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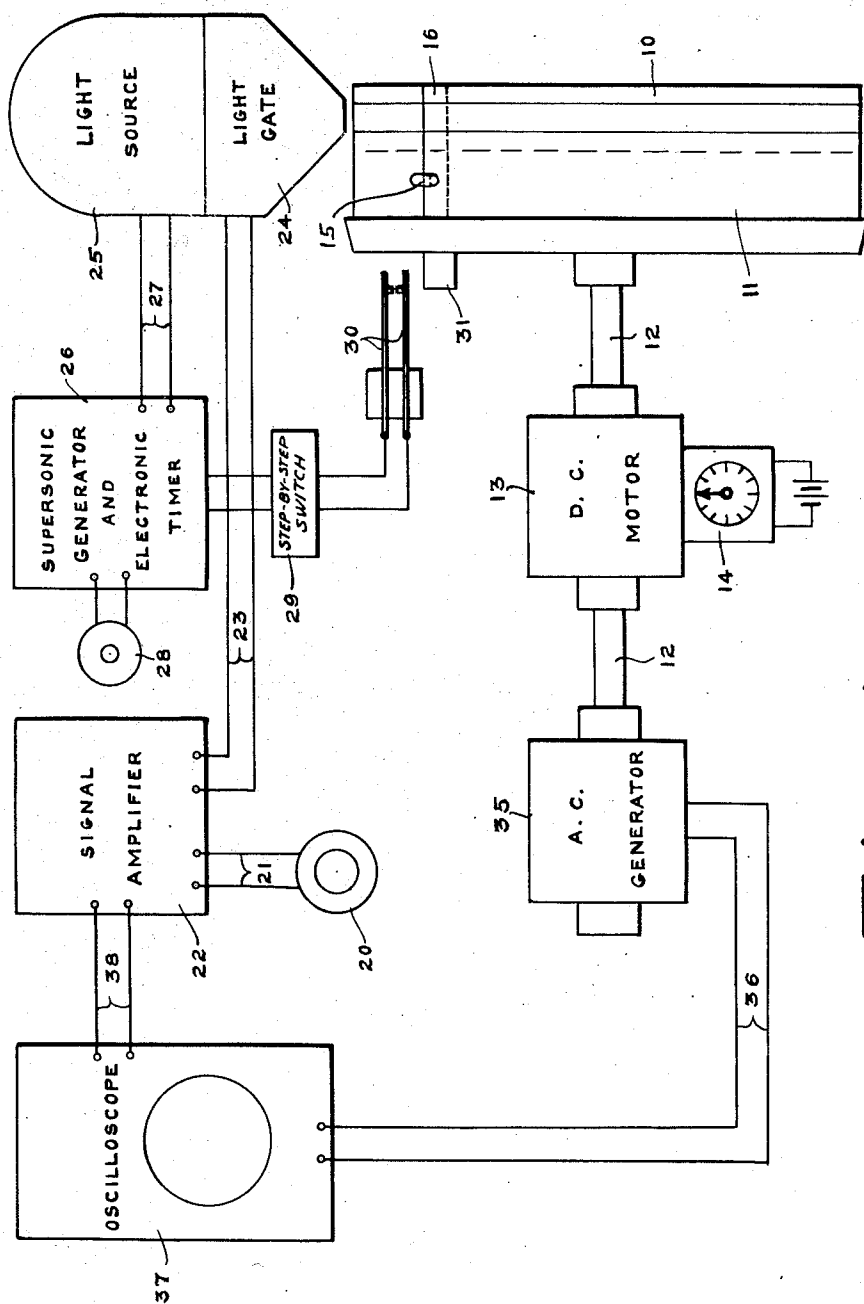
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2,563,647

SYSTEM FOR MAKING CONTINUOUS SOUND RECORDS

Filed April 3, 1946

2 Sheets-Sheet 1



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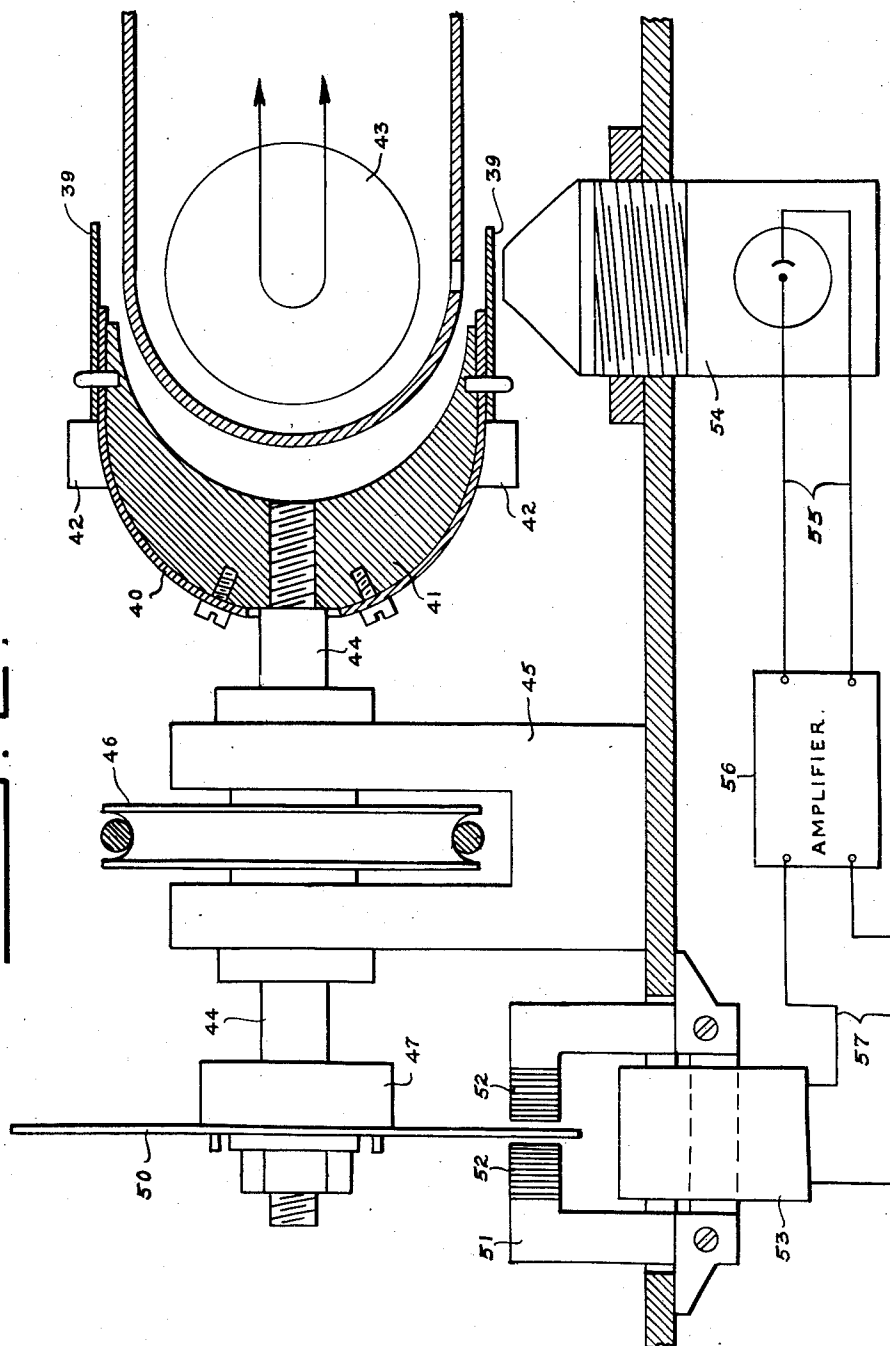
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Fig. 2.



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SYSTEM FOR MAKING CONTINUOUS
SOUND RECORDS

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4 Claims. (Cl. 179—100.3)

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This invention relates to a system for making continuous sound records and more particularly to a system for making a re-entrant magnetic sound record on a continuous circular sound track.

An object of the invention is to provide a system for making a continuous magnetic sound record which is re-entrant with a high degree of accuracy and is adapted to produce a continuous tone without distortion or click at the joined ends of the record.

Another object is to provide a novel and improved system for making a continuous magnetic sound record on a circular disc.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

In accordance with the present invention a continuous tone which is to be recorded on the magnetic disc is first recorded photographically on a transparent film. The film is then cut accurately to contain an integral number of wave lengths and is joined to form a continuous band. The band is then driven synchronously with the magnetic disc, while the sound is picked up photoelectrically from the film and is re-recorded magnetically on the disc. In this system inasmuch as the disc and film are driven at the same speed and the film contains an integral number of wave lengths, the disc will likewise contain an integral number of wave lengths and the sound tracks will be re-entrant to the degree required, regardless of minor variations in the speed of rotation of the disc or in the frequency of the tone being recorded.

Although the novel features which are believed to be characteristic of this invention are pointed out more particularly in the claims appended hereto, the invention itself will be better understood by referring to the following description taken in connection with the accompanying drawings in which a specific embodiment thereof has been set forth for purpose of illustration.

In the drawings:

Fig. 1 is a schematic diagram of a system for recording sound on an endless film; and

Fig. 2 is a schematic diagram of a system for transferring the sound record from the film to a magnetic disc.

Referring to Fig. 1, a film 10 is shown as mounted on a drum 11 which is driven by a shaft 12 of a variable speed motor 13, shown as a D. C. motor having a speed control element 14. The film 10 is secured to the drum by suitable means shown as a pin 15 or by an adhesive and

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is cut to a size corresponding generally to the periphery of the drum, although the ends of the film may be lapped somewhat as indicated at 16.

The tone to be recorded is derived from a pick-up device 20, shown as a microphone, which is connected by lines 21 to a suitable signal amplifier 22, thence by lines 23 to light gate 24 of standard type which is adapted to vary the intensity of light in accordance with the impressed signal. A light source 25 is positioned to supply light waves through the light gate 24 onto the film 10. The light source 25 is preferably actuated by a supersonic frequency supplied from a supersonic generator 26 by lines 27. The supersonic frequency excitation of the light source prevents distortion of the reproduced sound due to the energizing frequency. A control switch, shown as a push button 28, is connected to the supersonic generator 26 to control the operation thereof. The operation of the supersonic generator 26 is also controlled by a step-by-step switch 29 which is connected in series to the switch 28 and is actuated by contacts 30. The contacts 30 are positioned to be closed by a lug 31 attached to the drum 11 at a point corresponding to the beginning and end of the film 10, as for example the point of the overlapped ends 16. The arrangement is such that the switch 30 is closed each time the lug 31 passes the designated point. The step-by-step switch 29 which may be either mechanical or electrical is arranged to alternately energize and de-energize the supersonic generator 26 upon successive actuations of the contacts 30. Hence when the push button 28 is held closed, the first actuation of the switch 30 will energize the supersonic generator and cause light rays to be produced by the light source 25 and to be projected through the light gate 24 onto the film 10. At the next actuation of the contacts 30 the supersonic generator 26 is de-energized. Hence the light source is energized only for a single rotation of the drum 11, provided of course the push button 28 is released before the third actuation of the switch 29 takes place.

An alternator 35 is driven by the shaft 12 of the motor 13 and is adapted to produce a voltage having a frequency corresponding to the frequency of the signal being picked-up by the pick-up device 20 or to a sub-multiple thereof. This voltage is supplied by lines 36 to a comparing device shown as a cathode ray oscilloscope 37. A signal from the amplifier 22 is likewise supplied to the oscilloscope 37 by lines 38. The lines 36 and 38 may be connected to the horizontal and vertical sweep electrodes of the oscilloscope

so that a pattern is produced on the oscilloscope screen determined by the relative frequencies of the picked-up signal and the generated voltage.

For example, in order to produce a film band of 92 complete waves with a length of about 10 inches the drum 11 must be designed to have a circumferential distance of about 20 inches in which 192 waves could be recorded. In recording a tone having for example 1481.6 cycles per second, the drum would be required to rotate at 7.72 revolutions per second. The tone generator could be chosen to produce 48 cycles per revolution so that its output would have 370.4 cycles per second which is a quarter of the signal frequency. The speed of the drive motor is then adjusted so that the oscilloscope pattern corresponds to a 4 to 1 ratio. Then it will be certain that 10 inches of the film will correspond to 48 cycles of the fundamental tone sought. If, however, the tone frequency varies during the tenth of a second required for recording, the length of the sound track may vary slightly from the nominal value of 10 inches, varying possibly between 9.9 and 10.1 inches.

The film thus produced is then developed and cut to contain exactly 96 waves with a high degree of precision and the ends of the film are joined into a band forming a continuous sound track without mechanical discontinuity. Any suitable means may be utilized for joining the ends of the film. The ends may for example be bias cut so as to eliminate the possibility of a click when the sound is reproduced therefrom. Preferably the ends are joined at a point of maximum sound effect so that any variation at the point of juncture will be masked. The joined film, which is now in the form of a continuous band, may be used as a master record for producing the magnetic records therefrom as shown in the system of Fig. 2.

Referring to Fig. 2, the circular film band 39 is mounted on a plurality of flexible fingers 40 which are mounted on a spindle 41 and carry weights 42 which serve to expand the fingers due to centrifugal force when the spindle is rotated, so as to maintain the band 39 in a rigid condition. The spindle 41 is hollow to receive a light source 43 and is secured for rotation on a shaft 44 which is mounted in a bearing block 45. The shaft 44 is driven by suitable means shown as a pulley 46. The pulley, however, may be replaced by a driving motor if desired. The shaft 44 also carries a shoulder 47 to which is secured a magnetic disc 50 on which the sound is to be recorded. A recording head 51 is positioned to cooperate with the disc 50. This recording head may be of the type disclosed in my co-pending application Serial No. 643,290, filed January 25, 1946, now abandoned, for Magnetic Sound Recording and Pick-Up Device and comprises a magnetic frame having pole pieces 52 and an energizing coil 53.

Light from the source 43, after passing through the film 39, is applied to a photoelectric pick-up device indicated at 54 and is of a suitable type to convert variations in light intensity into variations in voltage. The output from the pick-up device 54 is supplied through lines 55 to an amplifier 56 and thence through lines 57 to the coil 53 to produce a magnetic record on the disc 50. Inasmuch as the band 39 contains an integral number of waves, it is obvious that the continuous record produced on the disc 50 will likewise contain an integral number of waves and is adapted for the production of a continuous tone therefrom.

The disc 50 may, for example, be used as a tone disc of an electromagnetic organ of the type described more in detail in my co-pending application Serial No. 646,040, filed February 7, 1946, now abandoned, for Electromagnetic Organs.

It will be noted that in the above described system the necessity for accurately synchronizing the magnetic disc with the picked-up signal is avoided as minor variations in frequency are compensated for by the different lengths of the sound track 10 which are joined to form the band 39. The spring fingers 40 are sufficiently resilient to accommodate such minor variations in lengths of the band, and to hold the band rigidly as required for reproduction. Manual adjusting means may, however, be provided for adjusting the diameter of the supporting fingers if desired, in which case the centrifugal weights 42 may be omitted.

Although a specific embodiment of the invention has been shown for purposes of illustration, it is to be understood that the invention is capable of various uses and that changes and modifications may be made therein as will be readily apparent to a person skilled in the art. The invention is only to be restricted in accordance with the scope of the following claims.

What is claimed is:

1. A signal reproducing system comprising an endless photographic sound record in the form of a circular band, means supporting said band, a magnetic member carrying an endless record track, means driving said band and said magnetic member in synchronism, photo-electric pick-up means connected to respond to the signal recorded on said band, a magnetic recording head connected to respond to said photo-electric pick-up means and positioned to make a continuous magnetic sound record on said track, and means whereby said band support may be adjusted in accordance with variations in length of said band so that a continuous reentrant sound record is provided from which a continuous reentrant magnetic record may be recorded.

2. A signal reproducing system comprising an endless photographic sound record in the form of a circular band, means supporting said band, a magnetic member carrying an endless record track, means driving said band and said magnetic member in synchronism, photo-electric pick-up means connected to respond to the signal recorded on said band, and a magnetic recording head connected to respond to said photo-electric pick-up means and positioned to make a magnetic sound record on said track, said band support comprising a plurality of flexible fingers peripherally disposed about said band for carrying the same and means expanding said fingers for holding said band rigidly in a circular form so that a continuous reentrant sound record is provided from which a continuous reentrant magnetic record may be recorded.

3. A signal reproducing system comprising an endless photographic sound record in the form of a circular band, means supporting said band, a magnetic member carrying an endless record track, means driving said band and said magnetic member in synchronism, photo-electric pick-up means connected to respond to the signal recorded on said band, and a magnetic recording head connected to respond to said photo-electric pick-up means and positioned to make a magnetic sound record on said track, said band support comprising a plurality of flexible fingers pe-

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ripherally disposed about said band for carrying the same, said fingers having means responsive to centrifugal force for expanding the same to hold said band in a rigid circular form so that a continuous reentrant sound record is provided from which a continuous reentrant magnetic record may be recorded.

4. The method of recording a continuous tone on a re-entrant magnetic sound track which comprises recording said tone on a photographic film, cutting said film accurately to a length having an integral number of sound waves, forming said film into an endless band, driving said endless band and said magnetic sound track in synchronism, deriving the recorded signal from said band and recording the derived signal on said magnetic sound track in the form of an endless re-entrant recording.

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