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2,428,778

PHOTOELECTRIC REPRODUCER FOR PLURAL CONSECUTIVE SOUND TRACKS

Filed Jan. 15, 1944

2 Sheets-Sheet 1

Fig. 1.

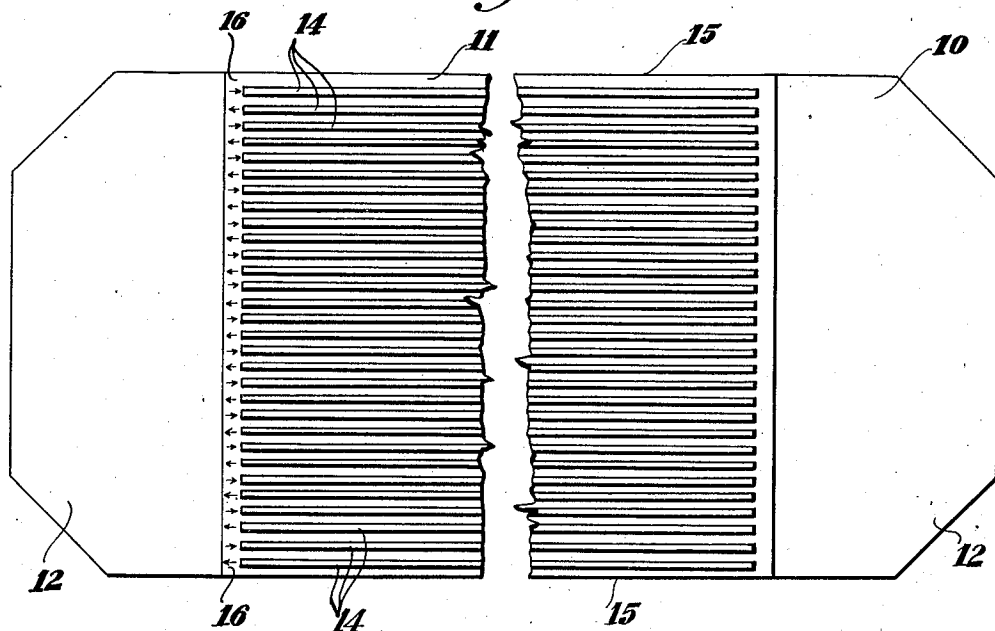


Fig. 2.

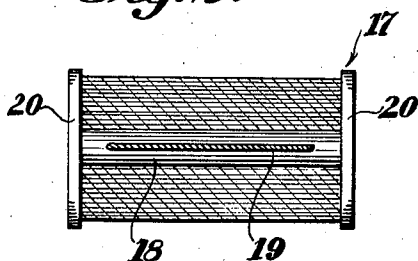
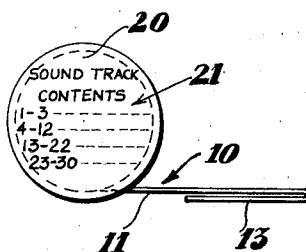


Fig. 3.



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Fig. 4.

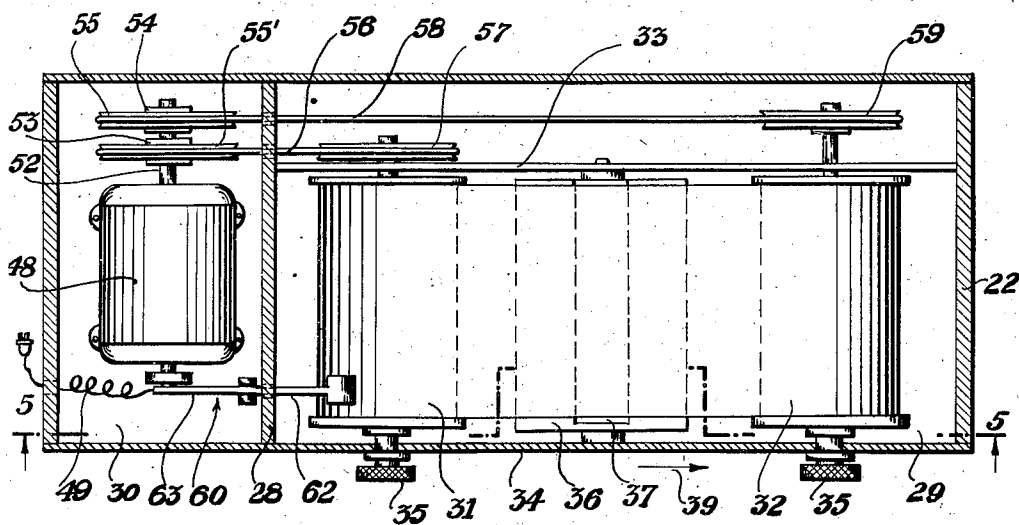
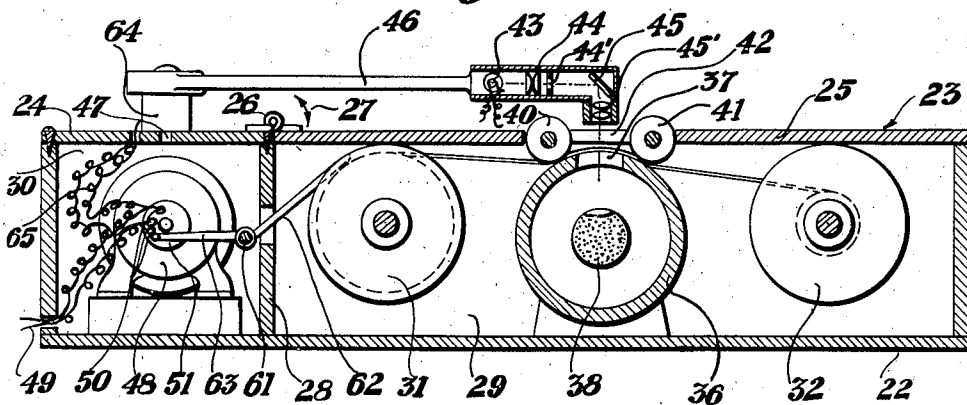


Fig. 5.



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PHOTOELECTRIC REPRODUCER FOR PLURAL CONSECUTIVE SOUND TRACKS

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Application January 15, 1944, Serial No. 518,427

4 Claims. (Cl. 179—100.3)

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My present invention relates to printed matter and more particularly to strips having printed thereon a plurality of sound tracks. My invention furthermore relates to sound reproducing devices for reproducing sound recorded on printed strips of this type.

It is an object of my present invention to provide a new type of sound record carriers which enable reproduction of sound in a particularly simple and efficient way.

It is a further object of my present invention to provide strip-shaped sound record carriers with a plurality of parallel sound tracks in a new way, not done heretofore.

Still a further object of my present invention consists of sound reproducing devices which are portable, and extremely simple in construction and enable reproduction of sound tracks printed on strips of paper or like material.

Still another object of my present invention consists of sound reproducing devices adapted for reproducing sound automatically from a plurality of sound tracks arranged parallel to each other on a relatively wide paper or film strip.

With the above objects in view, my present invention mainly consists of a printed matter comprising a strip-shaped flexible member having printed thereon a plurality of parallel sound tracks extending in longitudinal direction of this strip-shaped member. Preferably, this strip-shaped flexible member is transparent, consisting of transparent paper or film material and a plurality of parallel opaque sound tracks are printed thereon which extend in longitudinal direction parallel to a longitudinal edge of this strip-shaped transparent member.

In accordance with a preferred embodiment of my present invention, I make this flexible member, e. g. paper or film strip, substantially wider than customary film strips used for professional cinematographic purposes, i. e. so-called 35 mm. film, and provide a relatively large number, for instance 20 to 40 parallel sound tracks on such a film.

It is evident that such a great number of parallel sound tracks enables reproduction of records for a relatively long time with a relatively short paper or film sound strip. Thus, for instance, if 30 sound tracks of customary type are printed parallel to each other on a film or paper strip and these sound records are reproduced with the usual speed, it is possible to arrange sound tracks the reproduction of which will take a full hour on a strip of about 53 feet length. This considerably reduces the diameter of the spools on

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which these sound strips are wound up and also the size of the reading device for reproducing such sound strips. Furthermore, the mechanism of sound reproducing devices for spools of this type is substantially simpler than one for large film reels or the like.

It is possible to print all sound tracks on one face of a transparent strip or to print some of these tracks on one face of the strip and some on the other. It will be advantageous to choose this latter manner of arranging the sound tracks if the same have to be printed very near to each other.

I have found it advantageous to arrange the sound tracks running in alternately opposite directions so as to enable their reproduction continuously during to and fro movement of the strip on which they are printed.

In each of the sound tracks, the sound records have to be arranged in such a manner that at both ends the single sound records are closer to each other than in the rest of the sound track so as to enable correct reproduction of these records when the speed of the sound strip is smaller, as usual at the beginning and end of reproduction.

Furthermore, I have found that during reproduction the strip may be moved by rotating the spool on which it is wound up and therefore such sound strip does not need any perforations along its edges. Thus, I may use extremely thin unperforated film or paper material, considerably reducing the size of the sound carrying strips as compared with that of customary film rolls. Of course, in such a case, it is advantageous to provide reinforcing strip portions at both ends of the thin sound trip for securing it to the core of the spool on which it is wound up.

Spools for the purposes of the present invention, i. e. spools on which the strips containing the sound tracks are stored or wound up during reproduction, may be provided with markings indicating the contents of each of the sound tracks of the printed sound strips. These markings are preferably arranged on disk-shaped end members secured to both ends of the cylindrical core of the spool and forming part of the latter.

My present invention comprises also a device for consecutively reproducing sound tracks provided on strips of the above described type, i. e. for consecutively scanning a plurality of sound tracks arranged on the strip-shaped sound record carrier parallel to the edges thereof and running in alternately opposite directions. A sound reproducing device of this type comprises two par-

allelly arranged rotatable spools on one of which the above mentioned strip-shaped sound record carrier is wound up and a relatively flat housing containing these parallelly arranged spools spaced from each other in such a manner as to enable unwinding of the sound record carrier from one spool and winding it up on the other; this sound reproducing device also comprises motor means for rotating the spools alternately in opposite directions and a sound reproducing unit including a light source and photo-electric means arranged between the spools in such a manner as to be adapted to cooperate consecutively with each of the parallel sound tracks, while the sound record carrier on which these sound tracks are arranged in moving to and fro between the spools. Of course, it is also possible to use a stationary sound reproducing unit and to arrange the spools together with the sound record carrier slidable relative to this stationary sound record carrier.

A preferred embodiment of my new sound reproducing device includes also means for automatically reversing the direction of movement of the strip-shaped sound record carrier between the spools as soon as this carrier is almost entirely unwound from one of the spools and wound up on the other. Of course, as mentioned above, I might use in such a device a sound reproducing unit of usual type if I move this unit step by step from one track to the next each time the direction of movement of the sound strip is reversed. However, it is simpler to arrange a stationary member having a smooth surface portion over which the sound record carrier is sliding during its movement from one spool to the other, to provide a slit-shaped aperture in this surface transversal to the direction of sliding of the carrier and to arrange a photo-electric cell under this slit-shaped aperture; a slidable light source directing a light beam on the sound record carrier has to be arranged over the same in such a manner that the beam passing through the carrier impinges on the photo-electric cell arranged under it. This light source has to be mounted for step by step movement transversal to the longitudinal direction of the strip-shaped sound record carrier; it is also advisable to provide operating means driven by the motor means mentioned above for automatically shifting this light source step by step in longitudinal direction of the slit over which it is arranged from one sound track to the next each time the direction of movement of the strip-shaped sound record carrier between the spools is reversed.

The novel features which I consider as characteristic for my invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a top view of a strip provided with sound tracks in accordance with my present invention;

Fig. 2 is a spool with a strip of the type shown in Fig. 1 wound up on it, said strip being shown in cross section;

Fig. 3 is an end view of the spool and strip shown in Fig. 2, seen in direction of arrow 3 of Fig. 2;

Fig. 4 is a top view of a sound reproducing device according to my present invention with the cover part thereof removed;

Fig. 5 is a cross section through the sound reproducing device shown in Fig. 4, along line 5—5 of Fig. 4.

The sound strip 10 shown in Fig. 1 of the drawing consists of a strip portion 11 of extremely thin transparent material, e. g. paper or plastic, provided at both ends with reinforced strip portions 12. These portions may be produced as shown in Fig. 3 by folding back the end portions 13 of strip 11 and securing them to the strip itself by gluing or otherwise. Of course, it is also possible to make these reinforced strip portions of other material than the strip itself. Thus, for instance, the sound strip might consist of a very thin film strip provided with reinforced strip portions made of paper and secured to the film strip.

As shown in Fig. 1, I provide a plurality of sound tracks 14 on strip 11 extending parallel to the edges 15 of this strip and running alternately in opposite directions indicated by arrows 16 printed at the end of the sound tracks 14. It is advisable to provide such arrows or similar markings on the strip so as to know in which direction a sound track is running if one intends to start reproduction not at one of the outer tracks but at one of the inner tracks.

As mentioned above, all sound tracks might be printed on the same face of the strip 11; however, it is also possible to print them alternately on opposite faces of this strip. If the material of which the strip is made is sufficiently thin, this difference in printing does not influence the quality of the reproduced sound; but it is advantageous to print on opposite faces of the strip 11 if the sound tracks are to be arranged very near to each other. Since the above mentioned sound tracks are printed, i. e. not photographically recorded, it is very easy to print each second sound track, e. g. the first, third, fifth, seventh and so on, on one face of the strip 11 and the alternate sound tracks between them, namely the second, fourth, sixth, eighth and so on, on the other face of the strip. This greatly facilitates printing of sound tracks of this type.

In order to enable reproduction of any desired part of the recorded sound track, it is necessary to identify the various sound tracks. For this purpose, I provide as shown in Fig. 3 markings 21 on the spool 17 on which the sound strip 10 is wound up. This spool 17 consists of a cylindrical core member 18 provided with a longitudinal slot 19 engaging one of the reinforced strip portions 12 and two disk-shaped end members 20 secured concentrically to the ends of core member 18. On the outer surface of at least one of these end members 20 I provide markings 21 of the type shown in Fig. 3, listing the sound tracks and the contents of each of these tracks, thereby enabling easy identification of the same.

A sound reproducing device for reproducing sounds recorded on sound strips of the above described type is shown in Figs. 4 and 5. This device comprises a housing 22 provided with a cover 23. This cover 23 consists of two cover parts 24 and 25 pivoted to each other at 26. Cover part 24 is secured permanently to the top of the housing 22 by means shown in the drawing, while cover part 25 is turnable about a pivoting axis 26 in direction of arrow 27.

A partition wall 28 is provided inside of housing 22, dividing the same into two compartments, namely the sound reproducing compartment 29 and compartment 30 housing the driving and operating mechanisms.

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In the sound reproducing compartment two spools 31 and 32 of the type described above and shown in Figs. 2 and 3 are arranged. These spools are rotatably journaled in partition wall 33 and front wall 34 of housing 22, parallel to each other. Knobs 35 serve for removably holding these spools in the housing walls.

The sound reproducing means themselves are arranged between the two spools, partly within housing 22, partly in the plane of cover part 25 secured to the same, and partly over this cover part secured to cover part 24 as shown in Figure 5. That part of the sound reproducing means which is arranged within housing 22 consists of a hollow drum 36 having at least at its top a smooth outer surface and a longitudinal slit 37 arranged within the same and extending parallel to the spools 31 and 32.

Within this stationary drum 36, I arrange a photo-electric cell 38 of well-known type having a longitudinal shape and extending under slit 37 parallel to spools 31 and 32.

The sound strip 11 wound up on spool 31 is unwound in direction of arrow 39 and wound up on spool 32. During its movement from one spool to the other it slides over the smooth outer surface portion of drum 36 past slot 37. In order to hold the sound strip 11 in contact with drum 36, I provide two guiding rollers 40 and 41 freely rotatably secured to cover part 25 in the way shown in the drawing. Of course, this cover part is also provided with a longitudinal window 42 bounded by the rollers 40 and 41, as shown in Fig. 5.

The light source necessary for reproducing the sound is arranged above window 42 and consists of an electrical bulb 43, mechanical slot 44', an optical focusing system 44, a deflecting mirror 45 and a lens system 45' directing the light beam emitted by bulb 43 on the sound strip 11 sliding over slot 37. The light beam is modulated by the density variations of the sound track 14 and the thus modulated beam impinges on the photo-electric cell 38 influencing and modulating the photo-electric current of the same in well-known way. The thus modulated current is then transformed into audible signals.

Bulb 43, slot 44', optical system 44, reflecting mirror 45 and lens system 45' are all carried by arm 46 which is turnably pivoted at 47 to cover part 24; this enables step by step movement of the light source from one sound track to the next by turning the entire system about its pivoting point 47 in the required way.

Theoretically, the above described parts of my new device are sufficient for reproducing sound recorded on sound strips of the type proposed by me. However, in this case it would be necessary to rotate the spools and to shift the light source by hand. In order to avoid this, I provide means for automatically rotating the spools 31 and 32 as necessary for proper reproduction of sound, for automatically reversing the direction of movement of sound strip 11 each time it is almost entirely unwound from one of the spools, and for automatically shifting the light source from one sound track to the next each time the movement of sound strip 11 is reversed. I wish to mention that I explicitly claim the above described means and combination of the same in general and not only the specific embodiment described below in detail.

One embodiment of such rotating, reversing and shifting means is shown in Figs. 4 and 5 of

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the drawings. The same comprises an electrical motor 48 arranged in the compartment 30 of housing 22. This motor 48 is connected with a source of electric current by means of the electric wire 49 and the contacts 50 arranged on contact plate 51.

The motor 48 is provided with a driving shaft 52 carrying two clutches 53 and 54, constructed in such a manner that clutch 53 operatively connects shaft 52 with belt pulley 55 only when shaft 52 is turning counter-clockwise and clutch 54 connects belt pulley 55 with shaft 52 only when the latter is turning clockwise. As shown in Fig. 4, pulley 55 is connected by belt 56 with pulley 57 driving film spool 31 and pulley 55 in operatively connected by belt 58 with pulley 59 driving spool 32.

Thus, it is evident that by reversing the direction of rotation of shaft 52 it is possible to rotate either of the spools 31 and 32, i. e. if shaft 52 rotates clockwise, only spool 32 will be driven by the shaft while if shaft 52 rotates counter-clockwise, spool 31 will be driven by the shaft. It is thus possible to drive spools 31 and 32 alternately in opposite directions and to reverse the direction of movement of film 11 simply by reversing direction of rotation of shaft 52 at the appropriate moments.

These appropriate moments are those when the sound strip 11 is almost entirely unwound from spool 31 and also when the strip is entirely wound up on this spool. Thus, it is possible to provide a double armed lever 60 turnably secured at its pivoting point 61 to the bottom wall of housing 22 in such a manner that one lever arm 62 contacts the sound strip roll 11 wound up on spool 31 and the other lever arm 63 is sliding along the contacts 50. It is evident that it is possible without difficulty for everybody skilled in this art to arrange these contacts 50 in such a manner that the direction of rotation of motor 48 is reversed by the double armed lever 60 each time the sound strip 11 is almost entirely wound up or unwound from spool 31. This reversal of direction of rotation of motor 48 will result in reversal of the direction of rotation of shaft 52 which latter will cause alternate rotation of spools 31 and 32 by motor 48.

The step by step shifting movement of arm 46 and the light source carried by the same can be obtained by an electromagnetic mechanism 64 connected by conductor 65 with the contacts 50 and operating in such a manner as to shift arm 46 from one track to the next each time the direction of rotation of motor 48 is reversed. Various electromagnetic mechanisms might be used for above purposes; thus, for instance, it is possible to employ for these purposes an electromagnetic mechanism of the type disclosed in the U. S. Patent No. 1,918,102—C. W. Hewlett.

The new sound strip and similar printed matter has to be printed continuously, i. e. it is necessary to print on a strip of 50 feet or more sound tracks or like records which do not repeat themselves. Of course, in order to print such records, the printing means by which the prints are transferred on the strip to be printed has to have a length equal to that of the strip or there have to be a number of printing means following each other without interruption.

In accordance with my present invention, sound strips of the above described type are preferably printed by printing means which has the shape of an endless printing band or the shape

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of a long printing strip moving between two rolls during the process of printing.

While I have illustrated and described the invention as embodied in portable devices for reproducing the same I do not intend to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of my invention.

Without further analysis, the foregoing will so fully reveal the gist of my invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What I claim as new and desire to secure by Letters Patent is:

1. A device for consecutively scanning a plurality of parallel sound tracks arranged on a strip-shaped sound record carrier parallel to one of the edges thereof running in alternately opposite directions comprising two parallelly arranged rotatable spools on one of which said strip-shaped sound record carrier is wound up, a relatively flat housing containing said parallelly arranged spools spaced from each other in such a manner as to enable unwinding of said strip-shaped sound record carrier from one of said spools and winding it up on the other of said spools, motor means arranged in said relatively flat housing for rotating said spools alternately in opposite directions, and sound reproducing means arranged mainly between said spools arranged within said relatively flat housing in such a manner as to be adapted to cooperate consecutively with each of said parallel sound tracks on said strip-shaped sound record carrier while the same is moving to and fro between said spools, said sound reproducing means comprising a stationary member arranged within said relatively flat housing having a smooth surface portion over which said strip-shaped sound record carrier is sliding during its movement from one spool to the other, a photo-electric cell arranged within said relatively flat housing adjacent to said smooth surface portion of said stationary member under the same and extending transversally to the direction of movement of said strip-shaped sound record carrier, a slit in said smooth surface portion of said stationary member extending parallel to said photo-electric cell, an opening in said housing extending over said slit, and a light source arranged outside said housing over said opening in the same and said slit in said smooth surface portion of said stationary member, said light source being mounted on said housing for step by step movement in longitudinal direction of said photo-electric cell, so that the light beam emitted by said light source is adapted to pass through said opening in said housing and consecutive sound tracks on said strip-shaped sound record carrier while the same moves to and fro between said spools and to impinge after modulation by said sound tracks on said photo-electric cell.

2. A device for consecutively scanning a plurality of parallel sound tracks arranged on a strip-shaped sound record carrier parallel to one of the edges thereof running in alternately opposite directions comprising two parallelly arranged rotatable spools on one of which said

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strip-shaped sound record carrier is wound up, a relatively flat housing containing said parallelly arranged spools spaced from each other in such a manner as to enable unwinding of said strip-shaped sound record carrier from one of said spools and winding it up on the other of said spools, motor means within said housing for rotating said spools alternately in opposite directions, means associated with said motor means and arranged also within said housing for automatically stopping rotation of the film receiving spool by said motor means every time said strip-shaped sound record carrier is almost entirely wound up on said spool and simultaneously starting rotation of the other spool, thereby automatically reversing directions of movement of said strip-shaped sound record carrier between said spools every time said strip-shaped sound record carrier is almost entirely unwound from one of said spools and wound up on the other, and sound reproducing means arranged mainly in said housing between said spools in such a manner as to be adapted to cooperate consecutively with each of said parallel sound tracks on said strip-shaped sound record carrier while the same is moving to and fro between said spools, said sound reproducing means comprising a stationary member arranged in said housing having a smooth surface portion over which said strip-shaped sound record carrier is sliding during its movement from one spool to the other, a photo-electric cell arranged within said housing adjacent to said smooth surface portion of said stationary member under the same and extending transversally to the direction of movement of said strip-shaped sound record carrier, a slit in said smooth surface portion of said stationary member extending parallel to said photo-electric cell, an opening in said housing extending over said slit in said stationary member and a light source arranged outside said housing over said opening in the same and in said smooth surface portion of said stationary member, said light source being mounted on said housing for step by step movement in longitudinal direction of said photo-electric cell, so that the light beam emitted by said light source is adapted to pass through said opening in said housing and consecutive sound tracks on said strip-shaped sound record carrier while the same moves to and fro between said spools and to impinge after modulation by said sound tracks on said photo-electric cell.

3. A device for consecutively scanning a plurality of parallel sound tracks arranged on a strip-shaped sound record carrier parallel to one of the edges thereof running in alternately opposite directions comprising two parallelly arranged rotatable spools on one of which said strip-shaped sound record carrier is wound up, a relatively flat housing containing said parallelly arranged spools spaced from each other in such a manner as to enable unwinding of said strip-shaped sound record carrier from one of said spools and winding it up on the other of said spools, motor means arranged within said housing for rotating said spools alternately in opposite directions, means arranged within said housing for automatically stopping rotation of the film receiving spool by said motor means every time said strip-shaped sound record carrier is almost entirely wound up on said spool and simultaneously starting rotation of the other spool, thereby automatically reversing directions of movement of said strip-shaped sound record

carrier between said spools every time said strip-shaped sound record carrier is almost entirely unwound from one of said spools and wound up on the other, and sound reproducing means arranged mainly within said housing between said spools in such a manner as to be adapted to cooperate consecutively with each of said parallel sound tracks on said strip-shaped sound record carrier while the same is moving to and fro between said spools, said sound reproducing means comprising a stationary member arranged within said housing and having a smooth surface portion over which said strip-shaped sound record carrier is sliding during its movement from one spool to the other, a photo-electric cell arranged within said housing adjacent to said smooth surface portion of said stationary member under the same and extending transversally to the direction of movement of said strip-shaped sound record carrier, a slit in said smooth surface portion of said stationary member extending parallel to said photo-electric cell, an opening in said housing extending over said slit in said stationary member, a light source arranged outside said housing over said slot in said housing and said slit in said smooth surface portion of said stationary member, said light source being mounted on said housing for step by step movement in longitudinal direction of said photo-electric cell, so that the light beam emitted by said light source is adapted to pass through said opening in said housing and consecutive sound tracks on said strip-shaped sound record carrier while the same moves in said housing to and fro between said spools and to impinge after modulation by said sound tracks on said photo-electric cell within said housing, and operating means driven by said motor means within said housing for automatically shifting said light source on said housing step by step in longitudinal direction of said opening in said housing over which it is arranged from one sound track to the next every time the direction of movement of said strip-shaped sound record carrier between said spools is automatically reversed by said motor means.

4. A device for consecutively scanning a plurality of parallel sound tracks arranged on a strip-shaped sound record carrier parallel to one of the edges thereof running in alternately opposite directions comprising two parallel arranged rotatable spools on one of which said strip-shaped sound record carrier is wound up;

a relatively flat housing containing said parallelly arranged spools spaced from each other in such a manner as to enable unwinding of said strip-shaped sound record carrier from one of said spools and winding it up on the other of said spools; means arranged in said relatively flat housing for rotating said spools alternately in opposite directions; a film guiding member arranged within said relatively flat housing between said parallelly arranged spools and having a smooth surface portion over which said strip-shaped sound record carrier is sliding during its movement from one of said parallelly arranged spools to the other; a photo-electric cell arranged within said relatively flat housing between said parallelly arranged spools adjacent to said smooth surface portion of said film guiding member and extending transversally to the direction of movement of said strip-shaped sound record carrier; means emitting a light beam adapted to pass through said strip-shaped sound record carrier while the same is guided by said film guiding member arranged in said relatively flat housing between said parallelly arranged spools so that said light beam impinges upon said photo-electric cell arranged also within said relatively flat housing between said parallelly arranged spools adjacent to said smooth surface portion or said film guiding member; a turnable support turnably secured to said flat housing; said light emitting means mounted on said turnable support spaced from the axis of turning of the same; and means to step said turnable support and said light emitting means mounted on said turnable support so that the light emitted by said light emitting means is directed towards the next adjacent sound track on said strip-shaped sound record carrier whenever the end of one sound track is reached.

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