

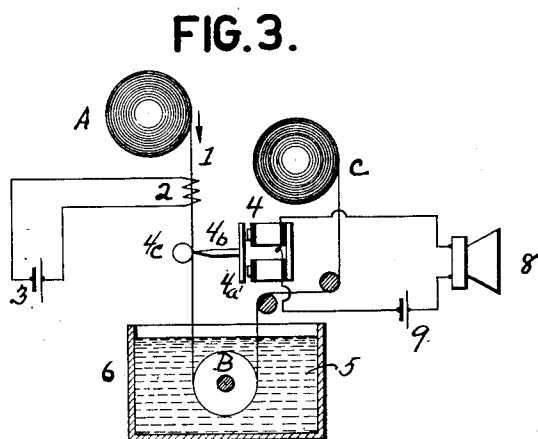
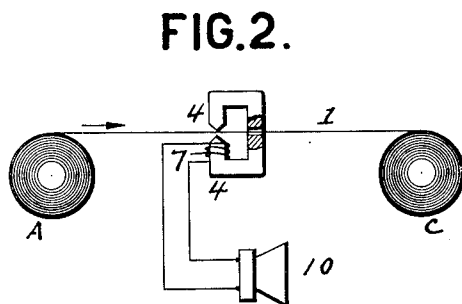
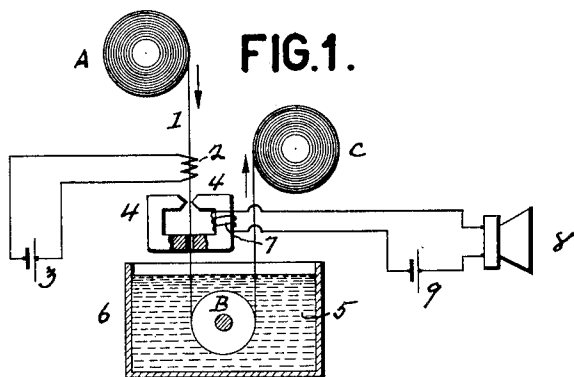
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DEVICE AND METHOD FOR RECORDING SOUND WAVES

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UNITED STATES PATENT OFFICE

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DEVICE AND METHOD FOR RECORDING SOUND WAVES

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This invention relates to a device and method for recording sound waves, and more particularly, it relates to an electro-magnetic means for recording oscillations of audio frequencies by electro-magnetically or mechanically transposing magnetically permeable particles suspended in a mixture upon a supporting element.

In the prior art much experimentation has been conducted to magnetically record audio frequency oscillations upon a steel wire by passing it through a magnetic field, the potential of which is varied through oscillations impressed upon the field, recording being effected through molecular transposition. This system has several limitations, such as low intensity of reaction and an impermanent effect. By my invention these limitations are reduced and the magnetic recording is accomplished without any molecular change in a metal wire; there is a more positive effect which permits recording of greater intensity and permanency.

I have found that when a magnetically permeable material, such as finely divided ferro-ferric oxide (Fe_3O_4), is thoroughly blended in a mixture, such as that of shellac and Venice turpentine, it remains in perfect and uniform suspension, and that the oxide particles within the mixture are transposed under varying electrical field influences when the mixture is fluxed or in a plastic state. For recording purposes the mixture is applied as a coating upon a flexible wire or strip, as soft iron or copper, which is preferably passed through the fluid mixture, the coating being then baked, becoming a smooth black enamel. Heated, preferably by induction, to about 70°C . the coating becomes plastic, and in this state is passed through a magnetic field of varying flux, the small permeable particles within a limited area, aligning themselves according to the varying field characteristics. The permeability of the coated strip is varied by electro-magnetically moving the iron oxide particles and fixing them in their new positions. Through varying the magnetic flux by oscillations impressed upon the controlling field from a source of electrical oscillations, such as a microphone circuit, the newly

assumed positions are determined by the frequencies and intensities of those oscillations. It is of advantage to restrict the magnetic field as far as practicable to the area occupied by the coated strip in its passage between the poles; this may be accomplished as by tapering the magnet poles, though such a step is not necessary if a soft iron wire or strip be employed as the base for the coating. By prompt cooling by air blast or other cooling means, the magnetic particles are permanently set in their new positions. However, if the field variations are of very great intensity, the permeable particles can be sufficiently re-aligned without the heating or cooling.

If audio frequency oscillations are so impressed upon the coating, as by modulating a static magnetic field, as the coated strip is passed through the field, there are definite movements of the oxide particles corresponding to the magnetic field modulations. With the particles fixed in their new positions the coated strip, on being passed through a magnetic field connected with a translating device, such as a telephone receiver capable of responding to induced potential caused by changes in the permeability of the magnetic particles, reproduction of the original oscillation recording is effected.

For the suspension or binding mixture, that described is preferred, but any organic or inorganic binder permitting the movement of suspended magnetically permeable particles and adapted to quick hardening may be substituted. Iron oxide of the magnetic oxide type (Fe_3O_4) has been found highly satisfactory because, unlike iron dust and various other permeable materials, it remains more evenly distributed in the supporting mixture. And because of its high permeability, soft iron wire is a desirable base for the coating; however, other materials of greater or less permeability than iron can be applied for, unlike the steel wire of the earlier magnetic recording systems, the core itself has no function other than that of a mechanical support for the coating; that is, there is no molecular transposition or any other effect in the wire support; it is readily permeated by the magnetic lines of force.

It is apparent that the coating, while in a plastic state, can also be subjected to mechanical impacts at audio frequencies which likewise transpose the particles within the coating. But the method of magnetically transposing the magnetically permeable particles is considered preferable to a mechanical method, due to the reduction of inertia. Reproduction of the oscillations so impressed may be effected in the manner above described.

For effacing the record, the coated wire is heated and then passed through an intense constant electrical field, by means of which the transposed oxide particles resume their normal positions; that is, they are uniformly distributed throughout the coating mixture which is then cooled.

Amplification can be obtained through the employment of the means usually adopted for this purpose.

For a better understanding of the invention reference is made to the accompanying drawing of an embodiment of the invention in which Fig. 1 diagrammatically illustrates the magnetic recording system, Fig. 2, the reproducing system and Fig. 3, a recording system employing a magnetically controlled needle or the like for mechanically changing the position of the magnetic particles.

Referring more in detail to Fig. 1, A and C respectively represent spools from which and upon which is wound iron wire 1, coated with a mixture of shellac, Venice turpentine and minute particles of ferro-ferric oxide. The wire coating is made plastic by heater element 2, current for which is supplied by source 3, before passing between the poles of electro-magnet 4, after which the coated wire with the magnetically permeable particles transposed, passes through cooling solution 5, in container 6, and around immersed spool B. Upon magnet 4, is mounted coil 7, in circuit with energy source 9, and microphone 8.

In Fig. 2, the coated wire 1, upon which the oxide particles transposed by the recording operation through the impression of oscillations upon the field, is passed between magnet poles 4, from spool A to spool C. Upon the magnet 4, is wound coil 7, in circuit with telephone receiver 10, the induced energy in that circuit being modified in accordance with the changes in the magnetic field corresponding to the recorded oscillations on the coated wire as it passes through the field.

The elements in Fig. 3 bearing the same numbers, correspond with like elements in Fig. 1. In this system the oxide particles are transposed by mechanical means rather than directly by magnetic influence; the wire coated with the plastic mixture is passed between roller 4_c and needle 4_a, the latter attached to movable armature 4_b of magnet 4. With the density of the magnetic field varying responsively to audio frequency oscillations

impressed upon microphone 8, tin circuit with coils 7, the movable armature 4_b varies the pressure of needle 4_a against the plastic coating, mechanically causing the transposition of the oxide particles in the coating. The movement of the armature with audio frequency oscillations impressed upon the microphone circuit and the pressure of the needle against the face of the plastic coating causes corresponding undulations in the coated surface, which is then cooled. The same cooling means as that shown in Fig. 1 is employed. The permeable oxide particles are thus fixed in their changed positions, the sound waves being then reproduced by the passage of the coated strip through a magnetic field, the oscillations in which serve to modulate the current in the receiver circuit.

What I claim is:

1. The method of recording audio frequency oscillations which consists in varying the intensity of the field of an electro-magnet, by impressing electrical oscillations of audio frequency upon the circuit controlling said field and transposing magnetically permeable particles suspended in a mixture coated upon a magnetically permeable metal base within said field in accordance with said oscillations.

2. The method of recording audio frequency oscillations which consists in fluxing a mixture coated upon a metal strip and containing magnetically permeable particles, passing the fluxed mixture through a magnetic field, electromagnetically charging, and transposing said particles by impressing electrical oscillations of audio frequency upon a circuit controlling the intensity of said field, and in cooling the mixture while the particles are in said transposed state.

3. The method of recording audio frequency oscillations which consists in passing a metal strip having a plastic coating containing magnetically permeable particles, through the field of an electro-magnet, electromagnetically charging and transposing said particles by impressing electrical oscillations of audio frequency upon a circuit controlling the intensity of said field, and hardening the coating while the particles are so transposed.

4. The method of recording audio frequency oscillations which consists in passing through the field of an electro-magnet, a metal strip coated with a plastic mixture containing ferro-ferric oxide particles, and transposing the particles by varying the intensity of the field of said electro-magnet by impressing upon the circuit controlling said field electrical oscillations of audio frequency.

5. The method of recording audio frequency oscillations which consists in fluxing a mixture coated upon a magnetically permeable metal strip containing ferro-ferric

oxide, passing the mixture through the field of an electro-magnet, transposing particles of said ferro-ferric oxide material by varying the intensity of said field by impressing electrical oscillations of audio frequency upon the circuit controlling the intensity of said field and in cooling the mixture while the particles of said oxide are in said transposed state.

6. A device for recording audio frequency oscillations comprising an electro-magnet, a circuit for controlling the field of the magnet, means for passing through said field a metal strip coated with a semi-fluid binder containing magnetically permeable particles, and means for transposing said particles at right angles to the metal strip within the binder by impressing audio frequency oscillations upon said circuit.

7. A device for recording audio frequency oscillations comprising an electro-magnet, a circuit for controlling the field of the magnet, means for passing through said field an iron wire strip coated with a semi fluid binder containing magnetically permeable particles, and means for transposing said particles within the binder by impressing audio frequency oscillations upon said circuit.

8. A device for recording audio frequency oscillations comprising an electro-magnet, a circuit for controlling the field of the magnet, means for passing through said field a metal strip coated with a semi-fluid binder containing ferro-ferric oxide particles, and means for transposing said particles within the binder by impressing audio frequency oscillations upon said circuit.

9. A device for recording audio frequency oscillations comprising an electro-magnet, a circuit for controlling the field of the magnet, means for passing through said field a metal strip coated with a binder containing magnetically permeable particles, means for fluxing the binder, and means for transposing said particles within the binder by impressing audio frequency oscillations upon said circuit.

10. A device for recording audio frequency oscillations comprising an electro-magnet, a circuit for controlling the field of the magnet, means for passing through said field a metal strip coated with a binder containing magnetically permeable particles, means for transposing said particles within the binder by impressing audio frequency oscillations upon said circuit, and means for hardening the coating when the particles are transposed.

Signed at New York in the county of New York and State of New York this 13th day of July A. D. 1931.

SAMUEL RUBEN.