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SIGNAL RECORDING AND REPRODUCING METHOD

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Fig. 1.

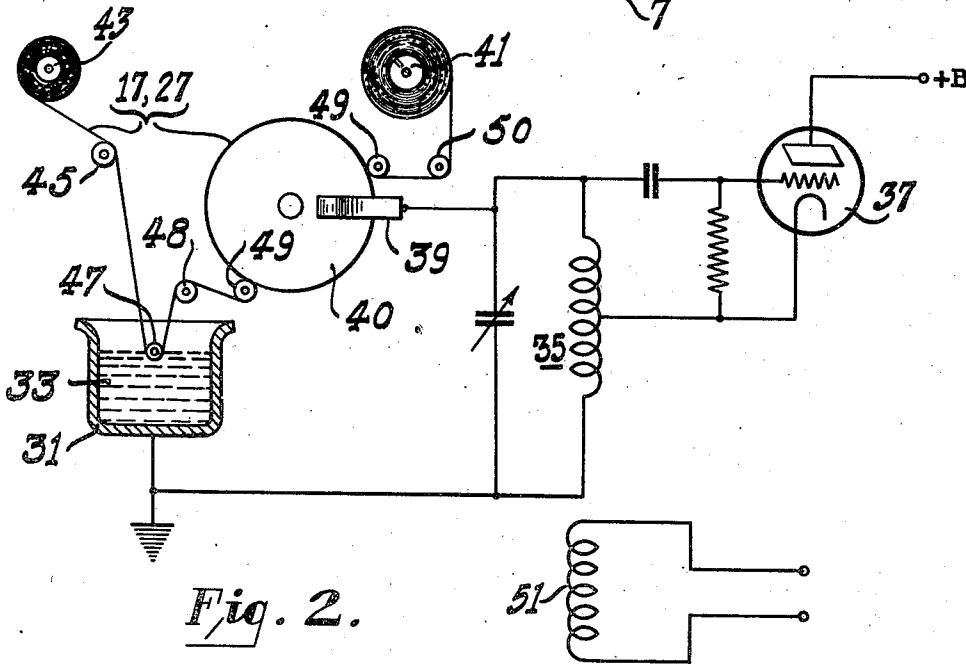
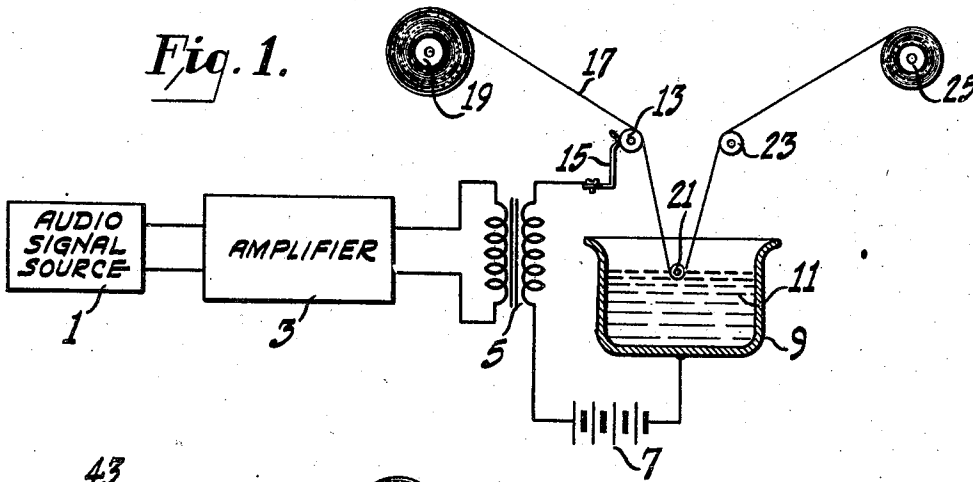


Fig. 2.



Fig. 3.

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SIGNAL RECORDING AND REPRODUCING
METHODGeorge C. Sziklai, Bloomington, Ind., assignor to
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8 Claims. (Cl. 179—100.1)

This invention relates to a signal recording and reproducing method, and has for its principal object the provision of a novel method of recording and reproducing sound electrically.

More particularly, it is an object of the present invention to provide an improved method of recording and reproducing sound electrically by means of which high fidelity recording and reproduction may be obtained.

Another object of the present invention is to provide a novel sound record which is durable and permanent in character.

Still another object of the present invention is to provide an improved sound record as aforesaid which will have a long playing time, yet will require small storage space.

A further object of the present invention is to provide an improved method of sound recording which will yield a plurality of identical sound records in only one recording operation.

It is also an object of the present invention to provide an improved method as aforesaid which is inexpensive to practice and is highly efficient, as well as to provide an improved record which will be comparatively low in cost.

In accordance with this invention, a strip of conductive tape or wire is connected to one of the terminals of an audio voltage source, the other terminal thereof being connected to a film forming solution. The strip is advanced along a path such that it is brought either into contact with or in very close proximity to the film forming electrolyte over a very small area of the strip. As the potential changes, a dielectric film of varying thickness forms on the conductive strip. The strip is preferably biased beyond the audio peak voltage, so that the thickness of dielectric film which forms on the strip will be a replica of the frequency and amplitude of the sound. To reproduce this sound record, the coated strip may be passed through a conductive bath, again with only a small area thereof in contact with the bath, so that this small portion or area acts as a condenser. The variations in thickness of the dielectric film will cause the capacity to change corresponding to the audio voltage which was used in forming the film. This change in capacity may be utilized to change the frequency of an associated reproducing circuit to produce frequency, amplitude, or phase modulation, depending upon the type of reproducing circuit employed, or it may be utilized similarly to a condenser microphone, for example, to vary a suitable voltage to produce signal voltages representative of the sound orig-

inally recorded. If a relatively wide strip or tape is used on which to record, the strip may be split longitudinally after recording to provide a plurality of individual, identical records, each of which may be reproduced separately. A plurality of identical records may also be produced by subjecting a number of strips to the recording operation simultaneously, the strips being arranged in side-by-side relation.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description of one embodiment thereof, when read in connection with the accompanying drawing in which

Figure 1 is a diagrammatic view of a recording system employing the method of my present invention.

Figure 2 is a similar view of a reproducing system by means of which the novel record of my invention may be reproduced, and

Figure 3 is a fragmentary sectional view of one form of my improved record.

Referring more particularly to the drawing, wherein similar reference characters designate corresponding parts throughout, there is shown, in Fig. 1, a source 1 of audio signals coupled to an amplifier 3, in turn coupled to an output transformer 5. One terminal of the secondary winding of the transformer 5 is connected through a polarizing battery 7 to a conductive receptacle 9 which contains an electrolyte 11. The other terminal of the secondary winding of the transformer has electrical connection with a conductive roller 13 through a resilient brush or the like 15.

A conductive strip, such as a tape or wire 17, is fed from a supply reel 19 around the conductive roller 13, then down around a small dielectric roller 21 where the strip 17 is given a sharp, substantially reverse bend of small radius, thence around a roller 23 and on to a takeup reel 25. The strip 17 and the electrolyte 11 are of such materials that they react chemically in response to an electrical potential to form a dielectric film or coating on the strip 17. Thus, the strip 17 may be of aluminum, magnesium, tantalum, tungsten, or any other suitable metal or alloys thereof, and the electrolyte 11 may be any one or number of weak acids, such as boric acid, citric acid, malic acid, tartaric acid, phosphoric acid, etc., or salts of these acids. Preferably, the strip

17 is of aluminum, and the electrolyte 11 is approximately a two percent aqueous solution of borax or ammonium borate.

The area of the strip 17 under the roller 21 which is in engagement with the electrolyte 11 at any instant should be very small lengthwise of the strip 17. For this purpose the roller 21 may be made adjustable within the receptacle 9, or the roller 21 may be fixed and the level of the liquid electrolyte 11 varied. If desired, the strip 17 may be brought down into very close proximity with the surface of the electrolyte 11, so that contact therebetween will be obtained through capillary attraction and the required electrolytic action will take place instantaneously over only a very narrow, line-like area transversely of the strip 17.

It will be obvious, from the foregoing, that, as the signal potential changes, a dielectric film layer or coating 27 of varying thickness will be formed along the length of the strip 17. The polarizing battery 7 serves to apply a bias beyond the peak audio voltage, so that regardless of the direction in which the audio voltage swings, a dielectric film of varying thickness will be formed on the conductive strip 17. In this way, variations in signal voltage will produce a dielectric coating of varying thickness representative of the frequency and amplitude of the sound or other signals being recorded. Obviously, a number of parallel strips may be fed past the electrolyte 11 simultaneously to provide a plurality of identical records which can be reproduced or played back separately, or, if a wide strip is used, it can be split longitudinally after recording across its entire width to provide a plurality of identical records.

A record formed as above may be utilized in a reproducing system such as that illustrated in Figure 2, for example. In this system there is shown a grounded conductive receptacle 31 containing a conductive body 33, such as mercury. The receptacle 31 is connected to one terminal of a tuned circuit 35 which constitutes the tank circuit of a suitable oscillator 37. The other terminal of the tuned circuit is connected through a resilient brush 39 to a large conductive roller 40. The coated strip 17, 27 may be fed from a supply reel 43 around a roller 45, and thence down around a small roller 47 similar to the roller 21 and around which the record strip takes a sharp, substantially reverse bend of small radius. From there, the strip 17, 27 passes around a roller 48 and then is guided by a pair of rollers 49 around and in contact with a large portion of the circumference of the conductive roller 40, and from there, the strip 17, 27 passes around a roller 50 to a takeup reel 41.

As the successive, small areas of the record strip 17, 27 come into contact with the conductive body 33, the varying thicknesses of the dielectric coating 27 will produce changes in capacity to vary the tuning of the tuned circuit 35 and thereby vary correspondingly the frequency of the voltage supplied by the oscillator 37. In this way, there are set up signal voltages representative of the sound originally recorded. The conductive roller 40, in cooperation with that portion of the conductive strip 17 between the rollers 49 and the dielectric coating 27 therebetween forms a large capacitor in series with the small, constantly varying, tuning capacitor under the roller 47 and it should be made so large that it will not appreciably alter the tuning provided by the small capacitor under the roller 47. A coupling coil 51

may couple the oscillator circuit to suitable reproducing apparatus such as a limiter, frequency discriminator, amplifier and loudspeaker, to reproduce the sound.

The speed with which the strip 17 is advanced either during recording or reproducing, and the area of contact between the advancing strip and the electrolyte 11 or the conductive body 33, as the case may be, will vary in accordance with the highest frequency which it is desired to record. For example, with an area of exposure of approximately .003 inch along the length of the strip, the strip may be advanced at a rate of 100 inches per minute to record up to 5000 cycles per second. With the same exposure area, if it is desired to record up to 10,000 cycles per second, the strip should be advanced at a speed of about 200 inches per minute. However, if the slower speed is preferred, the exposed area should be only 0.0015 inch along the length of the strip. In general, exposure areas of from about .01 inch to about .001 inch will be found satisfactory for most practical purposes.

Although I have shown and described certain forms of my invention in considerable detail, it will be obvious to those skilled in the art that many other forms of the invention, as well as variations in the ones described, are possible. For example, in the reproducing system of Fig. 2, a second and relatively long conductive receptacle similar to the receptacle 31 but very much longer than the latter and also containing mercury or any other suitable conductive body may be substituted for the large conductive roller and the strip 17, 27 caused to pass therethrough in advance of the takeup reel. Thus, there will also be provided a large capacitor in series with the small, constantly varying tuning capacitor under the roller 47. In an alternative reproducing arrangement, the roller 40 or other conductive member which aids in forming the large capacitor may be entirely dispensed with and the reels 41 and 43 made of conductive material with which both ends of the conductive strip 17 would have electrical contact. One brush corresponding to the brush 39 would then engage one of the reels to connect it to one terminal of the tuned circuit 35 and another, similar brush would have electrical contact with the other of the reels and would also be connected to the same terminal of the tuned circuit 35. If the tuned circuit 35 were connected to only one of the reels (for example, the takeup reel 41), then the gradually increasing inductance formed by the portion of the strip wound thereon would choke off the higher signal frequencies. However, by connecting the tuned circuit 35 to both of the reels 41 and 43, then, as the inductance increases on one wheel it would correspondingly decrease on the other, but the effective inductance would remain constant. Many other changes will, no doubt, readily suggest themselves to those skilled in the art. I therefore desire that my invention shall not be limited except insofar as is made necessary by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. The method of recording signals which comprises subjecting successive portions of an electro-conductive material to the action of a second material which is adapted to react therewith chemically under the influence of an electrical potential to form a dielectric coating thereon while applying thereto a varying potential representative of said signals whereby to form on said

first named material a dielectric coating of varying thickness representative of said signals.

2. The method of recording signals which comprises bringing successive, small areas of an electro-conductive material into reactive relation with a second material which is adapted to react therewith chemically under the influence of an electrical potential to form a dielectric coating thereon, and simultaneously applying thereto varying potentials representative of said signals whereby to form on said first named material a dielectric coating of varying thickness representative of said signals.

3. The method of recording signals which comprises bringing successive, small areas of an electro-conductive material into contact with a second material which is adapted to react therewith chemically under the influence of an electrical potential to form a dielectric coating thereon, and simultaneously applying thereto varying potentials representative of said signals whereby to form on said first named material a dielectric coating of varying thickness representative of said signals.

4. The invention set forth in claim 3 characterized in that said areas are contiguous whereby said coating is continuous on said first named material.

5. The method of recording signals which comprises passing a strip of electro-conductive material continuously along a path in the neighborhood of an electrolyte which is adapted to react chemically with said material under the influence of an electrical potential to form a dielectric coating on said strip, causing successive, con-

tiguous, small areas of said strip to contact said electrolyte as said strip advances in said path, and simultaneously applying to said strip varying potentials representative of said signals whereby to form on said strip a continuous dielectric coating of varying thickness representative of said signals.

6. The invention set forth in claim 5 characterized in that said path has a substantially reverse bend therein of small radius, and characterized further in that said strip is brought into contact with said electrolyte at said bend.

7. The invention set forth in claim 5 characterized in that said strip is of aluminum, and characterized further in that said electrolyte is constituted by an aqueous solution of a borate.

8. The method of forming a plurality of identical signal records which comprises passing a strip of electro-conductive material continuously along a path in the neighborhood of an electrolyte which is adapted to react chemically with said material under the influence of an electrical potential to form a dielectric coating on said strip, causing successive, contiguous, small areas of said strip to contact said electrolyte as said strip advances in said path, said areas extending all the way across said strip, simultaneously applying to said strip varying potentials representative of the signals whereby to form on said strip a continuous dielectric coating of varying thickness representative of said signals, and finally dividing said strip longitudinally to thereby provide a plurality of identical, individual records of said signals.

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