Jan. 16, 1962 M. A. KERR 3,017,466

MAGNETIC QUARTER-STRIPE SOUND TRACKS FOR 16 MM. FILM

Filed June 18, 1958 2 Sheets-Sheet 1

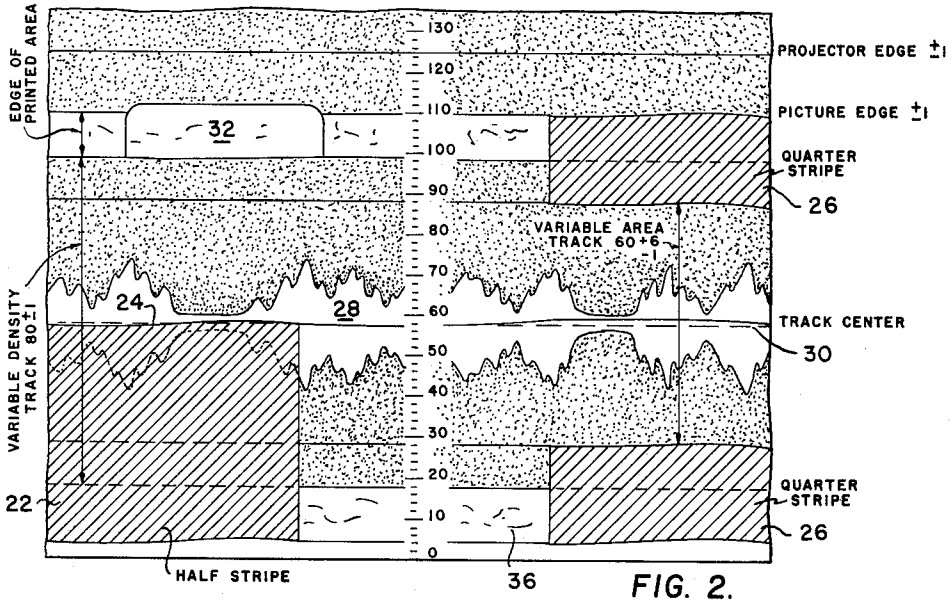


FIG. 2.

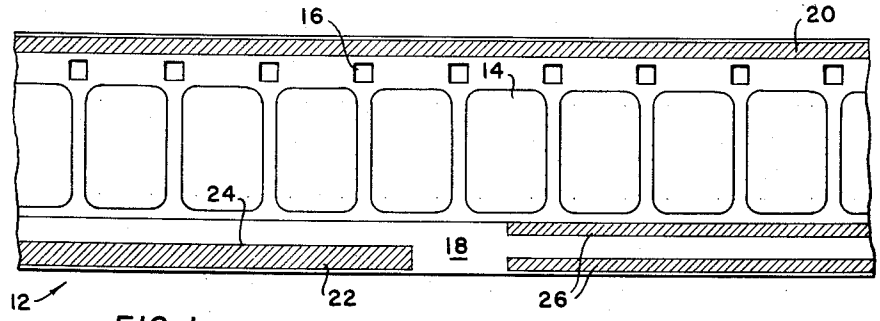


FIG. 1.

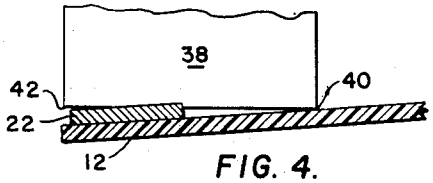


FIG. 4.

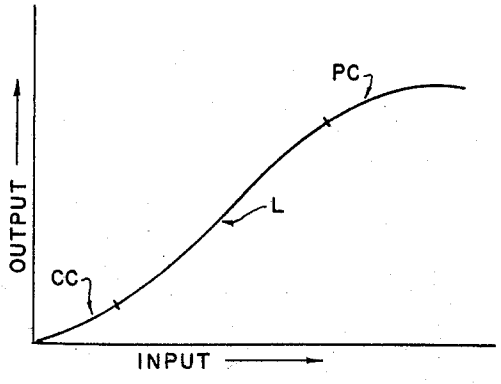


FIG. 3.

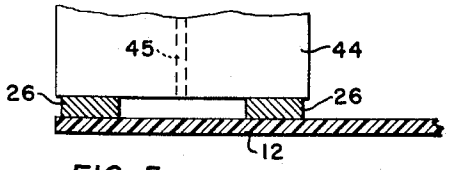


FIG. 5.

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MAGNETIC QUARTER-STRIPE SOUND TRACKS FOR 16 MM. FILM

Filed June 18, 1958 2 Sheets-Sheet 2

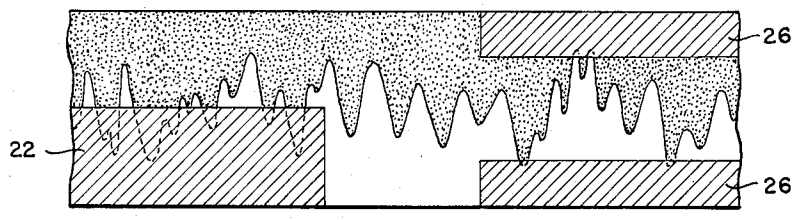


FIG. 6.

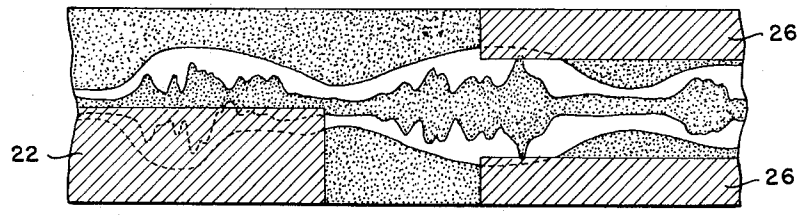


FIG. 7.

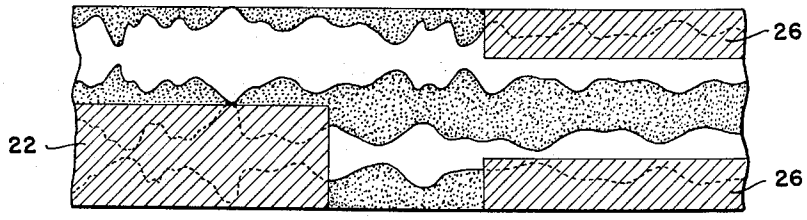


FIG. 8.

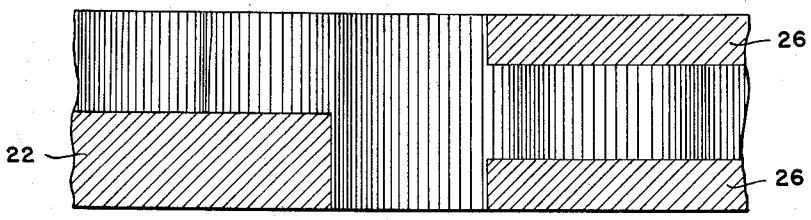


FIG. 9.

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MAGNETIC QUARTER-STRIPE SOUND TRACKS FOR 16 MM. FILM

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Filed June 18, 1958, Ser. No. 742,968
8 Claims. (Cl. 179—100.1)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a magnetic quarter-stripe sound track for 16 mm. film which comprises a pair of magnetic stripes placed at the edge or septum area of the photographic sound track and each occupying about ¼ of the width of the photographic track. The striping method shown can also be applied to optical sound tracks on 35 mm. films.

The primary object of this invention is to provide a single or dual additional record to be made on the existing type of photographic film without noticeable distortion, which occurs in the present practice.

Another object of this invention is to reduce the normal noise and hiss of the existing sound tracks.

Another object of this invention is to provide a magnetic sound track which will provide a constant signal from the associated magnetic head despite wear of the track or magnetic head.

Other objects and advantages of the invention will become more fully apparent from the following description of the annexed drawings which illustrate a preferred embodiment, and wherein:

FIG. 1 is a plan view of a 16 mm. photographic film having a half-stripe magnetic coating on the left in accordance with the proposed SMPTE recommended practice and two quarter-stripes on the right in accordance with the invention.

FIG. 2 is a detail view of the stripes on a bilateral variable area recording optical sound track.

FIG. 3 is a graph of a transfer curve showing various types of distortion.

FIG. 4 is a view in cross-section of a magnetic head and photographic film in accordance with the SMPTE recommended practice.

FIG. 5 is a view in cross-section of a magnetic head and photographic film in accordance with the invention.

FIGS. 6, 7, 8 and 9 are plan views of the SMPTE practice on the left and the invention on the right as applied to a unilateral variable area sound record in FIG. 6, a bilateral, variable area record with bias control of side shutters printed from a 35 mm. master in FIG. 7, a push pull, class A. bilateral, variable area record printed from 35 mm. film in FIG. 8, and a variable density recording in FIG. 9.

The Society of Motion Picture and Television Engineers has proposed, in the Journal of the SMPTE, May 1955, page 260, that 16 mm. photographic film, indicated at **12** in FIG. 1, having pictures or frames **14**, sprocket holes **16**, and an optical track **18**, be provided with a balance stripe **20** placed on the sprocket hole side of the film and a half-stripe **22** placed on the outside half of the optical track.

The half-stripe **22** ideally should have its inner edge **24** run along the exact center of the optical track **18**. In practice this is almost impossible to do because of the weaving of both the optical track and the magnetic half-stripe, which results in a type of distortion known as "single-sided peak clipping."

This weaving is more clearly shown in FIG. 2 where a bilateral variable area recording is shown with the half-

stripe **22** on the left. This distortion is very high (percentagewise) on low level passages and becomes lower in percent only when the signal level is raised. The ear acceptance of such a sound track is poor since the majority of a sound track is composed of low level sections of the sound.

For the above reasons the film industry has been thinking in terms of half-striping only variable density tracks on 16 mm. film even though there are many variable area tracks on which magnetic stripes are desired.

In order to overcome these disadvantages and to provide a plurality of sound tracks suitable for binaural and stereophonic sound systems, this invention primarily consists in applying a pair of magnetic stripes, each occupying about 25% of the optical track area and placed at each side thereof. These quarter stripes are indicated at **26** on FIG. 1, while more detail is shown in FIG. 2 of the optical track area with the half-stripe **22** on the left and the quarter-stripes **26** on the right.

A careful examination of FIG. 2, which discloses a variable area, bilateral recording **28**, with noise reduction by bias control of the recording galvanometer, will indicate that the half-stripe **22** cuts the recorded area in half which reduces the output from the photocell pick-up by 6 db.

More important, the weaving of the inner edge **24** of the half-stripe **22** and the track center **30** with respect to each other induces distortion and single sided peak clipping on low level as well as high level signals.

By contrast, the quarter stripes **26** have no effect at low levels and will only introduce possible distortion on the peaks of the sound track which occur at loud passages.

For clarity FIG. 3 discloses an arbitrary transfer curve for a system where the input signal increases along the abscissa and the output increases along the ordinate. A transfer curve is shown having low level or center clipping CC, a central portion L which may be relatively linear, and an upper portion PC which illustrates peak-clipping.

It has been shown in a Report of Investigation of Methods of Non-Linear Distortion, Lab. Project 5328, Progress Report 5, N55683-034, March 17, 1954, Material Laboratory, New York Naval Shipyard, Brooklyn 1, New York, by Joseph Hershkowitz that 1 to 1.5 db of center clipping will reduce speech intelligibility 10% while 6 db will reduce the word articulation score to 25% of the undistorted value. On the other hand 6 db or 12 db of peak clipping has negligible effect on intelligibility and only slight impairment of quality while infinite peak clipping reduced the word articulation score to 80% of the undistorted value.

The quarter stripes therefore may produce a type of distortion which has negligible effect on intelligibility and little effect on quality, while full output is obtained from the optical track.

Photographic film displays mechanical defects in the area of the optical track which create noise and hiss. The second set of sprocket holes on the optical side are sometimes printed, as at **32**, on the film in the transparent septum area **34**. Scratches **36** may be caused by rails in the picture gate of the projector and are particularly troublesome in the transparent septum area **34** which may not be masked out during film printing.

Most of these troubles may be masked out on both sides of the optical track by using the quarter stripes **26** placed along the edges.

The normal specification of the optical track according to SMPTE standards are shown in FIG. 2 along with quarter stripes in accordance with the invention. The quarter stripe along the outer edge is shown as extending from 0 to 28 mils in from the outer edge of the film. The

inner quarter stripe is shown as extending from 88 to 110 mils or from the outer limit of the variable area sound track to the picture edge.

Uneven wear on the film 12 and scratching of the optical sound track may be caused by the magnetic pick-up head 38 as shown in FIG. 4 at 40. Uneven contact between the head 38 and the half stripe 22 at 42 will produce undesired head wear and loss of high frequency response to the magnetic modulation. The magnetic stripes comprise a suitable and somewhat abrasive magnetic powder in an adhesive binder and are usually applied in a layer about .001 to .0015 inch thick.

In accordance with the invention a magnetic head 44, which may be single or dual for binaural or stereophonic sound, is shown in FIG. 5 touching the two quarter-stripes 26. More even wear of the stripes, magnetic head, and pressure shoe rails of the picture gate result from this arrangement and the optical sound track of the film 12 will not be scratched or cut by the head. In addition the dual heads may be spaced a greater distance apart to reduce cross-talk. She the dotted lines 45.

The SMPTE has recommended that the half-stripe not be used for unilateral variable area recording and FIG. 6, at the left, shows that if this is done continuous half-wave rectification of the signal will occur resulting in unbearable distortion. In contrast the quarter-stripes, shown at the right, will produce no low level distortion and only a small amount of peak clipping which is generally unnoticeable.

FIG. 7 shows a bilateral, variable area recording with bias control of the side shutters printed from a 35 mm. master. Since the center line of this record often weaves in relation to the edge of the film, it is believed that the quarter-stripes, shown at the right would be easier to apply and cause less distortion since the careful placement of the half-stripe in relation to the center line of the optical sound track is not necessary.

FIG. 8 shows a push pull, class A, bilateral, variable record area printed from a 35 mm. film with the half and quarter-stripes. Since the distance between the inner edges of the quarter stripes may be held to a very close tolerance, it is believed that less distortion will occur with the quarter-stripes than with the half-stripes since any weaving of the optical sound track with respect to the stripes will change the total transparent area with the half-stripe but will not change the total transparent area between the quarter stripes.

FIG. 9 shows a variable density optical track with the half and quarter-stripes. A greater signal output will be obtained from the optical track with the quarter stripes since some of the quarter stripe area is in the septum area while greater noise reduction will be obtained because the sound track edges and septum area are covered.

While this invention primarily is concerned with sound tracks on photographic film, the recording tracks may be used for sound, light, timing signals, or any other information which may be recorded.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A 16 mm. photographic film with a magnetic sound track comprising a photographic film having a photographic sound track along one edge, and magnetic means for recording another sound track on said film along said edge and overlapping said sound track whereby center clipping of photographic track may be avoided.

2. A photographic film comprising a photographic film having a photographic sound track, and a two section magnetic sound track positioned along the outer edges of and overlapping said photographic sound track whereby center clipping of said photographic track may be avoided.

3. A photographic film having both a photographic and magnetic sound track comprising a photographic film having a central section adapted to record a photographic image, one side section of said film adapted to provide a plurality of sprocket holes which are adapted to be driven by a sprocket for advancing said film, and the other side section of said film having a photographic sound track and a pair of magnetic quarter stripes placed at the edge of and overlapping said photographic sound track on said film, whereby center clipping of said photographic sound track may be avoided and the outer portions of said other section may be covered to eliminate the effect of film scratching.

4. A photographic film providing three sound tracks comprising a photographic film having a photographic sound track extending along one edge and a pair of magnetic sound tracks placed along each side of said photographic sound track, each magnetic track extending across about 25 percent of the width of said photographic track whereby film scratches at the edges of said photographic track may be minimized.

5. A magnetic sound track for a unilateral sound recording comprising a photographic film having a unilateral variable area recording, and a pair of magnetic stripes placed along the outer edges of and overlapping said recording, whereby center clipping of said recording may be avoided.

6. A system for recording and reproducing stereophonic and binaural sound comprising a photographic film, an optical record on said film, a pair of magnetic records comprising a magnetic stripe placed along each edge of and overlapping said optical record, and a dual magnetic recording and reproducing head mounted in contact with said magnetic stripes for recording and reproducing signals on said stripes.

7. A process for producing a magnetic sound track on 16 mm. film having an optical recording comprising applying a first magnetic stripe along one edge of said optical recording to occupy about 25% of said recording, and applying a second magnetic stripe along the other edge of said optical recording to occupy about 25% of said recording whereby an effective magnetic track of effectively 50% of said optical track may be obtained without low level distortion of said optical recording.

8. A magnetic quarter stripe sound track for 16 mm. film comprising a photographic film having an optical sound track along one edge, a pair of magnetic sound tracks placed over and overlapping said optical track and along the edges thereof, without any magnetic material along the center of the optical track whereby center clipping may be avoided and high intelligibility of said optical track may be retained along with said magnetic sound tracks for further information recording.

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