

May 20, 1941.

G. P. REGAN ET AL

2,242,548

METHOD AND MEANS FOR REPRODUCTION OF SOUND

Filed Sept. 28, 1938

3 Sheets-Sheet 1

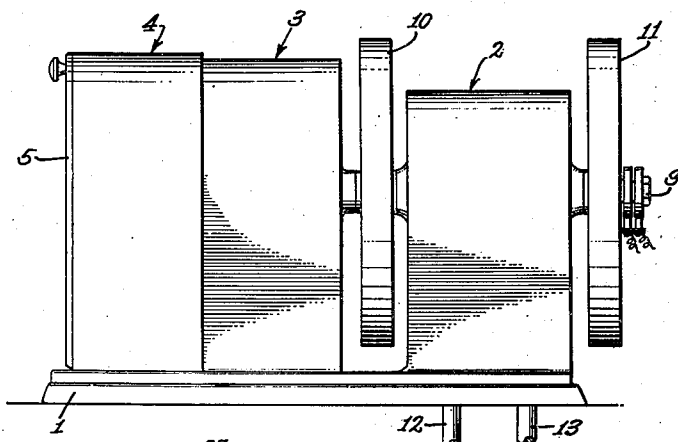


Fig. 1.

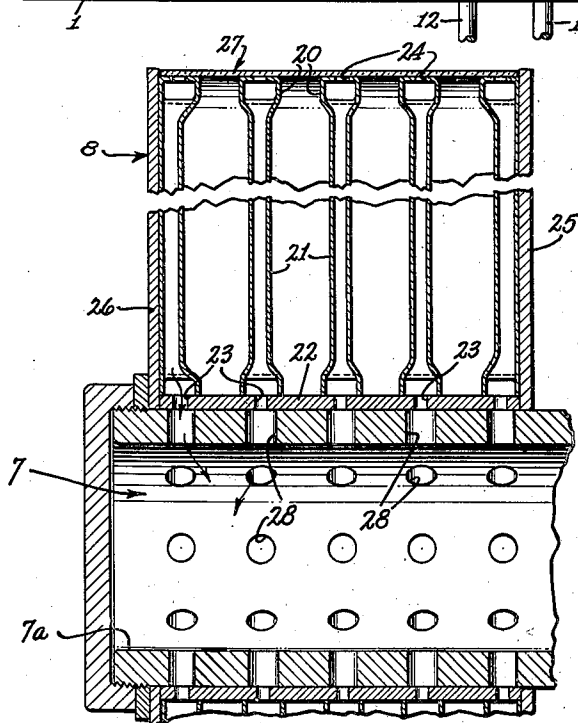


Fig. 5.

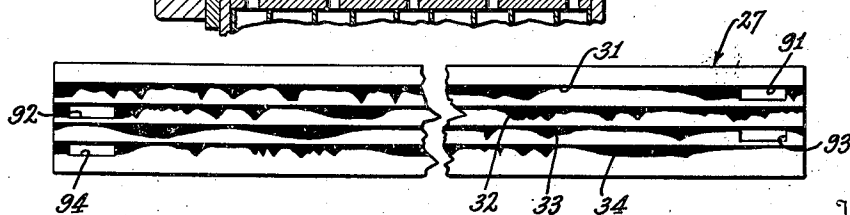


Fig. 4.

Inventors
GEORGE P. REGAN
FERENZ H. FODOR

By

C. A. McPerry

Attorney

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Fig. 2.

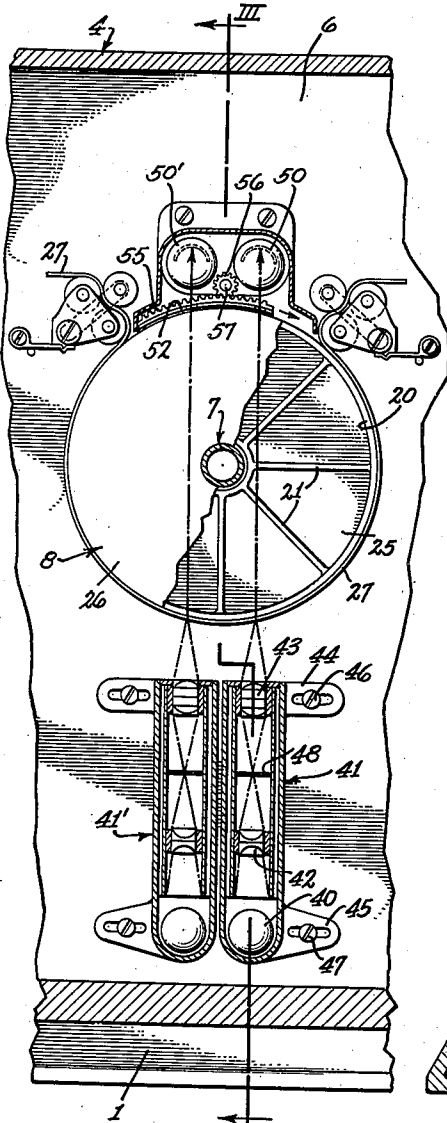


Fig. 3.

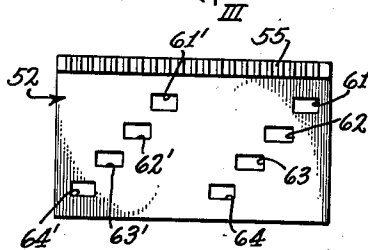
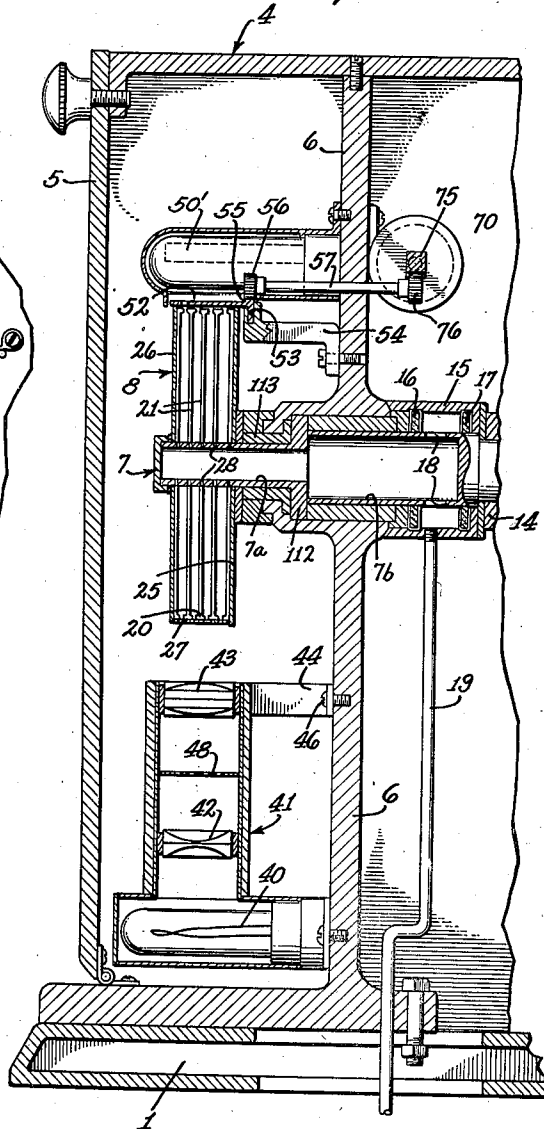


Fig. 6.

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Inventors
GEORGE P. REGAN
FERENZ H. FODOR

C. J. McKelvey

Attorney

May 20, 1941.

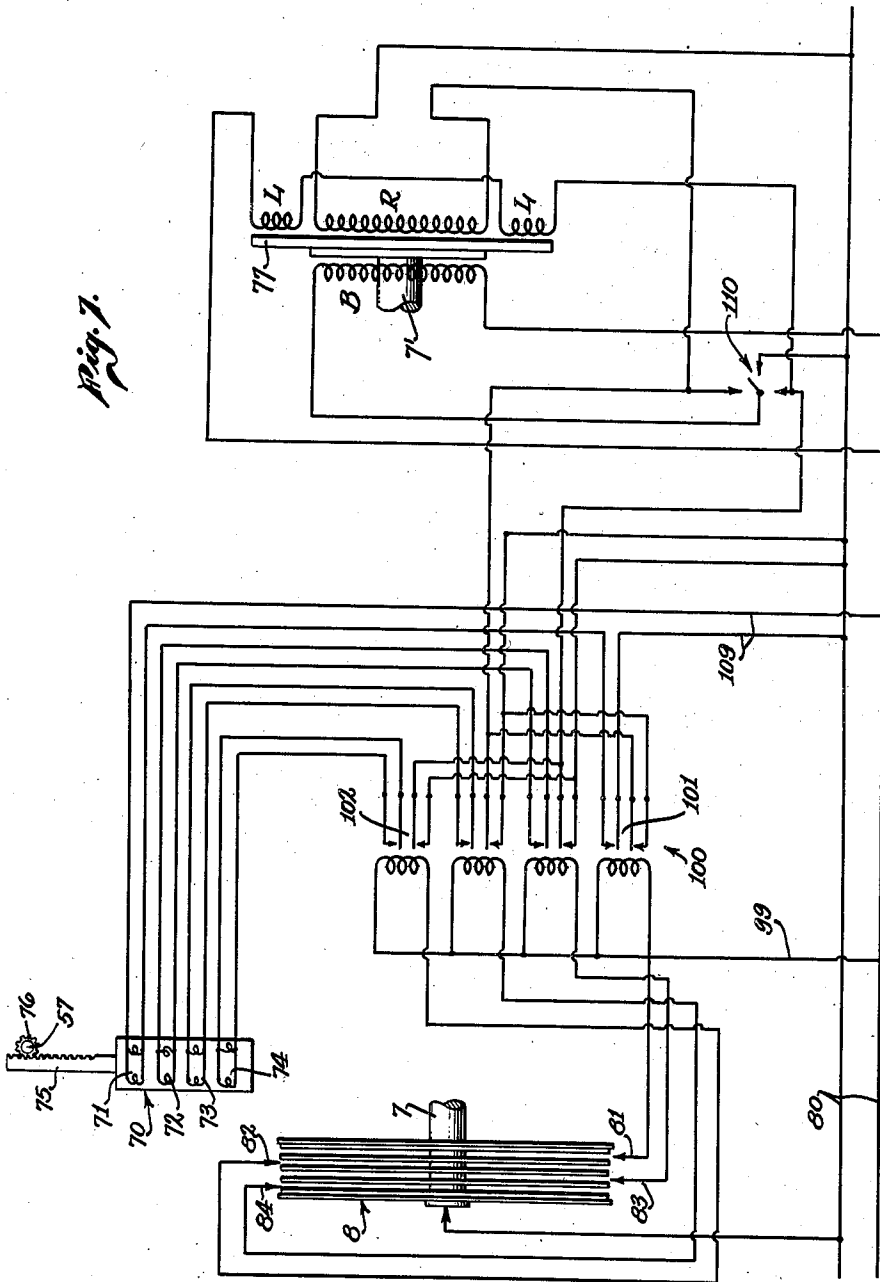
G. P. REGAN ET AL

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METHOD AND MEANS FOR REPRODUCTION OF SOUND

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Inventors

GEORGE P. REGAN
FERENZ H. FODOR

By

C. J. McKelvey

Attorney

UNITED STATES PATENT OFFICE

2,242,548

METHOD AND MEANS FOR REPRODUCTION
OF SOUND

George P. Regan, North Hollywood, and Ferenz
H. Fodor, Los Angeles, Calif., assignors to
Regan-Day, Inc., Los Angeles, Calif., a corpora-
tion of California

Application September 28, 1938, Serial No. 232,138

14 Claims. (Cl. 179—100.3)

This invention pertains to means and meth-
ods of controllably reproducing sound from a
plurality of longitudinally extending, substan-
tially parallel recordings carried upon a suit-
able carrier strip such as continuous strip film.
When used for broadcasting purposes, the inven-
tion permits the continuous uninterrupted pro-
duction of sound for a very protracted period of
time from only a short length of film. Novel
means are provided for regulating and control-
ling the direction of travel of the film in accord-
ance with the particular record which is being
reproduced, selection being thus made out of the
number carried by the film.

The invention also relates to means and meth-
ods for holding, supporting and advancing con-
tinuous strip film or the like without the use
of sprocket holes, thereby reducing the wear and
strain imposed on film. The apparatus con-
templates the use of a light source and a re-
producing pick-up, and means are provided for
selectively passing light from the source through
the film and onto the pick-up.

More specifically stated, the apparatus of the
invention includes a film-supporting drum con-
sisting of a plurality of spaced circular disc ele-
ments mounted upon a hollow driven shaft,
means being provided for applying suction to the
shaft. Conduits connect spaces between the disc
elements and the shaft, suction being thus caused
to maintain the film in contact with the major
portion of the periphery of the drum. The strip
film is fed onto the drum from any suitable reel
or magazine and is then taken off the drum onto
another reel. The apparatus also includes an
optical system adapted to project and pass light
through the film onto a reproducing pick-up. In
the event film thus carried is provided with a
plurality of transversely spaced but longitudinally
extending sound records, means are provided
for permitting light passing through only desired
transverse portions of the film to pass onto the
reproducing pick-up. The apparatus also in-
cludes means for driving the drum and shaft and
although such means may assume various forms,
the electromagnetic means for rotating the drum
shaft and for reversing the rotation thereof
which are described and claimed in a co-pend-
ing application entitled "Electromagnetic control
device," filed Sept. 28, 1938, under Ser. No. 232-
137, issued Oct. 24, 1939, as Patent No. 2,176,897,
is particularly well adapted for use in conjunc-
tion with the apparatus of this invention.

It is an object of the present invention, there-
fore, to provide means for controllably reproduc-

ing sound from continuous strip films carrying a
plurality of sound recordings.

Another object is to provide means for sup-
porting and moving continuous strip film in a
ready and economical manner without the use
of sprocket holes.

A further object is to provide means whereby
sound may be controllably reproduced from a
plurality of longitudinally extending, substan-
tially parallel recordings carried upon strip film.

A still further object is to provide means and
methods for regulating and controlling the di-
rection of travel of film in accordance with the
location of a record carried by the film and be-
ing reproduced.

These and other objects, uses and advantages
of the invention will be more apparent to those
skilled in the art from the following description
of certain illustrative embodiments of the inven-
tion.

In order to facilitate explanation of the inven-
tion, reference will be had to the appended draw-
ings, in which:

Fig. 1 is a general side elevation of one form
of apparatus embodying the invention.

Fig. 2 is a view of the front of the device with
the cover removed and part of the device in sec-
tion.

Fig. 3 is a vertical section taken along the
plane III—III of Fig. 2.

Fig. 4 is a diagrammatic representation of a
strip of film bearing sound recordings thereon.

Fig. 5 is an enlarged view in vertical section of
the film-supporting means embodied in Fig. 3.

Fig. 6 is a plan view of a masking element.

Fig. 7 is a wiring diagram in which certain
of the elements are diagrammatically represented.

Although the invention may be embodied in
devices capable of many uses, the description
given herein shall particularly refer to the use
of the invention in an apparatus for the repro-
duction of sound either continuously or in a pre-
determined controlled manner. The apparatus
may include a base 1 on which there are mov-
ably positioned a gear housing 2, a clutch hous-
ing 3 and a reproducing housing 4, the latter
being provided with a removable door or panel
5. An axial vertical section through the re-
producing housing 1 is shown in Fig. 3, a front
view thereof being shown in Fig. 2.

By referring to Figs. 2 and 3 it will be seen
that the base 1 is provided with a movably posi-
tionable partition member 6 in which there is
journaled a driven member or driven shaft, gen-
erally indicated at 7, such driven member car-

rying a film-supporting drum 8. The driven member 7 may be in axial alignment with driving shafts extending through the clutch housing 3 and the gear housing 2 and generally indicated at 9 (Fig. 1), such driving shaft carrying the fly wheels 10 and 11 and being driven by means of drive shafts 12 and 13 connected to motors, not shown, but capable of driving the shafts 9, suitable clutch means being contained in the housing 3 whereby the driven member 7 may be coupled to the driving members and shafts so as to rotate the driven member 7 in desired directions.

The arrangement of the clutches, driving shafts, etc., contained within the housings 2 and 3 is shown in the co-pending application entitled "Electromagnetic control device" referred to hereinbefore. For the purposes of the instant case, it may be said that the clutch housing 3 contains electromagnetic coils, one driven in one direction and the other in an opposite direction, such coils being capable of acting upon a plate element mounted upon one end of the driven shaft 7. By suitable electrical connections, which will be described hereinafter, these driving coils are selectively energized so as to impart desired rotation to the driven member 7. Although particular reference has been made to electromagnetic means for controllably rotating the driven shaft 7, it will be understood that other methods and means for controllably rotating the driven member 7 may be employed. By referring to Figs. 2 and 3, it will be seen that the driven shaft 7 is hollow and is provided with a forwardly extending portion 7a of smaller diameter than the rear portion 7b. The portions 7a and 7b may be unitary or they may be separately made and then suitably connected together as by bracing. By reason of the difference in external diameters of different portions of the driven shaft 7, it is possible to maintain such driven shaft in rotatable position but restrain it from axial movement. For example, the flange 112 may cooperate with the bearings 113 whereas the bronze bushing 14 carried by another partition, not shown, prevents movement of the driven shaft 7 in the opposite direction. The driven shaft 7 is preferably hollow, the outer end thereof being sealed as by means of a cap.

Surrounding a portion of the hollow shaft 7 is a chamber 15 pinned to the partition 6 and containing sealing rings 16 and 17. Ports 18 are formed in the cylindrical walls of the driven shaft 7 communicating with the annular space formed by the housing 15. The housing 15 is in turn connected as by means of the conduit 19 with a source of vacuum or suction, not shown. The interior of the driven hollow shaft 7 is thus supplied with suction and such suction is employed in holding strip film in positive contact with the drum 8 mounted upon the driven member.

The drum 8 as shown in the illustrative embodiments of this invention, may comprise a plurality of disc-like elements or wheels, each consisting of a rim 20 and hollow spokes 21. The rim and spokes of each disk-like element or wheel may be made from hollow tubing and attached to a sleeve 22. By referring to Fig. 5 it will be seen that perforations or ports 23 are formed in the sleeve 22 and communicate with the hollow spokes 21. The outer surfaces of the rim members 20 are also provided with peripherally spaced perforations or ports 24. Disc-like end plates 25 and 26 extend somewhat beyond the

periphery of the rim members 20 and form radially extending flanges adapted to prevent transverse weaving of the film 27 supported by the rim elements 20.

In actual construction the various disc-like or wheel-like elements of the drum have their outer surfaces ground and polished so as to produce a true drum adapted to support the film 27 on a cylindrical surface. The various wheels or discs are spaced, however, as shown in Fig. 5 for a purpose and in a manner more readily understood by subsequent description.

The entire drum assembly is then mounted upon the driven hollow shaft 7 which is also provided with a plurality of wall openings, such as the openings 28 communicating the interior of the driven shaft 7 with the ports 23 and with the hollow disc-like drum elements including spokes 21 and rims 20. Since the interior of the hollow shaft 7 is under vacuum, suction is exerted through ports 28, 23, spokes 21 and perforations 24 upon the surface of the film 27.

When the apparatus of this invention is employed for the reproduction of sound recordings carried on film magazine, benefit is derived by employing a film such as the film 27 (Fig. 4) bearing a plurality of longitudinally extending, substantially parallel spaced sound recordings as, for example, the sound recordings 31, 32, 33 and 34. When such film with its plurality of sound recordings is supported by the periphery of drum 8, it will be found that the edge areas of the film adjacent the longitudinal margins of each sound record carried by the film is supported by the drum. The film is caused to lie flat upon the drum by reason of the suction exerted thereon through the perforations or apertures 24. Transverse movement or weaving of the film is prevented by reason of the disc-like members 25 and 26 which cooperate with the longitudinal edges of the film strip 27. By supporting the film in such manner that areas adjacent the longitudinal edges of each longitudinally extending sound record are in contact with and supported by the rims of the wheels or discs constituting the drum, it becomes possible to advance the film in any desired direction and to reproduce, selectively, any one of the plurality of sound recordings carried by such film strip 27 without moving the film transversely.

Positioned below or at least to one side of the drum 8 is a light source, such as the incandescent filament source 40 removably positioned in a housing 41 and including a condensing lens system 42 and a further focusing and projecting lens system 43. The light source and its associated optical system carried by the housing 41 may be movably positionable on the partition 6 by means of the supporting flanges 44 and 45, each thereof being provided with slots adapted to receive machine screws 46 and 47 extending into tapped drillings within the partition 6. In Fig. 2 a duplicate light source and optical housing 41' is shown but only one will be described in detail.

Within the housing 41 is a slotted element 48 adapted to limit the light of the condensing lens 42 into a slot or narrow beam which is then projected by the lens system 43 onto the film 27 carried by the drum. The optical elements from which the condensing lens 42 and the projecting lens 43 are made may be cylindrical so as to permit the projection of a plurality of separate narrow scanning beams on the surface of the

film on the drum 8, each beam falling upon a separate sound track carried by the film 27.

On the opposite side of the drum 8 is a photoelectric pick-up, generally indicated at 50, adapted to receive light which may have been emitted by the light source 40 after it has passed through the film 27 carried by the outer surface of the drum 8. It will be noted that in the drawings another pick-up 50' is shown. Light emitted from the housing 41 will be picked up by the photoelectric cell 50 but not by the pick-up 50' since the shaft 7 obstructs the vision pick-up 50' to that point on the film where the scanning beam emitted by housing 41 is focused. Similarly, reproducing pick-up 50 will not pick up light emitted by the housing 41' but only the scanning beam emitted by housing 41. Reference will be made subsequently to the functions performed by the secondary light beam emitted by housing 41' and the secondary pick-up 50'.

Means are provided whereby the reproducing pick-up 50 may selectively receive light which is passed through any desired sound track only. Such means may comprise a masking element in the form of an arcuate member 52 provided with an arcuate flange 53, said flange extending into a milled slot formed in a supporting bracket 54 carried by the partition 6. A rack 55 is formed in the outer rear portion of the masking member 52, said rack cooperating with a pinion 56 mounted upon a shaft 57 journaled in the partition 6 and provided at its other end with means for adjustably and regulatably rotating the shaft 57. It will be evident that rotation of the shaft 57 will cause the masking member 52 to move over the surface of the drum 8 and between said drum and the pick-up 50. The masking member 52 is provided with a plurality of openings or ports, such as the ports 61, 62, 63 and 64, in staggered relation. It will now be seen that since only one of the openings or ports 61-64 will be in the path of light between that point on the lower surface of the drum where the scanning lights are focused and the pick-up 50, said pick-up 50 will only be responsive to light observed through one of the ports 61-64. The ports 61-64 are transversely spaced distances equivalent to the spacing of the sound tracks 31-34 so that by adjustably positioning the masking member 52, the pick-up 50 becomes selectively responsive to only one of the number of sound records carried by the film 27 over the drum 8.

A corresponding series of ports or openings 61' to 64' is also carried by the masking member 52, this secondary series of openings performing a similar function for the pick-up 50'.

Although various and sundry means may be used in selectively and regulatably positioning the masking element so as to render the reproducing pick-up selectively responsive to a desired sound track carried by the film on the drum 8, reference will be specifically made to an electrical method of so positioning the masking element. Such electrical method may involve the use of a solenoid 70 including a plurality of coils 71, 72, 73 and 74, the movable member of the solenoid 75 including a rack adapted to cooperate with and act upon a pinion 76 carried by the shaft 57.

By now referring to Fig. 7, the controlled operation of the method will become evident. Fig. 7 shows the drum 8 mounted upon the driven shaft 7, which driven shaft is connected as at 7' to a plate 77. The plate may be rotated in opposite directions by means of driving coils, one

driving coil being indicated at R and one at L, the L coil being an annular coil surrounding the coil R. A braking coil B is also shown, these three coils being capable of exerting their effect upon the plate member 77. When the coil R is energized, the driven member 7 will rotate in one direction; when the coil B is energized, the drum 8 will become stationary; when the coil L is energized, the drum 8 and its associated driven shaft 7 will rotate in the opposite direction.

Current from one side of a line 80 is connected to the drum 8. Resilient contact points 81, 82, 83 and 84 are ordinarily positioned opposite certain of the discs or wheels constituting the drum 8 and ordinarily are insulated from such drums by the film itself. As shown in Fig. 4, however, the film 27 is provided with means capable of cooperating with the spring-actuated fingers 81 to 84 so as to selectively permit contact of such fingers with the drum 8. Such means are shown in Fig. 4 as perforations or openings 91, 92, 93 and 94. The openings or perforations 91 and 93 are positioned at the ends of recordings 31 and 33 whereas the perforations 92 and 94 are positioned operably with respect to the ends of recordings 32 and 34. It is to be understood that recording 31 is reproducible from left to right whereas recording 32 is reproducible only from right to left.

When, for example, spring contact 81 extends through aperture 91 and makes contact with the drum 8, the selector relay 100, and particularly the relay 101, is energized, current now flowing from one side of the line 80 through the drum and through the contact 81 into the relay 100 and through line 99 to the other side of the line. When the relay 101 is energized in the manner stated, current is supplied to the coil 71 of the solenoid 70, causing the member 75 to advance the masking element 52 a desired predetermined distance. Simultaneously, however, a directional relay of the locking type indicated at 110 is energized, this relay causing current to be supplied through the appropriate driving coil and thus driving the drum 8 in a direction correlated with the transverse position of the sound record which is now in position for reproduction.

The relay points 101 are the only sets shown in the drawings as supplied with current from the main line 80 by conductors 109 but it is to be understood that the other upper sections of the individual relay points such as 102, are similarly supplied with current.

It will thus be seen that the apparatus of this invention is well adapted to the continuous reproduction of sound from a plurality of records carried by a strip of film, the direction of movement of the film being automatically changed concurrently with changes in the transverse location of a scanning light received by the reproducing pick-up. Furthermore, the transverse location of light passed through the film onto the pick-up is automatically varied in accordance with signals carried by the film, such signals in the illustrative example given comprising the ports or apertures 61 to 64 of the masking member 52. Not only is the transverse location of light passed through the film onto the pick-up changed automatically by the masking member 52 in accordance with the signals carried by the film but in addition the direction of movement of the film is varied and automatically changed in accordance with such signals. In other words,

it may be stated that the direction of movement of the film, changes in the transverse location of light passed through the film onto the pick-up and the signals or actuating means carried by the film are all interrelated and mutually affect each other.

In the description given hereinabove particular reference has been made to the reproducing pick-up 50. In the event the apparatus of this invention is to be employed in the selective reproduction of sound from the various records carried by the film so that individual phrases or portions of each record are to be reproduced, or when it is desired to automatically terminate the reproduction of sound at the end of a phrase and then selectively initiate subsequent reproduction at the beginning of a succeeding phrase in the record, then the relay pick-up 50' and its associated secondary light source 41' is employed.

Complete data regarding the use of a relay pick-up 50' in this manner is described in detail in Patent No. 2,094,847 issued October 12, 1937, to Regan and Franklin. The relay control shown in this patent may be used to advantage in controlling the electromagnetic coils for driving the film-advancing drum in desired directions and in stopping the drum at the required point.

Furthermore, it is to be understood that the film-advancing means may be used whenever it is desired to manually control the operation so that the entire method and apparatus may be carried out manually without reliance upon the automatic control features referred to.

Although the signal means carried by the film and specifically referred to hereinabove consisted of perforations or openings in the film, it will be understood that such signal means may assume different forms and may comprise, if desired, metallic inserts, notches, or the like. Moreover, the movement of the masking member may be accomplished pneumatically as, for example, by the use of vacuum, valves, cocks, stops, etc. being controlled either manually or by means of signalling or actuating devices carried by or formed in the film.

We claim:

1. An apparatus for substantially continuous reproduction of a plurality of transversely spaced longitudinally extending sound records carried by strip film, comprising: a drum for supporting and moving film, means for rotating the drum in either direction and stopping the same, a reproducing pick-up associated with said drum, stationary light sources adapted to pass light through various transverse portions of the film while on said drum, movable light masking means for passing light through desired transverse portions of the film into operative relation with said pick-up, and means associated with the film carried upon said drum for actuating the light masking means to pass light through desired transverse portions only of the film.

2. An apparatus for substantially continuous reproduction of a plurality of transversely spaced longitudinally extending sound records carried by strip film, comprising: a drum for supporting and moving film, means for rotating the drum in either direction and stopping the same, a reproducing pick-up associated with said drum, stationary light sources adapted to pass light through various transverse portions of the film while on said drum, movable adjustable means for passing light through desired transverse portions of the film into operative relation

with said pick-up, an electrical circuit including contacts cooperating with the film for regulating the direction of rotation of said drum in accordance with the location of the portion of film through which light is being passed onto the pick-up.

3. An apparatus for substantially continuous reproduction of sound from a plurality of transversely spaced longitudinally extending sound records carried by strip film, comprising: a film-supporting drum comprising a plurality of spaced circular disc elements mounted upon a driven hollow shaft, conduits communicating spaces between disc elements with the interior of the shaft, means for applying suction to the shaft during its rotation, means for rotating said hollow shaft, a light source, an optical system adapted to project light between said spaced disc elements and through film carried thereby, a reproducing pick-up in operative relation to the film on said disc elements and said light source, and means in operative relation to said pick-up in the path of light from said source for selectively passing light through desired spaces between the disc into said reproducing pick-up.

4. An apparatus for substantially continuous reproduction of sound from a plurality of transversely spaced longitudinally extending sound records carried by strip film, comprising: a film-supporting drum comprising a plurality of spaced circular disc elements mounted upon a driven hollow shaft, conduits communicating spaces between disc elements with the interior of the shaft, means for applying suction to the shaft during its rotation, means for rotating said hollow shaft, a light source, an optical system adapted to project light between said spaced disc elements and through film carried thereby, a reproducing pick-up in operative relation to the film on said disc elements and said light source, and means in operative relation to said pick-up in the path of light from said source for selectively passing light through desired spaces between the disc into said reproducing pick-up, said last-named means being actuated automatically by the film.

5. A film advancing and supporting means comprising a plurality of hollow spaced rims with hollow spokes mounted upon a hollow shaft, said spaced rims forming a drum adapted to support a film; means for supplying suction to said shaft, conduit means connecting said shaft and spokes, and perforations in the outer film-supporting surfaces of said rims.

6. An apparatus for advancing and supporting strip film comprising: a plurality of hollow wheel elements mounted upon a hollow shaft, outer surfaces of said wheel elements lying in a cylindrical plane adapted to support film, said wheel elements being axially spaced whereby areas adjacent the longitudinal areas of sound records carried by said film are supported by the outer surfaces of said wheel elements, means for applying suction to the interior of said wheel elements, suction ports formed in the outer surfaces of such wheel elements, and means for controllably rotating said shaft.

7. In an apparatus of the character described, the combination of: a drum-like film-supporting means, a plurality of means for driving said film-supporting means, means for selectively coupling said driving means with said film-supporting means; means for passing light through film on said supporting means, a pick-up adapted to receive light passed through said film, means for controlling light received by the pick-up, and

means associated with the film carried upon said film-supporting means for adjustably positioning said means for controlling light received by the pick-up.

8. An apparatus adapted for substantially continuous reproduction of a plurality of transversely spaced longitudinally extending sound records carried by strip film, comprising: a drum for supporting a moving strip film, said drum comprising a plurality of hollow spaced wheels, means for rotating the drum in either direction and stopping the same, a reproducing pick-up on one side of said drum, and a light source adapted to project a scanning light on various transverse portions of the film while on said drum, said light source being positioned on the other side of said drum and directed toward said reproducing pick-up.

9. An apparatus adapted for substantially continuous reproduction of a plurality of transversely spaced longitudinally extending sound records carried by strip film, comprising: a drum for supporting a moving strip film, said drum comprising a plurality of hollow spaced wheels, means for rotating the drum in either direction and stopping the same, a reproducing pick-up on one side of said drum, a light source adapted to project a scanning light on various transverse portions of the film while on said drum, said light source being positioned on the other side of said drum and directed toward said reproducing pick-up, and means positioned in the path of light from said source to the said pick-up for regulatably controlling the transverse location of light passed through the film onto the pick-up.

10. An apparatus adapted for substantially continuous reproduction of a plurality of transversely spaced longitudinally extending sound records carried by strip film, comprising: a drum for supporting and moving strip film, said drum comprising a plurality of hollow spaced wheels, means for rotating the drum in either direction and stopping the same, a reproducing pick-up on one side of said drum, a light source adapted to project a scanning light on various transverse portions of the film while on said drum, said light source being positioned on the other side of said drum and directed toward said reproducing pick-up; means positioned in the path of light from said source onto said pick-up for regulatably controlling the transverse location of light passed through the film onto the pick-up; and an electrical circuit including contacts cooperating with the film and adapted to energize the light controlling means to pass light through the desired transverse portions of the film only.

11. In an apparatus of the character described, a film supporting and advancing drum compris-

ing a plurality of spaced wheels mounted upon a hollow shaft, the cylindrical edge areas of said wheels being adapted to lie in a common cylindrical surface adapted to support film, a bearing for said shaft, means for restraining said shaft from movement in an axial direction, ports communicating with said hollow shaft, means for supplying vacuum to said ports, and a plurality of circumferentially spaced suction ports in the cylindrical edge areas of said wheels.

12. In an apparatus of the character described, a film supporting and advancing drum comprising a plurality of spaced wheels mounted upon a hollow shaft, the cylindrical edge areas of said wheels being adapted to lie in a common cylindrical surface adapted to support film, a bearing for said shaft, means for restraining said shaft from movement in an axial direction, ports communicating with said hollow shaft, means for supplying vacuum to said ports, a plurality of circumferentially spaced suction ports in the cylindrical edge areas of said wheels, a reproducing pick-up on one side of said drum, and a light source and optical system on the other side of said drum, said light source and optical system being adapted to project scanning beams upon film carried by said drum and towards said reproducing pick-up.

13. In an apparatus of the character described, a film supporting and advancing drum comprising a plurality of spaced wheels mounted upon a hollow shaft, the cylindrical edge areas of said wheels being adapted to lie in a common cylindrical surface adapted to support film, a bearing for said shaft, means for restraining said shaft from movement in an axial direction, ports communicating with said hollow shaft, means for supplying vacuum to said ports, a plurality of circumferentially spaced suction ports in the cylindrical edge areas of said wheels, a reproducing pick-up on one side of said drum, a light source and optical system on the other side of said drum, said light source and optical system being adapted to project scanning beams upon film carried by said drum and towards said reproducing pick-up, and a movable light-controlling and masking element between said pick-up and light source for passing light through desired portions only of the film on said drum.

14. In a method of supporting and moving strip film carrying a longitudinally extending sound record, the step of applying suction at a plurality of points at areas adjacent both of the longitudinal edges of sound record carried by the film, and moving said points at which suction is applied whereby the film is moved bodily while the sound track is maintained substantially flat.

GEORGE P. REGAN.
FERENZ H. FODOR.