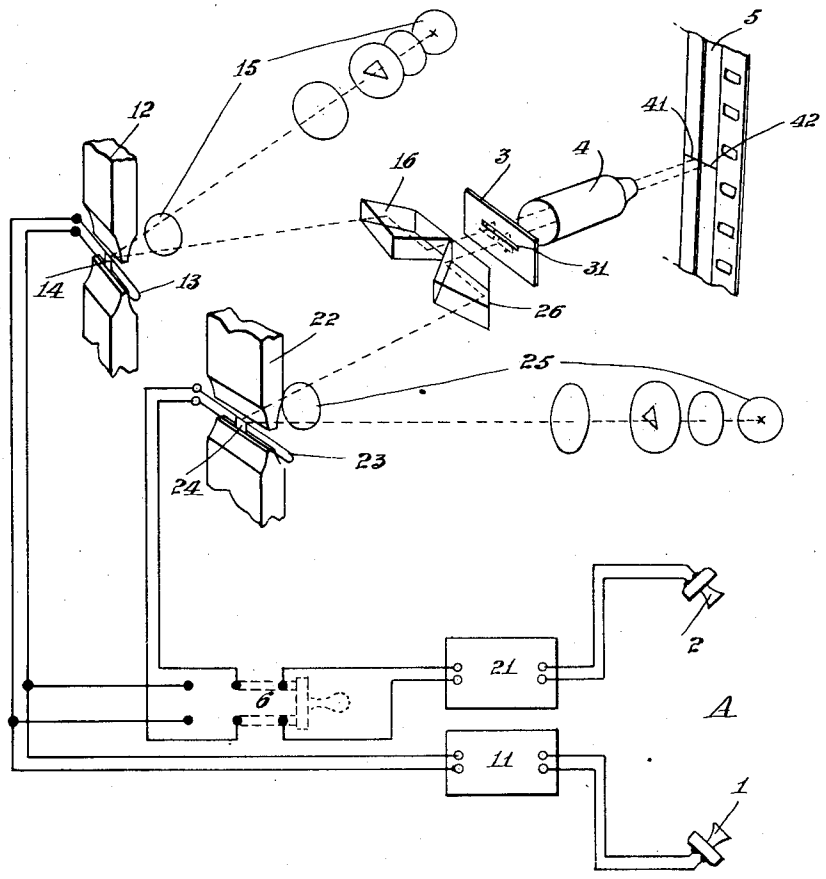
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PHOTOGRAPHIC SOUND RECORDING

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Fig. 1.



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Fig. 2.

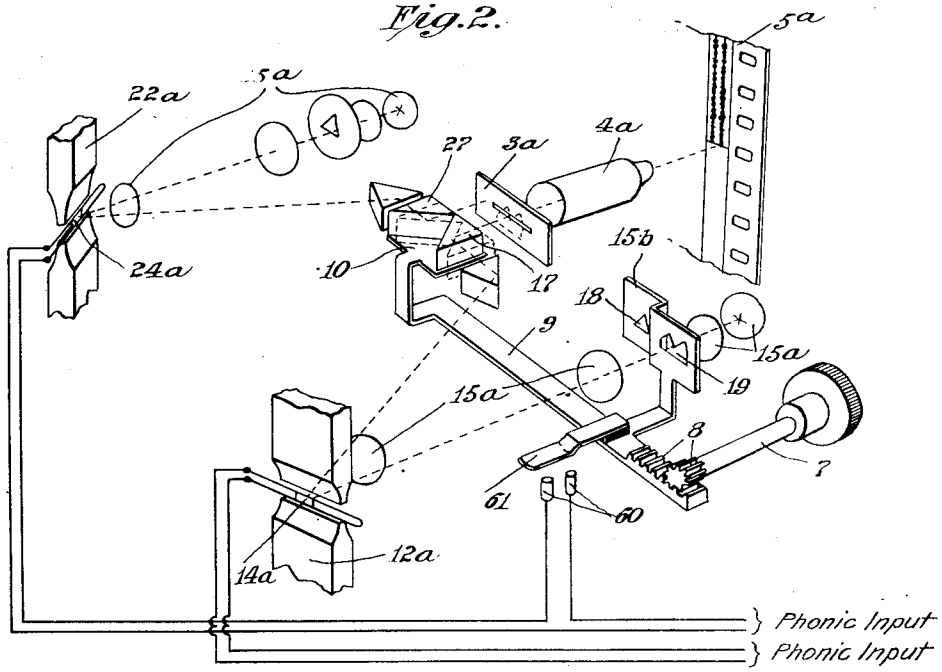
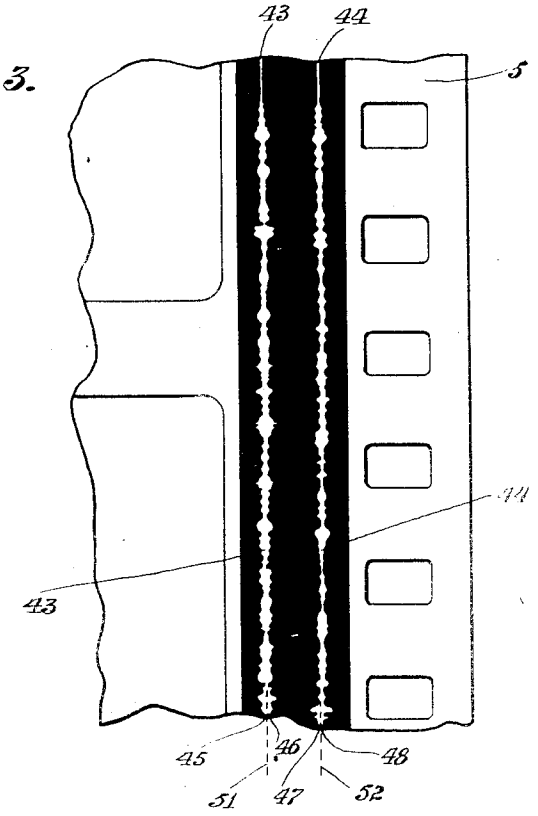


Fig. 3.



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Patented May 16, 1939

2,158,874

UNITED STATES PATENT OFFICE

2,158,874

PHOTOGRAPHIC SOUND RECORDING

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Application November 11, 1937, Serial No. 173,985
In Great Britain November 19, 1936

8 Claims. (Cl. 179—100.3)

This invention relates to new and useful improvements in apparatus for photographically recording sound on films and particularly in the form of a plurality of adjacent sound tracks.

It has been previously proposed to record sound photographically upon the film by means of dual record tracks of the variable density kind arranged in counterphase relationship, for the purpose of avoiding errors caused by fogging of the film or by curvature of the photographic characteristic curve. It has also been proposed to arrange two or more electro-optical recording devices, such as oscillograph or like valves to modulate or vibrate separate light beams and these, after such modulation or vibration has been imparted to them, have been directed on to the film surface by means of a single optical system so as to produce parallel and adjacent record tracks of the variable density kind thereon.

The object of the present invention is a system utilizing two or more electro-optical recording devices in such a manner as to produce parallel and adjacent tracks of the constant density variable area kind. The tracks may be either of the "stereophonic", of the "asymmetric" or of the "normal" types. The system may be used at will to produce any one of said types of film by employing a variable optical system adapted to be changed at the will of an operator.

In the art of recording sound on film photographically and of reproducing the resulting film by photo-electrical means, it has also been proposed to use two or more sound recording systems, each adapted to receive or selectively to respond to sound coming from different locations or directions. Such sound recording systems impress separate sound records upon a common film, so that by reproducing each such record by means of individual photo-sensitive devices, amplifiers and/or sound projectors it has been possible to reproduce, more or less naturally, the effect of sound apparently arriving from different directions or locations. Such recording and reproducing methods have been called "stereophonic".

A further object of the invention is the provision of means for the production of form of "stereophonic" films with increased facility in apparatus constructed to meet commercial requirements, and for the production of noiseless types of "stereophonic" records, that is, of records of this kind in which background noise is reduced to a minimum.

Although the apparatus according to the invention is of special service in the production of "stereophonic" records, when it is applied to the production of "normal" films bearing two or more sound tracks, it has the advantage that separate light sources may be utilized to project each of the beams or pencils of light which can be modulated by individual electro-optical recording units and consequently, a high light concentration can be produced on the multiple record tracks during the recording process.

In certain modified forms, the aparatus may be utilized to produce with increased illumination, records of the constant density variable area push-pull or bilateral or like types in which negative and positive half waves of the sound undulations are represented separately on opposed lateral zones of the film track, or in which records, reversed in phase, are thereon recorded. Such films have been hereinbefore briefly referred to as "asymmetric" films and will be so denominated herein.

By "normal" film, as hereinbefore referred to, is implied one of the variable area kind that is completely reproducible acoustically by means of a single photo-sensitive device in the reproducing soundhead, whereas "asymmetric" film of the same kind require two photo-cells or the like acting in push-pull connection for their full reproduction.

Whilst it is possible for "normal" or certain types of "stereophonic" film to utilize more than two tracks or sets of tracks on the sound record zone, it is in general desirable to restrict the operative light modulating devices to two in number. In the following explanatory description, reference is made to such dual apparatus, although the subpect matter of the invention comprises the use and arrangement for the purpose set forth of any suitable number of such co-acting devices.

According to the invention, as applied to the production of "stereophonic" films, two recording devices, each adapted to modulate a light beam or vary its direction, may be each connected to a separate circuit, which derives its phonic input from a separate sound sensitive device; the light beams after modulation by said recording means are each directed by means of suitable reflecting or refractive optical elements, either on to a double objective lenticular system which projects them on to the film on which they form two parallel records, or preferably on to a single and common objective lenticular system for the same purpose.

According to yet a further feature of the invention, in certain modifications of the apparatus, the two recording light modulating devices

utilized may be arranged in circuit with switching means, by the use of which they may be coupled in parallel or in series to a common input and thereby be operated only from one phonic circuit or sound sensitive device for the purpose of producing "normal" films having parallel record tracks.

In order to produce noiseless films of the "stereophonic" type of high quality, means are provided for producing noiseless records by applying to each oscillograph or other light modulating device a separate biasing current or potential derived in known manner so as to be in value a function of the peak intensity of the phonic current present in each separate recording circuit or channel.

Such biasing circuits per se, form no part of the present invention, but systems of the kinds referred to and described in the specification of British Patent Nos. 377,675 and 393,610 as applied to the production of variable area sound tracks may be employed for this purpose.

It will be obvious to those versed in the art that such biassing can also be applied to "normal" and "asymmetric" films produced by apparatus constructed according to the invention.

The optical system may in certain modifications of apparatus be so arranged that the light path can be varied to allow one only of the two light modulating devices to operate over the whole width of the combined sound track, and co-acting electrical switching means may be provided by the use of which the other light modulating device may be cut out of circuit, only the first mentioned recording apparatus remaining active so as to produce a "normal" film.

The optical system comprising deflecting, reflecting and/or refracting elements such as prisms or mirrors, serving to direct two recording light pencils through a terminal projecting lens system or systems is particularly advantageous in producing two closely adjacent and clearly defined recording images or sets of images on the film surface, whilst permitting of a wide latitude in the arrangement of the associated light modulating devices and light sources.

Particular constructional forms of apparatus according to the invention as applied to the production of "variable area" type sound records are diagrammatically indicated, as examples, in Figures 1 and 2 of the accompanying drawings whilst Figure 3 thereof indicates a "stereophonic" film of this type produced by the apparatus.

In Figure 1, two microphones 1 and 2 are arranged to receive sound produced by actors or emitted by objects located within the area A. The microphone 1 is connected through an amplifier 11 to a recording oscillograph 12, the associated microphone 2 being connected through a similar amplifier 21 to an oscillograph 22. The oscillographs 12 and 22 are of the type in which a loop of wire, ribbon or the like under the requisite tension carries a small mirror and is located within a unidirectional magnetic field. The two oscillograph vibrator loops 13 and 23 in this case, bear the mirrors 14 and 24 upon which light pencils are directed by means of optical systems 15 and 25 of known kind. Light beams reflected from the two mirrors fall upon prisms 16 and 26 and are directed by them on to the mask 3 having a rectangular slit 31, and thence along paths through a common objective optical system by means of which they form images 41 and 42 upon the sound track zone of the film 5.

Parallel sound tracks or sets of tracks, as the case may be, are thus formed upon this zone.

When it is desired for the recording system to produce a "normal" film, one of the amplifiers, for example 21, is cut out of circuit, by means of the switch 6, and the remaining amplifier 11 is connected in parallel and in correct phase to both the oscillograph loops 13 and 23. In this case, the two oscillographs produce two sets of tracks which are identical and thus produce a "normal" film.

In an alternative arrangement, not shown, the switch 6 will not cut amplifier 21 out of circuit, but will connect both amplifiers 11 and 21 in parallel and in correct phase to both the oscillograph loops 13 and 23, thus producing identical record tracks from the two oscillographs.

Figure 2 of the drawings indicates a modified arrangement in which two oscillographs are used as before, but in which a part of the optical system between the two oscillographs and the film is movable in order to permit of one oscillograph only producing a sound record covering the entire breadth of the sound track zone when a "normal" film is being produced.

In this figure, the two prisms 17 and 27 are mounted on a platform 10 of a movable carriage 9 and capable of being laterally displaced by a handle 7 and rack and pinion arrangement 8 so as to direct the light beam reflected, for example, from mirror 14*a* over the whole sound track of film 5*a*. A switch 61 is also mounted on carriage 9. The switch 60 cooperates with contacts 60 and serves to disconnect entirely the circuit of oscillograph 22*a*. The mask 15*b* forming part of the optical system 15*a* and provided with two sets of apertures 18 and 19 is also mounted on carriage 9. By operating handle 7, the prisms 17 and 27 forming part of the optical system will be moved so as to direct light from oscillograph 12*a* via mask 3*a*, through slit 31*a*, over the whole area of the sound track zone of the film 5*a*, and at the same time to interrupt the action of oscillograph 22*a* and to alter the image of the apertures in mask 15*a* from that produced by the single triangular aperture 18 to that produced by the double triangular aperture 19, so as to produce a pair of double-hump sound traces for a "normal" film extending over the whole sound track zone.

The mask aperture 19 lies a little out of the plane of mask aperture 18, so as to compensate for the alteration in the length of the light path occasioned by the small movement of the prismatic system and to focus the recording image on mask 3*a*.

In the preferred form of film produced by apparatus according to the invention as illustrated in Figure 3, each of the separate sound tracks or sets of tracks affecting each stereophonic channel is of the known noiseless double-hump type. Owing to the fact that the smaller amplitude of the sound wave undulations are represented by wave traces which are disposed away from the edges of each lateral zone of the double record track, such a sound track can be faithfully and accurately reproduced acoustically, notwithstanding any practical degree of lateral play or weaving motion of the film during its passage through the sound-head.

In Figure 3, a film bearing two records of the variable area double-hump noiseless type is schematically indicated. Only a portion of the

film bearing a sound track is shown on an enlarged scale. The multiple sound track zone lying to one side of the pictorial image track between this and the sprocket perforations.

Two sets of sound tracks **43** and **44** are each constituted by double-hump traces **45** and **46**, **47** and **48**, and it will be seen that the smaller amplitudes indicated by the wave traces at the points **43** and **44** are represented at a point closely adjacent to the cenral axes **51** and **52**. If the film is moved laterally over a certain limited distance, the isolation of the individual track or sets of tracks does not permit light passing through each such track or sets of tracks to fall upon more than one light sensitive reproducing element. Thus, despite any reasonable margin of lateral play or weave of the film, or of lateral maladjustment of the optical system or light sensitive units in commercial machines, effective stereophonic reproduction can be performed, and all distortion due to accidental overlap of more than one set of sound tracks upon a given light sensitive unit, as well as any cutting off of the peaks of the larger amplitude undulations or of the small amplitude undulations is avoided.

Such is also the case when the apparatus is utilised, as hereinafter set forth, for the production of asymmetric variable area films.

Although in Figs. 1 and 2 I have illustrated forms of dual recording apparatus in which the prismatic elements **16** and **26** or their equivalents precede the single mask **3** in the light path, in modifications not shown the light beam or pencil from each oscillograph or the like may be projected on to an individual mask bearing a slit and the pencils passing through such slits may be directed by means of a prismatic system equivalent to that shown but located behind said slits, into and through the projecting lenticular system **4** or the like.

Further, when the device is used for the production of "asymmetric" films of the variable constant density push-pull or like kinds, a circuit identical with that shown in Figure 1 can be used, but in this case, both oscillographs are connected to a common recording circuit, for example, that shown at **11** but in reversed senses, or are so connected by means of a switch similar to that shown at **6**.

Such an arrangement is adapted to produce a push-pull or asymmetric film which bears two double-hump variable area record traces or sets of traces which are individually of the biased or noiseless symmetrical type as described in the specification of British Patent No. 363,910, but these traces or sets of traces are according to the invention recorded in counter-phase to each other. Each individual lateral track or set of tracks is thus a complete record of the phonic wave train registered and is in the positive film reproducible by means of a light beam directed through it alone on to a single photosensitive reproducing element.

What is claimed is:

1. In an arrangement for recording multiple variable area sound tracks on film, a plurality of electro-optical sound modulating devices, one for each track, a plurality of optical systems including apertured masks, one for each modulating device for directing a light beam thereon, a single optical objective system common to said modulating devices, and a plurality of prisms one for each modulating device, between the latter and said objective system and arranged to direct parallel beams through the objective system whereby adjacent parallel sound tracks will be recorded on opposed lateral zones of the track.

2. In an arrangement for recording multiple variable area sound tracks on film, a plurality of electro-optical sound modulating devices, one for each track, a separate microphone associated with each modulating device, a plurality of optical systems including apertured masks, one for each modulating device for directing a light beam thereon, and a single optical objective system common to said modulating devices, whereby adjacent parallel sound tracks will be recorded on the film.

3. In an arrangement for recording variable area sound tracks on film, a plurality of electro-optical sound modulating devices, a separate phonic input for each modulating device, means for applying separate unidirectional biasing currents to each modulating device, a plurality of optical systems cooperating with said modulating devices, and a single optical objective system common to said modulating devices.

4. In an arrangement for recording multiple variable area sound tracks on film, a plurality of electro-optical sound modulating devices, one for each track, a separate microphone associated with each modulating device, means for applying separate unidirectional biasing currents to each modulating device, a plurality of optical systems including apertured masks, one for each modulating device for directing a light beam thereon, and a single optical objective system common to said modulating devices, whereby adjacent parallel sound tracks will be recorded on the film.

5. In an arrangement for recording variable area sound tracks on film, a plurality of electro-optical sound modulating devices, a plurality of phonic inputs, a variably operable switch for connecting an input with either of two modulating devices, a connection between a second input and one of said two modulating devices, a plurality of optical systems cooperating with said modulating devices, and a single optical objective system common to said modulating devices.

6. In an arrangement for recording variable area sound tracks on film, a plurality of electro-optical sound modulating devices, a plurality of microphones, a connection between one microphone and a modulating device, a variably operable switch for extending in one position a parallel branch of said connection to a second modulating device, a connection between said switch and a second microphone to connect the latter with said second modulating device in another position of the switch, a plurality of optical systems including apertured masks, one for each modulating device for directing a light thereon, and a single optical objective system common to said modulating devices.

7. In an arrangement for recording variable area sound tracks on film, two electro-optical sound modulating devices, a phonic input for each modulating device, a switch in the input of the first device, an optical system including a mask having a single aperture for directing a beam of light on the first device, a second optical system for directing a beam of light on the second modulating device, a second mask in the second optical system having adjacent single and double apertures, a movable carriage for said second mask to move one or the other aperture in the path of the light beam, said switch being also mounted on said movable carriage, a single optical objective system adjacent the film,

and two prisms mounted on said carriage to direct in parallel beams, the two beams emanating from said modulating devices towards said objective system.

8. In an arrangement for recording variable area sound tracks on film, two electro-optical sound modulating devices, a separate phonic input for each modulating device, a switch in the input of the first device, an optical system including a mask having a triangular aperture for directing a beam of light of triangular cross-section on the first device, a second optical system for directing a beam of light on the second modulating device, a second mask in the second optical system having adjacent apertures in different planes, one triangular and the other in the form of a double triangle, a movable carriage for said second mask to move one or the other aperture in the path of the light beam, said switch being also mounted on said movable carriage, a single optical objective system adjacent the film, two prisms mounted on said carriage to direct in parallel beams, the two beams emanating from said modulating devices towards said objective system, and a mask having a narrow rectangular slit between the prisms and the objective system.

OTTO KURT KOLB.