June 10, 1941. L. MARZOCCHI 2,245,286

ELECTROMAGNETIC SOUND RECORDING

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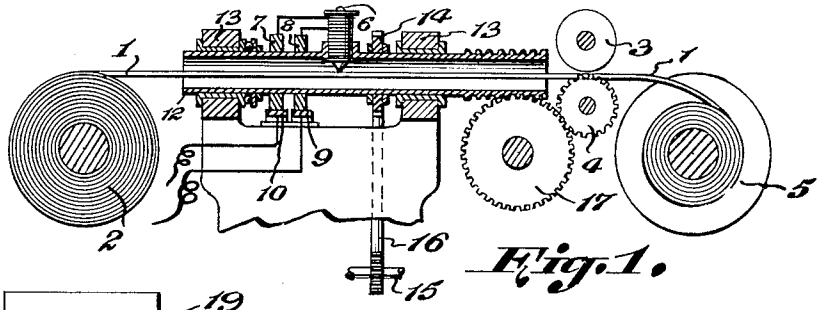

Fig. 1.

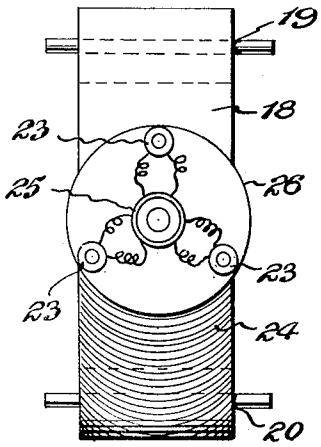

Fig. 2.

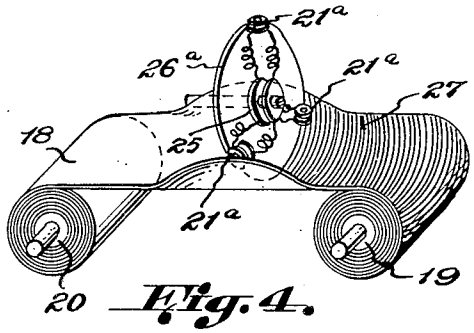

Fig. 4.

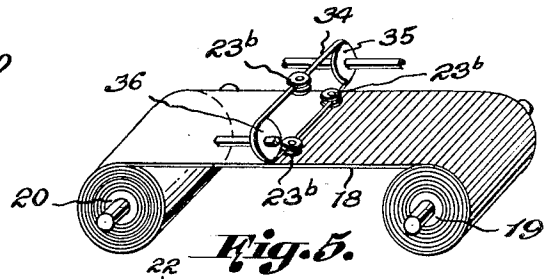

Fig. 5.

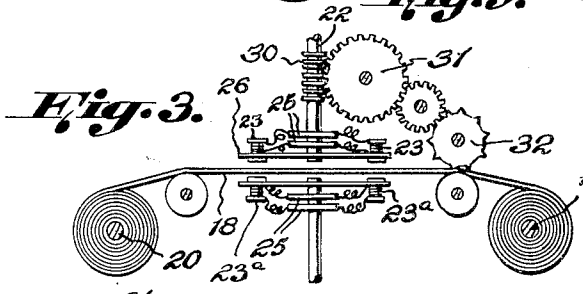

Fig. 3.

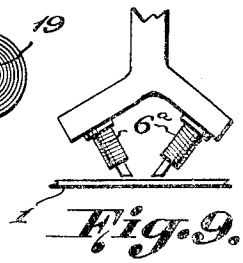

Fig. 9.

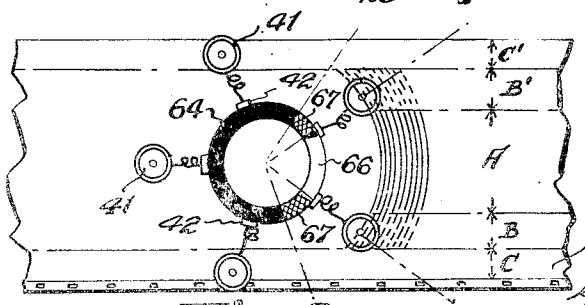

Fig. 8.

Inventor,
Luigi Marzocchi
By: Glascock, Downing & Seebold
Attys.

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ELECTROMAGNETIC SOUND RECORDING

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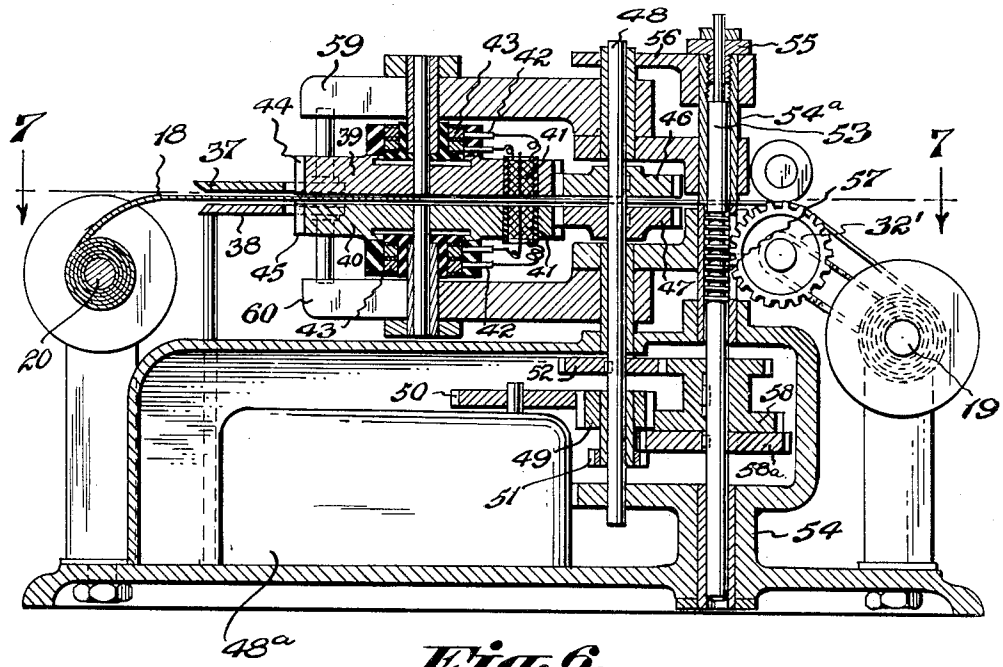


Fig. 6.

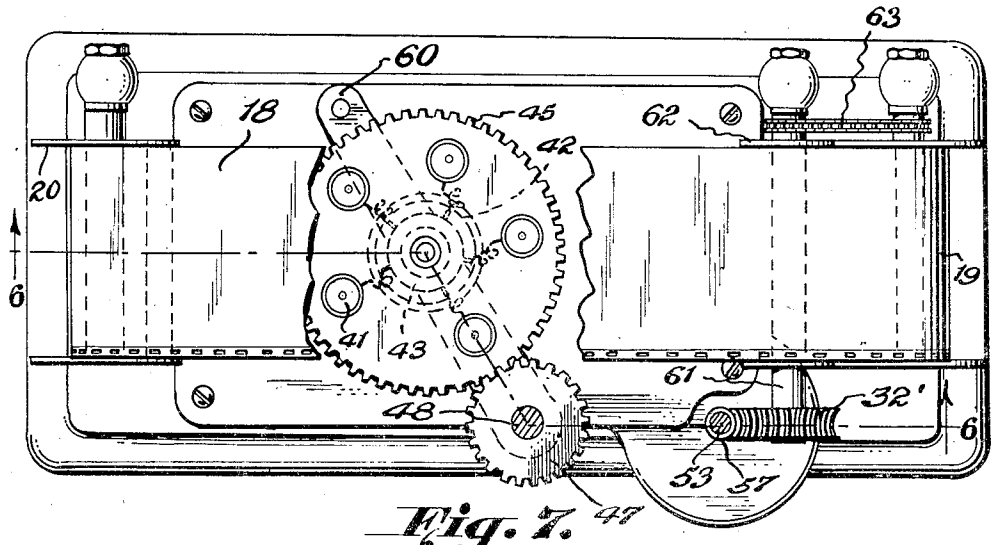


Fig. 7.

Inventor,
Luici Marzocchi
Glascock Downing & Seebold
By:
Attys.

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# UNITED STATES PATENT OFFICE

2,245,286

## ELECTROMAGNETIC SOUND RECORDING

Luigi Marzocchi, Milan, Italy

Application May 26, 1937, Serial No. 144,862
In Italy June 26, 1936

8 Claims. (Cl. 179—100.2)

The present invention relates to electro-magnetic sound recording and more particularly pertains to apparatus for recording sound and an elongated magnetizable element including a novel form of magnetized lines carried by the elongated magnetic element.

Several systems of magnetic sound recording and reproducing are known which are based on the Paulsen principle and realized on magnetizable metallic bodies such as cylinders, discs, wires and ribbons. The known arrangements, however, present inconveniences which provide obstacles to their practical utilization.

An object of the present invention is to provide apparatus for recording sound electro-magnetically wherein the sound track is recorded in a spiral fashion on a longitudinally moving wire.

Another object of the invention resides in the provision of means for recording sound on a metal tape wherein electro-magnets are provided adjacent both faces of the tape so that the magnetic circuit will be completed by the tape.

A still further object of the invention includes means for controlling the current flowing in the circuits of the recording magnets so as to gradually alter the degree of magnetization imparted to the tape particularly when the sound lines are arranged to extend in a transverse direction with respect to the lognitudinal axis of the record.

Other and further features and objects of the invention will be more apparent to those skilled in the art upon a consideration of the accompanying drawings and the following description wherein several exemplary embodiments of the invention are disclosed.

In the drawings:

Figure 1 is a longitudinal sectional view of apparatus for electro-magnetically recording sound on a wire.

Figure 2 is a plan view illustrating the manner in which the electro-magnets may be supported and moved to provide a series of transverse tracks on a metal tape.

Figure 3 is an elevational view indicating the fundamental elements of apparatus wherein the tape passes between two groups of electromagnets.

Figure 4 is a perspective view illustrating a modification of the apparatus shown in Fig. 2.

Figure 5 is a perspective view illustrating another arrangement for supporting and moving the electro-magnets.

Figure 6 is a sectional view taken on the line 6—6 of Fig. 7 illustrating a practical construction of the sound recording apparatus illustrated in Figure 3.

Figure 7 is a view taken on the line 7—7 of Fig. 6.

Figure 8 is a diagrammatic view illustrating the manner in which the electro-magnets are associated with one of the slip rings.

Figure 9 is a view of one form of magnet system usable with the present invention.

Referring to the drawings and particularly to Figure 1 the steel wire 1 is stored on a reel 2 and adapted to be drawn therefrom by rollers 3 and 4 and the wire is adapted to be wound on the reel 5. In passing from the reel 2 to the reel 5 the wire 1 passes through a rotating unit consisting of a tube 12 carrying an electro-magnet 6. The coil ends of the electro-magnet are connected to two slip rings 7 and 8 which are engaged by stationary contacts 9 and 10. The contacts 9 and 10 are adapted to transmit the impulses from a recording circuit to the electro-magnet 6. The tube 12 is mounted to rotate in bearings 13 and to be turned by a gear 14 which is driven from the shaft 15 by means of a link belt or chain 16.

The threaded part of the tube 12 provides a worm screw which engages the teeth of the gear wheel 17 which in turn drives the roller 4 so that the wire 1 is moved from the reel 2 in a longitudinal direction through the tube 12 at a rate of speed in dependence on the rate at which the tube is rotated. Thus, the cylindrical surface of the wire 1 is provided with a spiral line of magnetization of constant pitch which depends upon the gear ratio provided between the tube 12 and the roller 4.

The magnetic sound track recorded on the wire may be further improved by means of a pair of electro-magnets 6a arranged in the form of a V as shown in Fig. 9, so that the wire 1 will provide means for closing the magnetic circuit.

The sound record may take the form of a magnetic ribbon or tape 18 as shown in Fig. 2. A supply of the metal tape may thus be stored on the roller 20 and to be wound therefrom onto a roller 19. Adjacent one face of the ribbon or tape 18 a group of rotating electro-magnets 23 are provided so as to turn in a plane parallel to the tape. The electro-magnets may be supported on the disc 26 and when current is supplied to the electro-magnets by means of the slip rings 25 a series of transverse sound tracks 24 will be imparted to the tape.

The arrangement illustrated in Fig. 2 may be further improved by providing a second group of electro-magnets 23a adjacent an opposite face of the ribbon 18. The disc 26 may for example be driven by the shaft 22 having a worm gear 30

fixed thereon so as to drive the gear wheel 31. The gear 31 meshes with an additional gear wheel to drive a toothed wheel 32 which engages openings in the edge of the tape so as to draw the same from the roller 20.

The electro-magnets may be also supported and moved in a manner as illustrated in Fig. 4 wherein the disc 26a is mounted in a plan perpendicular to the tape 18 and the electro-magnets 21a are mounted at the periphery of the discs. With such apparatus the sound track 27 will extend in a direction substantially at right angles to the longitudinal axis of the tape and means may be provided for bending the tape in an arcuate fashion corresponding to the radius of the disc 26a.

The electro-magnets 23b shown in Figure 5 are mounted on a flexible carrier element 34 which is arranged to rotate on the pulleys 35 and 36. The electro-magnets 23b thus move in a plane substantially parallel to the face of the ribbon 18 to provide transversely extending sound tracks.

A constructional form of the apparatus for recording sound electro-magnetically on the metal ribbon 18 is illustrated in Figures 6 and 7 wherein the rollers 19 and 20 are mounted at each end of the apparatus. Two plates 37 and 38 are arranged in a spaced relation for guiding the ribbon 18 in passing from the roller 20 between two discs 39 and 40. Each of the discs carries five electro-magnets 41 which are circumferentially spaced therearound at equal intervals. One end of each coil is connected to a sliding contact 42 which engages the respective slip rings 43. The electro-magnets 41 are arranged in a circle having a diameter smaller than the width of the ribbon 18 so that the cores of magnet during rotation of the discs 39 and 40 move in a path to impart the magnetic flux to the ribbon.

The discs 39 and 40 are each provided with gear teeth as indicated at 44 and 45 so as to mesh respectively with gear wheels 46 and 47 which are fixed to a vertical shaft 48. The shaft 48 is driven by a motor housed within the casing 48a so as to drive the gear wheel 50 which meshes with the pinion 49.

The pinion 49 is slidably mounted on the shaft 48 and provided with a gear wheel 51 of a smaller diameter than the pinion 49. The speed at which the shaft 48 is driven by the motor may be changed by shifting the slidable pinion 49 to cause the teeth of the gear 51 to mesh with the teeth of the gear 58a or the teeth of the pinion 49 may be meshed with the teeth of the gear 58. Thus the shaft 53 on which the gears 58 and 58a are mounted is rotated and the rotary movement thereof is transferred to the shaft 48 by means of a pinion gear 52. The shaft 53 extends vertically from a bearing 54 and the upper end thereof is supported by a bracket 56. An intermediate portion of the shaft 53 is provided with a worm screw 57 which engages the teeth of the gear 32'. The gear 32' is fixed to a shaft 61 carrying a roller 62 which engages the ribbon 18 so as to move the same in the roller 20. For this purpose an edge of the ribbon 18 may be provided with openings in which teeth of the roller 62 engage so as to positively advance the ribbon. The roller or reel 19 may be driven from the shaft 61 by means of a chain 63.

Thus the motor drives the discs 39 and 40 so that the electro-magnets 41 are moved in a transverse direction across the ribbon 18 and the tape is moved in a longitudinal direction at a speed that bears a definite ratio to the movement of the electro-magnets.

In order that slight variation may be made between the angular positions of the magnets 41 with respect to the longitudinal moved position of the tape the shaft 53 is provided with means for moving the same slightly in a longitudinal direction. Such means includes a nut 55 rotatably arranged at the upper end of the shaft and fixed thereto against longitudinal movement so that the threaded portion thereof may be raised or lowered in the threaded bushing 54a.

The two rotating discs 39 and 40 are supported by means of arms 59 and 60 which are swingable on the shaft 48.

One of the slip rings 43 is provided with an insulated portion 64 as indicated in Fig. 8 and a conducting portion 66. The portions 67 arranged intermediate of the insulated portion 64 and the conduction portion 66 each have varying resistances. Thus, when the electro-magnets 41 turn in a clockwise direction no current flows in the coils when the brushes 42 engage the insulated portion 64. When the brush 42 however engages the portion 67 of variable conductivity, the current in the coil is progressively increased until the brush 42 reaches the metallic section 66. Thus the lateral edge C' of the tape does not receive any magnetic lines of flux and the edge portion B' is provided with a sound track of gradually increased magnetization and the central zone A is provided with a full magnetic sound track. As the electro-magnets 41 leave the conducting portion 66 the brush 42 engages the second partly conducting portion 67 so that the current in the coil of the electro-magnet gradually decreases to provide the edge portion B with a magnetic sound track of gradually decreased magnetization. After the brush 42 engages the insulated portion 64 no current flows in the coil of the electro-magnet to provide a lateral portion C which is devoid of any magnetization.

Thus the magnetic lines are arranged on the ribbon 18 in such a manner that the sound tracks do not intersect each other so as to cause a meaningless tangle of the recorded sound tracks and when reproducing sound from such a sound track the scanning magnets moving in a transverse direction gradually generate current in accordance with the gradual magnetization of the portions B and B'.

While the invention has been described with reference to specific structural details it is to be understood that changes may be made by persons skilled in the art. Such changes may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. Apparatus for magnetically recording sound comprising in combination, a supply of metallic wire for receiving the recording, means for moving the wire longitudinally at a given rate of speed, a plurality of electromagnets movably arranged adjacent said wire, a sound recording circuit including the electro-magnets, and means for bodily rotating the electro-magnets in a plane transverse to the axis of the wire and at a rate of speed having a definite ratio with respect to the longitudinal movement of the wire.

2. In apparatus for electromagnetically recording sound, a supply of metallic wire for receiving the recording, means for moving the wire longitudinally at a given rate of speed, an annular support arranged around the wire, an elec-

tromagnet carried by the annular support, a sound recording circuit including the electromagnet, and means for rotating the annular support so as to move the electromagnet in a plane transverse to the axis of the wire and at a speed having a definite ratio with respect to the longitudinal movement of the wire.

3. A metallic magnetic sound record having sound tracks forming a magnetized portion, and side portions of the record having gradually changing degrees of magnetization.

4. A metallic ribbon type magnetic sound record having substantially parallel magnetized sound tracks arranged transverse to the longitudinal axis of the record and each track having gradually changing degrees of magnetization.

5. A steel tape magnetic sound record having substantially parallel sound tracks transverse to the longitudinal axis thereof, each track having a magnetized central portion and a lateral portion of gradually changing degrees of magnetization.

6. In apparatus for magnetically recording sound the combination of, a supply of magnetizable recording tape, means for longitudinally advancing said tape at a predetermined rate of speed, a plurality of electromagnets operably arranged adjacent one face of the tape, another group of electromagnets operably arranged adjacent the other face of the tape and means for moving all of said electromagnets in unison transversely with respect to the movement of the tape and at a rate of speed bearing a fixed relationship to the longitudinal movement of the tape.

7. In apparatus for magnetically recording sound the combination of, a supply of magnetizable recording tape, means for longitudinally advancing said tape at a predetermined rate of speed, a plurality of electromagnets in operative relationship with said tape, means for moving said magnets transversely with respect to the movement of the tape and at a rate of speed bearing a fixed relationship to the longitudinal movement of the tape, means for establishing electrical connections to each electromagnet from a sound recording circuit, and means associated with said second mentioned means for varying the resistance of the connections.

8. In apparatus for magnetically recording sound the combination of, a supply of magnetizable recording tape, means for longitudinally advancing said tape at a predetermined rate of speed, a plurality of electromagnets in operative relationship with said tape, means for moving said magnets transversely with respect to the movement of the tape and at a rate of speed bearing a fixed relationship to the longitudinal movement of the tape, slip rings for receiving current impulses from a sound recording circuit, brushes engaging each slip ring connected to the electromagnets, and at least one of said slip rings having portions of different conductivity.

LUIGI MARZOCCHI.