May 17, 1932. G. LIGUORI 1,858,553

METHOD OF AND MEANS FOR RECORDING AND REPRODUCING SOUNDS

Filed Nov. 2, 1931

Fig. 1

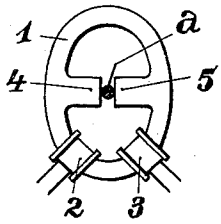


Fig. 2

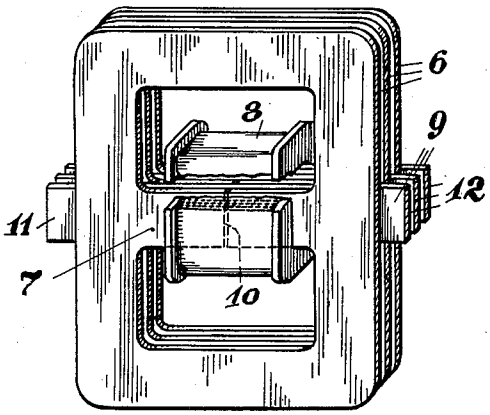


Fig. 3

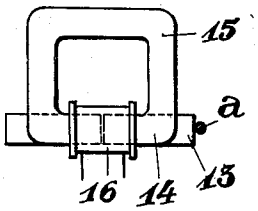


Fig. 4

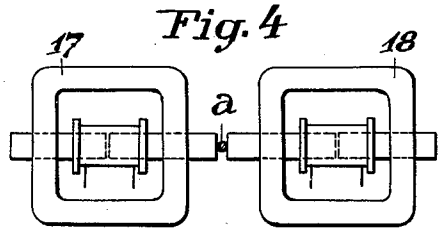


Fig. 5

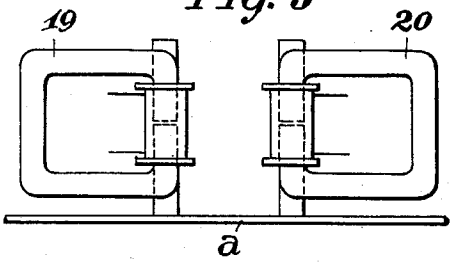


Fig. 6

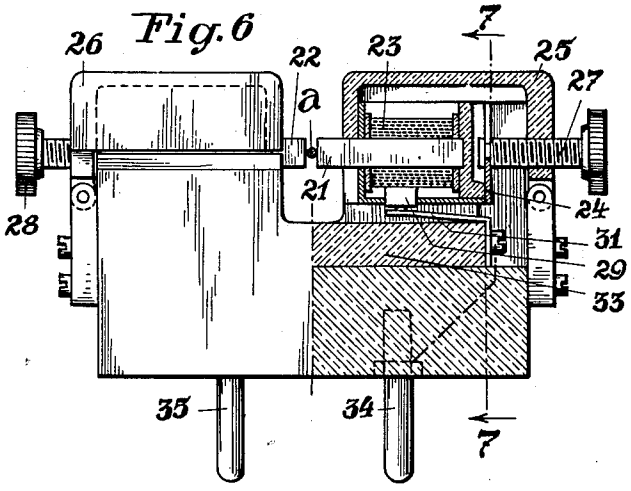
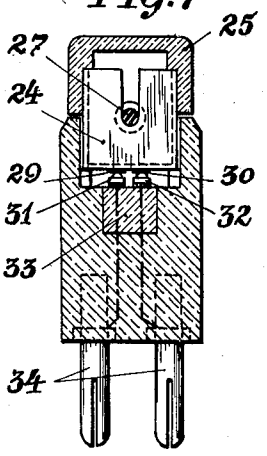


Fig. 7



Inventor

Giovanni Liguori

by R. Singer Attorney

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UNITED STATES PATENT OFFICE

GIOVANNI LIGUORI, OF MUNICH, GERMANY

METHOD OF AND MEANS FOR RECORDING AND REPRODUCING SOUNDS

Application filed November 2, 1931, Serial No. 572,585, and in Germany July 27, 1931.

This invention relates to improvements in a method of recording and reproducing sounds by means of magnetizable wires, bands and the like, and it also relates to means for carrying out the method.

It is an object of the invention to effect the recording or reproduction of sounds by locally differentiated magnetization of relatively movable wires, bands and the like and to avoid thereby the interference which otherwise would be produced by the vibration of the recording element itself.

Another object of the invention is to eliminate in a method of recording or reproducing sounds by the aid of magnetizable members the disturbances set up by the saturation of the magnetizing elements themselves.

It is, furthermore, an object of the invention to eliminate the influence of reactions as inductions, etc., which may be produced in the magnetizable member by the varying magnetizing conditions of the magnetic field itself.

In processes for recording and reproducing sounds, as referred to above, the member to be magnetized is usually moved relatively to a field wherein the density of the lines of force or the magnetic flux are altered in accordance with sound waves. The magnetizing element is frequently formed by a magnet through the field of which the member to be magnetized is caused to travel. When the magnetizing element is energized to the point of saturation, the alterations in the magnetic flux are not in proportion to the inducing causes, and hence the local alterations of magnetic conditions produced in the member to be magnetized also cease to be proportionate to said inducing causes. It is, furthermore, obvious that owing to the passage of the member to be magnetized through the field of the magnetizing element, other reactions are induced which interfere with the magnetic flux and which set up a distortion of these locally differentiated magnetic conditions.

It is, therefore, an object of the invention to provide a method wherein the member to be magnetized is caused to travel through a magnetic field which remains uninfluenced or is less influenced by the above mentioned distorting conditions, although the magnet is under control of those energizing conditions which set up the fluctuating magnetic field.

This is accomplished by providing, in addition to the main magnetic circuit, a magnetic shunt circuit, and causing the wire, band or the like to be influenced by said shunt. A magnetic shunt of this type may be provided in the field of dispersion of the magnetizing element proper, and it is, therefore, an object of the invention to carry out the differential magnetization by causing the member to be magnetized to travel through said field of dispersion of a closed magnetic circuit. The utilization of the shunt which again may present a closed magnetic circuit has the effect of preventing oversaturation of the iron parts within this shunt field. The main flux passing through the main magnetic circuit will make it possible to maintain the shunt magnetic circuit at a point far below the saturation point.

Another advantage of utilizing a magnetic shunt circuit for setting up the differential magnetization in the carrier or member to be magnetized is that the mechanical vibrations of said carrier are greatly reduced, and owing to this reduction of mechanical vibrations of the carrier, the reactions, as inductions, etc. which would interfere with the proper magnetization are likewise reduced so as to furnish a record or reproduction free of distortion and agreeing with the source of sound in recording the sounds, or agreeing with the record in reproducing a sound.

With these and other objects in view, the invention is described in the following specification in which reference is made to the drawings.

In the drawings:

Fig. 1 is a diagrammatical front elevation of a magnetic circuit with a shunt, as used for this invention;

Fig. 2 shows perspectively, on a larger scale, a magnet of a type suitable for this invention;

Fig. 3 shows diagrammatically in front elevation, a magnet furnishing a magnetic

main circuit and shunt in an arrangement modified from that of Fig. 1;

Fig. 4 illustrates diagrammatically an arrangement of magnets, as shown in Fig. 2, for sound recording or reproducing purposes.

Fig. 5 shows diagrammatically a system of magnets, as shown in Fig. 3, for sound recording or reproducing purposes;

Fig. 6 shows partly in elevation and partly in section a magnet arrangement convertible from a sound recording system into a reproducing system, and

Fig. 7 is a vertical cross-section on line 7—7 of Fig. 6.

In the embodiment illustrated in Fig. 1, the closed magnetic circuit is formed by an annular magnet core 1 carrying the two energization coils 2 and 3. A magnetic shunt circuit is provided by pole pieces 4 and 5 extending into the space surrounded by the annular magnet 1, said poles being directly opposite each other, and leaving a gap between them for the passage of the member *a* to be magnetized. This member which constitutes the carrier of the locally differentiated magnetic conditions may be a wire or band of steel or the like. As in other magnets serving the purpose of impressing a record on a magnetizable element, the core 1 may be built up of individual superimposed plates or laminæ.

In Fig. 2, the manner in which a different type of magnet also providing means for creating a magnetic shunt may be built up of individual laminæ is illustrated. The annular core 6 is built up of individual plates which are each provided with oppositely directed projections to form upon assembly a transverse bar 7. As shown in dotted lines in Fig. 2, the bar 7 is transversely split to facilitate the positioning of the body of the energizing coil 8 on said bar. The magnetic shunt is produced in this form of energizing magnet by a plurality of laminæ or strips 9 of substantially rectangular shape alternately positioned between the projections of the bar 7. These magnetic shunt strips not only extend transversely of the annular core 6, but project at the ends thereof, as shown at 11 aud 12 to constitute projecting poles. These laminæ 9 also are energized by the coil 8, since they also form a core for the same, But while the main core 6 constitutes a closed ring, the shunt core 9 presents poles 11 and 12, past which the member to be magnetized may be relatively moved.

In the embodiment of Fig. 3, the main magnetic circuit again is formed by an annular core 15. The leg 14 of this core is slitted, as shown, and rectangular strips 13 again are alternate with the laminæ of the annular frame 15 along the leg 14 thereof. The coil 16 which is positioned on the leg 14 owing to the provision of the slit serves for inducing the magnetic flux in the core 15 as well as in the strips 13. The main magnetic circuit in the core 15 will be a closed one, but there will be a magnetic shunt field which is less influenced by the distorting disturbances of the main current and flux, and in the field of the shunt, or dispersion field, the magnetizable member *a* is caused to travel by moving said carrier *a* closely past the ends of the strips 13.

In the embodiment illustrated in Fig. 4, a pair of electromagnets of a construction similar to that illustrated in Fig. 2, indicated at 17 and 18, is arranged with the shunt magnet poles in opposition to each other, the record carrier *a* being caused to travel between the projecting poles of the shunt magnets.

Similarly in Fig. 5, a pair of magnets 19, 20 of the type illustrated in Fig. 3, is made use of for producing a record in the wire *a* which travels closely adjacent the same ends of the shunt poles.

The embodiment illustrated in Figs. 6 and 7 discloses in combination with the magnetic core generating the main magnetic field and in combination with an arrangement of magnets for producing a shunt field, means for adjusting the distance between the record carrier *a* and the shunt magnets. Owing to this adjustment device the carrier may travel while being spaced any desired distance from the end of the shunt magnet, or it may travel while remaining in contact therewith so as to eliminate the influence of mechanical vibrations on the record carrier.

In these figures the main magnetic circuit is formed by a plate 23 in permanent connection with frames 25 and 26 respectively to form two closed magnetic circuits. Each of the frames 25 and 26 supports slidably therein a yoke 24 which also serves as a mounting for the magnetic shunt strips 21 and 22 respectively. The magnetic shunt elements 21, 22 may be adjusted so as to approach each other or be spaced from each other.

The yoke 24 also serves as a mounting for the energizing coil 23 in each of these closed magnetic circuits, this energizing coil at the same time being positioned about the pertaining shunt magnet 21, 22.

The current may be led to the magnetizing coil 23 from a contact pin 34 through a conductor which extends through a base plate and which is connected wtih a contact spring 31. The winding of the coil 23 terminates in a contact 29 adapted to engage the free end of the pertaining contact spring 31 so as to carry the current to the coil 23 in any position to which this yoke 24 may be adjusted. The coil 23 shown in Fig. 6 is connected serially with a similar coil in the frame 26 from which the current is let out via similar way to the other contact pin 34.

For the purpose of accurately determining the location of this yoke and thereby also the location of the shunt magnets 21, 22,

a micrometer screw 27 is threaded through the pertaining frame 25 and 26 respectively and is rotatably engaged in a portion of the yoke 24.

In this manner the member *a* to be magnetized may either be directly engaged by the pole faces of the shunt 21, 22 or it may be caused to travel at a slight distance from the same.

In practical tests it has been found advisable when this system is utilized for recording sounds, to maintain the member *a* in touch with the face of the shunt pole. If, however, sounds are to be reproduced from a record *a* it is advisable to maintain said record or carrier *a* quite close to the face of the shunt pole without bringing it into actual touch with the same.

It will be apparent from the above description that in this system of recording or reproducing sound vibrations or other vibrations by locally altering magnetic conditions of a carrier member, the magnets influencing the carrier (or influenced by the carrier upon reproduction) are rendered dependent on a shunt magnetic field. In this manner magnetic saturation of the main magnet will have no detrimental effect as long as the shunt magnets are not magnetized to saturation, and distorted recording or reproducing will be avoided.

I claim:

1. A system of magnetically recording and reproducing sounds by means of magnetizable wire, bands and the like, consisting of energizing a closed main magnetic circuit in accordance with the varying intensity and pitch of the sound waves, producing a magnetic shunt influenced by said closed main magnetic circuit, and positioning the magnetizable wire, band and the like in the field of said magnetic shunt.

2. A system of electromagnetically recording and reproducing vibratory movements by conversion into a correspondingly fluctuating electric current, which consists of energizing a magnet by said fluctuating current, said magnet being shaped to produce a closed magnetic circuit, branching a magnetic shunt off said closed magnetic circuit, said magnetic shunt having a free pole, and positioning the member to be magnetized adjacent the free pole.

3. A process of electromagnetically recording and reproducing vibratory conditions which can be converted into a fluctuating electric circuit, which consists of energizing a closed magnetic circuit by the electric current into which said vibratory conditions have been converted, branching a magnetic shunt from said main magnetic circuit in such relation to said energizing current that said shunt also is influenced in accordance with said fluctuating current, and positioning a movable magnetizable member into the field of dispersion of said magnetic shunt.

4. A process of electromagnetically recording and reproducing vibratory conditions converted into fluctuating electric current, which consists of differentially magnetizing a closed magnetic main circuit by said fluctuating electric current, branching a magnetic shunt from said main magnetic circuit in such relation to the energizing means as to be likewise influenced by said fluctuating electric current, said magnetic shunt having at least one pole free, and adjustably positioning the member to be magnetized relatively to said free pole of said magnetic shunt.

5. A system of electromagnetically recording and reproducing sounds, which consists of energizing a closed magnetic circuit by an electric current fluctuating in accordance with the sound vibrations, branching a magnetic shunt from said magnetic circuit and positioning the magnetizable member in engagement with said shunt.

6. In an apparatus for electromagnetically recording and reproducing sounds by means of a magnetizable member, the combination of a closed magnetic core, means for magnetizing the same, and a pole projecting from said closed core and constituting a magnetic shunt to said closed magnetic core, the magnetizable member being movable past said pole.

7. In an apparatus for electromagnetically recording and reproducing sounds by means of a magnetizable movable member, the combination of a magnetic annular core built up of a plurality of laminæ, a magnetizing coil mounted on a portion of said magnetic core, and additional laminæ interspersed between the laminæ of said first mentioned magnetic core but projecting from the same and positioned in registry with a portion of the same to constitute a shunt for said magnetic core, the magnetizable member being located in said shunt.

8. In an apparatus for electromagnetically recording and reproducing sounds by means of a magnetizable member, the combination of an annular magnetic core, an energizing coil mounted on a portion of said core, and a magnetizable bar extending through said magnetizing coil and projecting from said core to constitute a shunt field to the magnetic field produced by said core, the magnetizable member being in said shunt field.

9. In an apparatus for electromagnetically recording and reproducing sounds by means of a magnetizable member, the combination of an annular magnetic core having a transverse bar connecting opposite points of said annular core, an energizing coil mounted on said transverse bar of the core, and an additional transverse bar in registry with the said first named transverse bar and also part-

ly surrounded by the said coil, said additional bar projecting laterally from the annular core to constitute a shunt to the field produced by the annular core, the magnetizable member being in said shunt field.

10. In an apparatus for electromagnetically recording and reproducing sounds by means of a magnetizable member, the combination of an annular magnetic core built up of a plurality of plates, said plates being provided with web portions projecting towards each other transversely of the core, an energizing coil supported on said web portions, additional laminæ alternately arranged with said transverse web portions and having end parts projecting from the annular core, the magnetizable member being positioned adjacent said projecting parts.

11. In an apparatus for electromagnetically recording and reproducing sounds, the combination of a plurality of annular magnetic cores spaced from each other and each being provided with an energizing coil, bars extending through each of said annular cores and projecting towards the other annular core, the two bars of the cores being spaced from each other, and a magnetizable member receivable between said bars.

12. In an apparatus for electromagnetically recording and reproducing sound by means of a magnetizable member, the combination of a pair of annular magnetic cores at fixed distance from each other, each of said cores being provided with an energizing coil, magnetic shunt poles projecting through said annular cores in direction towards the opposite core, and means for adjusting said magnetic shunt poles, the magnetizable member being receivable between said poles.

13. In an apparatus for electromagnetically recording and reproducing sound by means of a magnetizable member, the combination of a pair of closed magnetic cores, each core containing a yoke, an energizing coil supported by each yoke, a magnetic shunt element extending from each coil, and means associated with each of the magnetic cores for independently adjusting the yoke relatively to the other core, whereby the shunt elements may be subject to greater or smaller spacing from each other, the magnetizable member being receivable between said shunt elements.

14. In an apparatus for electromagnetically recording and reproducing sounds by means of a magnetizable member, the combination of a closed magnetic core, an energizing coil for the same, a magnetic shunt element branched from said magnetic core and influenced by said energizing means, and means for adjusting the distance between the magnetizable member and said shunt element.

In witness whereof I affix my signature.

GIOVANNI LIGUORI.