

Oct. 21, 1941.

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2,260,202

SOUND FILM RECORDING OR REPRODUCING DEVICE

Filed April 3, 1940

3 Sheets-Sheet 1

FIG. 1

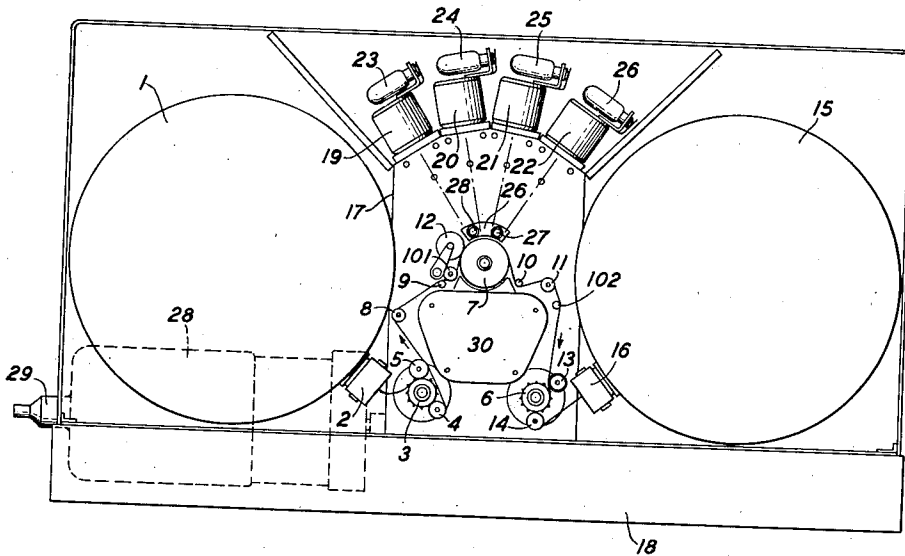


FIG. 8

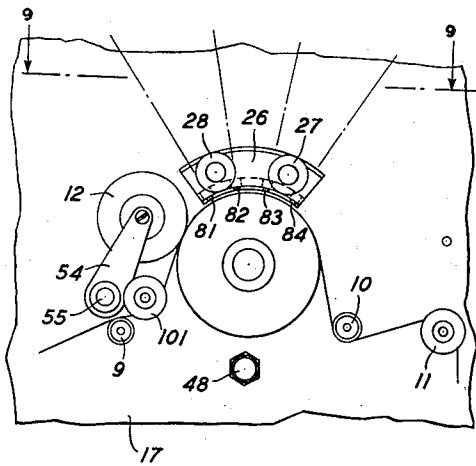
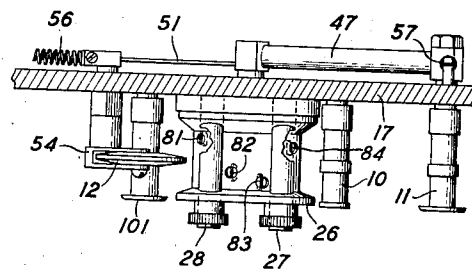


FIG. 9



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3 Sheets-Sheet 2

FIG. 2

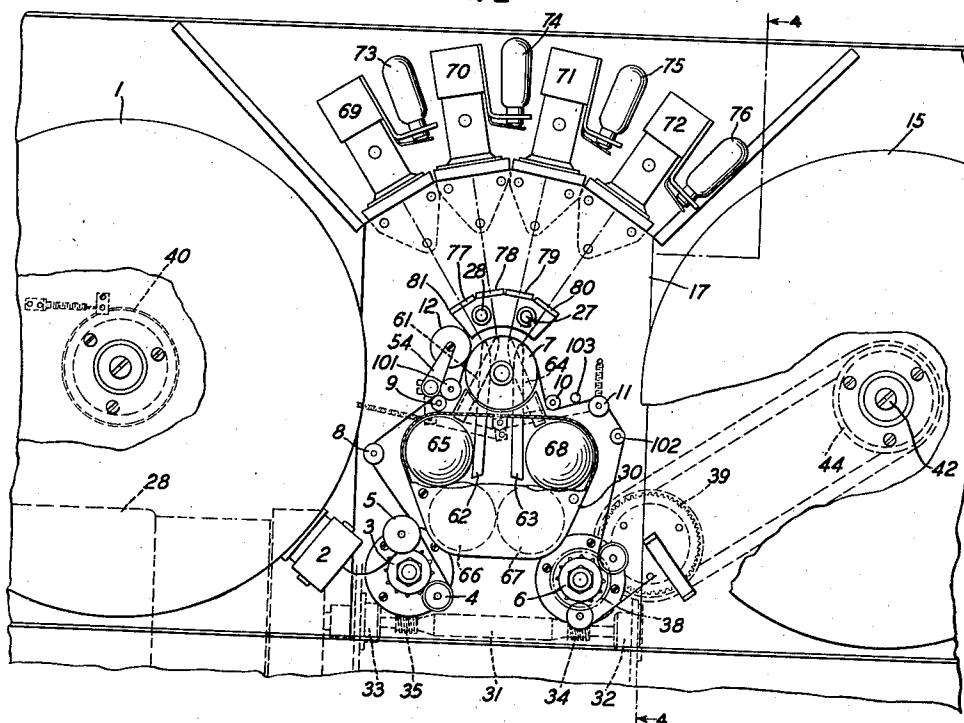
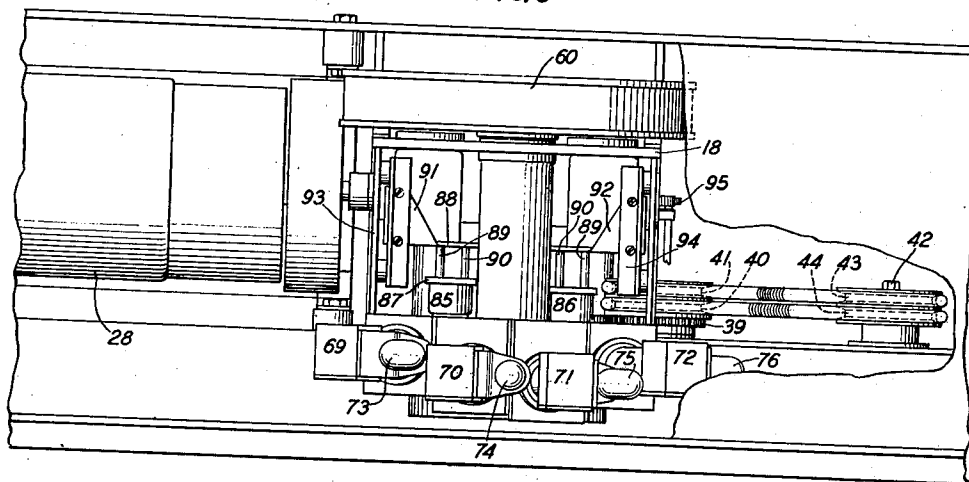


FIG. 3



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SOUND FILM RECORDING OR REPRODUCING DEVICE

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Application April 3, 1940, Serial No. 327,583

14 Claims. (Cl. 179—100.3)

This invention relates to film recording and reproducing systems and apparatus and more particularly to such apparatus incorporating means for simultaneously recording, or reproducing from, a plurality of individual sound tracks on a single film.

The object of the invention is to provide a recording and/or reproducing apparatus of compact construction incorporating a plurality of recording or reproducing optical systems for simultaneously recording, or reproducing from, a plurality of sound tracks on a single film in engagement with a single supporting roller gate.

A further object of the invention is to provide a combined recording and reproducing apparatus wherein the recording and reproducing optical systems may be readily interchanged without disturbing the film driving and guiding elements of the apparatus.

A feature of the invention resides in the construction of the apparatus permitting the disposition of a plurality of recording or reproducing optical units circumferentially adjacent the film engaging side of a single film supporting roller and displaced relative to each other axially of the roller.

The invention will be best understood from the following detailed description, reference being had to the appended drawings.

Fig. 1 is a side elevation of the machine showing the recording units in place;

Fig. 2 is a corresponding view of the machine with the reproducing units in place and illustrating the device in somewhat greater detail;

Fig. 3 is a plan view;

Fig. 4 is an end elevation partly in section;

Fig. 5 is a detail view showing operating mechanism for a film retaining pressure roller and the position of an optical unit with respect to the recording drum;

Fig. 6 is a detail view showing the mounting of the spherical reproducing lenses in their carrier which is interchangeable with a carrier mounting cylindrical recording lenses;

Fig. 7 shows the construction of a band brake which is used to prevent overrunning of the film supply reel;

Fig. 8 shows the cylindrical recording lenses in position adjacent the recording drum; and

Fig. 9 shows mounting details of the recording lens unit together with details of film retaining and guide rollers.

As shown in Fig. 1 film from a supply reel 1 is drawn through a light seal 2 by a driven sprocket 3 about which the film is given wrap by

means of unflanged retaining roller 4 and flanged retaining roller 5. Roller 5 also serves to assist in guiding the film toward a flanged guide roller 8. A driven sprocket 6 pulls the film over a drum 7. This drum is driven by the passage of the film thereover and is coupled to an inertia member which will be discussed hereinafter. In its passage to and from the recording drum 7 the film is guided by guide rollers 8, 9, 10, 11 and 12 and is held snugly against the drum by means of a pressure roller 12. Guide and retaining rollers 13 and 14 cooperate with sprocket 6. After leaving sprocket 6 the film is taken up in the usual manner by a take-up reel mounted in a container 15. On its way to the take-up reel the film passes through a light seal 16. Removably secured to a standard 17 mounted on a base member 18 are recording units 19, 20, 21 and 22 together with their associated exciter lamps 23, 24, 25 and 26. These light valves are preferably of a construction disclosed in my copending application Serial No. 318,922, filed February 14, 1940. A part of the optical system for each light valve is self-contained but final definition of the line of light on the film is obtained by means of small cylindrical lenses, to be subsequently described, mounted in a removable carrier 25 which is secured to standard 17 by means of thumb screws 27 and 28. Power for the device is supplied by means of a motor 28 shown in dotted lines. An end bearing of the motor is shown at 29. A cover 30 closes a compartment protecting a plurality of photocells in a manner to be more fully described hereinafter.

Referring now to Fig. 2 it may be seen that motor 28 drives a shaft 31 supported by suitable bearings 32 and 33 and carrying worms 34 and 35. As may best be seen in Fig. 4, the worm 34 cooperates with a worm wheel 36 which is secured to the shaft on which sprocket 6 is mounted. This shaft may rotate in suitable bearings between standard 17 and a rear standard 18, both of which are secured by any convenient means to the base 1. Sprocket 3 is driven by worm 35 through a gear corresponding to gear 36, the sprocket shaft being supported between standards 17 and 18, as has just been described. The sprocket shaft 37 has secured thereto a gear 38 which drives gear 39 (Fig. 2). As may best be seen in Fig. 3 a pair of pulleys 40 and 41 are mounted on the shaft with gear 39 and are driven thereby. A take-up reel is mounted on a shaft 42, this shaft being driven by means of pulleys 43 and 44 which are belt-connected to pulleys 41 and 40, respectively. The belts used are in the form of helical springs, the

diameter of the helix being relatively large. The creep of these spring belts over their cooperating pulleys, as a result of compression on one side and stretch on the other side, provides a sufficiently flexible connection to the take-up reel so that the usual friction clutch may be dispensed with.

As the film is drawn from the supply reel the supply reel rotates and generates a considerable amount of inertia. In case the motor circuit is opened to stop the machine, it is desirable that some means be provided to slow down and stop rotation of the supply reel. A band brake for this purpose is provided and is indicated generally in Fig. 2 at 40. This brake is shown in greater detail in Fig. 7 and consists of a band of woven or webbing belting 41 anchored at 42 and maintained under tension by means of a spring 43, one end of which may be adjustably secured in a mounting bracket 44. The brake band 41 cooperates with a drum 45 fixedly secured to a shaft 46 driven by rotation of the supply reel which may be keyed thereto in the usual manner. It should be noted that the direction of rotation of the drum is in a direction to tend to loosen the wrap of the band. After the system attains equilibrium, an extremely uniform load or drag is produced by the device.

In order that the translating drum 7 may be driven by the film during its passage thereover, it is necessary that the film be wrapped tightly about the drum at all times. This is insured by means of a mechanism about to be described and best seen in Fig. 5. The flanged idler roller 11 is rotatably mounted on a stud secured to a lever arm 47 which is free to pivot about a stud 48 secured to standard 17. A right-angled extension 49 of lever 47 provides a pivot point 50 for a lever 51 secured to a lever arm 52 by means of a pivot 53. Pressure roller 12 is suitably journaled in a pivoted arm 54 which is rigidly secured to arm 52, both arms being rotatable about a common pivot 55. A spring 56 tends to produce clockwise rotation of lever arms 52 and 54 to cause roller 12 to press the film lightly toward roller 7. A spring 57 tends to produce counter-clockwise rotation of lever arms 47 and 49 about their common pivot. As the film is pulled downward by sprocket 6, the pull on the roller 11 tends to produce counter-clockwise rotation of levers 47 and 49. Such rotation moves lever arm 51 to the left and tends to produce a clockwise rotation of arms 52 and 54. As a result of the linkage arrangement just described, it is obvious that pull on the film by sprocket 6 tends to press roller 12 firmly against the film at the point where it engages roller 7 and thus maintain it snugly wrapped around the roller. The film is also guided by means of a freely rotatable roller 10 mounted on a fixed stud 58.

The foregoing description applies particularly to the interval during which roller 7 is started from rest and is being accelerated to full speed. After it has attained full speed, the film pull is insufficient to overcome spring 57 and lever 47 returns into engagement with limiting stop 103. In this position of lever 47, roller 12 applies a moderated pressure to the film.

Roller 1 is mounted on the end of a shaft suitably journaled in supports 17 and 18. These bearings have not been shown but their general disposition may be understood by reference to Fig. 4. An inertia member 60 is rigidly secured to the same shaft as sprocket 7 and is driven thereby. This inertia member may take the form of a solid flywheel or a velocity regulator

of the type commonly known in the art as a "kinetic scanner" but is preferably of the type shown and described in my copending application Serial No. 294,855, filed September 14, 1939. It is the function of this inertia member to cause the roller 7 to turn at an extremely uniform rate of speed to maintain the uniform velocity of film travel which is essential to recording sound on, or reproducing sound from, photographic film.

As may be seen in Fig. 4, the roller 7 is provided with a series of deep grooves extending well below its outer periphery. These grooves are spaced axially along the shaft so as to cooperate with correspondingly spaced optical elements forming part of either the recording or reproducing optical systems. As shown in Fig. 2, glass rods 61, 62, 63, and 64 extend into these grooves and pick up light which has passed through the film at points corresponding axially with the position of the grooves and guide such light to photocells 65, 66, 67 and 68, respectively. These photocells translate the varying light energy into varying electrical energy and supply the loud-speakers of the system during reproduction. They may also be used, if desired, to energize monitoring loud-speakers during recording.

As shown in Fig. 2, four reproducing units cooperate with the four records on the film. These units are indicated at 69, 70, 71 and 72 and support exciting lamps 73, 74, 75 and 76. The units are removably secured to standard 17 and are interchangeable with the recording units previously described. Each reproducing unit incorporates optical means for collecting light from its associated exciting lamp and focusing it in a fine line across the sound track to which it is individual. Cooperating with these optical systems is a group of four spherical lenses 77, 78, 79 and 80 mounted in a carrier 81 which may be readily removed by means of thumb screws 27 and 28 previously discussed in connection with cylindrical lens carrier 26.

This lens carrier is shown in greater detail in Fig. 6 which shows the space relation of the various lenses along the axis of the translating drum. Fig. 5 shows added details of the mounting of these lenses which, in the present case, are standard microscope objectives, although obviously the type of optical system used with the device may vary widely. These lenses are preferably adjustable for focussing purposes.

Figs. 8 and 9 show substantially the same views of the machine as are shown in Figs. 5 and 6. In Figs. 8 and 9, however, the removable sector-shaped lens carrier used to supply part of the recording optical system is shown in position. Small cylindrical lenses 81, 82, 83 and 84 are carried by this sector which is removably secured by thumb screws 27 and 28. These lenses, when in position, are close to the film and their axes extend in parallel relation to the axis of the translating roller. As may be seen by inspection of either figure, they have a progressive angular offset with respect to the periphery of the roller. They are also staggered horizontally along the axis of the roller as may be clearly seen in Fig. 9.

The photocells are mounted in suitable sockets 85 and 86 as shown in Fig. 3. As the photocells must be so mounted as to extend into proper position to cooperate with the glass light conducting rods 61 to 64, the sockets are mounted on plates such as 87 which are spaced from a vertical panel 88 by means of tubular spacing

members such as 89 and 90. This panel together with a chassis support is secured by means of brackets 91 and 92 to vertical standards 93 and 94 by means of resilient mountings. The chassis may support suitable vacuum tube amplifiers for the various photocells. These amplifiers have not been shown in order to avoid needless complications in the drawings. The lateral spacing of the photocells and the method of using the spacing members are clearly shown in Fig. 4.

A film footage counter may be driven by means of a worm wheel 95 which cooperates with a worm on the main driving shaft of the device as indicated on Figs. 3 and 4.

What is claimed is:

1. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a film support, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units in cooperative space relation with respect to said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, and means to interchangeably mount said sets of optical units in cooperative space relation in proximity to said film.

2. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a curved support for said film, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units circumferentially of said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, and means to interchangeably mount said sets of optical units, circumferentially of and in cooperative proximity to said film.

3. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a film support, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units in cooperative space relation with respect to said film support, a set of optical units cooperating with said set of recording units and mounted in a unitary carrier, a second set of optical units cooperating with said set of reproducing units and mounted in a unitary carrier, and means to interchangeably mount said carriers whereby said optical units are mounted in cooperative proximity to said film.

4. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a curved support for said film, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units circumferentially of said film support, a set of optical units cooperating with said set of recording units and mounted in a curved common unitary carrier, a second set of optical units cooperating with said set of reproducing units and mounted in a curved common unitary carrier, and means to interchangeably mount said carriers to dispose said optical units circumferentially of and in cooperative proximity to said film.

5. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a curved support for said film, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units circumferentially of said film support, a set of optical units cooperating with said set of re-

cording units and mounted in a curved common unitary carrier, a second set of optical units cooperating with said set of reproducing units and mounted in a curved common unitary carrier, and means to interchangeably mount said carriers to dispose said optical units circumferentially of and in close proximity to said film, said optical units being so mounted in said carriers as to be angularly spaced with respect to the curvature of said film support and laterally spaced axially of said film support.

6. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a film support, a set of recording units, each of said recording units including an exciting lamp, a light valve and a portion of an optical recording system, a set of reproducing units, each of said reproducing units including an exciting lamp and a portion of an optical reproducing system, means to interchangeably mount said sets of units in cooperative relation with respect to said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, and means to interchangeably mount said sets of optical units in close cooperative relation with respect to said film.

7. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a film support, a set of recording units, each of said recording units including an exciting lamp, a light valve and a portion of an optical recording system, a set of reproducing units, each of said reproducing units including an exciting lamp and a portion of an optical reproducing system, said portion including light deflecting and focussing means, means to interchangeably mount said sets of units in cooperative relation with respect to said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, and means to interchangeably mount said sets of optical units in close cooperative relation with respect to said film.

8. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a film support, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units in proper space relation with respect to said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, means to interchangeably mount said sets of optical units in cooperative space relation and in proximity to said film, light guiding members extending through said film support into close proximity to said film, and a photoelectric cell individual to each member and cooperating therewith.

9. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a film support, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units in proper space relation with respect to said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, means to interchangeably mount said sets of optical units in cooperative space relation and in proximity to said film, glass rods extending through said film support into close proximity

to said film, and a photoelectric cell individual to each glass rod and responsive to light received from its associated rod.

10. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a rotatable film support, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units circumferentially of said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, and means to interchangeably mount said sets of optical units, circumferentially of and in proximity to said film.

11. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, film driving means, a rotary inertia member, a film driven rotary film support directly coupled to said rotary inertia member, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units circumferentially of said film support, a set of optical units cooperating with said set of recording units, a second set of optical units cooperating with said set of reproducing units, and means to interchangeably mount said sets of optical units, circumferentially of and in proximity to said film.

12. In a device for recording sound on, or reproducing sound from, a multiple track photographic film, a rotary film support, grooves in said support, there being a groove for each sound track space on said film, a set of recording units, a set of reproducing units, means to interchangeably mount said sets of units circumferentially of said film support, a set of optical units cooperating with said set of recording units, a sec-

ond set of optical units cooperating with said set of reproducing units, means to interchangeably mount said sets of optical units, circumferentially of and in proximity to said film, light guiding members extending through the grooves in said film support into proximity to said film, and a photoelectric cell individual to each of said members and cooperating therewith.

13. In combination, in a film recording or reproducing apparatus, a casing, means in said casing for driving said film, a curved film support in said casing adapted to be engaged by said film, a plurality of lens units circumferentially disposed adjacent the film engaging side of said film support and offset transversely of said support with respect to each other, a plurality of light modulating devices and means on said casing for mounting each of said modulating devices on said casing in optical alignment with one of said lens units.

14. In combination, in a film recording or reproducing apparatus, means for driving said film, a roller adapted to be engaged by said film, said roller having a plurality of circumferential grooves therein, a plurality of individual optical systems circumferentially disposed adjacent the film engaging side of said roller and offset with respect to each other axially of said roller, a plurality of light sensitive elements disposed adjacent the non-film engaging surface of said roller, and a plurality of light transmitting rods extending into the grooves in said film driven roller and interposed between said film and said light sensitive elements, each light transmitting rod being arranged to transmit the light projected through said film by one of said optical units to one of said light sensitive elements.

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