translating apparatus for selectively recording or reproducing sounds having, in combination, a source of light, an optical system for directing a narrow beam of light upon a film, a light responsive cell positioned to receive the light passing through the film and means for controlling the light acting upon the film comprising, an electromagnetically operated mirror mechanically biased to a normal inactive position in which one edge of the light beam strikes the central part of the film, a microphone for vibrating the mirror from its normal position and means operable at will to produce a steady deflection of the mirror from normal position to a position in which the light beam is thrown entirely across the film and simultaneously to disconnect the microphone from the electromagnetically operated mirror.

6. An optical translating apparatus for selectively recording or reproducing sounds having, in combination, a source of light, an optical system for directing a narrow beam of light upon a film, a light responsive cell positioned to receive the light passing through the film, and means for controlling the light acting on the film comprising an electromagnetically operated mirror mechanically biased to a normal inactive position, a microphone for vibrating the mirror from its normal position, a source of potential for producing a steady deflection of the mirror from normal position and a switch operable at will to connect the microphone to the electromagnetically operated mirror and simultaneously to disconnect the source of potential from the mirror.

7. An optical translating apparatus for selectively recording or reproducing sounds having, in combination, a source of light, an optical system for directing a narrow beam of light upon a film, a light responsive cell positioned to receive the light passing through the film, and means for controlling the light acting on the film comprising an electromagnetically operated mirror mechanically biased to a normal inactive position in which one edge of the light beam strikes the central part of the film, a microphone for vibrating the mirror from its normal position, a source of potential for producing a steady deflection of the mirror from normal position to a position in which the light beam is thrown entirely across the film, a switch operable at will to connect the source of potential to the electromagnetically operated mirror and simultaneously to disconnect the microphone from the mirror, and a rheostat arranged in a circuit with the source of potential for adjusting the steady deflection of the mirror from normal position.

8. An optical sound translating apparatus having, in combination, a source of light, a light condenser, a screen having a slit arranged in a concentrated beam of light from the condenser, an objective lens in the path of light from the slit, a film guided for movement in a plane passing through the rays of light directed from the objective lens and a sound operated light controlling means located along the light path between the slit and the film comprising a mirror suspension, a hinge upon which the mirror is mounted, an actuating rod attached to the mirror suspension adjacent the hinge and a vibration absorbing element positioned to contact with the mirror suspension in substantial alignment with said hinge and the point of attachment of the actuating rod but at the opposite side of the actuating rod from said hinge

JACKSON O. KLEBER.

CERTIFICATE OF CORRECTION.

Patent No. 1,937,089. November 28, 1933.

JACKSON O. KLEBER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 105, claim 1, for "and" read or; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of February, A. D. 1934.

(Seal)

F. M. Hopkins
Acting Commissioner of Patents.