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MULTI-SYSTEM SOUND RECORDING AND PHOTOGRAPHIC STRIP

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## MULTI-SYSTEM SOUND RECORDING AND PHOTOGRAPHIC STRIP

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This invention relates to sound recording and reproduction systems and more particularly to a sound recording and photographic strip for these systems.

In the operations of recording sound, when by the optical method sound modulated light is directed to the photographic emulsion; when by the magnetic method sound modulated magnetic influence is directed to magnetizable material in strip form; and when by the mechanical method sound modulated mechanical vibrations of a stylus are directed to displaceable material in strip form.

In the operations of reproducing sound from the record, when by the optical method, light reflected from or passed through the emulsion and thereby modulated by the optical record is received on a light responsive electrical device producing modulated electric current which is passed through suitable agencies to a sound reproducer; when by the magnetic method modulated magnetic influence is received upon a magnetically responsive electrical device likewise producing modulated electric current applied as in the optical chain; and when by the mechanical method, vibrations of a stylus modulated by traverse of the stylus record operate an electrical device to produce modulated current which is again applied as in the optical chain.

These various recording and reproducing agencies are set forth in detail in U.S. Patent No. 2,725,784 of which this application is a continuation in part.

An object of this invention is to provide a sound recording strip permitting recording by stylus and reproducing optically (by transmitted and reflected light), magnetically, and mechanically. A further object is to provide a sound recording strip permitting optical reproduction and subsequent erasure and conditioning for reuse. A further object is to provide a photographic film for simultaneous photographic and sound recording on which the sound may be mechanically recorded and optically reproduced. A further object is to provide a photographic film for selective sound recording and reproduction. A further object is to provide a record on which sound may be recorded mechanically and from which sound may be reproduced mechanically, optically, and magnetically.

Referring to the drawing:

Fig. 1 shows a composite photographic film in the process of being scribed for recording sound and in the process of reproducing the record optically and magnetically.

Fig. 2 shows a bifurcated scribe and a composite recording strip for making a single strip magnetic record.

Fig. 3 shows the relation of the record parts of Fig. 2.

Fig. 4 shows a chisel pointed scribe in position for scribing a sound record.

Fig. 5 shows a combination sound recording strip and a detachable reflector strip therewith.

Fig. 6 shows a combination sound recording strip and a detachable reflector strip therewith adapted to operate

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as a belt rolling along successive increments of the recording strip.

Referring to Fig. 1, a transparent base strip 1 carries a photographic emulsion 2 and a sound recording composite arrangement of base 4 and a fine skin layer 5. Immediately below the composite structure 4—5 on the under side of the base 1 is a reflecting strip 6 attached by pressure adhesive to the base in a manner to facilitate removal of the reflector when such operation is desired for purposes later disclosed. The pressure adhesive 6—1 and the reflector strip 6 are unreleasably joined. The nature of the base strip 1 is such that it readily releases the pressure adhesive 6—1 when the strip 6 is flexed away from the base 1. In operation the base 1 may be propelled by contact with belt 7 operating over pulley 8 or by sprocket, not shown, operating in sprocket holes 9. The belt 7 has groove 7' in which to receive the reflector strip 6 and give traction to the latter. A pressure adhesive in the belt groove provides the required degree of traction.

A scribe 10 is actuated by means not shown to cut hills and dales in the composite structure 4—5 for a sound record. As an example of the composite material the member 4 may be translucent gelatine about 60μ thick. The member 5 may be magnetizable material such as powdered Alnico or iron oxide about 3μ in thickness. The scribe 10 may be a single sapphire having a wedge cutting angle tip. Other plastics than the gelatine may be used for the sub layer and for bonding the outer layer. The cutter removes a thin shaving of gelatine and magnetic material. The gelatine layer may later be hardened to withstand retreading by the scribe. For the gelatine hardening treatment potassium chrome alum,  $K_2SO_4$ ,  $Cr_2(SO_4)_3$ ,  $24 H_2O$ , is generally preferred with some glycerin being added for maintaining flexibility. Too much chrome alum will make the film brittle, but a degree of hardness approaching brittleness is desirable to give wearing quality. A very wide range is permitted so that the quantity is not critical.

It is desirable to reproduce sound from the record within, say, 1/5 second after the inscribing operation occurs and other means than the mechanical one is preferred. This invention lends itself to such reproduction by two optical methods and a magnetic method. The cutter or stylus shaped like an obtuse wedge moves in synchronism with the sound vibration to be recorded and removes a thin shaving of the magnetic powder and gelatine as the structure 4—5 and its support 1 are displaced below the cutter at a uniform speed. Preferably the cutter rides the center of structure 4—5 and in action bifurcates the magnetic layer. A preferred width of maximum trace of  $2a=2$  mm. is commonly used in sound film practice. To this end the cutter may be given a double amplitude of 50μ. It is a special characteristic of this system that only a small amplitude is required for the cutter. By giving the cutter an obtuse angle wedge shape the mechanical movement of the oscillating system may be as little as 25μ. Careful construction is required for belt drive and uniform motion as set forth in applicant's parent application, Patent 2,661,652. Fluctuations in the load due to variations in cutting cannot be taken up by the sprocket holes without producing detrimental vibrations. Special belt drive and motion stabilization are provided and set forth in detail in the above specification.

The optical methods of reproduction are by projecting a fine pencil of light through the bifurcated opaque layer 5 of magnetic powder. Again referring to Fig. 1, the edges 5a and 5b of magnetic powder layer 5 are serrated in accordance with sound vibrations and modulate the light passing through the bifurcation. This light is provided by source 11 along pencil 12. After pass-

ing through the opening in the opaque layer the pencil passes through the layer 4 to reflector 6 where it is turned back along path 13 to light responsive cell 14 from which modulated electric current is taken, amplified, and used to operate a sound reproducer.

As shown in Fig. 1, the reflecting layer 6 may be stripped from the base 1 as the propelling belt 7 is passed over the operating pulley 8 and wound up by means not shown. The reflecting layer may not give quite the quality of reproduction desired in which also the reflecting layer 6 may be designated as 6a when operating as a continuous belt set in groove in belt 7. The reflecting layer may not give the quality of sound desired and direct transmission of light may be effected from source 15 as pencil of light 16 after being modulated by serrations 5a and 5b, passing through the gelatine 4 to light responsive cell 17. From cell 17 events transpire as stated from cell 14. The cutter 10 is provided with an obtuse cutting angle so that slight variations in movement of the cutter toward and from the record will reproduce large variations in the width of the transparent track as the tool removes opaque coating from the transparent base. Also, when the opaque coating is of magnetizable material and magnetized, these large variations provide large magnetic field variations forming a magnetic sound record.

Referring to Fig. 6, the structure 1—2—4—5 is shown with reflecting member 6 on the back thereof, much shorter in length than the structure members and disposed as a belt over pulleys 18 and 19 with splice 20. This belt is disposed under the light source and light responsive cell for the purpose previously stated.

Referring to Fig. 4, base member 21 carries gelatine layer 22 in which polished powdered aluminum is dispersed to form a reflector. Layer 23 over reflector 22 may be of material lending itself to scribing and modulation by scribe 10', such material for example as black mercuric sulphide. In this case light from a source not shown passing through the bifurcation provided by the scribe 10' would be reflected as modulated light to activate a light responsive cell with sequence of action thereafter as previously described.

Referring to Fig. 5, transparent base member 24, carries reflecting layer 25 by pressure adhesion, gelatine layer 26 and opaque layer 27 of black mercuric sulphide. Scribe 10" acting upon the opaque layer in the manner previously described provides a sound record for both optical reproduction systems either or both of which may be employed. Members 24 and 26 when extended laterally as members 1 and 2 of Fig. 1 provide for the photographic record to accompany the sound record. When both optical reproduction systems are used, the member 24 being the base of a photographic film operated over roll 8 of Fig. 1, this reflecting strip 25 is readily released from the pressure adhesion to base 24 until the second optical reproducer has acted and then returned to member 24 by means not shown for further dual reproduction.

Referring to Fig. 2, a base strip 28 carries a photographic emulsion 29 and thereabove a translucent gelatine layer 30. On layer 30 are superposed outer opaque layers 31 and 32 and intermediate opaque layer 33 of magnetizable powder. The opaque layers—say of black mercuric sulphide—provide a boundary to light paths modulated by double pointed cutter 10". The shape of the cutter is such as to operate on the outer edges of the magnetic strip. Additionally, styli of the character 10 may operate on the strips 31 and 32. If strip 28 is not transparent, transparent gelatine layer 30 may be made reflective in the manner cited. Stereophonic recording may be effected on this structure.

Again referring to Fig. 1, the serrated edges 5a and 5b of the magnetic material in their passage under magnetic reproducing head 34 by reason of the variations in the magnetic field they produce as they move along induce

modulated current in the head which is used in the well known manner for sound reproduction. The optical reproducer 11 and magnetic reproducer 34 are shown for purposes of illustration separated longitudinally along the inscribed sound record. However, the operating relationship of the reproducers is not limited to the separation shown since they may be positioned to reproduce from practically the same section of the record. It is obvious that the detachable strip of reflecting material is equally effective with a modulating area in the photo emulsion provided by photo processing.

I claim:

1. A composite flexible film for recording sound for motion pictures for reproduction by a plurality of systems including reflected and transmitted light comprising a flexible opaque workable skin layer, a sublayer of workable translucent plastic which will accept a sound recording scribe, a supporting flexible carrier strip; and a reflecting layer releasably attached to said carrier by pressure adhesive opposite to said sublayer and adapted by said adhesive to be momentarily separated from said carrier to permit transmission of reproducing light and replacement for reflection of reproducing light, said adhesive being unreleasably attached to said reflecting strip.

2. A composite flexible film for recording sound for motion pictures for reproduction by a plurality of systems including magnetic, reflected and transmitted light comprising a flexible opaque magnetizable skin layer, a sublayer of workable translucent plastic which will accept a sound recording scribe, a supporting flexible carrier strip; and a reflecting layer releasably attached to said carrier by pressure adhesive opposite to said sublayer and adapted by said adhesive to be momentarily separated from said carrier to permit transmission of reproducing light and to be replaced for reflection of reproducing light, said magnetizable layer holding a record for magnetic reproduction, said adhesive being unreleasably attached to said reflecting strip.

3. A composite flexible film for recording sound for motion pictures for reproduction by a plurality of systems including mechanical by stylus, reflected and transmitted light comprising a flexible opaque workable skin layer, a sublayer of workable translucent plastic which will accept a sound recording scribe and subsequent chemical treatment for imparting thereto wear resistance to reproducing scribe, a supporting flexible carrier strip; and a reflecting layer releasably attached by pressure adhesive to said carrier adapted by said adhesive to be momentarily separated from said carrier to allow transmission of light modulated for sound reproduction and to be replaced on said carrier for reflection of reproducing light, said adhesive being unreleasably attached to said strip.

4. A combination motion picture film and sound record therefor for reproduction of sound by agencies in close proximity to each other employing modulated reflected light and modulated transmitted light comprising a motion picture film, a variable area sound track in the normal longitudinal position of the photographic sound track on said picture film, a strip of material having a reflecting surface facing the back of said film opposite the normal longitudinal position of said variable area and there held by pressure adhesive permitting progressive separation from said film between the said respective reproducing agencies while said agencies are in operation using said reflected light from said strip and transmitted light adjacent said separated portion of film, said adhesive being unreleasably attached to said reflecting strip.

5. A combination motion picture film and sound record therefor for recording and reproducing sound by agencies in close proximity to each other employing a scribe and modulated reflected light and modulated transmitted light comprising a motion picture film, a flexible opaque skin layer of workable material, a sublayer of workable translucent plastic which will accept said recording

scriber on said picture film in the normal longitudinal position of the photographic sound track, a strip of material having a reflecting surface facing the back of said film opposite to said skin layer and there held by pressure adhesive permitting progressive separation from said film between the said respective reproducing agencies while said agencies are in operation said adhesive being unreleasably attached to said reflecting strip.

6. A motion picture film comprising a base having a picture portion, a sound record portion between said picture portion and one edge of said film adapted to modify light for sound reproduction, and a removable reflecting strip with pressure adhesive unreleasably attached to the latter operatively connected with said film base by said adhesive on the side thereof opposite to said sound record and progressively detachable.

7. A motion picture film comprising a base having a picture portion, a sound record portion between said picture portion and one edge of said film with variable transparent area adapted to modify light for sound reproduction and with variable opaque magnetic area providing the boundary of said transparent area providing dual records of the same sound waves; and a removable reflecting strip operatively connected with said base on the side thereof opposite to said sound records and progressively detachable.

8. A motion picture film comprising a base having a picture portion, a sound record portion between said picture portion and one edge of said film adapted by a variable area to modify light for sound reproduction, and a removable reflecting strip operatively connected with said film base on the opposite side from said sound record and progressively detachable therefrom, the light modifying portion of said sound record having a bifurcated magnetic sound record made up of opaque magnetic material bounding said variable area.

9. A composite sound record including a transparent base strip, a reflecting strip, a pressure adhesive releasably attaching said reflecting strip to said base strip; on said base strip opposite to said reflecting strip a sublayer of workable translucent plastic material which will accept the action of a sound scribe; three opaque strips forming a skin over said sublayer, the middle one of which is of workable magnetizable material and both edges of which when scribed forming the bounding edges of two variable area sound records with the other two strips forming the outer boundaries of said variable areas.

10. In a sound recording and reproducing system wherein a scribing member is suitably actuated to record sound on a composite recording strip and wherein means are provided for reproducing sound from said strip by reflected light, by transmitted light and by variable magnetic action, a composite recording strip including a transparent base strip, a reflecting strip, a pressure adhesive removably attaching said reflecting strip to said base strip; on said base strip opposite to said reflecting member a sublayer of workable translucent plastic material which will accept the action of said scribing member, and a flexible opaque workable skin layer over said sublayer of magnetizable material adapted to be varied in width to form at least one variable boundary to the light used in said sound reproduction by use of light.

11. In a sound recording and reproducing system wherein scribing means is actuated to record sound on a traveling composite record strip and wherein means are provided for reproducing sound from said record optically and magnetically, a composite recording strip including a transparent base strip, a sublayer of workable translucent plastic material on said base strip, and an

opaque skin layer containing magnetizable material for magnetic recording on said sublayer, said skin layer accepting said scribing means so that when it is so scribed it is progressively bifurcated forming a variable area sound record between fork arms carrying said magnetizable material.

12. A combination in accordance with claim 11 including a reflecting strip and a transparent pressure adhesive releasably attaching said reflecting strip on said base strip on the side of the latter opposite to said sublayer for adapting said composite strip to optical sound reproduction by reflected light and by transmitted light.

13. In a sound recording and reproducing system wherein a scribing member is suitably actuated to record sound on a composite recording strip and wherein means are provided for reproducing sound from said strip by reflected light, by transmitted light and by variable magnetic action, a composite recording strip including a transparent base strip, a reflecting strip, a pressure adhesive releasably attaching said reflecting strip to said base strip; on said base strip opposite to said reflecting member a sublayer of workable translucent plastic material which will accept the action of said scribing member, and a flexible opaque workable skin layer over said sublayer of magnetizable material adapted to be bifurcated by said scribing member to form both side boundaries for a variable area sound record, the remnant of said skin layer providing a magnetic sound record.

14. A composite motion picture film carrying an optical sound record adapted to sound reproduction selectively by transmitted light and reflected light including a transparent base strip with one surface of a character to release therefrom a pressure adhesive, a pressure adhesive carried on said surface, a reflector strip unreleasably carrying said adhesive, and on the other surface of said base strip an optical sound record of the character noted, said adhesive and reflecting strip adapting said composite member to said reflected light operation, removal of said reflecting strip and associated adhesive adapting said record to reproduction by transmitted light, and replacement of said strip and adhesive again adapting said record to reproduction by reflected light.

15. In combination a transparent base strip, a motion picture film and a sound record of the variable area type mounted on one side of said base strip, a reflecting strip on the other side of said base strip, and a transparent adhesive releasably attached to said base strip and releasably attached to said reflecting strip opposite to said sound record, said pressure adhesive and reflecting strip by reason of their adjustable nature extending the use of said sound record beyond reproduction by transmitted light to include reproduction by reflected light and a return to reproduction by transmitted light.

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