Dec. 9, 1941. L. THURM 2,265,879

METHOD OF AND MEANS FOR ELECTROMAGNETICALLY RECORDING AND REPRODUCING SOUND

Filed July 29, 1939

Fig.1.

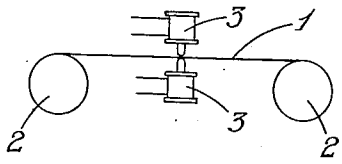


Fig.2.

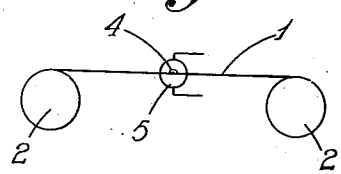


Fig.4.

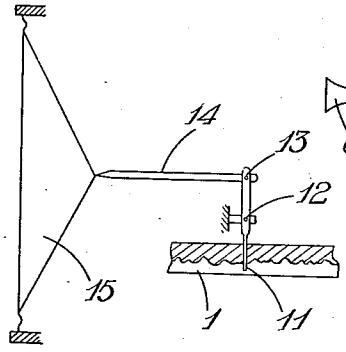


Fig.3.

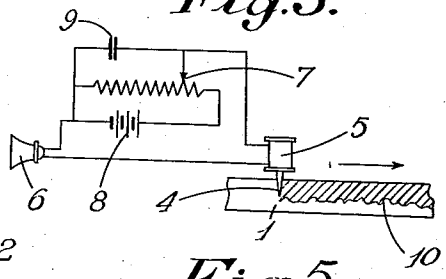


Fig.5.

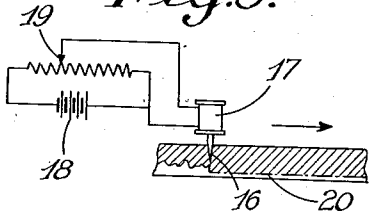


Fig.6.

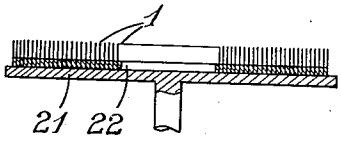


Fig.7.

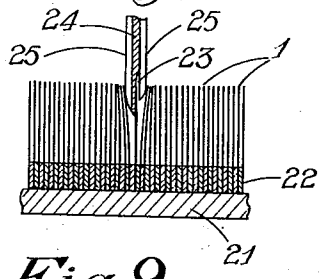


Fig.8.

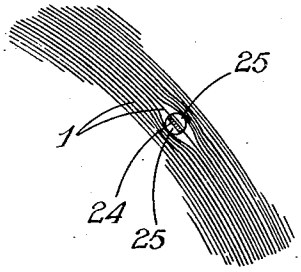
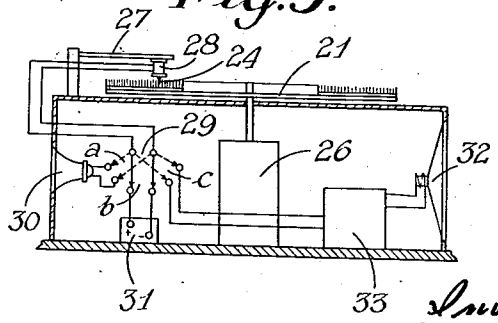


Fig.9.



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METHOD OF AND MEANS FOR ELECTRO-MAGNETICALLY RECORDING AND REPRODUCING SOUND

Léon Thurm, Schaerbeek-Brussels, Belgium

Application July 29, 1939, Serial No. 287,418
In Belgium August 5, 1938

9 Claims. (Cl. 179—100.2)

This invention relates to the electro-magnetic recording and reproduction of sound. Hitherto the electro-magnetic recording of sound on magnetisable supports such as a wire, a metal sheet or ribbon or the like has been effected across the thickness of the wire, sheet or other support, that is to say transversely to the direction of movement of the support between the poles of an electro-magnet. Likewise the reproduction of sound is effected with the aid of a similar electro-magnet whose magnetic circuit is closed across the thickness of the wire or sheet, the current being modulated by the differently magnetised particles passing between the poles of said electro-magnet.

Some inconveniences of this method are as follows: the degree of modulation is limited because it is proportional to the thickness of the metal record; the records take up a considerable space and they are costly, if it is desired to have a high grade record of some length; the operating mechanism is complicated and delicate; there is an objectionable ground noise due to friction of the jaws or pole pieces of the electro-magnets; the reproducing system has an impedance too great to allow high frequencies to pass; the current fluctuations are not sufficiently powerful to actuate directly a loud-speaker.

It is a general object of my invention to provide a method and means for recording sounds and for reproducing sounds electro-magnetically that will obviate these inconveniences, particular objects being to provide a method and means in which:

(*a*) Recording instead of being effected across the thickness of the magnetic support, is made along the surface, thereby making it possible to use very thin strips or ribbons of say 0.03 mm. thickness instead of ribbons or wires of 1 mm. thickness as used hitherto;

(*b*) The magnetic circuit of the electro-magnet remains open, thus avoiding deformation due to saturation of a closed circuit, and the core or pole piece of the electro-magnet is given a tapered or pointed shape, thereby making possible a very fine modulation;

(*c*) The friction of the magnetic core on the magnetisable strip is reduced and rendered uniform, so that the usual ground noise is practically eliminated;

(*d*) The recording electro-magnet is quite independent of the reproducing electro-magnet, so that each of them can be adapted exactly to the function it is to perform;

(*e*) The recording electro-magnet has a winding of relatively low impedance so that it may be coupled directly with the microphone without the interposition of a transformer, whereby two causes of absorption and deformation of vibrations are eliminated;

(*f*) Polarisation of the recorder and of the strip or support may be brought to an optimum value, remote from the magnetic saturation of the support;

(*g*) The reproducing element may be free of any winding, whereby its mechanical and electrical inertia is reduced, and it can consist merely of a magnetic needle directly actuating the diaphragm of a loud-speaker;

(*h*) A loud-speaker may be used having neither inductor, nor armature, nor permanent magnet, nor electric current source, whereby a hitherto unequalled fidelity of reproduction may be attained.

With these objects in view, the method according to my invention consists of magnetising the support along its surface by means of a magnetising core extending parallel to said surface. A very thin metal strip, preferably of a thickness of the order of 0.01 mm., is used as the magnetisable support and during the recording operation said strip is moved past a tapered magnetising core, preferably shaped as a needle, which extends parallel to the surface of said strip, but at right angles to its direction of movement.

In order to produce a support for sound records, in a preferred embodiment of my invention, the very thin magnetisable strip or ribbon is wound into a spiral, together with and in alternating relation to a thin strip of insulating or non-magnetic material, such as adhesive paper for example, the magnetic strip being of greater depth or width than the insulating strip. With such a support, I am enabled to use a magnetising needle of considerably greater thickness than the distance between adjacent convolutions of the spiral, as owing to their extreme thinness the convolutions of the magnetic strip are very flexible and they are deflected on each side of the needle while the needle glides in contact therewith. In order that only one convolution of the strip be influenced by the needle at any moment, I use a magnetising needle combined with a part of non-magnetic material for moving aside the adjacent convolutions.

The needle used for magnetising the strip may also be used as a pick up for reproducing the sound, in which case its winding is connected with a loud-speaker. Said needle may also be

used for obliterating the record on the support or for de-magnetising the same, so that the support may receive another record.

In the accompanying drawing diagrammatically illustrating by way of example some of the features of my present invention:

Figs. 1 and 2 show the difference between the usual method of magnetising a strip for sound recording and the method according to my invention.

Fig. 3 is a side view of a strip and its magnetising needle.

Fig. 4 is a side view of a strip with a pick up needle.

Fig. 5 is a side view of a strip with an obliterating needle.

Fig. 6 shows a strip wound spiral-fashion to form a disc shaped record.

Fig. 7 is an enlarged view of some of the convolutions with a needle of special construction.

Fig. 8 is a fragmental view of the disc-shaped record on an enlarged scale.

Fig. 9 shows an apparatus embodying my invention.

In Fig. 1 I have shown a magnetisable strip 1 on its way from one reel 2 to another passing between the cores 3 of electro-magnets according to the usual method of electro-magnetic sound recording. In Fig. 2 the strip 1 is moved past a tapered core or needle 4 extending parallel to the surface of the strip, according to my present invention.

The relative positions of the needle 4 and strip 1 will be clearer from Fig. 3, which also show the low impedance winding 5 of the electro-magnet. This winding 5 is in circuit with a microphone 6 and with a potentiometer 7 connected in parallel with a battery 8 and a condenser 9, for suitably polarising the needle and the strip. Through this circuit, the modulation of the voice or other sound emitted in front of the microphone 6, is recorded in the strip 1. A strip of extreme thinness, of the order of 0.01 mm. thickness, is used and this strip is superficially magnetised by the needle 4 along a modulated curve 10, the shaded area representing conventionally the magnetised portion of the strip.

The same needle 4 may be used as a pick up and connected with a loud-speaker through an amplifier or otherwise. Or, as shown in Fig. 4 the strip may be moved past a small rod or lever 11 which is pivotally supported at 12 and is pivoted at 13 to an arm 14 which transmits directly to a loud-speaker 15 the vibrations received from the rod 11 magnetically influenced by the strip 1. The loud-speaker 15 then reproduces the sounds which had previously been emitted before the microphone 13.

In Fig. 5 I have illustrated the strip 1 moving past the needle 16 of an electro-magnet whose winding 17 is supplied from a battery 18 with current controlled by a potentiometer 19, so as to obliterate the record, the magnetisation then being levelled as shown by the line 20. The strip 1 then is ready for receiving a fresh record, or it may be de-magnetised before receiving a fresh record.

The magnetic strip may be wound spiral-fashion on a disc-shaped support 21 as shown in Fig. 6. In this embodiment of my invention the thin strip 1 is stuck on a strip of paper 22 of less width so that the convolutions formed by the strip 1 project well above the paper convolutions 22 as best shown in Fig. 7.

In order to magnetise the strip on disc 21, I use a member formed of a magnetic needle 24 comprised between two parts 25 of non-magnetic material and having a slit 23 between the needle and one of said parts so that the said member may straddle the strip as shown in Figs. 7 and 8. In this position the adjacent convolutions are pushed aside by the non-magnetic parts and only one convolution at one time is influenced by the magnetic needle 24. While the record is being taken, the disc 21 is rotated by a motor 26 (Fig. 9) and the member 24, 25, which may be movably supported in any suitable way, as from a bar or rail 27, rides on convolution after convolution of the strip 1, the convolutions resuming their former shape behind the member 24, 25 owing to the elasticity of the metal strip as shown in Fig. 8.

In Fig. 9 the member 24, 25 forms the core of an electro-magnet whose winding 28 is connected with a switch 29 which, in position *a*, connects said winding with a microphone 30. In position *b* the switch 29 connects the winding 28 with a battery 31 for obliterating the record. In position *c* the switch 29 connects the winding 28 with a loud-speaker 32 through an amplifier 33.

It will be understood that the above construction is merely given by way of example and that the details of my invention may be varied without departing from the scope of the appended claims.

I claim:

1. In means for electro-magnetically recording sound, the combination of a magnetic circuit comprising a magnetic needle-shaped core and a very thin strip of metal possessing magnetic retentivity, said core extending parallel to the surface of said strip and in contact with one side of said strip over part of its width, a winding surrounding said core, means for longitudinally moving said strip past said core, and means for sending modulated currents through said winding comprising a microphone, a source of current between said winding and said microphone, a condenser and a potentiometer shunting said source of current.

2. In means for electro-magnetically recording sound, the combination of a very thin strip of metal possessing magnetic retentivity wound spiral-fashion together with and in alternating relation to a non-magnetic strip, a disc-shaped base supporting said winding, means for rotating said disc, a magnetisable needle extending parallel to the surface of said magnetisable strip and in contact with one convolution thereof, said needle being partly made of non-magnetic material, and means for sending modulated magnetising impulses into said needle.

3. In means for electromagnetically recording sound according to claim 2, said metal strip being flexible transversely of its length, said needle being adapted to fit between two adjacent convolutions of said metal strip and having a magnetisable core adapated to contact one of said adjacent convolutions and a guard of non-magnetic material adapted to contact with the other of said adjacent convolutions.

4. In means for electromagnetically reproducing sound, the combination of a very thin strip of metal possessing magnetic retentivity wound spiral-fashion together with and in alternating relation to a non-magnetic strip, said metal strip being flexible transversely of its length, a disc-shaped base supporting said winding, means for rotating said disc, a magnetisable needle extending parallel to the surface of said magnetisable

strip, said needle having a magnetic core and side portions of non-magnetic material, a slit being formed between said core and one of said side portions to engage said metal strip.

5. A device for the magnetic transfer of sound, comprising a strip of extremely thin metal, capable of retaining magnetism, and possessing a magnetic tracing substantially only on one surface thereof, a pivotally mounted thin needle of magnetic material extending parallel to the magnetized surface of said strip, transversely to the axis thereof and in operable relation therewith, and capable of vibrating responsive to the variance in the magnetic tracing on the surface of said strip, means for moving said strip and said needle relatively to each other, and a loudspeaker having a sound arm connected therewith, to which arm said needle is connected, for transmitting to the loud speaker the vibrations set up from said magnetic tracing.

6. A device for the faithful and accurate magnetic transfer of sound, with good modulation and in the substantial absence of distortion, comprising a strip of extremely thin metal capable of retaining magnetism, an electromagnet having a needle-like core for tracing a magnetic sound path substantially only on one surface of said metal strip, said core extending substantially parallel to the surface of said strip, transversely to the axis thereof, and in operable relation therewith, means for electrically energizing said electromagnet in accordance with the sound to be recorded on said strip, and means for moving said strip relative to said core.

7. A device for the faithful and accurate magnetic transfer of sound, with good modulation and in the substantial absence of distortion, comprising a strip of metal capable of retaining magnetism, said strip having a thickness of the order of magnitude of but 0.03 millimeters, an electromagnet having a needle-like core for tracing a magnetic sound path substantially only on one surface of said metal strip, said core extending substantially parallel to the surface of said strip, transversely to the axis thereof, and in operable relation therewith, means for electrically energizing said electromagnet in accordance with the sound to be recorded on said strip, and means for moving said strip relative to said core.

8. A method of accurately and faithfully recording sound, in the substantial absence of distortion, comprising providing a strip of magnetizable material, tracing a magnetic path substantially only on one surface thereof, responsive to the frequencies of the sound to be recorded, thereby permitting the use of a strip of extreme thinness, by placing a magnetic member energized in response to the sound to be recorded, substantially parallel to the surface of said strip, approximately normal to the axis thereof, and in contact only with that side of the strip in which the magnetic path is to be traced, producing a relative movement between said strip and said member, sending magnetic impulses into said member, responsive to said sound, and thereby magnetizing said strip substantially only on that surface in contact with said member.

9. A method of recording sound, comprising providing a strip of magnetizable material, winding said strip in helical manner, so that the said strip possesses a plurality of closely spaced, flexible convolutions, tracing a magnetic path substantially only on one surface of said strip, responsive to the frequencies of the sound to be recorded, thereby permitting the use of a strip of extreme thinness, by placing a magnetic member having a conducting strip and an insulating strip for separating the adjacent convolutions of the magnetic strip during the passage of said conducting strip therealong, and which conducting strip is energized in response to the sound to be recorded, substantially parallel to the surface of said strip, approximately normal to the axis thereof, and in contact only with that side of the strip on which the magnetic path is to be traced, rotating the strip, thus wound, with its convolutions thus magnetically separate from adjacent convolutions, sending magnetic impulses into said magnetic member responsive to said sound, and thereby successively magnetizing each convolution of said strip substantially only on that surface in contact with said member.

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