Feb. 4, 1958 W. O. WATSON 2,822,429

PLURAL CONTROL TRACK SYSTEM

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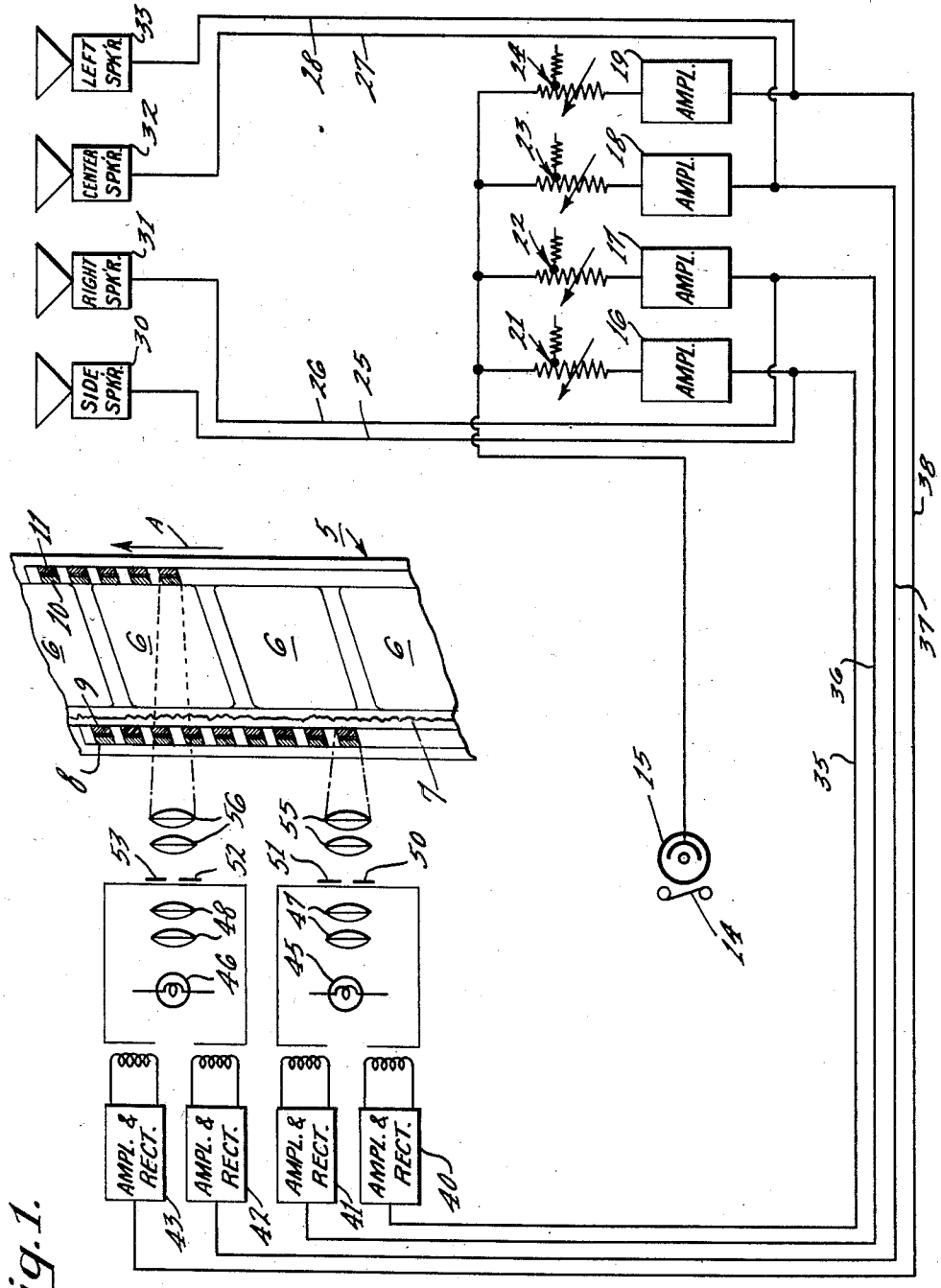


Fig. 1.

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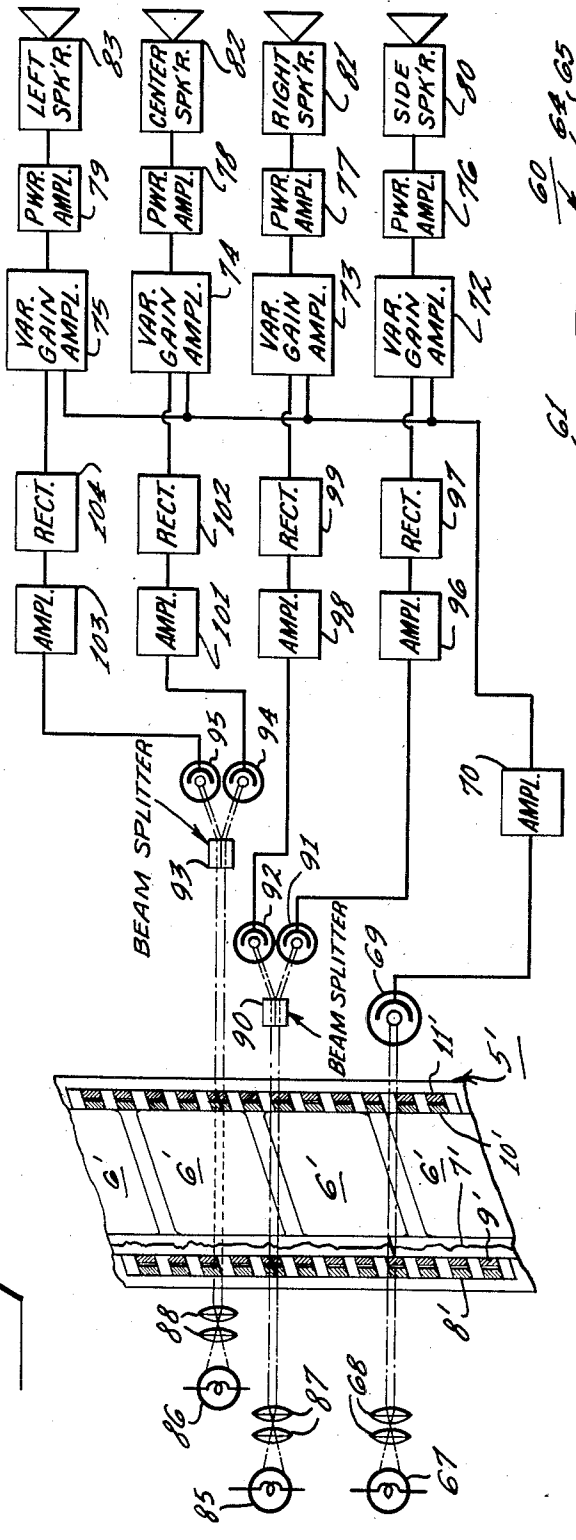


Fig. 3.

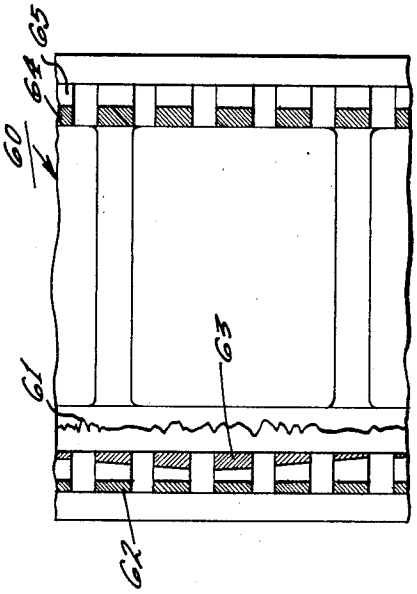


Fig. 2.

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PLURAL CONTROL TRACK SYSTEM

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2 Claims. (Cl. 179—100.3)

This invention relates to sound recording and reproducing systems, and particularly to a multi-control track system for a multi-channel sound reproducing system.

Stereophonic and directional sound reproducing systems using a plurality of spatially disposed loudspeakers and two or more channels have been used. Certain of these prior systems utilize separate control tracks positioned in various longitudinal areas of the film carrying the sound tracks and pictures, while others utilize the film portions between the perforations or sprocket holes of the photographic film. For instance, Burrill U. S. Patents No. 2,270,260 and No. 2,270,261 show a control track having both amplitude and phase modulated types of tracks located in the sprocket hole connecting areas, while Goshaw U. S. Patent No. 2,322,435 shows a control track utilizing the areas between the perforations in a manner which permits the use of high frequency control signals.

The present invention is directed to the use of a plurality of individual control tracks positioned in the areas between the perforations, each control track independently controlling the gain or level of a particular channel. The areas between the sprocket holes may be variable area or variable density modulated. By providing an independent control track for each channel, a particularly smooth transition between speaker outputs is obtainable. In this manner, the sudden raising and lowering of the sound level in any one speaker is avoided and a more natural sound presentation is obtainable.

The system uses a single sound track which is fed to the separate channels, such as four in number, one channel feeding a center speaker, one channel feeding a speaker at the left, one channel feeding a speaker at the right, and the fourth channel feeding auditorium speakers at the sides of an auditorium or theater. By varying the level in each channel independently, a single sound track will provide directional sound effects without the use of multiple signal tracks, which require film areas not normally available on a picture film. Since the areas between the sprocket holes are available for control tracks, a single signal track can be made truly directional.

The principal object of the invention, therefore, is to facilitate spatial sound presentations.

Another object of the invention is to provide an improved system for directional sound presentations.

A further object of the invention is to provide a multi-control track system for a multi-channel sound reproducing system using a single sound track.

A still further object of the invention is to provide a multi-channel track system positioned in the areas between the sprocket holes of photographic sound picture films for controlling the levels in the channels of a multi-channel sound reproducing system.

The novel features which are believed to be characteristic of this invention, both as to the manner of its organization and the mode of its operation, will be better

understood from the following description when read in conjunction with the accompanying drawings, in which:

Fig. 1 is a combination schematic and diagrammatic view of the control track recording portion of a system embodying the invention;

Fig. 2 is a detail view of a sound picture film showing four control tracks with different modulations thereon; and

Fig. 3 is a combination schematic and diagrammatic view of the sound reproducing portion of a system embodying the invention.

Referring now to Fig. 1, a combination sound and picture film **5** is shown having picture areas **6**, a composite sound track **7**, and four control tracks **8**, **9**, **10**, and **11** being recorded thereon, the film travelling in the direction of the arrow A. The recording of the control tracks is normally accomplished during the rerecording operation whereby the sound track **7** on a film **14**, or from film **5**, is reproduced and detected by a photocell **15** and impressed on four amplifiers **16**, **17**, **18**, and **19** over respective volume controls **21**, **22**, **23**, and **24**. The output of the four amplifiers is connected over conductors **25**, **26**, **27**, and **28** to respective speakers **30**, **31**, **32**, and **33**. The speakers are marked "side," "right," "center," and "left," and are so spatially disposed in the rerecording room.

Also, bridged across the output of amplifiers **16**, **17**, **18**, and **19** by conductors **35**, **36**, **37**, and **38**, are amplifier and rectifier units **40**, **41**, **42**, and **43**, respectively. The outputs of the last-mentioned units are each connected to optical recording systems consisting of light sources **45** and **46**, optical units **47** and **48**, four shutter units **50**, **51**, **52**, and **53**, and optical units **55** and **56**. Shutter **50** modulates light from lamp **45** to produce control track **8**, shutter **51** modulates light from lamp **45** to produce control track **9**, shutter **52** modulates light from lamp **46** to produce control track **10**, and shutter **53** modulates light from lamp **46** to produce control track **11**, these shutters being connected to respective volume control units **21**, **22**, **23**, and **24**. Thus, as the level of the speakers **30**, **31**, **32**, and **33** is raised and lowered by the control units **21**, **22**, **23**, and **24**, the width of the respective control tracks **8**, **9**, **10**, and **11** will be varied.

To show the result of the shutter modulation, reference is made to Fig. 2, whereby a film section **60** has a sound track **61** and four control tracks. A control track **62** shows a fixed modulation of fifty percent (50%); a control track **63**, a varying modulation; a control track **64** with one hundred percent (100%) modulation; and a control track **65** with zero modulation, adjacent control tracks being slightly separated.

As the composite sound track is detected and reproduced and impressed on the four channels, each channel is monitored by its respective speaker, and the volume of each channel is varied in accordance with the type and position of the source or sources of sound depicted on a screen on which the concomitant pictures are projected. Thus, if it is desired that all of the sound emanate from the center speaker, no modulation will be placed on control tracks **8**, **9**, and **11**, but only on control track **10**. If it is desired to have the same output level from all speakers, such as may be desired when the sound track is that of a large orchestra, then each control track will have the same degree of modulation thereon. Thus, as the picture is projected and the sound sources change and shift across the screen, each control track will be modulated to emit the sound from the proper speaker and correspondingly adjust shutters **50**, **51**, **52**, and **53**.

Referring now to Fig. 3, a film **5'** is shown with its pictures **6'**, sound track **7'**, and control tracks **8'**, **9'**, **10'**,

and 11'. The reproduction of the sound track 7' is accomplished by a detecting system including an exciter lamp 67, an optical unit 68, and a photocell 69, connected to an amplifier 70. The output of the amplifier 70 is connected to the inputs of four variable gain amplifiers 72, 73, 74, and 75 in parallel, which in turn are connected to respective power amplifiers 76, 77, 78, and 79, feeding respective loudspeakers 80, 81, 82, and 83. These are side, right, center, and left speakers in a theater or auditorium.

The four control tracks 8', 9', 10', and 11' are detected by two light sources 85 and 86 with respective optical units 87 and 88 which project light through the four tracks, control track 8' and 9' being separated by a beam splitter 90 and detected by photocells 91 and 92, and tracks 10' and 11' being separated by a beam splitter 93 and detected by photocells 94 and 95. The output of cell 91 is amplified by an amplifier 96, rectified by a rectifier 97 and fed to the variable gain amplifier 72 for varying the gain thereof in accordance with the modulation of track 8'. The output of photocell 92 is connected to an amplifier 98 and a rectifier 99, the output of the latter controlling the gain of the variable gain amplifier 73. The output of cell 94 is amplified by an amplifier 101, rectified by a rectifier 102, and impressed on the variable gain amplifier 74. The output of cell 95 is impressed on an amplifier 103, then on rectifier 104 to control the gain of the variable amplifier 75.

Thus, as the film 5' is advanced through the reproducing projector and the pictures are projected on the theater screen, each control track will vary the level of the sound signal in its respective channel. This will provide the same directional sound effects as were created by the mixer during the recording operation. The system, therefore, provides four separate 96 cycle variable amplitude signals obtained from normally unused portions of the film and which will provide from a single sound track particularly effective sound distribution in a theater. This distribution produces directional effects and the shift in output level between speakers will vary gradually, although sudden variations can be obtained when the sound source or sources require such changes. The film is standard from the picture and sound track standpoints and only a single sound track is needed to obtain directional sound, the sound film being reproducible in any theater, including those not equipped with a plural channel sound system.

Another feature of the invention is that old film may be reprinted with multiple control tracks thereon to provide enhanced presentations in theaters having multichannel sound installations.

I claim:

1. A system for producing a multi-control track sound film for a directional sound reproducing system, said film having standard size pictures thereon and a standard size sound track thereon located in the normal position of a sound track on standard sound motion picture film, comprising means for generating signal currents as a single signal, means for reproducing sound from said signal currents at a plurality of different positions, said last-mentioned means including a plurality of volume controls and a corresponding plurality of speakers located at said different positions, a volume control being provided for each speaker to vary the volume of said sound reproduced therefrom, a corresponding number of light modulators, means for impressing light from said modulators on the areas between the sprocket holes of said film to record a plurality of control tracks on said areas, and means for individually connecting each of said volume controls to a different one of said modulating units to provide modulation of each control track in accordance with the variations of its volume control.

2. A system in accordance with claim 1 in which each of said modulators includes a light source, optical means for separately projecting light from each of said sources in separate areas between the sprocket holes of said film, and shutter means for varying the amount of light impressed on said separate areas in accordance with the variations of said volume controls.

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