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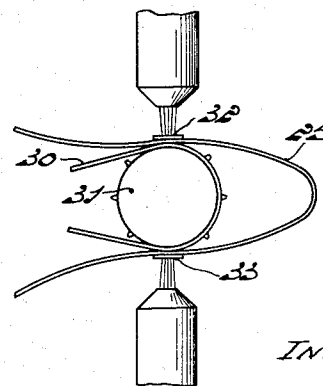
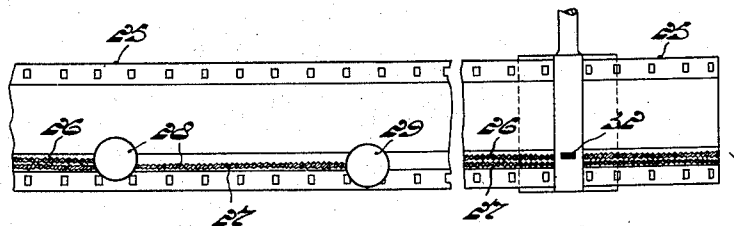
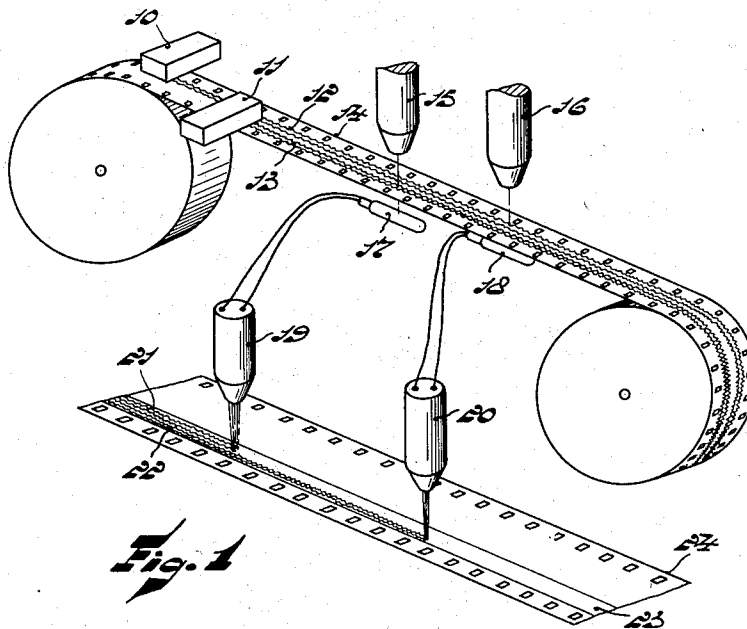
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2,273,755

METHOD OF PRODUCING SOUND RECORDS

Filed Jan. 8, 1940

2 Sheets-Sheet 1



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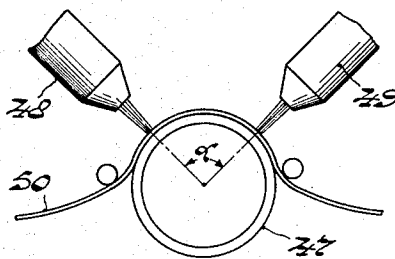
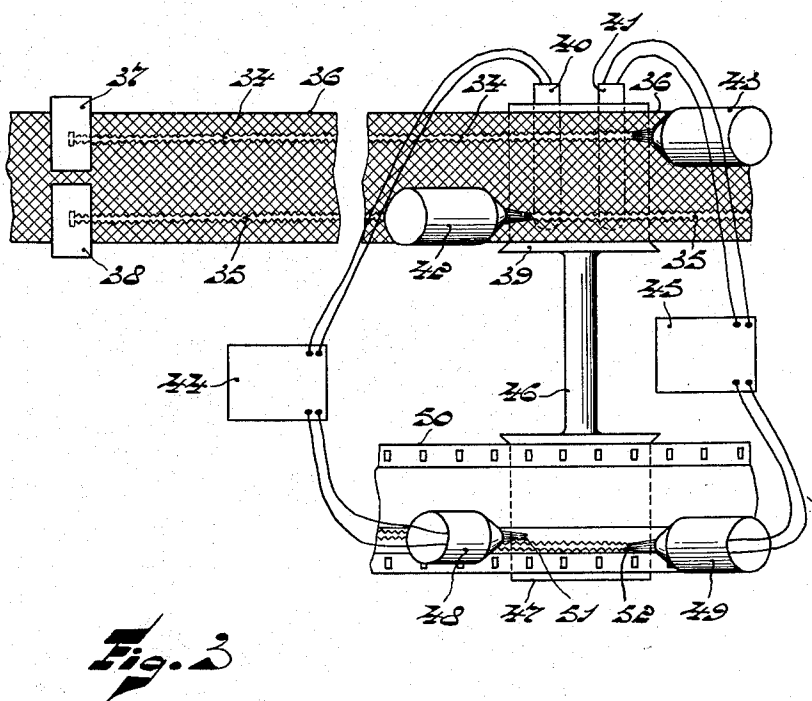
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METHOD OF PRODUCING SOUND RECORDS

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METHOD OF PRODUCING SOUND RECORDS

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3 Claims. (Cl. 179—100.3)

It is known to produce sound records in the form of a plurality of sound tracks which are recorded simultaneously and in juxtaposition and are adapted to be reproduced simultaneously, for example, push-pull records, stereophonic records and records of a plurality of sound sources in the form of separate sound tracks, etc.

In stereophonic sound recording use is made of a plurality of microphones or groups of microphones, generally two microphones which are arranged at some distance from each other and whose output currents are recorded separately or in groups, in such manner that at least two sound tracks are obtained of the same source of sound, each sound track, however, originating from a separate microphone or group of microphones. If these sound tracks are reproduced by loudspeakers or groups of loudspeakers which are arranged similarly to the microphones, the sound seems to originate not from the loudspeakers themselves but from a source of sound entirely detached from the loudspeakers, resulting in a "sound perspective." If the source of sound moves during recording, this movement will also be perceptible in reproduction.

It is already known to produce a sound record on a film in the form of a plurality of sound tracks which are adapted to be scanned simultaneously and at the same point. In view of the construction of the reproducing apparatus, particularly a reproducing apparatus for sound-plus-picture film, it is desirable that the sound tracks should be located within the available width of the sound track and that the corresponding parts of the stereophonic sound tracks should be juxtaposed on the finished film, that is to say that the corresponding amplitudes are not displaced in the longitudinal direction of the film. In view of the dimensions of the recording devices, these conditions can only be satisfied with difficulty in the production of the record. The present invention has for its purpose to provide a solution to these difficulties.

According to the invention, a plurality of sound tracks is recorded simultaneously on a film, at points which are displaced relatively to one another in the plane of the film and this displacement is compensated in transference of the tracks to another film so that the sound tracks are located within the normal available width of the sound track and with the corresponding amplitudes in juxtaposition.

The term "transference" is to be understood to mean the copying as well as the scanning and re-recording of the sound tracks in the form of

sound tracks which at least substantially correspond to the original sound tracks. Thus, for example, it is also possible during scanning and re-recording to mix another sound record in one or in the two tracks.

The phrase "displaced in the plane of the film" means that the corresponding amplitudes of the sound tracks which jointly constitute the record are displaced either in the longitudinal direction or in the transverse direction or in both directions of the film. The term "available width of the sound track" is to be understood to mean that width of the sound track which is available for all the sound tracks under the usual economical and technical conditions. In normal sound-plus-picture films this width is that of the standardized strip between the series of pictures and the sprocket holes, such as is also used for simple sound tracks. With sound films the width of the film is chosen on the ground of economical considerations and will consequently be as small as possible.

According to one embodiment of the invention the sound tracks are recorded within the available width of the sound track but in the longitudinal direction of the film at points which are displaced relatively to one another. This displacement is compensated during the copying of this film and, with correct compensation, we finally obtain a film on which the two sound tracks are within the available width and with the corresponding amplitudes in juxtaposition.

According to another embodiment of the invention, the sound tracks are displaced either only in the transverse direction or both in the transverse and in the longitudinal directions, that is to say that the distance between the sound tracks in the transverse direction is larger than is admissible for the available width of the sound track. The sound tracks thus displaced are scanned and re-recorded on a second film, the displacement in the transverse direction and, if necessary, also the displacement in the longitudinal direction being compensated by a suitable arrangement of the recording devices. The scanning is effected at points which are displaced in the longitudinal direction, while the recording devices are so arranged that the tracks recorded are located within the available width of the sound track. If the sound tracks are recorded with displacement in the longitudinal direction during the first recording, the scanning can also be effected without longitudinal displacement. The distance between the recording devices in the longitudinal direction of the film is so chosen

that the corresponding amplitudes of the record are in juxtaposition in the two sound tracks. During scanning and re-recording the sound tracks of the first record may be wider than is admissible for the finished sound film.

With this method use may advantageously be made of mechanical recording means whereby a sound track in the form of depth variations and optically reproducible width variations is cut through an opaque covering layer by means of an obtuse V-shaped chisel. In this case the first record is immediately ready for reproduction so that delay due to the additional recording can be avoided. The subsequent recording may take place either by mechanical or by photographic means.

The invention will be more clearly understood by reference to the accompanying drawings, showing, by way of example, a few embodiments thereof.

Fig. 1 shows one example, according to which the two sound tracks of a stereophonic record are recorded with relative displacement in both the longitudinal direction and the transverse direction of the recording carrier, this displacement being compensated again during scanning and re-recording.

In Fig. 2, the recording is effected within the available width but with displacement of the recording points in the longitudinal direction, said displacement being compensated during copying.

Fig. 3 represents an arrangement with which the two sound tracks are recorded in juxtaposition, but with a larger width than is admissible for the finished film, the required displacement in the transverse direction being obtained during scanning and re-recording.

Referring to Fig. 1, 10 and 11 are two mechanical recording devices, obtaining their input voltages from separate microphones which are spatially separated but influenced by the same source of sound. These recording devices record two sound tracks 12 and 13 respectively on a common film 14. The corresponding amplitudes in the sound tracks 12 and 13, which jointly constitute a stereophonic record, are displaced in the longitudinal direction of the film to such extent as corresponds to the distance between the recording tools of the devices in the longitudinal direction of the film. These longitudinal and transverse displacements are necessary, since the dimensions of the recording devices do not permit of their being located exactly in juxtaposition over the film.

However, in the usual reproducing apparatus, particularly in reproducing apparatus for sound-plus-picture films, the scanning points are juxtaposed for constructional reasons. The width available for the sound tracks is fixed and is nowadays not larger than the standardized sound-track width on sound-plus-picture films, even for a plurality of sound tracks in juxtaposition. The displacement in the longitudinal and in the transverse directions on the film 14 must now be compensated during scanning and re-recording.

The sound tracks 12 and 13 are scanned by two scanning devices 15 and 16 and transformed into electric currents by means of two photocells 17 and 18. The said currents are recorded in the form of two separate sound tracks 21 and 22 within the width available on a sound-plus-picture film 24, i. e. within the standardized sound-track strip 23, by means of two recording devices 19 and 20. These sound tracks 21 and

22 should be directly in juxtaposition in the transverse direction of the film; the space required for the arrangement of the recording devices consequently must be found in the longitudinal direction of the film. However, to satisfy the condition that the corresponding amplitudes of the two sound tracks 21 and 22 are juxtaposed, the longitudinal displacement of the scanning points 15 and 16 is chosen such that this displacement, together with the longitudinal displacement of the recording apparatus, is equal to the longitudinal displacement of the recording apparatus 19 and 20 which is necessary for constructional reasons.

Consequently, it is advantageous for the sound tracks 12 and 13 to be mechanically cut to exhibit both depth variations and optically reproducible width variations by means of an obtuse V-shaped chisel cutting through an opaque covering layer, since the first carrier 14 is only an intermediate stage in the recording method, which must be ready for scanning again as soon as possible. In this case sound tracks are obtained which are immediately ready for scanning. To suppress the background noise in the first record, the latter is preferably produced as a so-called noiseless record.

According to Fig. 2, two sound tracks 26 and 27 are recorded within the available width on a common carrier 25. The two recording devices 28 and 29 must consequently be displaced in the longitudinal direction so that the amplitudes corresponding to one another are also recorded with relative displacement. The displacement in the longitudinal direction is compensated during copying. The sound tracks are copied separately on to another film 30. Use is made of a continuous copying machine on whose copying sprocket-drum 31 are present two copying points 32 and 33 respectively. The copying point 32 is of such a limited size that only the sound track 26 is copied, whereas the copying point 33 only admits an exposure of the sound track 27. The length of the loop between the two copying points in the film 25 is made greater than that in the copying film 30 to such extent as corresponds to the displacement in the longitudinal direction between the recording devices 28 and 29. This longitudinal displacement is thus compensated during copying. Instead of using a single copying machine having a plurality of copying points, use may also be made of the usual copying machine having only one copying point. In this case only one sound track is exposed each time when the film to be copied traverses the machine. The compensation of the longitudinal displacement is then obtained in such manner that after each copying the position of the copying film relatively to the film to be copied is varied in the longitudinal direction by the required amount.

Since in copying on sprocket rollers the sprocket holes of the two films must be located on the teeth of the roller, the longitudinal displacement of the recording device for perforated films in preferably equal to an integral number of sprocket holes. In this case this film can be copied in the above-mentioned manner on a single-sprocket copying roller.

Fig. 3 shows a device whereby a stereophonic record in the form of two sound tracks 34 and 35 is cut by mechanical means in a carrier 36 without longitudinal displacement but at a larger transverse distance from one another. The tracks 34 35 in this case are located so far from one another that the cutting apparatus 37 and

38 can be arranged in juxtaposition. The tracks themselves have also a greater width than the usual sound tracks on photographic films. This distance between the tracks and the larger width of the track are reduced to the desired dimensions during scanning and re-recording.

The recording apparatus 37 and 38 are in juxtaposition so that the corresponding amplitudes of the two sound tracks are not displaced in the longitudinal direction. The scanning and re-recording is effected with equal longitudinal displacement of the scanning and the recording devices, in such manner that the longitudinal displacement of the recording devices 48 and 49 which is unavoidable for constructional reasons, 15 corresponds to the longitudinal displacement of the scanning devices 42 and 43. Of course, in addition to obtaining compensation of the longitudinal displacement, attention should also be paid to the width of the sound track during 20 re-recording.

The device represented permits of reproducing and re-recording in a single device, the ratio of speed between the films 36 and 50 being ensured by coupling scanning roller 39 with a recording 25 roller 47 through a common shaft 46. The sound tracks 34 and 35 are scanned by two scanning devices 42 and 43 which are displaced in the longitudinal direction of the film, reproduced as electric currents by means of photo-cells 40 and 41, amplified by amplifiers 44 and 45 respectively 30 and re-recorded by recording devices 48 and 49 in the form of two sound tracks 51 and 52 on a sound-plus-picture film 50. The angular distance between the scanning points 42 and 43 35 in the longitudinal direction of the film is of such a magnitude that the running time of the film 36 is equal to the running time of the film 50 over the arcuate distance between the recording points 48 and 49, which results in the corresponding amplitudes of the two tracks, which initially 40 have been recorded without longitudinal displacement, being re-recorded without longitudinal displacement in juxtaposition, even if the ratio of the speeds of the films 35 and 50 is different 45 from unity. The ratio between these arcuate distances is equal to the ratio between the film speeds. If both the scanning devices and the recording devices engage the periphery of film rollers running with the same speeds, the ratio 50

between the diameters of the rollers is equal to the ratio of the film speeds; in this case the angle between the scanning points is always equal to the angle α between the recording points.

Though all the above examples relate to stereophonic recording, it is evident that the invention can be applied to all kinds of recording wherein the record is constituted by a plurality of sound tracks which are in juxtaposition and are scanned simultaneously and at the same point.

What I claim is:

1. A device for copying on a carrier a plurality of sound tracks displaced longitudinally on a second carrier comprising, a copying sprocket drum adapted to receive said carriers, and a plurality of sound copying devices spaced apart around said roller and spaced apart laterally thereof.

2. A device for scanning and recording on a carrier a plurality of sound tracks displaced relatively to each other on a second carrier, comprising a scanning roller adapted to receive the second carrier, a plurality of scanning devices spaced apart around said roller and each adapted to scan one of the sound tracks, a copying roller adapted to be rotated in synchronism with the first roller, and a plurality of copying devices each associated with one of said scanning devices, the angular displacement of the copying devices being equal to the angular displacement of the corresponding scanning devices.

3. A device for scanning and re-recording on a carrier a plurality of sound tracks displaced relatively to each other on a second carrier, comprising a smooth-faced scanning roller, a scanning device for each sound track and displaced relatively to each other around said roller, a second roller adapted to receive said first carrier, and a recording device associated with each scanning device and displaced with respect to each other around said second roller, the ratio between the length of the surface of the first roller between two scanning devices and the length of the surface of the second roller between two corresponding recording devices being equal to the ratio of the speed of the second carrier and the speed of the first carrier.

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