Dec. 6, 1949 G. O. HARM 2,490,053

LEVEL-WIND MECHANISM FOR MAGNETIC RECORDERS

Filed Aug. 22, 1944 3 Sheets-Sheet 1

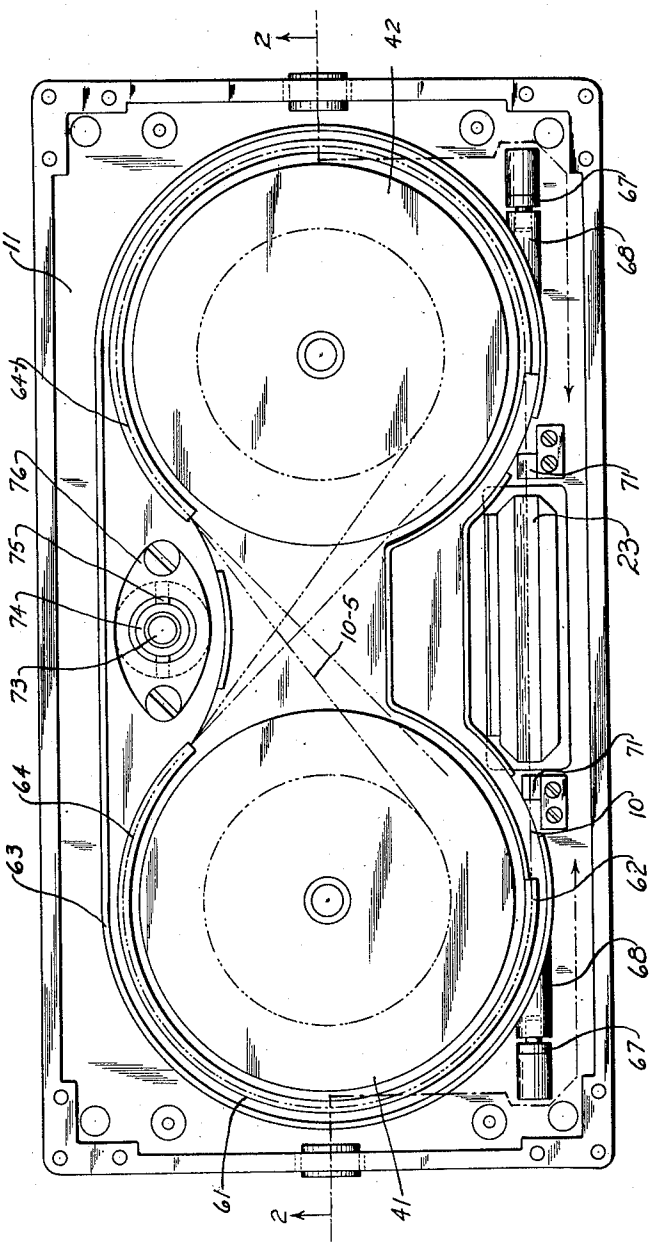


FIG. 1.

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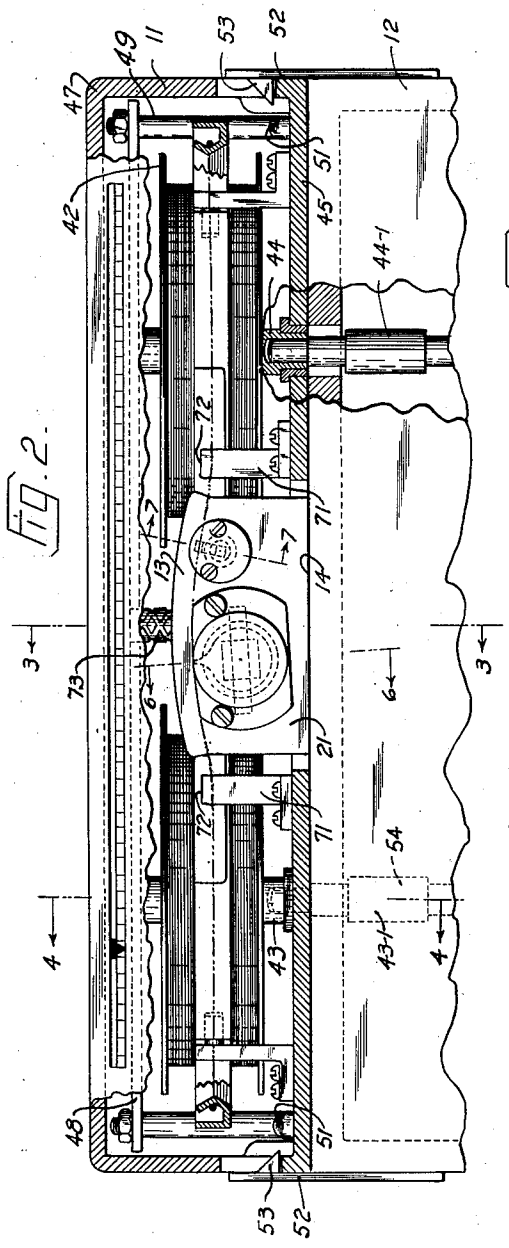


FIG. 2.

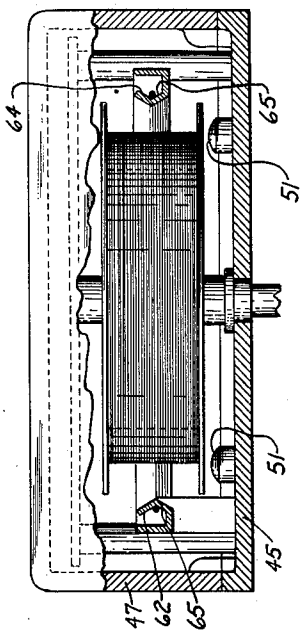


FIG. 4.

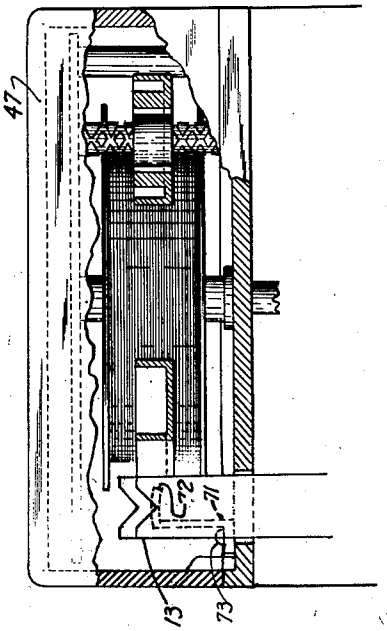


FIG. 3.

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LEVEL-WIND MECHANISM FOR MAGNETIC RECORDERS

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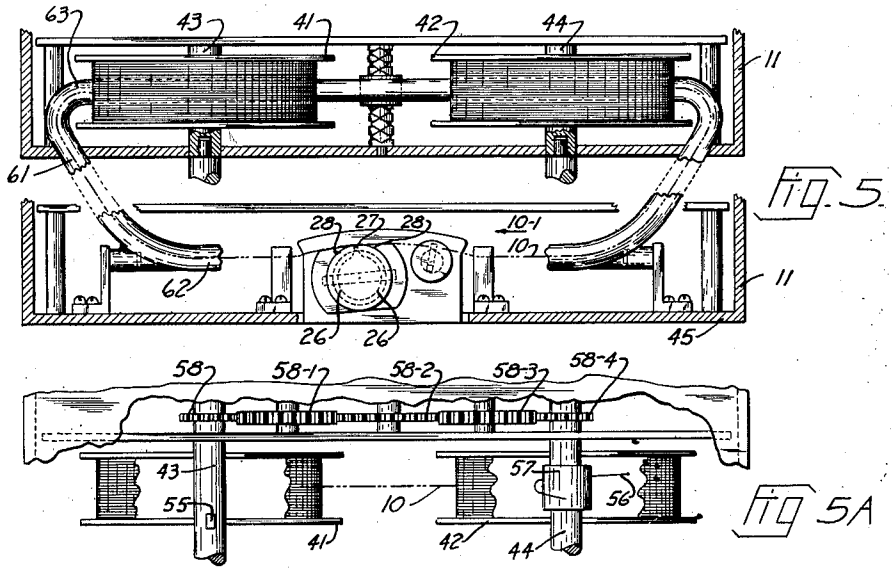


Fig. 5

Fig. 5A

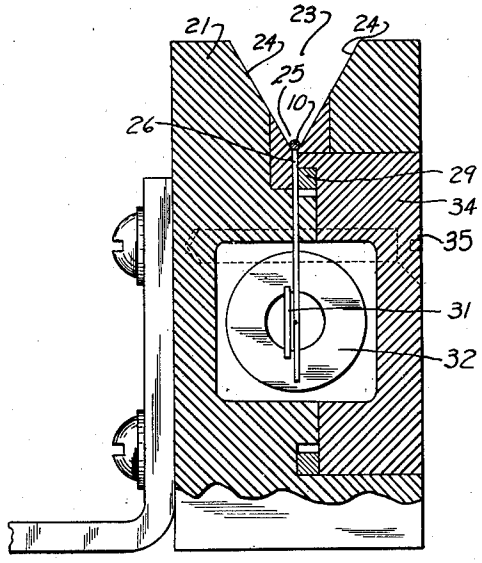


Fig. 6

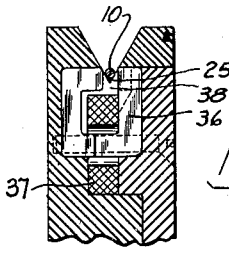


Fig. 7

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2,490,053

LEVEL-WIND MECHANISM FOR MAGNETIC RECORDERS

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Application August 22, 1944, Serial No. 550,510

6 Claims. (Cl. 179—100.2)

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This invention relates to magnetic recording and reproducing apparatus, and more particularly to apparatus utilizing a spirally-wound magnetic signal carrier, such as a tape or wire, for recording and reproducing signals.

Among the objects of the invention are novel magnetic recording and reproducing devices of the foregoing type which overcome critical difficulties heretofore encountered with such devices and which render their operation more foolproof and reliable.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawings wherein

Fig. 1 is a top view showing in a general manner a recording-reproducing device exemplifying the invention, with the cover wall removed;

Fig. 2 is a vertical cross-sectional view of the device shown in Fig. 1, along line 2—2 of Fig. 1;

Figs. 3 and 4 are cross-sectional views along lines 3—3 and 4—4 of Fig. 2;

Fig. 5 is a partially-exploded diagrammatic view illustrating the general cooperative relationship of some of the elements of the device shown in Figs. 1 to 4;

Fig. 5A is a diagrammatic view illustrating the reel mounting;

Fig. 6 is a cross-sectional view of the magnetic head along line 6—6 of Fig. 2; and

Fig. 7 is a cross-sectional view of the magnetic transducer head along line 7—7 of Fig. 2.

The drawings show an exemplification of the invention as applied to a magnetic record track formed of a thin magnetic spirally-wound wire-like filament 10 which is stored, guided and impelled in its proper operating condition within a self-supporting detachable guide unit 11 designed for detachable interconnection with a driving or motor unit 12 which supplies the mechanical power required for impelling the magnetic signal carrier past a magnetic transducer head 13, the motor unit serving also to house the amplifier and the control elements for controlling the recording and reproducing operations. The magnetic head 13 is of a special construction and will now be described in connection with Figs. 1 to 3 and 5 to 8.

It comprises a substantially rigid block-like

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guide wall structure 21 which is shown suitably held on the top wall 14 of the motor unit 12. The upwardly projecting relatively narrow and elongated side of the guide wall structure 21 is arranged to form an outwardly opening elongated guide channel structure 23 having two winglike channel walls provided with outwardly tapering guide surfaces 24 extending from an elongated narrow channel track 25 forming the deepest region of the channel structure 23. The elongated narrow channel track 25 has a width of the order of the thickness of the wire filament 10 and is so designed as to serve as a positive elongated guide surface which engagingly supports and guides a substantial length of the recording filament 10 as it moves through the transducing head 13.

The outwardly tapered guide surfaces 24 of the channel structure are so designed that a tensioned filament length which is biased toward the channel structure is automatically guided by the guide surfaces into positive guiding engagement with the long narrow channel track 25 forming the deepest part of the channel structure. The taper of the guide surfaces 24 is so designed and correlated to the shape of the narrow channel track as to cause a thickened filament element, such as a tie-knot joining two filament ends, to be lifted outwardly from the narrow channel track 25 and cause it to ride along outward regions of the tapered deflecting surfaces 24 while moving through the transducer head 13. In addition, the taper of the guide surfaces 24 is such that they present to a wire protrusion deflected thereby a support which prevents forces exerted by the tensioned moving wire from wedging the wire protrusion within the narrow inward region of the channel.

Within the transducer head structure 21 is mounted a magnetic core structure having two relatively thin pole pieces 26 of highly permeable magnetic sheet material which are longitudinally alined in a plane on the opposite sides of a narrow magnetic gap 27, the dimensions of which are shown exaggerated for the sake of clarity, but which is only about .001 inch. The two aligned pole pieces 26 are so held clamped within the blocklike structure 21 of the magnetic head 13 as to expose along an intermediate portion of the channel structure the two narrow pole faces

28 bordering the narrow gap 27 for tangentially engaging a wire filament guided in positive engagement along the channel track 25 of the transducer head.

The two pole pieces 26 are shown united to a common mounting ring 29 and are arranged to complete a magnetic circuit with a yoke member 31 of highly permeable magnetic material which is surrounded by a transducer winding coil 32. The wall structure 21 has formed therein a laterally-facing generally-circular cavity exposing in the interior a surface shaped for receiving and holding in a properly aligned operating position the double-pole-piece unit with the two pole pieces as well as the yoke member 31 with its transducing coil 32 in the manner indicated in Fig. 6.

The double-pole-piece unit associated with the mounting ring 29 of the transducer head is shown held in its proper operative position within the cavity of the wall structure 21 by a cover member 34 which is affixed to the wall structure as by two screws 35. The magnetic head 13 is also equipped with electromagnetic obliterating means of obliterating all previous magnetic records on each element of the signal carrier filament moving toward the gap region 27 of the two transducer head pole pieces 26.

The obliterating means are shown formed of a substantially closed magnetic core structure 36 and a winding coil 37 surrounding the core. One side of the core structure 36 is provided with a gap region 38 crossing a portion of the channel track 25 so that each element of the signal carrier filament 10 moving in the direction of the arrow 10—1 has to pass through the gap region 38 of the obliterating core structure 36 on which all the previous magnetic recordings are obliterated before each element of the signal carrier is brought to the gap region of the transducer head pole pieces 26. The obliterating core structure 36 and its winding 37 are so designed that when the winding is excited by suitable obliterating current, either A. C. or D. C., a strong obliterating flux will be produced in the gap region 38 of a magnitude sufficient to obliterate all previous magnetic records on each signal carrier element passing therethrough and bring it to a uniform condition.

The wire 10 is shown stored in spirally-coiled form on two reels 41, 42 which are shown mounted on two revolvably mounted shafts 43, 44 which are revolvably supported in the detachable guide unit 11. The guide unit comprises a holder structure formed of a casing having a lower casing wall member 45 and an upper casing wall member 47 suitably secured to each other as by screws, not shown, extending through suitably thickened wall portions of the casing. A mounting wall 48 or plate is supported at a suitable level above the lower casing wall member 45 and secured thereto, as by four spacer rods 49, the ends of which are suitably fastened, as by rivet and screw joints, to the two wall members 45, 48.

The two ends of each of the two reel shafts 43, 44 are rotatably mounted in bearing members, such as Oilite-type, self-lubricating bearing members, suitably held in holes of the bottom wall 45 and the mounting wall 48.

The reel holder unit is designed for easy detachable coupling in the properly aligned position to the separate motor unit. The motor unit 12 is shown provided along its upwardly facing coupling wall 14 with two aligning pins 51 interfitting with corresponding aligning holes formed in the bottom wall 45 of the reel holder structure. The reel holder is automatically locked in the aligned coupled position by two spring arm latches 52 suitably secured to the side walls of the motor unit 12 and having latch projections 53 which overlie and interlockingly engage underlying edge portions of the bottom wall which are exposed through cutouts provided in the end walls of the casing structure 47. The upper face of each latch projection 53 is tapered so that when the reel holder is pushed downwardly into its aligned position on the motor unit, the two latches 52 are pushed outwardly and then automatically returned by their spring arms to their inward latched position when the guide unit is brought to its downward coupled position shown in Figs. 2 to 4.

The motor unit is provided with two reel driving shafts 43—1, 44—1 suitably mounted therein so that when the reel holder 11 is placed in its aligned coupled position on the motor unit 12, the two motor shafts 43—1, 44—1 established automatic coupling connection with the two reel shafts 43, 44, respectively.

The intercoupling portions of the lower ends of the reel shafts 43, 44 and the upper ends of the driving shafts 43—1, 44—1, are of the self-centering type. The driving shafts 43—1, 44—1 are designed to embody sufficient self-restoring yieldability so as to assure that when the reel holder unit 11 is coupled to the motor unit 12 the cooperating shaft ends 43, 43—1, 44, 44—1 are automatically centered and brought into coupling engagement. In the arrangement shown, the upper ends of each driving shaft 43—1, 44—1 are connected to the main body of the shaft through an elastically yieldable member, such as a bellows-like metal sleeve 54 and the upper end of each driving shaft is provided with a grooved or splined periphery and a pointed tip so as to enter and establish positive coupling engagement between its grooved exterior and the corresponding grooved interior hole formed on the lower ends of the two reel shafts 43, 44.

The two ends of the coiled wire are suitably fastened to the inner cores of the two reels 41, 42 and the guide arrangement is of such character as to assure that the length of wire passing through the transducing head 13 is at all times under tension. In Fig. 5A is shown one simple manner for assuring that the wire is at all times under tension.

As shown, one of the reels, namely, in the arrangement shown, reel 41, which is intended to be rotated clockwise for winding thereon the wire during a recording or reproducing operation, is shown affixed to its shaft 43 as by a key 55, the other reel 42 being interconnected to the shaft through elastically yieldable energy storing means in the form of a spirally-coiled spring 56 interconnected between the core of the reel 42 and a collar 57 of the shaft 44.

The two reels are mechanically connected to each other not only by the length of wire 10 extending between the two reels but also by an additional positive motion-transmitting means indicated in Fig. 5A by a series of interengaging, rotatably-mounted gears 58, 58—1, 58—2, 58—3, 58—4, which, as indicated in Fig. 5A, may be housed in the compartment of the cover wall 47.

A spirally-wound flat spring of the type used in alarm clocks, but of non-magnetic metal, may be used as the biasing spring 56 and it is so designed that when the entire length of the wire, except for the end anchored on reel 41, is wound

on the reel 42, the spring 56 will have a sufficient initial tension to maintain the wire under predetermined minimum tension; and that the spring shall have sufficient energy-storing capacity and permit sufficient coiling upon itself as to make it possible for the reel 42 to turn at a slightly different speed than reel 41 as the wire is wound on reel 41 and the successive layers of wire wound thereon cause it to move with increasing peripheral velocity and cause the reel 42 from which the wire is being unwound to turn at increasing speeds.

In order to properly record with a wire stored in spirally-coiled form on the reels, it is essential that the wire is properly distributed in level layers while it is being wound on one reel from the other. In accordance with the invention, the up-and-down oscillatory motion is imparted to the wire as it is being wound from one reel to the other by a special level-winding structure which is shown formed by a substantially rigid channel frame member 61 having one side 62 lonigtudinally aligned on the side of the two reels along which the magnetic head 13 is located, the other side 63 of the channel structure 61 being provided with two channel sections 64, 64—1 of a cross-section indicated in Fig. 4 providing an outwardly facing guide channel track 65 along which the length of wire 10—5 leading, for instance, from reel 41, is guided first over the arcuate channel track of the channel section 64—1 toward the channel track 25 of the transducer head and led therefrom over the channel track 65 of the channel section 64 to the spool body of reel 42.

The channel structure is shown pivotally mounted, as by pivot brackets 67 secured to the bottom wall 45 of the holder structure engaging pivot protrusions 68 of the channel structure which are so arranged that the channel track portion 65 extending along the side of the channel structure aligned opposite the transducer head guides the wire and passes it toward the bottom region of the deepest channel track region 25 of the wing-like transducer head structure.

In order to assure that the wire is subjected at all times to the biasing action in the direction into engagement with the channel track 25 of the transducer head, there are also shown provided two additional biasing arms 71 having a downwardly facing channel portion 72 engaging the upper side of portions of the wire 10 moving away and toward the channel track 25 of the transducer head in the manner indicated in Fig. 3, the two arms 71 being suitably secured, as by screws 73, to the bottom wall 45 of the holder structure.

The pivot supports 67 for the level-winding structure 61 are so arranged as to make it possible to oscillate its side 63 up and down for causing the wire to be distributed helically, layer upon layer, while assuring that the portion of the wire which moves past the transducing head is not disturbed by the oscillatory motion by reason of the fact that a long portion of the moving wire is engaging the channel tracks 65 of the level-winding channel structure on the way toward and away from the transducer head.

The up-and-down oscillatory motion around the pivots 67 is shown imparted to the level-winding structure 61 by an endless screw 73 having its ends suitably journalled in the bottom wall member 45 and the mounting plate 48 of the holder structure, the threads of the level-winding screw serving to impart an oscillatory up-and-down motion to a claw nut 74 which is

shown flexibly connected, as by pivot pins 75 and a mounting bracket 76, with the side 63 of the level-winding structure 61 extending on the side opposite the side on which it is pivotally supported.

As shown in Figs. 1 and 3, the mounting bracket 76 is suitably affixed over an opening in the wall portion of the side 63 of the level-winding structure 61 and the upper end of the level-winding screw 73 is driven at a suitably reduced speed by a reduction gearing located in the compartment enclosed by the cover wall 47 so that the oscillatory wire leveling operation is suitably correlated to the rate at which the wire is wound on one or the other of the reels. The features involving the combination of a detachable reel holder unit designed for cooperation with a drive unit on which the magnetic transducer head is supported and arranged so that when the reel holder unit is coupled to the motor unit the magnetic record track is automatically brought into operative engagement with the transducer head, are not part of the present invention but are claimed in the application of S. J. Begun, Ser. No. 550,572 filed August 22, 1944, now abandoned. The magnetic recording devices described herein to exemplify a form of the present invention embody various other inventive features which are claimed in applications Ser. No. 550,571 filed August 22, 1944, Serial No. 687,046 filed July 30, 1946 and Serial No. 688,738 filed August 6, 1946, all assigned to the assignee of the present application.

It will be apparent to those skilled in the art that the novel principles of the invention disclosed herein in connection with specific exemplifications thereof will suggest various other modifications and applications of the same. It is accordingly desired that in construing the breadth of the appended claims they shall not be limited to the specific exemplifications of the invention described herein.

I claim:

1. In a magnetic record transducing arrangement for transducing magnetic records, such as recording or reproducing magnetic signals, by magnetic flux interlinkage between a track element of a moving magnetic record track and a relatively fixed magnetic record transducer head including windings carrying electric signals corresponding to the magnetic records: two revolvably mounted reels and a record track arranged to form two coils held on said two reels and an intermediate track portion extending between said coils so that when said track is wound on one reel it is unwound from the other reel; said reels forming part of storing means including guide means and impelling means for guiding and impelling an intermediate track portion of said record track extending between said reels along a predetermined path past said transducer head; said guide means including a guide structure engaging and guiding said intermediate track portion and holding a portion thereof passing through said transducer head at a substantially fixed level relatively to the pole faces of said transducer head; and means for imparting to a portion of said guide structure reciprocatory movement for causing it to level wind the record track on the reel on which it is being reeled; said guide structure including a unitary relatively rigid member comprising unitary spaced guide portions engaged by portions of the track leading from each of said two reels, for holding a section

of the intermediate track portion exposed for engagement with the transducing head.

2. In a magnetic record transducing arrangement for transducing magnetic records, such as recording or reproducing magnetic signals, by magnetic flux interlinkage between a track element of a moving magnetic record track and a relatively fixed magnetic transducer head including windings carrying electric signals corresponding to the magnetic records: two laterally-spaced revolvably-mounted reels and a record track arranged to form two coils held on said two reels and an intermediate track portion extending between said coils so that when said track is wound on one reel it is unwound from the other reel; said reels forming part of storing means including guide means and impelling means for guiding and impelling an intermediate track portion of said record track along a predetermined path past said signal transducer structure; said guide means including a guide structure engaging and guiding said intermediate track portion and holding a portion thereof passing through said transducer head in a substantially fixed position relatively to the pole faces of said magnetic transducer head; and means for imparting to a portion of said guide structure reciprocatory movement for causing it to level wind the record track on which it is being reeled; said guide structure including a unitary relatively rigid guide member mounted for pivotal movement about an axis generally parallel to a plane through the axes of the two reels and having spaced guide portions engaged by portions of the track leading from each of said two reels, said guide portions holding a section of the intermediate track portion exposed for an engagement with a transducing head.

3. In a magnetic record transducing arrangement for transducing magnetic records, such as recording or reproducing magnetic signals, by magnetic flux interlinkage between a track element of a moving magnetic record track and a relatively fixed magnetic record transducer head including windings carrying electric signals corresponding to the magnetic records: two revolvably mounted reels and a record track arranged to form two coils held on said two reels and an intermediate track portion extending between said coils so that when said track is wound on one reel it is unwound from the other reel; said reels forming part of storing means including guide means and impelling means for guiding and impelling an intermediate track portion of said record track extending between said reels along a predetermined path past said transducer head; said guide means including a guide structure engaging and guiding said intermediate track portion and holding a portion thereof passing through said transducer head at a substantially fixed level relatively to the pole faces of said transducer head; and means for imparting to a portion of said guide structure reciprocatory movement for causing it to level wind the record track on the reel on which it is being reeled; said guide structure including a substantially rigid guide member for guiding a length of said record track around the circumference of at least one of said reels.

4. In a magnetic record transducing arrangement for transducing magnetic records, such as recording or reproducing magnetic signals, by magnetic flux interlinkage between a track element of a moving magnetic record track and a relatively fixed magnetic record transducer head

including windings carrying electric signals corresponding to the magnetic records: two revolvably mounted reels and a record track arranged to form two coils held on said two reels and an intermediate track portion extending between said coils so that when said track is wound on one reel it is unwound from the other reel; said reels forming part of storing means including guide means and impelling means for guiding and impelling an intermediate track portion of said record track extending between said reels along a predetermined path past said transducer head; said guide means including a guide structure engaging and guiding said intermediate track portion and holding a portion thereof passing through said transducer head at a substantially fixed level relatively to the pole faces of said transducer head; and means for imparting to a portion of said guide structure reciprocatory movement for causing it to level wind the record track on the reel on which it is being reeled; said guide structure including substantially rigid guide member elements for guiding portions of said record track around the circumference of said two reels.

5. In a magnetic record transducing arrangement for transducing magnetic records, such as recording or reproducing magnetic signals, by magnetic flux interlinkage between a track element of a moving magnetic record track and a relatively fixed magnetic transducer head including windings carrying electric signals corresponding to the magnetic records: two laterally-spaced revolvably mounted reels and a record track arranged to form two coils held on said two reels and an intermediate track portion extending between said coils so that when said track is wound on one reel it is unwound from the other reel; said reels forming part of storing means including guide means and impelling means for guiding and impelling an intermediate track portion of said record track along a predetermined path past said signal transducer structure; and guide means including a guide structure engaging and guiding said intermediate track portion and holding a portion thereof passing through said transducer head in a substantially fixed position relatively to the pole faces of said magnetic transducer head; and means for imparting to a portion of said guide structure reciprocatory movement for causing it to level wind the record track on the reel on which it is being reeled; said guide structure including a substantially rigid guide member for guiding a length of said record track around the circumference of at least one of said reels.

6. In a magnetic record transducing arrangement for transducing magnetic records, such as recording or reproducing magnetic signals, by magnetic flux interlinkage between a track element of a moving magnetic record track and a relatively fixed magnetic transducer head including windings carrying electric signals corresponding to the magnetic records: two laterally-spaced revolvably mounted reels and a record track arranged to form two coils held on said two reels and an intermediate track portion extending between said coils so that when said track is wound on one reel it is unwound from the other reel; said reels forming part of storing means including guide means and impelling means for guiding and impelling an intermediate track portion of said record track along a predetermined path past said signal transducer structure; said guide means including a guide structure engaging and guiding said intermediate track portion

and holding a portion thereof passing through said transducer head in a substantially fixed position relatively to the pole faces of said magnetic transducer head; and means for imparting to a portion of said guide structure reciprocatory movement for causing it to level wind the record track on the reel on which it is being reeled; said guide structure including substantially rigid guide member elements for guiding portions of said record track around the circumference of said two reels.

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