

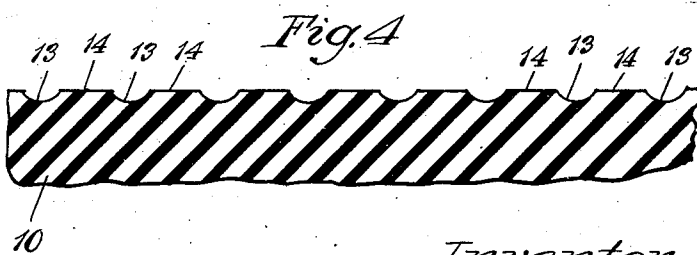
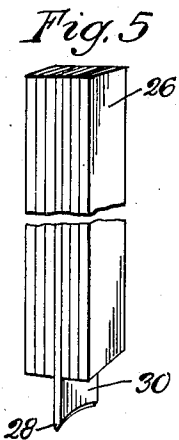
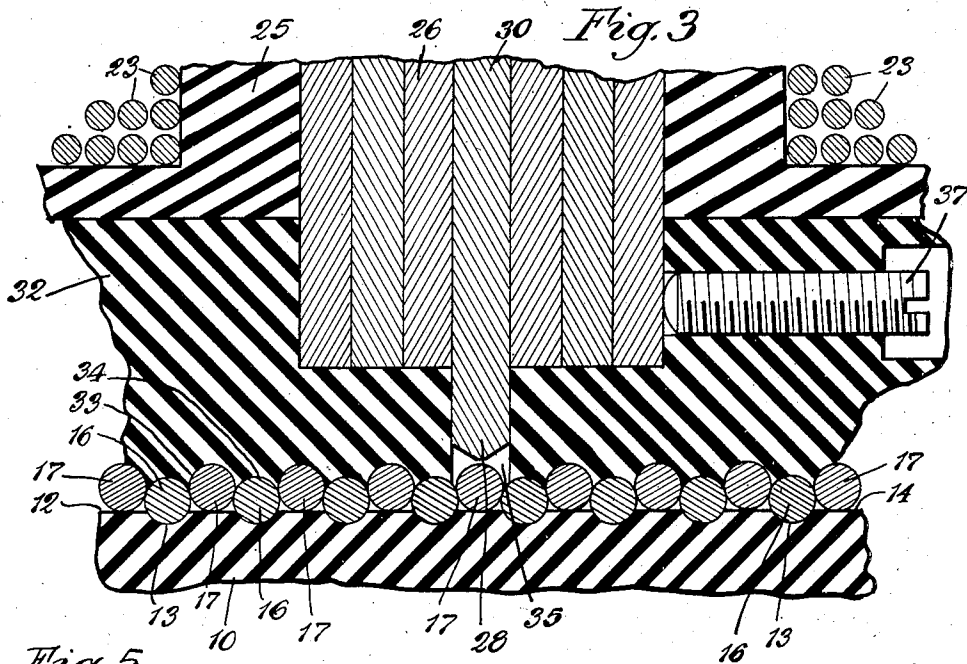
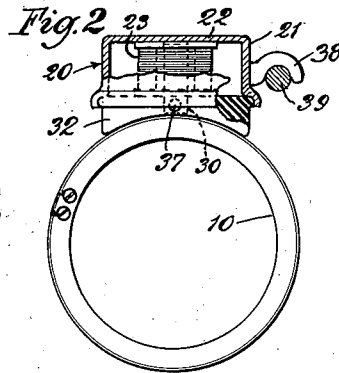
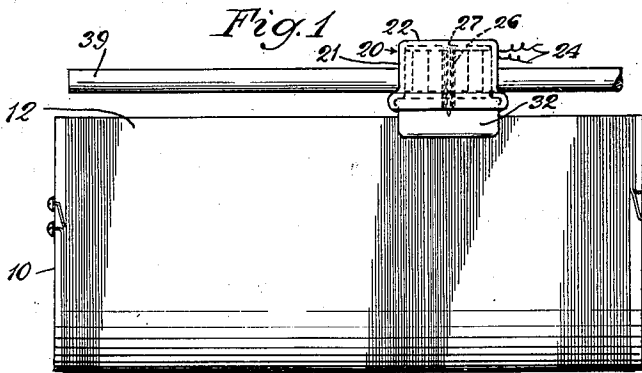
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2,431,739

MAGNETIC SOUND RECORDING

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MAGNETIC SOUND RECORDING

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This invention relates to electrical apparatus for magnetic recording and reproduction and has particular application to records of the type having magnetizable material in preformed rigid structures of which cylinders are the most common examples. While the art of magnetic recording on and reproducing from cylinders is old, nevertheless such records have hitherto been considered impractical for use. The advantages of a cylinder record over a wire or tape handled by two or more reels are quite substantial, particularly with regard to the ready accessibility of any portion of a cylinder. In contrast to this, rewinding of a wire or tape is time consuming, in addition to which the repeated flexing of the wire, as well as the tensile strain, has undesirable effects on the crystalline structure of the wire and the magnetic properties thereof.

It has been found that conventional cylinders of magnetic material have serious faults. Thus, in order to avoid intermodulation between adjacent sound tracks, it is necessary to provide a substantial spacing between adjacent sound tracks. Thus, it becomes difficult to provide a narrow sound track. As a result, cylinder records of the prior art have a low efficiency as a recording medium.

This invention provides a cylinder record structure which is highly efficient as far as magnetic recording and reproduction is concerned, is relatively simple and economical to make and is substantially free from undesirable effects, such as intermodulation between adjacent sound tracks, noise due to stray fields, particularly the earth's field. A record embodying the present invention, while generally usable for magnetic recording and reproduction, is particularly useful in connection with the magnetic recording and reproduction methods and devices disclosed and claimed in my United States Patents 2,361,752 and 2,361,753.

In general, a structure embodying the present invention comprises a magnetizable sound track of conventional material having high magnetic retentivity cooperating with a barrier track of material having low magnetic retentivity. It is preferred to have the two retentivities as extreme as possible consistent with practical considerations as cost and the like. Thus, as an example, high carbon steel piano wire or any one of a number of stainless steels available in wire form have suitable properties for use as a sound track. Examples of barrier track material having low retentivity are soft iron, or alloys of iron containing between about 45% and about

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80% nickel and, in some instances, having small amounts of chromium and molybdenum and available in the trade under such names as Permalloy, Mumetal and the like. Because the nickel alloys generally have a lower retentivity than soft iron, such alloys are preferable to soft iron. The two tracks parallel each other and are magnetically coupled.

Thus, a record may consist of a suitable non-magnetic base upon which may be a helical winding in bifilar relationship of two wires or filaments having low and high magnetic retentivity respectively. The relative disposition of the two wires may be varied within wide limits providing, however, that coils of wire forming one track are magnetically related to coils of the other wire forming the other track. It is not necessary that the track forming material have a circular cross section or that the size of one wire be equal to the size of the other wire or that the two tracks be at the same level. In practice, however, round wires are readily obtainable and are preferred. The two wires may conveniently be of the same gauge.

Without being bound by theory, it is my belief that the track having low magnetic retentivity functions to provide return paths for the magnetized elements in the sound track formed by the wire of high magnetic retentivity and functions as a magnetic barrier for the sound track.

In order that the invention may be fully disclosed, reference will now be made to the drawing wherein

Figure 1 is a front elevation of a transducer head on a cylinder record embodying the present invention.

Figure 2 is an end view partly in section of the structure of Figure 1.

Figure 3 is an enlarged sectional detail of the record and transducer of Figure 1.

Figure 4 is an enlarged detail of part of a record blank without sound and barrier tracks.

Figure 5 is an enlarged perspective detail of the transducer core and magnetizing tip.

A record embodying the present invention may be formed by providing non-magnetic cylinder 10 as a base. Cylinder 10 may be formed either of non-magnetic metal, such as aluminum or brass, or of insulating material having satisfactory strength and mechanical properties. Thus, cylinder 10 may be formed of any one of a number of plastics, such as phenol formaldehyde condensation products sold under the trade name of Bakelite. The interior of cylinder 10 may be shaped as desired to accommodate the arbor of

a cylinder type recording or reproducing machine. Since the general construction of such machines is well known in the art, no detailed description thereof is deemed to be necessary. In general, cylinder 10 should have a sufficiently thick wall and be of such material as to be capable of being manufactured within tolerances of the order of about one-thousandths of an inch.

Cylinder 10 has outer surface 12 which may be smooth but which preferably has formed thereon helical groove 13. Groove 13 may have any desired depth, and is preferably shaped to accommodate a round wire. Groove 13 resembles a thread groove in that it has pitch and progresses along the length of the cylinder. The pitch of groove 13 is large enough so that an intermediate helical region 14 is formed. Region 14 may be left flat, as shown, or may have a second groove formed therein, in which case the two grooves would have the same relation as the grooves of a double thread.

Wound around cylinder 10 in groove 13 is wire 16. This wire has its ends anchored to the cylinder in any suitable fashion, as by pins, and is wound under sufficient tension to maintain the wire in position on the cylinder. Wire 16 may be either of high magnetic retentivity or low magnetic retentivity. Disposed in region 14 is wire 17, the coils of this wire also forming a helix and the ends being anchored to maintain the wire in position. Wire 17 may be of low or high magnetic retentivity, it being understood that, if wire 16 has a low magnetic retentivity, then wire 17 will have high magnetic retentivity.

It is preferred to so design the record that the wire of high magnetic retentivity will extend somewhat above the wire of low magnetic retentivity. Thus, as shown in the drawing, wire 17 resting on flat portion 14 of the cylinder will extend above wire 16 providing, of course, that the wire gauges are equal. It is understood, however, that by proper choice of depth of groove 13, wire 17 may rest higher (with respect to the surface of cylinder 10) than wire 16 even though wire 17 be of finer gauge. However, within substantial limits, the relative sizes of the two wires and the relative disposition of the two wires may be varied.

Cylinder 10 is adapted to be rotated on its axis in a manner well known in the art. Cooperating with the wire wound cylinder is a transducer head for recording or reproducing and generally indicated by numeral 20. Head 20 has casing 21 of any suitable ferromagnetic material as soft iron for magnetically and electrically shielding the transducer head proper.

Casing 21 may have any desired shape and, as shown here, is a generally rectangular cup-shaped member having top 22. Disposed within the casing is winding 23 having leads 24. Winding 23 is on insulating spool 25 and has axially within the same pole piece 26. Pole piece 26 is of any suitable magnetic material having low retentivity. Thus, any metal or alloy satisfactory for use in the barrier track may be used for the pole piece. Pole piece 26 may extend for the full length of winding 23 with upper end 27 in contact with casing top 22 or spaced therefrom. Thus, good results have been obtained with a gap of about one-eighth inch. This is not critical. Pole piece 26 has an active pole tip 28 adapted to be in close proximity to the sound track in the normal operation of the system. It is preferred to have as small a clearance between the pole tip and the sound track as possible.

Thus, a clearance of the order of one or two thousandths of an inch is satisfactory although larger clearances may be used.

While the dimensions of the pole piece may vary within wide limits, it is clear that the pole tip cooperating with the sound track should have a dimension, in this case thickness, small enough so that the magnetic effects are substantially confined to one sound track. The width of the pole tip, however, may be substantial in terms of the length of sound track for the frequencies recorded as disclosed and claimed in the patents previously referred to.

Pole piece 26 may be formed of solid metal or a plurality of laminations. In the event that the pole piece is of solid metal, pole tip 28 will be formed by suitable machine work. It is preferred, however, to use laminations for making the pole piece with the plane of the laminations being perpendicular to the cylinder axis. Thus, as shown in Figure 5, pole piece 26 may have central lamination 30 extend below the remaining laminations. The remaining laminations may be cut shorter making a simple pole structure with a minimum of machine work. The end of central lamination 30 may be rounded or sharpened, as shown in Figure 3.

Central lamination 30 is preferably curved along its width to conform to the curvature of the sound track. Its thickness is preferably, though not necessarily, of the order of the diameter of the sound track wire. Thus, as an example, all the laminations may each have a thickness of the order of .005 inch. The width of the laminations may vary within wide limits, one dimension successfully used being about one-fourth inch. The length of central lamination 30 projecting beyond the stack forming pole piece 26 is unimportant within wide limits. In the construction previously referred to as an example, central lamination 30 projected about one-eighth of an inch.

Cooperating with the bottom of casing 21 and with the pole piece to maintain the same in position is moulded shoe 32 of any suitable material. Thus, shoe 32 may be of the same material as cylinder 10, as one example. The shoe may be fastened to casing 21 in any desired manner and has the bottom thereof shaped to provide a series of grooves adapted to conform to the sound and barrier tracks. Thus, as shown, shoe 32 would have two series of grooves 33 and 34 respectively. Grooves 33 are adapted to cooperate with wire 17, while grooves 34 are adapted to cooperate with wire 16. Shoe 32 is moulded to interfit with pole piece 26 and to maintain the same snugly in position. Shoe 32 has channel 35 into which pole tip 28 extends. Channel 35 coincides with one of series 33 of the grooves, preferably the center. Thus, the shoe will tend to adjust itself as shown in Figure 3 with pole tip 28 disposed in close proximity to wire 17, which, in this particular instance, may be the sound track. It is understood that, if wire 16 is the sound track, then channel 35 will be located so that pole tip 28 is disposed opposite to wire 16.

Set screw 37 may be provided in shoe 32 for locking the pole piece in desired position. It is understood that shoe 32 is threaded to accommodate set screw 37. Set screw 37 may be of non-magnetic material if desired.

Since the sound and barrier tracks form a double thread on cylinder 10, it is evident that shoe 32 may be considered as a portion of a nut

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having a cooperating double thread. In practise, with the two tracks on different levels, the shoe automatically adjusts itself to the correct position shown in Figure 3. Thus, by rotation of the cylinder with respect to the transducer head, longitudinal movement of the transducer along the cylinder results. The transducer head may be provided with semi-circular bracket 38 normally resting lightly on guide rod 39. When desired, the transducer head may be raised from the cylinder and allowed to rest on guide rod 39. Other guide and support means may be provided, as desired.

Winding 23 will be fed with audio frequency currents from a suitable source for recording purposes. During reproduction, audio frequency potentials will be generated within winding 23. Thus, the winding will be connected to either the output or the input of an amplifier in a manner well known in the art.

It is understood that suitable erasing means for de-magnetizing the sound track may be provided. Such erasing means are well known in the art and may be used.

A cylinder embodying the present invention using stainless steel and Mumetal wire each having a diameter of .005 inch and having 128 sound tracks to the inch or having about 256 wire turns to the inch with a cylinder length of the order of about six inches and an outer diameter of about two and one-half inches has been successfully used with a transducer head provided with a laminated pole piece having the dimensions previously given as an example. A sound track speed of about six inches per second past the pole piece was used, thus making possible a ten-minute recording on a cylinder. Such a cylinder has substantially the same dimensions, when new, of wax cylinders generally available on the market and adapted to be used after shaving.

What is claimed is:

1. A record for use in magnetic recording and reproduction, said record comprising a non-magnetic rigid base member having an outer surface, a one-layer helical bifilar wire winding arranged

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as a covering for said surface, one wire of said bifilar winding consisting of a metal having high magnetic retentivity and the other wire consisting of a metal having low magnetic retentivity, said wires being in magnetic relation to each other throughout their lengths.

2. For use in magnetic recording and reproduction, a record comprising a non-magnetic cylinder and a one-layer bifilar wire winding disposed around the outside of said cylinder to form a pair of helical tracks, said two wires being of metals having high and low magnetic retentivity respectively and being in magnetic relation to each other throughout their lengths to form sound and barrier tracks respectively.

3. The record according to claim 2 wherein one of said wires is crowded between adjacent coils of the other wire so that said one wire forms a helical track at a different level with respect to the axis of the cylinder from the other track.

4. The record according to claim 2 wherein the sound track wire of high magnetic retentivity is crowded between adjacent coils of the barrier track wire of low retentivity with the sound track level being raised higher from the cylinder than the barrier track level.

5. The record according to claim 2 wherein the wire materials are high carbon steel and nickel iron alloy respectively.

6. The record according to claim 2 wherein said wires have a diameter of the order of about .004 inch and are of stainless steel and iron alloy containing a high percentage of nickel.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,167,188	Schaarwachter et al.	July 25, 1939
720,621	Rosenbaum	Feb. 17, 1903