

Dec. 13, 1949

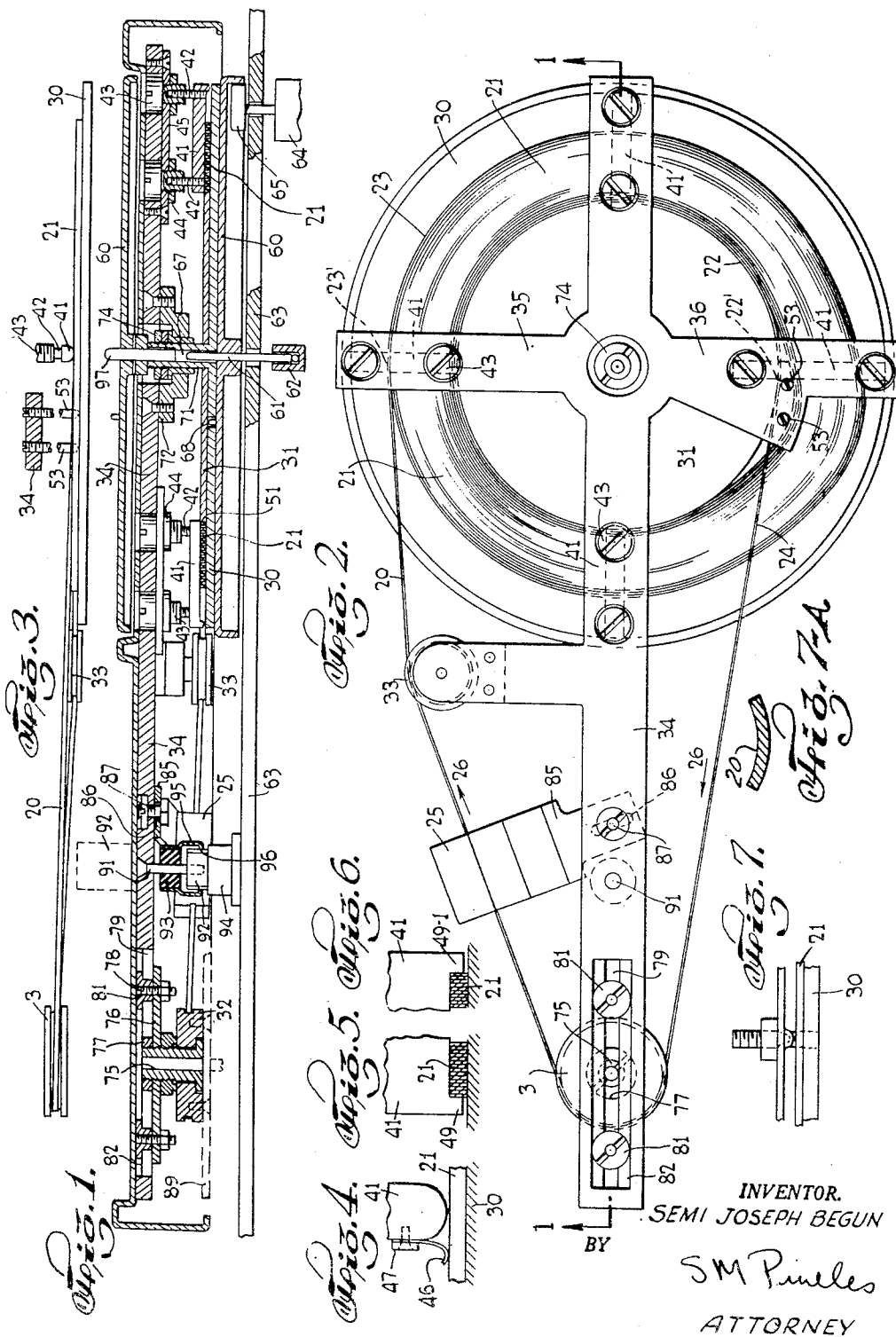
S. J. BEGUN

2,490,771

MAGNETIC RECORDING AND REPRODUCING APPARATUS USING
AN ENDLESS SPIRALLY WOUND MAGNETIC TAPE

Filed Sept. 6, 1945

8 Sheets-Sheet 1

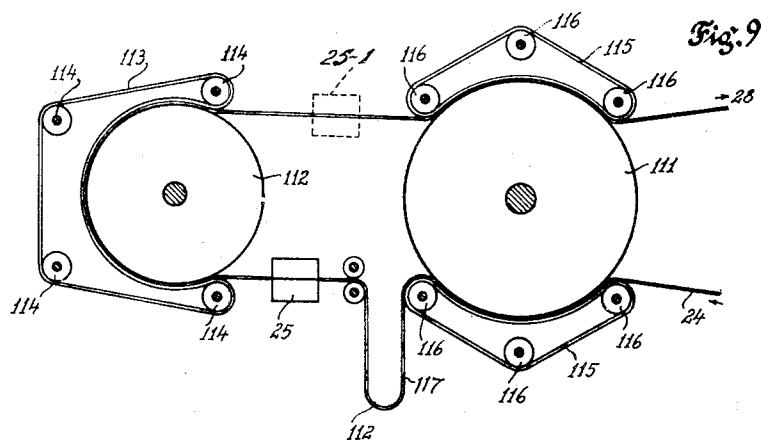
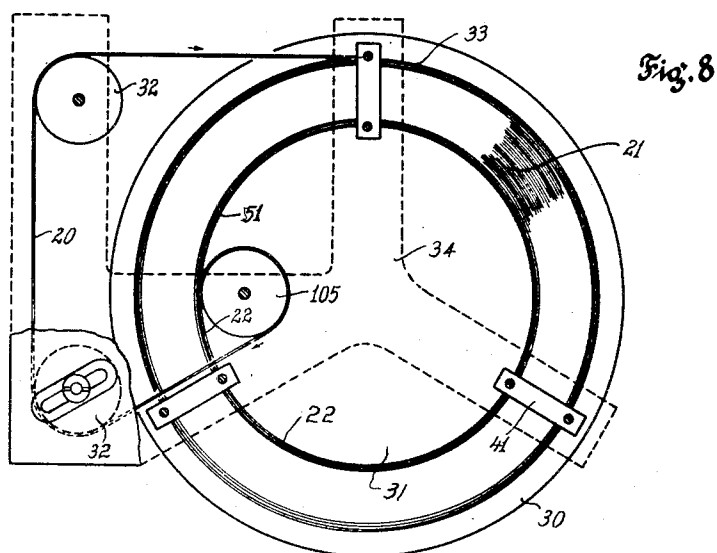


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MAGNETIC RECORDING AND REPRODUCING APPARATUS USING
AN ENDLESS SPIRALLY WOUND MAGNETIC TAPE
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AN ENDLESS SPIRALLY WOUND MAGNETIC TAPE
1945

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Fig. 10

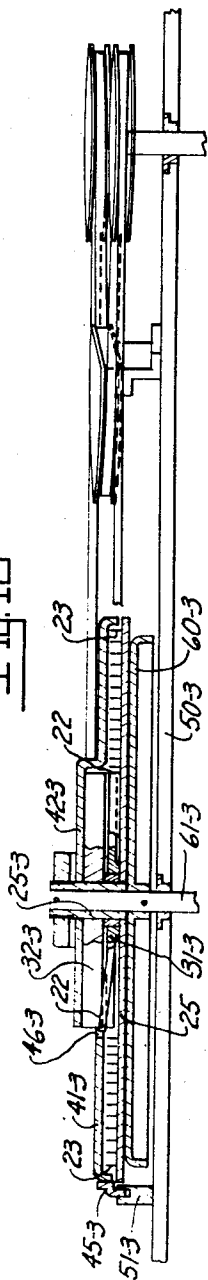


Fig. 11

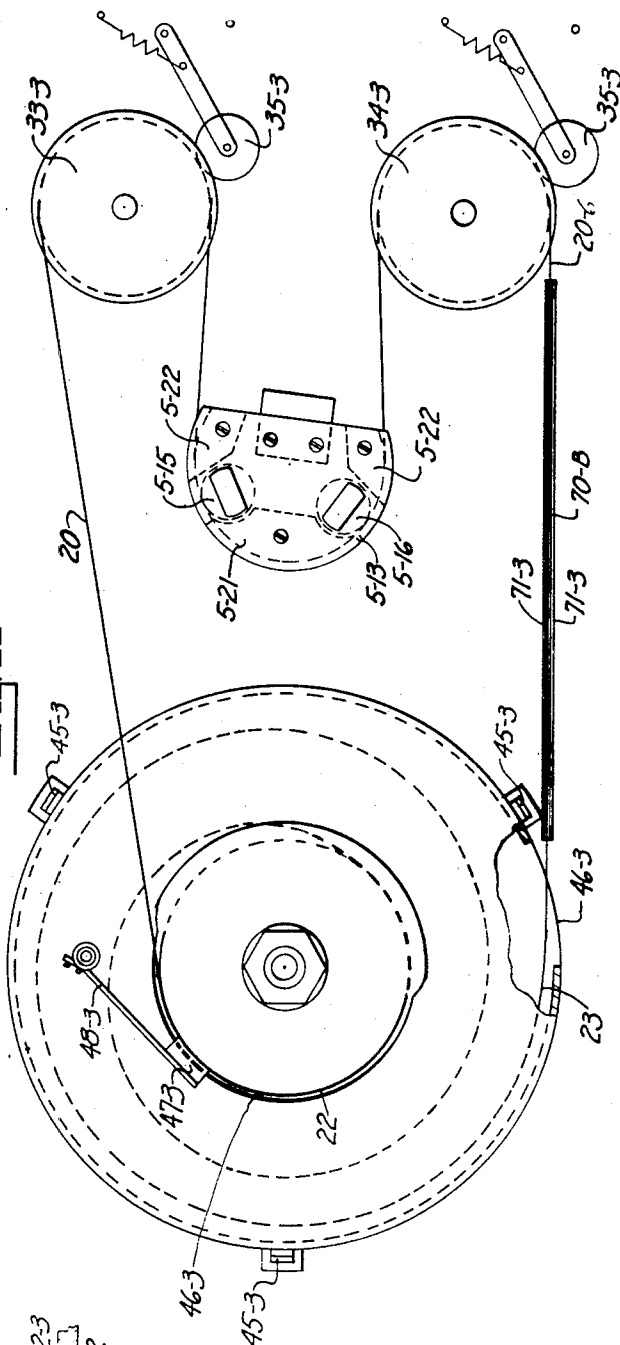
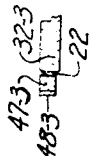


Fig. 10-A



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Fig. 12.

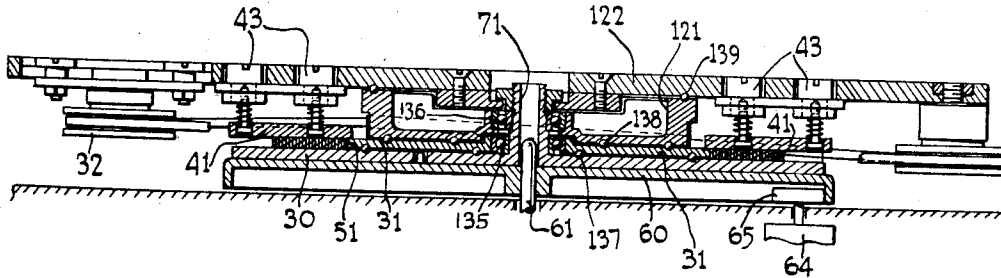


Fig. 14.

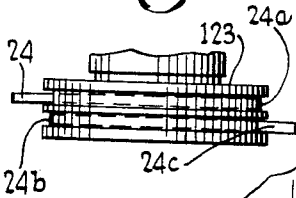
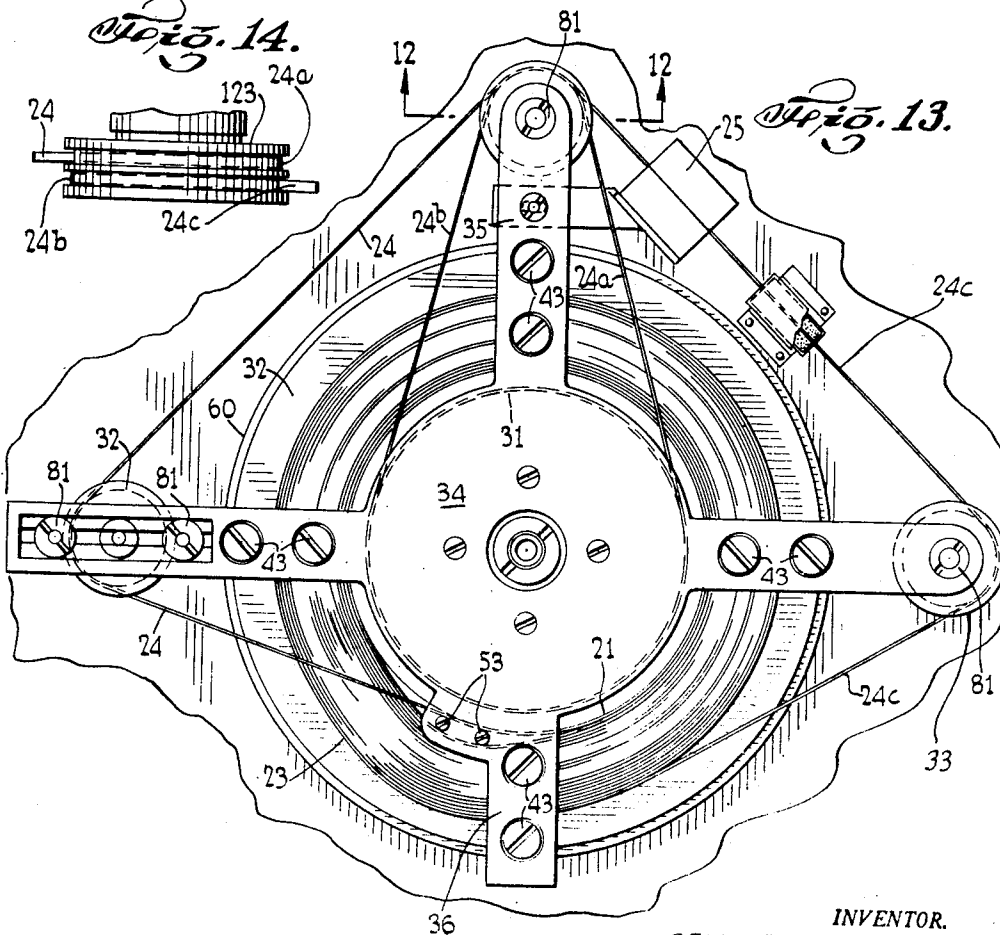


Fig. 13.



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Fig. 15.

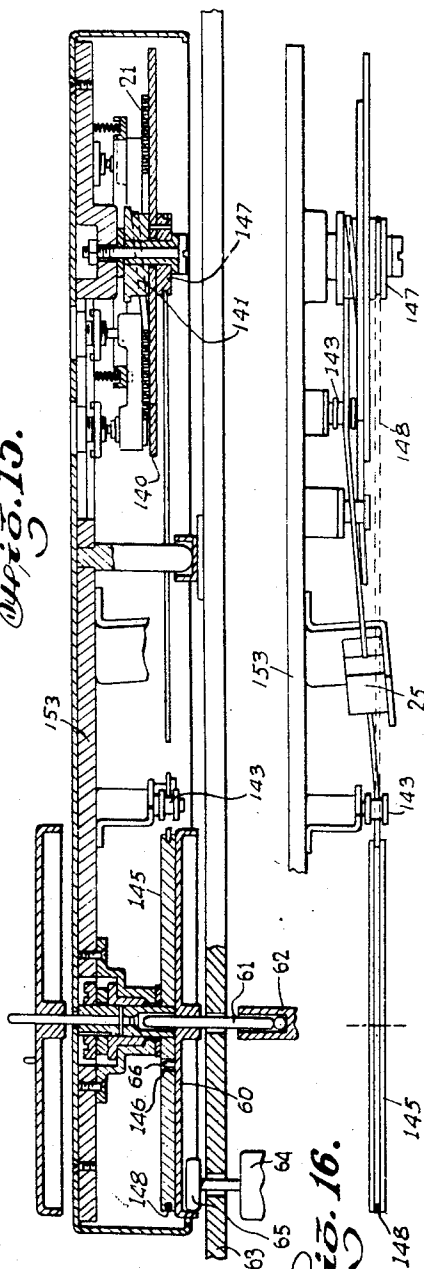


Fig. 16.

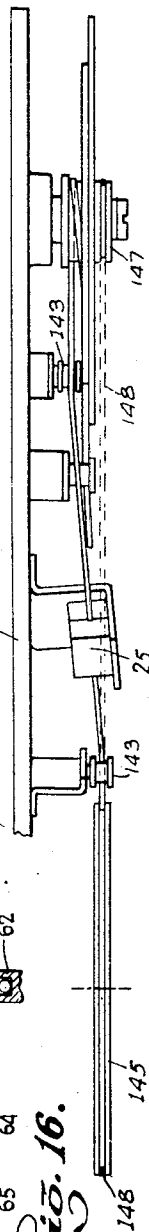
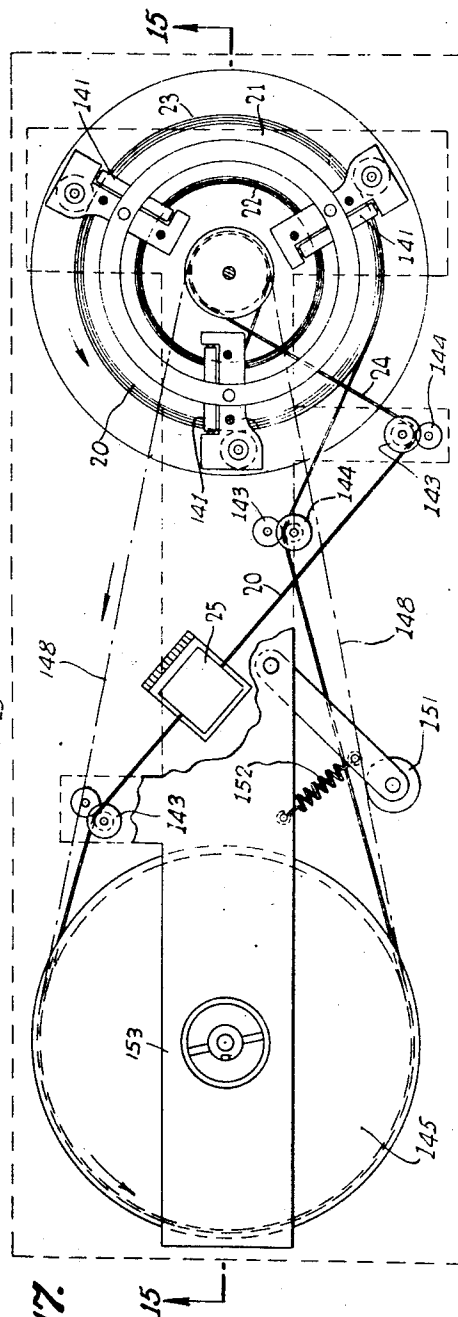


Fig. 17.



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Fig. 18.

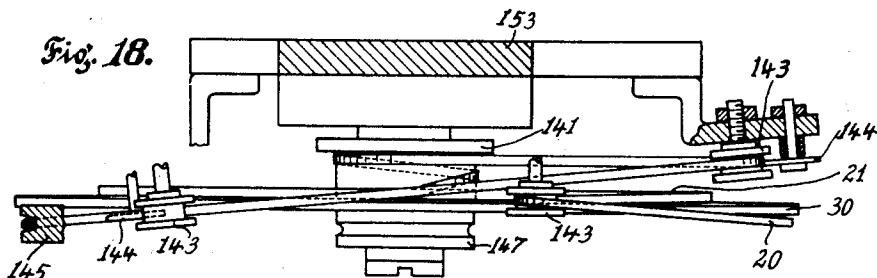


Fig. 19.

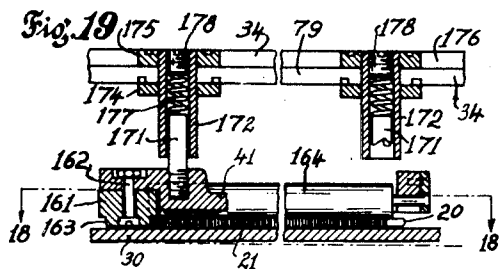


Fig. 21.

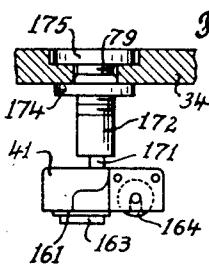


Fig. 20.

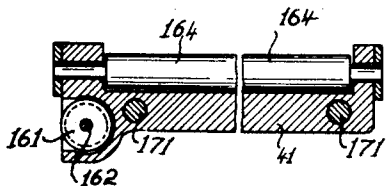


Fig. 22.

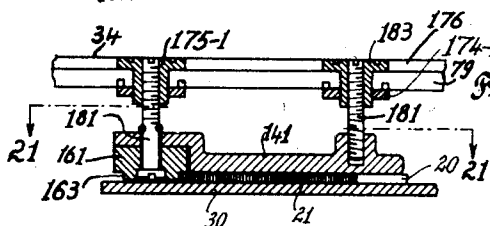
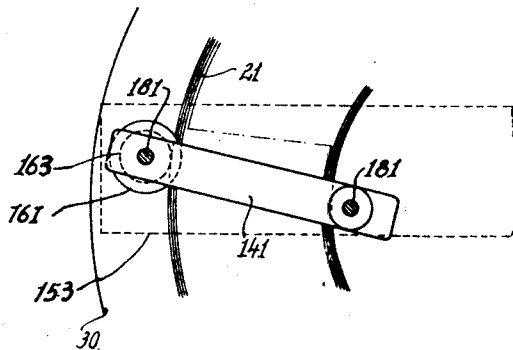


Fig. 23.



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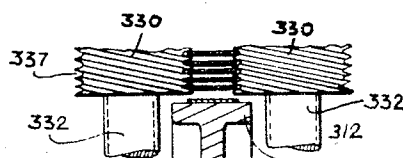
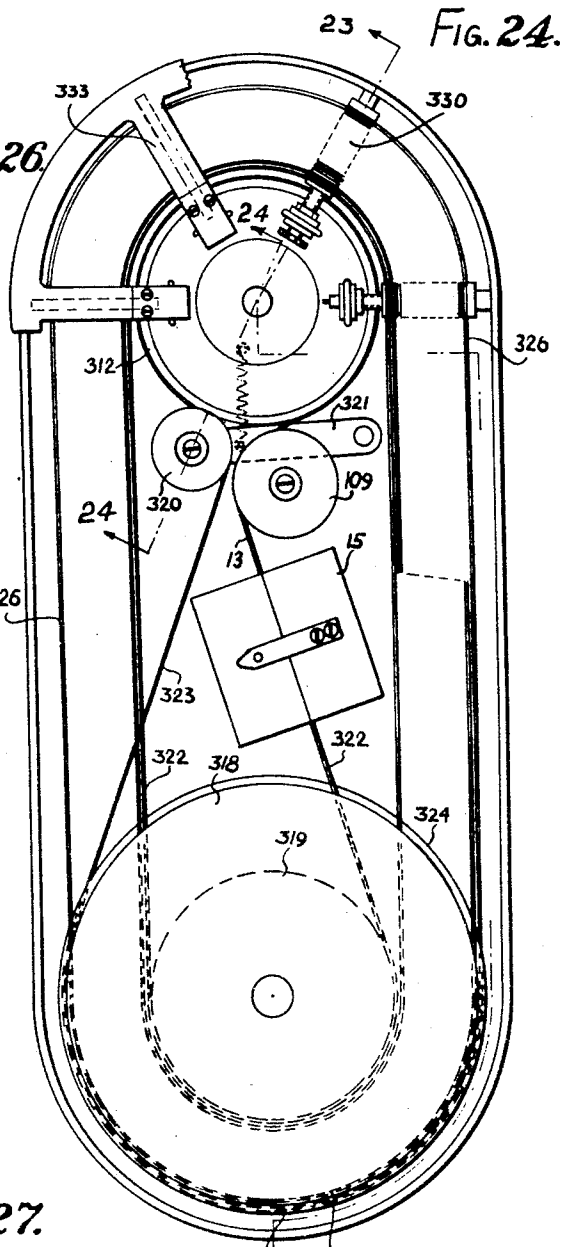
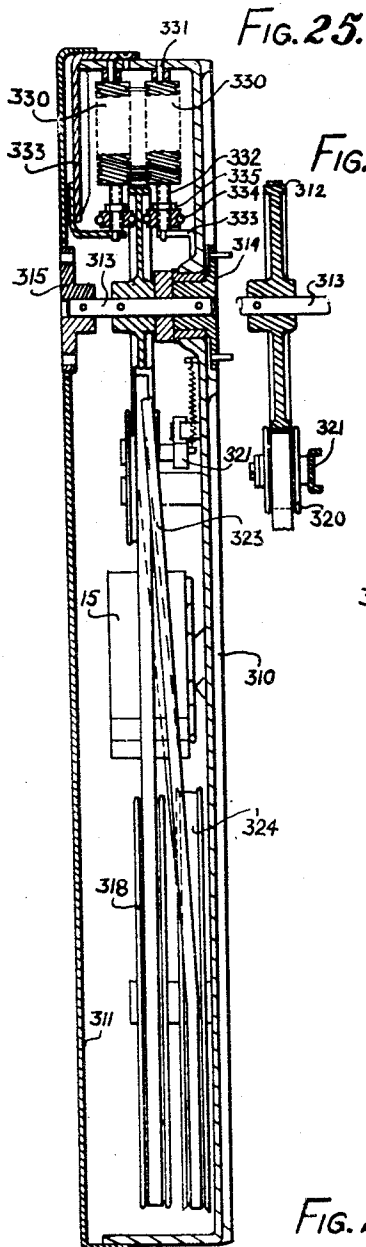
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MAGNETIC RECORDING AND REPRODUCING APPARATUS USING
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Fig. 28.

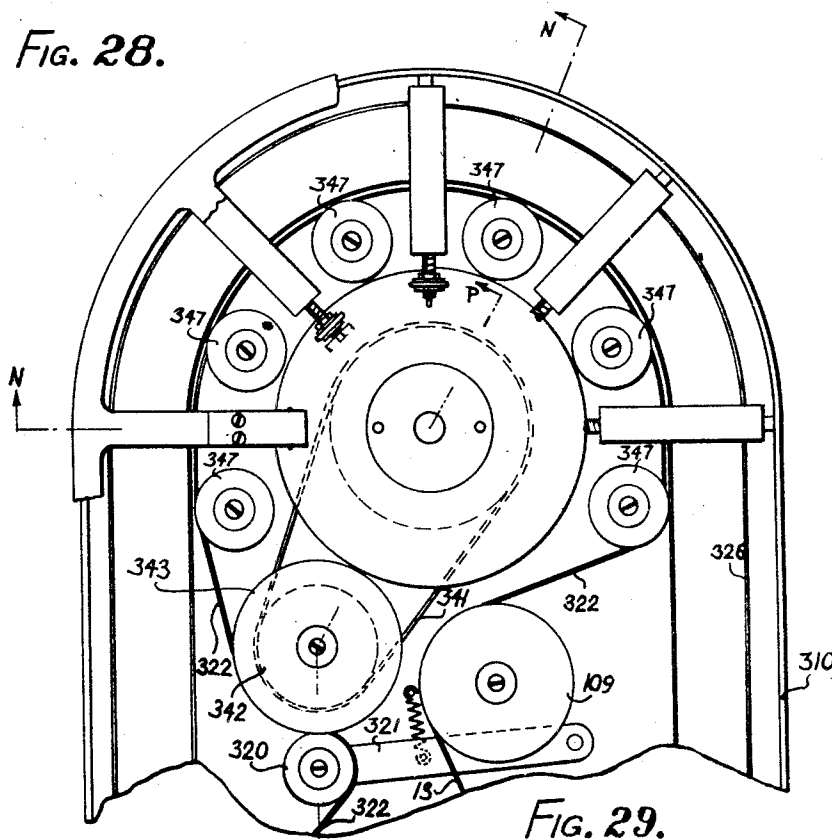


Fig. 29.

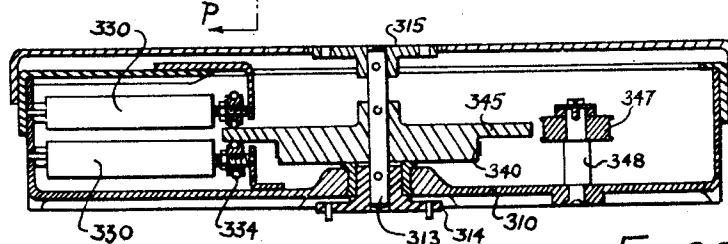
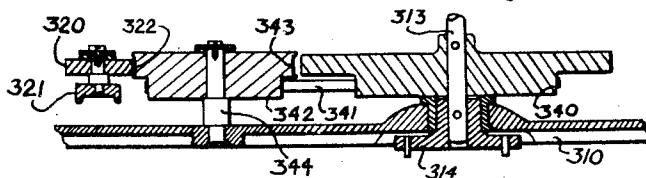


Fig. 30.



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UNITED STATES PATENT OFFICE

2,490,771

MAGNETIC RECORDING AND REPRODUCING APPARATUS USING AN ENDLESS SPIRALLY WOUND MAGNETIC TAPE

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Application September 6, 1945, Serial No. 614,709

20 Claims. (Cl. 179—100.2)

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This invention relates to magnetic recording and reproducing devices, and more particularly to such devices utilizing an endless spirally wound magnetic tape coil as a recording medium.

Among the objects of the invention is a novel magnetic recording device of the foregoing type, which is free from the difficulties inherent in all prior endless spiral coil magnetic tape recording devices, as well as various other improvements in magnetic recording devices. A distinct important phase of the invention involves a magnetic recording device of the foregoing type in which the endless tape coil is combined with a detachable holder unit arranged for detachable coupling interconnection with a separate drive unit, such as a turn-table drive of a standard phonograph.

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 vertical sectional view illustrating a magnetic tape recording device exemplifying one form of the invention;

Fig. 2 is a plan view of the principal elements of Fig. 1;

Fig. 3 is a front view of some of the elements of Fig. 1;

Fig. 4 is an end view of one of the guide members of Fig. 1;

Figs. 5 and 6 are side views of different modifications of the guide member of Fig. 4;

Fig. 7 is a portion of the coil guide structure of the type shown in Fig. 1;

Fig. 7A is a cross-sectional view of a metallic magnetic record tape;

Fig. 8 is a plan view similar to Fig. 2 illustrating a modified form of device exemplifying the invention;

Fig. 9 is a view similar to Fig. 2 illustrating a modified form of some of the elements of a device, such as shown in Fig. 1;

Fig. 10 is a partially cross-sectional and partially elevational view of another form of endless tape coil recording device exemplifying the invention;

Fig. 10A is a cross-sectional view along line 10A—10A of Fig. 11;

Fig. 11 is a top view of the device of Fig. 10;

Fig. 12 is a vertical sectional view illustrating another form of magnetic tape recording device exemplifying the invention;

Fig. 13 is a plan view of some of the elements of Fig. 12;

Fig. 14 is an elevational view of one of the aligning rollers along line 14—14 of Fig. 13;

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Fig. 15 is a view similar to Fig. 1 illustrating another form of magnetic recording device exemplifying the invention;

Fig. 16 is a front view of some of the elements of Fig. 15;

Fig. 17 is a plan view of some of the elements of Fig. 15;

Fig. 18 is an end view of some of the elements of Fig. 15;

Fig. 19 is a cross-sectional view illustrating a guide structure element;

Fig. 20 is a cross-sectional view along line 20—20 of Fig. 19;

Fig. 21 is a cross-sectional view along line 21—21 of Fig. 19;

Fig. 22 is a view similar to Fig. 19 of a modified form of guide member arrangement;

Fig. 23 is a plan view of the guide member of Fig. 22 and its relation to the cooperating elements;

Fig. 24 is a plan view of another form of recording device exemplifying the invention, with its cover removed;

Fig. 25 is a cross-sectional view along line 25—25 of Fig. 24;

Fig. 26 is a detailed cross-sectional view of some of the elements of Fig. 24 along line 26—26 thereof;

Fig. 27 is a detailed sectional view of some of the elements of the device shown in Figs. 24 and 25;

Fig. 28 is a view similar to Fig. 24 of a modified form of recording device of the type shown in Fig. 24;

Fig. 29 is a cross-sectional view along line 29—29 of Fig. 28; and

Fig. 30 is a cross-sectional view along line 30—30 of Fig. 28.

Various efforts have been made in the past to provide a commercially practical magnetic sound recording and reproducing device utilizing an endless magnetic signal carrier. One type of such device, in which such endless magnetic sound carrier is wound in the form of an endless helix around a plurality of spaced guide rollers, is now commercially available and finds great appeal among singers, speakers, actors, and students of elocution and foreign languages desiring to hear their voice or speech.

However, although there has been existing an urgent need for a much simpler and more compact endless magnetic tape recording and reproducing arrangement in which the endless magnetic signal carrier tape is wound in the form of a compact spirally wound coil, no commercially

practical arrangement of this type has hereto been available. Such compact spirally coiled endless magnetic tape recording arrangement is particularly desirable for use in connection with devices, such as disc recording and phonograph devices, especially if such endless magnetic tape recording arrangement could be made in the form of readily interchangeable units adapted for operation by the standard drives of conventional turn-tables of disc phonographs or disc recording machines.

An endless magnetic tape recording and reproducing arrangement exemplifying one form of the invention will be described in connection with Figs. 1, 2 and 3.

The endless magnetic signal carrier is formed of a thin tape 20 which is wound into a spiral coil 21 with the innermost convolution 22 connected to the outermost convolution 23 by a cross-over loop 24 which is guided so as to move with the required clearance above the spiral coil convolutions 21.

For satisfactory recording and reproduction of sound, or similar signals, the endless magnetic tape 20 has to be impelled through the magnetic head 25 at a uniform speed, and each portion of the endless tape 20 must move with the same linear velocity regardless of whether it is a part of an inner or outer convolution of the spiral coil 21. Since the outer convolutions have a longer periphery, each outer convolution of the tape coil 21 must, therefore, move with greater angular velocity than the adjacent inner coil convolution. As a result, adjacent convolutions of the tape coil 21 must continuously slip past each other, and if they are permitted to remain in actual physical contact, friction between the coil tape convolutions will take place.

The frictional slippage forces which are thus developed between adjacent coil convolutions as a result of their uniform speed linear motion, in the direction from the outer convolution 23 to the inner convolution 22 of the tape coil 21, tend to contract and thereby tighten the individual convolutions. If such spirally wound tape coil is made with more than a few convolutions, the contracting and tightening of each convolution increases the frictional forces exerted on the adjacent inner convolutions, and they in turn increase the contraction and tightening actions until their cumulative effect creates abnormally large stresses which stop the motion of the tape 20 or damage it. These difficulties made it heretofore impossible to construct a commercially practical magnetic recording device of the foregoing type having enough tape coil convolutions for making records of the length usually required from a practical recording device.

According to the invention, the foregoing difficulties are overcome by so guiding the linearly impelled convolutions of such spirally wound magnetic tape coil recording arrangements, as to subject them to forces which tend to expand and separate and loosen the individual tape coil convolutions, and thus counteract the convolution contracting and tightening forces.

I have found that in an endless magnetic tape recording arrangement operating with a spirally wound magnetic tape coil of the type shown in Figs. 1 and 2, even when using a very thin tape of permanently magnetizable steel, having a thickness of the order of only three thousandths of an inch, the adjacent linearly impelled convolutions of such coil may be kept in the required loose condition, and harmful excessive slippage

friction between the convolutions of the tape coil prevented, if the lower edges of the tape coil convolutions 21 are held in a generally horizontal position in sufficient frictional engagement with a rotating surface of an underlying revolvably mounted disc member 30 which is driven at sufficiently high speed so that the rotating disc 30 acts as a convolution expanding member which subjects the lower edges of the tape coil convolutions to frictional forces which tend to expand and loosen them in outward direction, and thus counterbalance the slippage friction forces which tend to contract and tighten the tape coil convolutions in inward direction.

Figs. 1 to 3 show one practical form of a guiding and driving arrangement for such spirally coiled endless tape recording device.

The convolutions of the substantially flat compact tape coil 21 are held and guided in horizontal operating positions by the upwardly facing outward surface region of a revolvably mounted and generally horizontally extending circular disc 30, which serves as a coil guiding member.

The inner convolution is guided by the periphery of the revolvably mounted inner disc roller 31 and revolvably mounted cross-over and alignment rollers 32, 33, respectively, which are so positioned that when the tape is impelled at a uniform linear speed in the direction of the arrow 26, the tape elements of the inner convolution 22 are continuously withdrawn from its inner position within the coil 21 and moved over the periphery of the inner revolvably mounted guide member or roller 31 in an upwardly inclined direction along the cross-over loop 24 toward the cross-over roller 32 so as to clear the tape coil 21, and therefrom over the alignment roller 33 in a tangential direction to the starting point of the outer coil convolution 23, while the edges of the tape coil convolutions 21 maintain engagement with the underlying tape guide and expanding disc 30. The tape guide disc 30, the inner tape roller 31 and the cross-over and alignment rollers 32, 33 are held in the required revolving operating positions by a suitable holding structure, such as suitably shaped rigid mounting or holder bar 34. The alignment roller 32 may be omitted, if the cross-over roller 31 is mounted in an inclined position, so that the part of the cross-over loop 24 extending from the inner convolution is kept by one side of its grooved tape guide rim clear from the tape coil convolutions 21, while its other side is aligned opposite the starting point of the outer tape convolution 23.

The linearly impelled convolutions of the endless tape coil 21 are held in their horizontal operating position in engagement with the underlying surface of the tape coil expanding disc 30 by a plurality of elongated guide members 41 held in a generally radial direction above peripherally displaced portions of the spiral tape coil 21. The guide members 41 are so arranged and positioned as to prevent the convolutions of the tape coil from climbing from their normal operating position.

In the form of the invention shown in Figs. 1 and 2, four tape coil guide members are used, and they are held in their operating position by portions of the elongated holder bar 34 overlying the tape coil convolutions and by two of its two cross arms 35, 36. Each guide member 41 is held in its position above the tape coil 21 by two upwardly projecting studs 42 having threaded ends engaging internally threaded holes of adjusting

screws 43 rotatably held by nuts 44 in holes of a mounting plate 45. The mounting plate 45 is shown secured, as by screws, to the underside of the holder bar 33 which is provided with holes within which the heads of the adjusting screws 43 are confined.

By turning the heads of the adjusting screws 43, the level of the lower edge of each guide member 41 may be adjusted to assure that the lower edges of the convolutions of the tape coil 21 remain in their position in which they maintain frictional engagement with the underlying surface of the tape coil guide disc 30.

As shown in the transverse cross-sectional view, Fig. 4, of the guide bar 41, its lower side is rounded so as to confine its engagement with the adjacent edges of the tape coil convolutions to a very small area and reduce to a minimum the friction developed at the engaging surfaces. By mounting on one side of the guide bar 41 a spring strip of non-magnetizable metal, or brush-like layer 46 of elastic non-magnetic bristle-like filaments, so that its lower edge lightly engages the upper edges of the tape coil convolutions 21 without exerting thereon excessive pressure, it is possible to maintain the lower edges of the tape coil convolutions 21 in good frictional engagement with the underlying tape expanding disc 30 while keeping the guide bar 41 adjusted in a position at which its lower edge is spaced by a slight gap from the upper edges of the tape coil convolutions 21.

In order to effectively counterbalance the convolutions contracting and tightening effect of the slippage friction forces between the adjacent linearly impelled tape coil convolutions 21, the underlying coil expanding disc 30 should not only maintain frictional engagement with their lower edges but it should also be rotated at a greater speed than the linear speed at which the tape 20 is impelled along it. With a given magnitude of the frictional engagement, the expanding forces imparted by the rotating disc to the tape coil convolutions engaged thereby will be determined by the magnitude of the difference by which the speed of the expanding disc portion exceeds the linear speed of the tape convolution engaged thereby. The greater this excess of speed is, the greater the expanding forces imparted by the rotating disc to the tape convolution engaged thereby.

Since the linear speed of all tape coil convolutions is uniform, and the speed of the underlying disc surface portions increases with the diameter of the convolutions, each successive outer convolution coupled to such rotating expanding disc is subjected to increasingly larger expanding forces. As a result, such arrangement will keep all convolutions of the tape coil 21 loose and the slippage forces between adjacent convolutions are reduced to a negligible value and they do no harm.

If the tape expanding disc is rotated at a sufficiently high speed, the expanding forces imparted by its periphery to the tape convolutions coupled thereto will cause the tape coil to expand in outward direction. Excessive expansion of the tape coil 21 under such operating conditions may be prevented by providing the outer ends of the tape guide bars 41 with downwardly extending stop projections 49, as shown in Fig. 5, for limiting the maximum outward expansion of the tape coil 21.

In general, it is sufficient to rotate the tape expanding disc 30 with a speed which, without overbalancing contracting effect of the slippage fric-

tion forces, is sufficient to reduce them to a magnitude at which the convolutions of the tape coil are maintained in a loose condition and excessive slippage friction does not develop. Under such operating conditions, the tape coil 21 may tend to contract. Since the angular velocity of the rotating disc, which determines the magnitude of the expanding forces exerted by its surface on the tape convolutions is reduced as the diameter of the tape coil is reduced, it may be desirable to prevent the excess contraction of the tape coil convolutions.

Such excessive contraction of the tape coil 21 may be prevented by providing the inner end of each guide bar 41 with a stop projection 49—1, in the way shown in Fig. 6, for instance.

A uniform operating speed through the magnetic head 25 may be imparted to the tape 20 by applying a rotary driving force either to the cross-over roller 32 or to the tape coil expanding disc 30. If the rotary driving force is applied to the cross-over roller 32, the linearly driven cross-over loop 24 imparts a rotational movement to the tape coil 21 and through the frictional coupling engagement of its lower convolution edges to the underlying tape expanding disc 30, the latter is rotated at an angular speed at which its peripheral portion engaged by the inner coil convolution 21 is at least equal to the linear speed of said inner convolution 21. The diameter of the inner coil convolution and its speed may be determined by the inner stop projections 49—1 of the guide bars 41, such as shown in Fig. 6.

In the arrangement shown in Figs. 1 to 3, the circular rim 51 of the inner tape coil disc roller 31 serves as the inner boundary of the spiral coil 21.

The inner convolution 22 of the tape coil 21 is withdrawn from its position of engagement with the inner rim 51 of the inner coil roller 31 at a tangential direction from a point close to the place where one of the guide bars 41, in the case shown, the guide bar underlying the cross arm 36 keeps the tape coil confined in its space above the disc 30 so as to assure that the inner tape convolution 22 is guided properly from the space within which the tape coil 21 to the higher level of the cross-over roller 32.

In a similar way, the other side of the cross-over loop 24 reaches tangentially its position in the outer tape coil convolution 23 at a place where the coil is held confined along the disc 30 by guide bar 41 underlying the other cross arm 35.

Since the inner convolution 22, in passing from the coil must rise gradually in tangential direction from its position on the inner rim 51 along the cross-over loop 24 to the cross-over roller 32, the portion of the inner rim 51 along which the inner tape convolution 22 gradually rises must be kept free and the facing portion of the tape coil 21 must be deflected therefrom.

In the form of arrangement shown in Figs. 1 to 3, this is accomplished by mounting immediately adjacent the guide bar 41, at the place where the inner tape convolution 22 starts to rise, and leaves its tangential engagement with the rim 51 of the inner coil roller 31, two deflecting pins 53 extending downwardly to near the surface of the tape disc 30 for keeping the coil convolutions 21 away from the rim portion of the inner coil roller 31 from which the inner coil convolution 22 extends, and thus provide the necessary clearance between the coil convolutions 21 and the overlying bridging portion of the cross loop 24.

I have found that a tape coil arrangement of the type shown in Figs. 1 and 2, using a flat steel tape only three mills thick driven by an underlying tape expanding disc 30 driven at 78 revolutions per minute and having an inner coil roller 31, ten inches in diameter, arranged in the way shown in Figs. 1 and 2, will impart to the outer convolutions of a tape coil 21, sufficient outwardly expanding forces as to automatically expand the coil to a position in which the cross-over loop 24 is kept sufficiently tight for maintaining good coupling engagement between the cross loop 24 and the cross over roller 32, if the latter is used to drive the tape at the desired operating speed.

Any form of drive may be used for imparting the rotary driving motion to either the tape expanding disc 30 or to the cross-over roll 32. The spiral magnetic tape coil arrangement of the invention shown in Figs. 1 to 3 is designed so that it may be driven by a standard drive of the type used for driving disc phonograph or disc recording machines. Thus the revolvable elements of the magnetic coil guide and driving arrangement, such as shown in Fig. 1, may be revolvably mounted on a turn-table board of a conventional disc phonograph either on the top or on the underside thereof, without interfering with its use for playing or making disc records.

In the form shown in Figs. 1 and 2, the drive and guide elements for the endless spirally wound magnetic recording tape arrangement is designed in the form of a detachable coil holder unit which may be placed on the top of a standard disc type phonograph for coupling either the tape expanding disc 30, or the cross-over roller 32 to the motor driven turntable of the phonograph, so that it may be driven thereby, in the same way as a conventional phonograph disc is driven during a reproducing or the record cutting operation.

In the drawings, a conventional turntable disc 60 is shown fixed to a vertical turntable shaft 61 which is revolvably mounted in a bearing housing 62 suitably held below the turntable board 63 of a conventional phonograph or radio cabinet. The turntable disc 60 may be rotated at the standard speed, for instance, 78 revolutions per minute, by any conventional motor drive, such as a motor 64 having a rubber surfaced driving pulley 65 which is pressed against the surface of the rim of the turntable disc 60, so as to rotate it at the required speed. The expanding disc 30 of the tape coil drive and guide arrangement has a central hole 67 and a circular row of coupling holes 68 so that by placing it on the turntable disc 60 it is instantly coupled thereto in the same way as a phonograph disc.

The center portion of the tape expanding disc 30 is provided with an upwardly projecting hollow shaft section 71, which is revolvably mounted in a bearing bracket 72 suitably secured to the underlying portion of the holder bar 34. The upper end of the hollow disc shaft 71 is retained in its revolving position within the bearing bracket 72 by a nut 74, so that when the holder bar 33 is lifted, the tape expanding disc 30, the tape coil 21, and the other elements held thereon will be lifted from their position on the phonograph top.

The cross-over roller 32 may be revolvably held either on the cross bar 34, as shown, or may be mounted on a shaft projecting upwardly from the phonograph top board 63, in which case, the cross-over loop is slipped into the peripheral guide groove of the cross-over roller 31 after the tape coil holder bar 33 with the coil guiding and driving arrangement has been placed in the op-

erating position on the turntable disc 60. By mounting the cross-over roller 32 from the coil holder bar 34, on which the other elements of the magnetic tape drive are mounted, the operation of removing or coupling the tape coil holder unit on the phonograph board is simplified.

In the form shown in Figs. 1 and 2, the cross-over roller 32 is revolvably held by the lower flanged portion of a hollow shaft section 75 which is held affixed within the hole of a mounting bracket 76 by a nut 77 engaging the upper end of the hollow shaft section 75, two upwardly projecting threaded studs 78 extending from the mounting bracket 76 of the cross-over roller 32 held by nuts 81 extending across a longitudinal channel 79 of the holder 34 and are clamped in the adjusted position by a nut collar fitting into the recessed wall portion 82 of the coil holder 34. By loosening the nuts 81, the mounting plate 76 with the cross-over roller 31 may be longitudinally shifted along the slot 79 and the tension of the endless tape coil 21, adjusted so that after the desired adjustment is made, the mounting plate with the cross-over roller 31 are clamped in the adjusted position.

As shown in Figs. 1 and 2, the magnetic head is carried by a bracket 85 having a longitudinal slot 86 engaging a stud 87 projecting downwardly from the mounting bar 34 and being held thereon by a nut, so as to permit adjustment of the magnetic head in its proper engagement with the portion of the cross-over loop of the endless tape passing therethrough.

If the cross-over roller 32 is used for driving the tape 20 at uniform speed, it may be combined with a coupling disc 89, which as indicated in dotted lines, forms in conjunction with the cross-over roller 32 a unitary structure similar to the expanding disc 30 designed for ready coupling to the turntable disc 60, the lower surface of the coupling disc 89 being on the same level as the lower surface of the tape expanding disc 30. With such arrangement, the endless coiled magnetic recording tape coil driving and guiding unit, having all its elements operatively combined into a unitary structure, may be coupled in an operative position on a standard phonograph table so as to drive the tape by coupling the turntable disc 60 either to the tape expanding disc 30 or to the cross-over roller coupling disc 89.

As shown in Figs. 1 and 2, the holder bar 34 has a downwardly projecting register pin 91 fitting into an opening of a register socket 92 suitably held on the phonograph board 63, so as to assure that when the top holder bar 34, which is placed in its operative position on the phonograph board 63 and the tape drive is coupled to the turntable disc 60, the coil holder bar 34 will remain stationary.

The coil holder bar 34 is also provided with an electric connector member 93 arranged to make detachable connection with a connector member 94, located on the phonograph board 63, whenever the coil holder 34 is placed thereon in its operative position. Any suitable known readily engageable and disengageable electric connector arrangement, such as plug and socket connector arrangements, may be used for this purpose. In the form shown, the connector member 93 is combined with the register pin 91 and has a plurality of contact springs 95 which engage a plurality of contact strips 96 held by the cooperating connector member 94 which is combined with the register socket 92. The connector members 95, 96 serve to complete the oper-

ating circuits from the elements of the magnetic head and to the amplifier and all other control elements used for recording and from the endless tape coil 21 in the way described, for instance, in my corresponding application Serial No. 340,030, filed June 12, 1940, now Patent No. 2,356,146, dated August 22, 1944, in connection with Figs. 1 to 11. With such arrangement, the operating circuits required for controlling the recording and reproducing operations carried on by the endless coiled magnetic recording tape 21 of the holder 34 are automatically established and broken when the coil holder 34 is placed or removed from its operative position shown in Figs. 1 and 2.

All the elements of the spiral magnetic tape coil drive and guide arrangement including the magnetic head and the electric circuit interconnectors are thus held in their proper operating position by the holder 34.

The so arranged endless magnetic recording tape coil holder may be enclosed in a casing of sheet metal, for instance, which is suitably secured, as by screws, to the holder bar 34.

A plurality of such magnetic recording holders may be stacked one above the other so that the same motor drive and control arrangement may be used for driving and controlling the operation of a plurality of endless magnetic tape, for instance, in the way described in my application Serial No. 524,479, filed February 29, 1944, now abandoned, as a continuation in part of my application Serial No. 340,030 filed June 12, 1940, now Patent No. 2,356,146, dated August 22, 1944.

To this end, a coupling disc 60, similar to the turntable disc 60, may be provided with a shaft 97 having a downwardly projecting portion slidably keyed within the hole of the hollow shaft 71 of the tape expanding disc 30, so as to drive a tape expanding disc 30, similar to that shown in Figs. 1 and 2, when it is placed on the top thereof.

The upwardly facing surface of tape coil holder 34 may be provided with an upwardly facing register socket member 92 and connector member 94 for cooperation with a register member 91, combined with connector elements of the type shown in Fig. 1, so as to provide by-pass connections from all tape holder units stacked up one on the top of the other to a common motor drive and common control arrangements.

If desired, provision may also be made for locking a plurality of stacked up magnetic tape coil holder units in their operating position on the turntable board. To this end, the board 63 and the casing 97 may be equipped with latching elements, such as described in my copending application Serial No. 524,479 filed February 29, 1944, now abandoned, as a continuation in part of my application Serial No. 340,030, filed June 12, 1940, now Patent No. 2,356,146, dated August 22, 1944.

In operating an endless spirally coiled magnetic tape recording arrangement of the type described above, the upper tape guide elements 41 should be so held relatively to the tape coil 21 as to permit the tape coil 21 to move substantially without friction relatively thereto, while assuring that the lower edges of the tape coil convolutions maintain frictional engagement with the rotating coil expanding disc 30. The cross-over and aligning rollers 32, 33 should be so mounted and have such inclination as to lift the portion of the cross-over loop rising from the inner coil convolution without interference

with any other element of the drive and without subjecting the cross-over loop to any substantial strain. The inner tape coil convolution should be tangentially withdrawn from the periphery of the inner coil guide roller 31 adjacent the portion of the inner coil convolution 22 which is held down within its position on the expanding disc by one of the radial guide members, and should be similarly brought back to a similarly located point of the outer convolution 23.

The endless tape should be long enough to provide for the required looseness between the tape coil convolutions 21 so that they may slip past each other while driven at a uniform linear speed through the magnetic head. The tape coil 21 should be held on a portion of the tape expanding disc 30 which is rotated at a sufficient speed so as to automatically expand and maintain the tape coil convolutions in a loose condition.

The tape coil should be wound loose enough so as to provide sufficient slack to eliminate excessive friction. On the other hand, the tape should not be too loose, since otherwise if it should happen to tighten up in one part, it may become excessively loose in another part, and if an excessively loose tape spiral does not find sufficient space to expand, it may buckle and become kinked. Accordingly, the slack in the tape should not be permitted to be large enough to allow such buckling.

The surface of the tape 20 should be highly polished. The solder junction or junctions on the endless tape 20 should be made as smooth as possible, and the soldering junctions should be only negligibly thicker than the other portions of the tape.

The expanding or spreading of the tape coil 21 brought about by the rotation of the expanding disc 30 automatically tightens the cross-over loop in the desired tension condition, and makes it possible to impel such endless tape coil either by driving the expanding disc or one of the rollers over which the cross-over loop is guided. If a cross-over roller is used for driving the tape, the frictional engagement between the cross-over loop and the cross-over roller may be increased by a pressure roller pressing the tape against its periphery.

In the operation of an endless spirally-coiled magnetic recording tape of the type described above, it is important to adjust the driving arrangement so that the tape is maintained loose and at a predetermined desirable tension. This is facilitated by the adjustable mounting of the cross-over roller 31 in the guide channel of the coil holder 33 or by some similar arrangement. The tension of the moving endless tape coil may be adjusted to the proper value as follows:

After releasing the clamping screws of the cross-over roller 31, it is first pulled outwardly so as to increase the tension of the cross-over loop and the moving tape 21 until the coil is tightened and the slippage friction between the tape convolutions stops the motion of the tape. Thereupon, the cross-over roller 31 is gradually moved inwardly so as to progressively release the cross-over loop and loosen the tape so that it starts moving, while observing the decrease of the tape tension, for instance, by a tension meter applied to the cross-over loop. The gradual loosening of the tape will gradually decrease the tension of the tape until a condition is reached at which a fur-

ther release of the cross-over roller does not give a further decrease of the linear tension of the tape. This is the desired condition in which such endless spirally-coiled magnetic recording arrangement should be operated. The cross-over roller should be clamped and locked in the position at which the tape has the so-adjusted tension condition.

According to one phase of the invention, the tape 20 of a flat-coil endless tape recorder of the type described above is provided with a convex-concavo cross-section, as shown in Fig. 7A, so that its concave surface faces the interior of the flat tape coil and the tape has a tendency to straighten out and expand its coil convolutions in outward direction.

Fig. 8 shows a modification of the cross-over loop guiding arrangement illustrated in Figs. 1 to 3. A cylindrical guide roller 105 is revolvably held by the holder bar 34 so that its outer periphery is aligned tangentially directly above the underlying circular periphery of the inner rim 51 of the tape inner disc roller 31, which is engaged by the inner convolution 22 of the tape coil 21. The inner convolution 22 is tangentially withdrawn from its place along the rim 51 of the inner tape coil roller 31 at the point at which it is in tangential alignment with the guide roller 105 and helically guided thereover along the cross over loop passing over two cross-over rollers 32 mounted on an extension of the holder bar 34 to the starting point of the outer convolution 33, as in the arrangement of Figs. 1 and 2.

If very high quality reproduction is desired, the arrangement of Figs. 1 and 2 may be modified in the way shown in Fig. 9. In this arrangement, the cross-over loop 24 of the spiral magnetic tape coil 21 is guided over two rollers 111, 112 revolvably held by the holder bar 34 in a way similar to the cross-over roller 32 of Figs. 1 and 2. The roller 112 is designed so as to have a large inertia, and a length of the tape is held frictionally coupled thereto, as by means of a belt 113 which is pressed against a portion of its periphery by a plurality of belt guide rollers 114, suitably supported, as by a bracket mounted on the holder bar 34. The two sides of the cross-over loop extending between the inertia roller 112 and the tape coil 21 are held tightly coupled to the periphery of the intermediate inertia roller 111, as by coupling belts 115, held pressed against the opposite peripheral portions of the roller 111 by belt guide rollers 116.

As in the arrangement of Figs. 1 to 3, the tape expanding disc 30 or the roller 112 which serves as a cross-over roller, drives the tape 20 at the desired uniform linear speed. The inertia roller 111 to which the sides of the cross-over loop are coupled, serves to isolate the outer portion of the cross-over loop passing over the second inertia roller 112 from the tape driving disc 30. The side portion of the cross-over loop moving from the isolating roller 111 toward the inertia roller 112 may be made very loose, and is shown with a freely hanging loop portion 117.

However, since the portion of the loop which passes through the magnetic head 25 is held firmly coupled to the periphery of the inertia roller 112 which has a relatively large inertia, this loop portion will be impelled through the magnetic head at the peripheral speed of the inertia roller 112, the large inertia of which will equalize fluctuations of the speed transmitted thereto from the driving disc 30.

Figs. 10 and 11 show another form of a flat

endless tape coil magnetic recording device exemplifying the principles of the invention. The convolutions of a substantially flat compact magnetic tape coil 21, forming part of an endless tape, are held and guided in a horizontal operating position by an upwardly facing guide surface of a circular guide wall member 30—3 in a manner similar to that described in connection with Figs. 1 and 2. The inner convolution 22 of the tape coil 21 is engaged by the periphery of a revolvably mounted circular inner guide disc 13—3 and the inner tape coil convolution 22 is withdrawn from the coil by guiding it along a helical path indicated, for the sake of clarity, in an exaggerated manner in Fig. 10, from its position on the revolvable guide disc 31—3 over a portion of the adjacent circular cylindrical periphery of a similar stationary circular guide disc 32—3, of the same diameter and mounted adjacent thereto in alignment therewith.

The inner convolution 22 of the tape coil 21, so withdrawn along a helical path over peripheral portions of the inner revolvably mounted circular guide disc 31—3 and the adjacent stationary circular guide disc 32—3, is then guided over the peripheral guide grooves of two revolvably mounted guide rollers 33—3, 34—3 along the cross-over tape loop 20 past the magnetic transducer heads 5—15, 5—16, back to the starting point of the outermost tape convolution 23 of the tape coil. The two guide rollers 33—3, 34—3 may form part of a fly-wheel structure designed to maintain the motion of the tape length passing through the transducer head 5—11 at a constant speed, suitable means, indicated by spring biased pressure rollers 35—3, being provided to assure effective coupling engagement between the fly-wheel rollers 33—3, 34—3 with the portions of the cross-over loop 20 engaged thereby.

The magnetic heads 5—15, 5—16 may be of the general type described in the copending application of S. J. Begun, Serial No. 550,573, filed August 22, 1944, now abandoned. It has two wall members 5—12 which are provided along their exposed edge with an outwardly tapering elongated guide channel 5—13, the deepest portion of which has a channel track of a width equal to the width of the tape 20, in the manner described in the application of Williams and Begun, Serial No. 546,808, filed July 27, 1944, now abandoned, in connection with Figs. 10 and 11. Between the two wall members are held clamped the pole piece edge portions of a double-pole-piece obliterating head unit 5—15 and a similar double-pole-piece transducer head unit 5—16, so that the pole faces of the double-pole-piece unit are exposed along the bottom region of the guide track into operative engagement with the record track moving thereover.

The deepest portion of the portion of guide channel 5—13 extending between the pole faces of the two double-pole-piece units 5—15, 5—16 and adjoining their outer regions are formed by the arcuate surface portions of flat plate members 5—21, 5—22, held clamped between the two outer wall members 5—12 of the transducer head. The two wall members 5—11 and plate members 5—22, 5—23 may be formed of ceramic material, so that their edge surface shall provide firm positive guide surfaces for the flat tape moving thereover toward and away from the pole face region of the two double-pole-piece units 5—15, 5—16 of the transducer head.

In the arrangement of Figs. 10 to 11, the guide wall member 25 is shown provided with a hollow

shaft section 25-3 on which is seated the bearing member of the revolvably mounted guide disc 31-3 and the upper stationary guide disc 32-3. The convolutions of the flat tape coil 21 are held confined in their position within the flat coil layer by a circular cover plate 41-3 provided with a central raised mounting portion 42-3 having a central mounting hole fitting over the shaft 25-3 and suitably retained thereon as by a nut ring 44-3 threadedly engaging the externally threaded end portion of the hollow shaft 25-3.

As shown in Figs. 10 and 11, the cover plate structure 41-3 is provided with an arcuate slot 46-3 overlying the peripheral range of the stationary guide disc 32-3 to provide a passage for the inner convolution 22 of the tape coil 21 as it is withdrawn from the inner guide disc 31-3 toward the cross-over loop in the manner indicated in Figs. 10 and 11. The cover plate, 41-3 is provided with three leg projections 45-3 arranged to engage supports 51-3 provided on the top wall 50-3 of the recording device. In order to hold the cover plate 41-3 and the guide disc 32-3 secured thereto in a stationary position, one or more of the top wall supports 51-3 is designed to form a socket which engages one of the leg projections 45-3 of the cover plate so as to prevent rotation thereof when it is mounted in its position on the recording device as shown.

In the recording device of Figs. 10 and 11, the guide wall member 25 with the cover plate 41-3 are arranged to form a detachable tape coil holder unit which may be removed from its position on the recording device by lifting it from the centering post 61-3 of a shaft member forming part of a turn-table 60-3 extending above the top wall 53 of the recording device and suitably driven by a turn-table drive mechanism supported on the inner side of the top wall 50-3.

The recording device of Figs. 10 and 11 may be operated in the same manner as the device of Figs. 1 and 2, for instance, by driving the coil supporting disc 25 at a suitable speed so as to impart to the tape coil convolutions of the tape coil 21 outward expanding forces tending to maintain the coil convolutions in loose condition while impelling the cross loop 20 past the transducer head. Alternatively, one of the guide rollers, for instance, guide roller 34-3 may be utilized to drive the cross loop 20 of the endless tape past the transducer head and a suitable driving interconnection is provided to drive the tape coil supporting disc 25 at a speed required in order to impart to the tape convolutions of the tape coil 21 the outward expanding forces which maintain the coil convolutions in the desired loose condition.

Other arrangements than that described above may be utilized for imparting to a flat coil of an endless magnetic recording tape of a recording device of the type described above outwardly expanding forces required to assure foolproof operation of such flat tape coil endless magnetic recording device. If the flat tape coil of such endless magnetic recording device does not have an excessive number of convolutions, and the exposed tape surface has united thereto a molecular layer or film of graphite lubricant, a recording device of the general type shown in Figs. 10 and 11 will operate in a foolproof manner even if the coil supporting wall 25 is retained in a stationary position and is affixed to the cover to form therewith a unitary casing enclosing the flat tape coil as long as provision is made to impart to the tape coil convolutions 21 outwardly expanding forces.

Figs. 10 and 11 show one manner for imparting outwardly expanding forces to the flat tape coil of an endless magnetic recording device of the foregoing type in which the tape coil supporting disc 25 is affixed to the cover wall 41-3 and forms therewith a stationary support for the tape coil. In order to impart to such flat tape coil housed in a stationary casing of the type described above in connection with Figs. 10 and 11 outwardly expanding forces, it is sufficient to positively impart to the outer convolution of the flat tape coil the linear speed at which the cross loop is withdrawn from the inner coil convolution 22 of the tape coil while making the endless tape of sufficient length so that the convolutions of the flat tape coil remain in relatively loose condition. Thus, if the outer convolution 23 of the tape coil is subjected to forces tending to expand it and give it a greater periphery, the outer convolution will tend to impart corresponding expanding forces to its next adjacent inner convolution which, in turn, will tend to impart corresponding expanding forces to its next adjacent inner convolution and so on, thereby preventing the cumulative development of frictional slippage forces between adjacent coil convolutions and the resulting large stresses which would stop the motion of the tape.

In the arrangement of Figs. 10 and 11, this is accomplished by using the guide roller 34-3 over which a portion of the cross loop is guided toward the outer tape convolution 23 of the tape coil for driving the cross loop past the transducer head and providing a rail 70-3 having two closely spaced walls within which the tape length 20-6 which is moving from the guide roller 33-4 toward the opening 46-3 in the rim of the cover plate 41-3 through which it passes into the outer convolution of the tape coil 21.

In order to maintain the tape cross loop 20 which is driven past the transducer head with the required tension, the portion of the inner convolution which is withdrawn over the exposed periphery of the stationary guide disc 32-3 is subjected to the braking action of a brake pad 47-3 which is held suitably biased against the cylindrical periphery of the guide disc 32-3 as by a spring arm 48-3, the other end of which is held suitably affixed to a bracket pin extending from the cover plate 41-3.

In the recording device of Figs. 10 to 11, the coil supporting wall 25 and the overlying cover wall 41-3 form a self-supporting detachable holder structure which holds confined the flat coil of the endless tape in its operative position and permits ready removal thereof from its operating position, the cross loop 20 being readily removed from its engagement with the guide rollers 33-3, 34-3 after the idler rollers 35-3 have been swung away therefrom. One flat endless coil housed in such holder unit may thus be readily replaced by another one, it being merely necessary to place the new holder unit on its position on the mounting and supporting posts provided on the top wall of the recording device and the cross loop may be readily threaded over the guide rollers and the transducer head. On removing such tape coil holder unit from its position, the external portion of the cross loop may be readily stored in the interior space between the walls 25 and 41-3 of the holder unit, for instance, by pushing it through the opening 46-3 into the space between the two walls 25 and 41-3.

In Figs. 12 to 14 is shown a more compact form of endless spiral coil magnetic tape recording ar-

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range-ment of the invention, as in the arrangement of Figs. 1 to 3, its spiral magnetic tape coil 21 being held on the revolvably mounted driven expanding disc 30 and its inner convolution 21 being withdrawn from its position on the rim of the independently revolvably inner coil guide roller 31 at the point where the two deflecting pins 53 keep the coil 21 away from the rim 51 to provide clearance toward the crossover loop 24 the other end of which leads to the outer coil convolution 22. High quality operation and great compactness is achieved by mounting an independently revolvably flywheel member 121 in axial alignment with the expanding disc 30 and the inner coil roller 31, the flywheel 121 and the inner coil roller 31 being shown mounted for independent rotation around the hollow shaft extension 71 of the expanding disc 30. A holder bar 122 serves as the similar holder bar 34 of Figs. 1 to 3, as the mounting support for all revolvable elements as well as the magnetic head 25.

The crossover loop 24, after being withdrawn, in the direction of its motion from the inner coil convolution 21 adjacent the deflecting pins 53, is led over the crossover roller 32 toward the upper groove of a similar roller 123 mounted on the cross arm 35 of the holder bar 34, the holder bar being led therefrom over loop portion 24a to the periphery of the flywheel 121 and along one or two downwardly pitched helix loops back over loop portion 24b to the lower groove of the cross arm roller 124 and therefrom at the lower level over the end portion 24c of the crossloop, by way of the aligning roller 33 to its position on the outer coil convolution 23.

As shown in Fig. 12 the inner coil roller 31 and the flywheel 121 run on antifriction members, being provided with suitable ball bearing races and balls which keep them in their operating position and permit them to rotate relatively to each other and to the expanding disc with a minimum of friction.

As shown in Fig. 9, the crossover loop 24 is arranged to move through a lubricant holder 25—for applying a graphite lubricant to the moving tape, in the manner described in the copending application Serial No. 440,312, filed April 24, 1942, by H. B. Miller, now Patent No. 2,426,838.

Figs. 15 to 18 show another form of endless spirally-coiled magnetic tape recording arrangement. An endless magnetic tape 20 is wound into a spiral coil 21 resting on the upper surface of a revolvably mounted tape expanding disc 140, and the inner convolution 22 of the tape coil 21 is led over a crossover loop 24 to the outer convolution of the tape coil, the coil being confined within its position on the disc by radial guide members, as in the previous arrangements.

Above the central portion of the tape coil expanding disc is revolvably mounted an inner guide roller 141 having a flange at its upper side. The inner convolution 22 of the tape coil 21 is guided away from its inner position on the tape coil expanding disc along a helical path on the inner guide roller and led therefrom over two sets of aligning roller pairs 143 to the peripheral groove of a revolvably mounted driving disc 145, and after passing thereover, the cross-over loop 24 is returned over similar aligning rollers 143 to the starting point of the outer convolution 23 of the tape coil 21, as in the previous arrangement.

The driving disc 145 is shown arranged to be driven by a turn table drive, and has coupling holes 146 through which it is coupled to the

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coupling pin 66 of the turn table disc 60, such as in Figs. 1 to 3.

The driving disc 145 is utilized not only to drive the tape, but also to drive the tape expanding disc 140 at a sufficiently higher speed than the linear speed of the tape, so as to impart to the tape coil 21 held thereon the required outwardly expanding forces.

The expanding disc 140 is shown provided with a downwardly extending grooved belt pulley 147 which is engaged by a rope belt 148, for instance, which also engages the peripheral groove of the driving disc 145 and holds the portion of the crossover loop 24 in its position within the peripheral groove of the driving disc 145. A belt tensioning pulley 151 pivotally mounted and suitably biased by a spring 152 may be used to keep the belt at the required tension.

The tape coil guide and drive arrangement of Figs. 12 to 18 is likewise designed to form a detachable unit, and all the elements of it, including the magnetic head and electrical circuit connectors, are shown mounted on a holder bar 153, as in the arrangement of Figs. 1 to 3, so that the combined tape coil holding unit may be readily removed from its coupling position on the turn table and exchanged with another, and thus permit selective recording with magnetic tape coils of greater or smaller lengths depending on the requirements. The tape cross loop aligning rollers 143 are shown combined with a revolvably mounted tape retaining roller 144 extending into the groove of the aligning roller so as to prevent the tape from dropping out if it is too loose.

As in the arrangement of Figs. 1 to 3, the tape coil drive and guide arrangement of Figs. 12 to 18 has all its revolving elements carried by a holder bar structure 153 and the tape driving disc 145 is provided with a hollow shaft suitably journaled in a bearing bracket held by the holder bar 153 to make it possible to couple to the top of the tape driving disc 145 of the shaft another turn table disc 60 for driving a similar tape holder unit placed on the top of the tape holder unit.

The radial coil guide members 141 of the arrangement shown in Figs. 12 to 18 are shown designed so as to retain the tape coil in its desired peripheral operating position on the expanding disc 140 and prevents its expansion or contraction beyond the desired point, and such guide members are intended for use with each of the previously described arrangements.

Figs. 19 and 20 show one form of such radial guide member bars 141 suitable for use in conjunction with a spiral magnetic tape drive of the type shown in Figs. 1 to 3. The outer end of the guide bar carries a stop roller 161 revolvably mounted on a pivot stud 162 held on the guide member 141. The lower end of the stop roller 161 has an inwardly recessed rim portion 163 located above the upper surface of the tape expanding disc 30 and forming a stop limiting the outward expansion of the tape coil, the shoulder portion of the roller 161 preventing upward climbing of the outer convolutions of the tape coil 21.

In addition, the radial guide member 141 holds journaled on two downward bearing extensions a radial guide roller 164 so that its lower rolling edge shall maintain the lower edges of the tape coil convolutions in frictional engagement with the underlying rotating surface of the tape expanding disc 30.

The radial tape coil guide members 141 are

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held in their operating positions by upwardly projecting studs 171. Each stud 171 is slidably held within a sleeve 172 which is clamped by nuts 174, 175 within a radially extending guide channel 176 formed in the overlying portion of the holder structure bar 34. The lower nut 174 has upwardly projecting wings engaging the edges of the channel 176 and the upper nut 175 has a collar fitting within a recess formed in the wall portion adjoining the channel 176, so as to confine all the elements associated with the holding structure 34 below its upper level, as in the arrangement of Figs. 1 and 2.

By loosening the clamping nuts 175 of the radial guide bar 141, it may be shifted in radial direction along the guide channel 176 to different positions depending on the size of the tape coil 21. A coil spring 177 held in each guide bar support sleeve 172 by threaded stud 178 applies an adjustable pressure to the guide member 141, so that by turning the stud 178, the pressure with which the guide member 141 is held against the upper edges of the tape coil convolutions may be adjusted.

Alternatively, if guide bars of the type shown in connection with the arrangement of Figs. 1 to 3 are used for a guide arrangement of the type shown in Figs. 12 to 14, it is merely necessary to provide at their outer ends a revolvably mounted stop roller 161, in the way shown in Figs. 22 and 23.

In order to adjust the level of a radial guide bar 141 of the type shown in Fig. 22 relatively to the convolutions of the tape coil 21, each end of the guide bar 141 may be provided with a stud 181 such as shown at the right of Fig. 22, having the downward thread which engages a suitably threaded hole in the guide bar and the upward oppositely pitched thread engaging adjusting nuts 174-1 and 175-1 held adjustably against rotation in a channel 79 of the overlying portion of the holder structure bar, in a manner analogous to the corresponding nuts 174, 175 of Figs. 19 to 21.

As shown at the left of Fig. 22, the end of the radial guide bar 141 may be held in its adjusted position by a threaded extension of its pivot stud 181, an internally threaded circular nut 175-1, retained in the holder bar channel 79 by a wing nut 174-1 the wings of which are engaged by the channel 79 to prevent it from rotation relatively to the channel. The upper end of the stud 181 may be rotated, as by a screwdriver, to adjust the level of the guide bar 141.

By turning as with a screwdriver the upper ends of the studs 181, the level of each guide bar 141 may be adjusted. Each guide bar 141 may be adjusted longitudinally along its channel so as to be brought nearer or away from the periphery of the underlying expanding disc 30 by unloosening the clamp nuts 175-1 of the associated studs 181 and clamping them again in the adjusted position.

Instead of mounting the generally-radially extending guide bars 141 along a radius of the expanding disc 30, it may be held at an angle thereto, in the way shown in the horizontal view, Fig. 23, of the guide bar shown in Fig. 20. When the tape coil 21 is revolved by the expanding disc 30 in counterclockwise direction, such mounting of the guide bars, in the direction inclined to the radial direction of the disc, increases the effectiveness of the lower edge of the guide bar facing the upper edges of the tape coil convolutions 21 in assisting the convolutions to be biased in out-

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wardly direction as they are being linearly impelled, while held in engagement with the upwardly facing surface of the rotating expanding disc 30.

In Figs. 24 to 27 is shown a self-contained spirally coiled magnetic tape guiding and driving arrangement combined with a magnetic head into a housing unit which may be inter-coupled with a series of similar units to a common motor driving mechanism for selectively recording and reproducing sound on the tape of either one of the units.

On the main wall 310 of a relatively flat casing enclosed by a cover 311 is revolvably mounted a tape driving pulley 312 having a driving shaft 313 which has on its opposite ends complementary coupling plates 314, 315 arranged so as to permit intercoupling of several similar driving pulleys 312 located in adjacent casings 311, with a similar coupling plate of a motor driven shaft extending from a wall of a casing which houses a driving motor and a control arrangement for controlling the recording and reproducing operations on a magnetic tape of such units.

On another shaft section 317 extending from the casing wall 310 is revolvably mounted a tape reel 319 for guiding in conjunction with the tape driving pulley a long endless magnetic recording tape 13 wound in the form of a multi-layer spiral coil around the tape reel 318 and the driving pulley 312 in the way shown. A magnetic head 15 and an alignment roller 109 are suitably mounted on the casing wall 310 so as to guide the interior layer of the tape 13 from the circular surface 319 of the tape reel 318 through the magnetic head 15 into frictional engagement with the rim of the driving wheel 312 against which it is held pressed by a pressure roller 320 which is mounted on a spring biased lever arm arrangement 321 so as to cause the driving wheel 312 to drive the inner tape layer 322 through the magnetic head 15 in the direction of the arrow 323 at a uniform speed required for satisfactory recording and reproducing of sound.

The end of the inner tape convolution 323 leaving its frictional engagement with the tape driving pulley 312 moves over the surface of the pressure roller 320 towards the outer surface of a large cross-over pulley 324 revolvably mounted adjacent the tape coil reel 318 so as to guide the end inner tape convolution 322 over its outer surface 325 toward the starting point of the outer convolution 326 of the endless tape coil wound around the tape pulley 312 and the tape reel 318. The tape driving wheel 312 with its pressure roller 320 and the cross-over pulley 324 are so spaced relatively to each other as to permit the tape to move with the required clearance from its innermost layer position 323 to its outermost layer position 326 without imposing excessive strain on any element of the endless tape.

A plurality of radially arranged spreader rollers 330 are mounted in revolving engagement with the opposite edges of the outer tape convolutions surrounding the rim of the tape driving wheel 312 so as to keep the outer-tape convolutions of the coil loose and permit them to slip along their adjacent surfaces without excessive friction while the tape driving pulley 312 impels the inner tape convolution 322 in the direction of the arrows 323 toward the starting point of the outer tape convolution 326. Each spreader roller has an outer shaft extension 331 journaled in the flanged wall of the casing and a shaft extension 332 journaled in suitable brackets 333 supported by the casing. The inner shaft extension 332

of each spreader roller is suitably driven as by a radially adjustable friction pulley 334 with a rim of friction material, such as rubber, which is pressed against the disc surface of the tape driving wheel 312 for rotating the spreader rollers 330 so that they maintain the outer convolutions of the tape coil in loose condition and are free to slip along their adjacent surfaces.

Since the outer convolutions of the tape coil must keep on moving at the speed at which the inner convolution 322 is impelled through the magnetic head, the spreader rollers 330 are so driven as to assist the outer convolutions of the tape coil to move at the speed of the inner frictionally driven tape convolution without successive friction. To secure optimum operating conditions, a suitable arrangement is provided for adjusting the speed with which the spreader rollers are driven, for instance, by changing the radial position of engagement of the roller driving pulleys 334 with the driving disc of the tape driving pulley 312. To this end, the roller driving pulleys are so mounted as to permit adjustment of their radial position, for instance, by providing a threaded engagement between the hub of the pulley 334 and the roller shaft 332 and a stop nut 335 so arranged on the shaft that, after adjusting the radial position of the stop nut, the pulley 334 will be kept by the stop nut in a predetermined fixed radial position at which the speed of the spreader roller 330 will maintain the outer convolutions of the endless tape coil in the desired loose condition and permit them to slip past each other without excessive friction.

In an endless tape guiding arrangement of the type shown in connection with Figs. 24 and 25 having tape coils with a large number of convolutions, the spreader rollers 330 may be provided with helical grooves 337, in the way shown in detail in Fig. 25, arranged to keep apart the outer convolutions of the endless tape coil while they slip past each other as they are drawn by the frictionally driven interior convolution 322 into frictional driving engagement with the rim of the tape driving pulley 312.

While a single motor driven tape driving pulley 312 with its set of spreader rollers 330 as shown in the arrangement of Figs. 24 and 25 will in most cases by itself be able to maintain the entire length of the outer convolutions sufficiently loose so that they may slip past each other without excessive friction, a similar loosely mounted tape driven pulley with a set of spreader rollers may be used instead of the tape reel 318 for guiding the convolutions of the endless tape coil so as to maintain the outer convolutions of the endless tape coils loose and free to move past each other without excessive friction.

In the arrangement described above in connection with Figs. 24 and 25 only the inner tape convolution 322 which is in frictional engagement with the rim of the tape driving pulley 312 is subjected to the frictional driving forces. The outer tape convolutions are free to slide past each other along their adjacent surfaces without being subjected to any substantial tension. A relatively long length of endless magnetic steel tape may thus be guided and driven past the magnetic head at a uniform speed for recording and reproducing sound without imposing substantial stresses on any portion of a long endless tape. The outer convolutions may be wound sufficiently loose so that even along the portions at which they are in engagement, the frictional forces are negligible and do not interfere with the motion

of the endless tape. Such frictional forces may be reduced by lubricating the moving tape convolutions, for instance, by replacing lubricating pads along the path of the tape convolutions.

In endless tape arrangements of the type shown in Figs. 24 and 25 operating with a relatively short endless tape requiring only a relatively small number of outer convolutions, the spreader rollers 330 with surfaces of a suitable friction material having no guiding grooves will be able to keep the outer convolutions in the required loose condition. The required freedom of slippage between the outer convolutions of such endless magnetic tape coil guide and driving arrangement may also be secured by maintaining the convolutions sufficiently lubricated by lubricating pads arranged to lubricate each convolution. Alternatively, an endless magnetic tape coil guiding and driving arrangement of the type shown in Figs. 24 and 25 may be provided with a housing which has a liquid lubricant reservoir and means for feeding the lubricant to the convolutions of the moving tape in a way similar to the construction of oil lubricated anti-friction bearings.

A plurality of separately encased endless coiled magnetic tape sound recording and reproducing units of the type described in connection with Figs. 24 and 25, each provided with suitable coupling means, may be coupled to a common motor drive housed in a similar casing for recording and reproducing sound in the way described in connection with any of the arrangements shown in Figs. 1 to 28. Each magnetic tape coil unit may be provided not only with its individual magnetic head, but also with its individual control arrangement driven through a suitable reduction gearing connected to its motor driven shaft 313. The individual control arrangements may be constructed so as to be operated either manually or by a remote control arrangement.

Another form of endless magnetic tape coil guiding and driving arrangement of the type described in connection with Figs. 24 to 27 is shown in Figs. 28 to 30. In this arrangement the motor driven shaft section 313 which is revolvably mounted on the main casing wall 310, as in the arrangement of Figs. 27 and 28, drives a pulley member 340 which in turn drives through a belt 341 a tape driving pulley 342 which is revolvably mounted on a shaft 344 suitably secured in the casing wall 310.

A disc section 345 of the motor driven pulley member 340 drives the friction pulleys 334 of radial sets of tape convolution spreader rollers 330 as in the arrangement of Figs. 24 to 27. There is further provided a row of tape guide rollers 347 revolvably mounted on shaft projections 348 extending from the casing wall 310 around the periphery of the motor driven pulley disc 345 so as to guide in conjunction with the tape reel 318 located at the opposite end of the casing 310 and the alignment roller 109 associated with the magnetic head 15, as in the arrangement of Figs. 22 and 23, the inner convolution 322 of the endless magnetic tape coil 13 along the outer surfaces of the guide rollers 347 to its point of engagement with the driving surface of the belt driven tape driving pulley 342 against the rim of which it is held by a pressure roller 320 for impelling the inner tape convolution at a uniform speed in the direction of the arrow and causing the end of the inner convolution 322 leaving its engagement with the driving pulley 343 to move over the cross-over pulley 325 to the starting point of the outer con-

volution 326 in a way similar to the arrangement of Fig. 22.

With this arrangement, the driving force imparted by the belt driven tape driving pulley 343 to the end portion of the inner tape convolution 323 draws the tape element of the inner convolutions as it leaves the magnetic head 15 over the alignment roller 109, along the guiding surface of the semi-annular row of guide rollers 347 till the tape element is brought into frictional engagement with the belt driven periphery 343 of the tape driving pulley 342 so that the end of the inner tape convolution 322 leaving its engagement with the tape driving pulley 343 may be deflected over the cross-over pulley 324 mounted adjacent the tape reel 318 on the other end of the coil casing and continue its travel along the outer convolution 326 of the endless coil. An additional set of outer guiding rollers for guiding the outermost convolution 326 of the endless tape coil may be provided along the outer periphery of the tape coil.

As explained hereinbefore, magnetic sound carrier holders of the type described in connection with Figs. 24 to 29, which combine in a self-contained unitary holder structure the carrier guiding and driving means for driving an endless magnetic tape through a magnetic sound transducing head mounted on the holder, are provided with coupling means for detachably coupling such holder to a self-contained power unit comprising a motor mechanism and an amplifier so arranged that upon coupling the coiled sound carrier holder to the power unit, operating connections are automatically established between the motor mechanism of the power unit and the carrier guiding and driving means of the carrier holder, as well as between the amplifier of the power unit and the magnetic head of the carrier holder for recording or reproducing sound in conjunction with the moving magnetic sound carrier. A suitable control arrangement, for instance, of the type described in connection with Figs. 22 to 24, for controlling the recording and reproducing operations on the coiled magnetic sound carriers is combined with the power unit for interchangeable cooperation with the detachable mounted coil carrier holder units.

Such detachable magnetic carrier holder units may be arranged in the way described in connection with Figs. 24 to 29 and provided with double intercoupling means so that a plurality of coiled magnetic carrier holder units may be intercoupled with a common power unit into a unitary magnetic sound recording apparatus and arranged to be selectively controlled by a common control arrangement forming a part of the power unit. Alternatively, each of the coil holder units may have its own remotely actuated control arrangement for independently controlling the recording and reproducing operations thereon.

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 device for transducing magnetic records, such as recording or reproducing magnetic signals by magnetic flux interlinkage between a magnetic record trans-

ducer means and elements of a relatively moving magnetic record tape: an endless magnetic record tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a desired linear speed along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution so that a portion of the connection tape length moves past said record transducer means; said guide means including a drive element driven at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed and thereby impart to the overlapping convolutions of said tape coil forces tending to expand said coil convolutions so as to maintain the slippage forces between the adjacently moving coil convolutions below a disturbing level; portions of said guide means constituting elements which maintain said coil convolutions confined within said layer and forming therewith parts of a substantially rigid detachable holder structure arranged for detachable coupling to a separate unit supplying the tape impelling forces without substantially disturbing the cooperative relation between the coil convolutions and the guide means engaged thereby.

2. In a magnetic record transducing device for transducing magnetic records, such as recording or reproducing magnetic signals by magnetic flux interlinkage between a magnetic record transducer means and elements of a relatively moving magnetic record tape: an endless magnetic record tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a desired linear speed along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution so that a portion of the connection tape length moves past said record transducer means; said guide means comprising a guide member having a generally upwardly facing guide surface member supporting the tape-coil edges on one side of said coil and including a drive element driven at a speed at least equal to said linear speed and drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said convolution at least at said linear speed and thereby impart to the overlapping convolutions of said tape coil forces tending to expand said coil convolutions so as to maintain the slippage forces between the adjacently moving coil convolutions below a disturbing level; portions of said guide means constituting elements which maintain said coil convolutions confined within said layer and forming therewith parts of a substantially rigid detachable holder structure arranged for detachable coupling to a separate motor unit supplying the tape impelling forces without substantially disturbing the cooperative relation between the coil convolutions and the guide means engaged thereby.

3. In a magnetic record transducing device for

transducing magnetic records, such as recording or reproducing magnetic signals by magnetic flux interlinkage between a magnetic record transducer means and elements of a relatively moving magnetic record tape; an endless magnetic record tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a desired linear speed along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution so that a portion of the connection tape length moves past said record transducer means; said tape having a convex concave cross section and being arranged so that its cross section is flattened when wound onto a coil and that its elastic restoring forces tend to expand said coil convolutions for reducing the slippage forces between adjacently moving coil convolutions below a disturbing level.

4. In a magnetic record transducing device for transducing magnetic records, such as recording or reproducing magnetic signals by magnetic flux interlinkage between a magnetic record transducer means and elements of a relatively moving magnetic record tape: an endless magnetic record tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a desired linear speed along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution so that a portion of the connection tape length moves past said record transducer means; said guide means comprising a guide member having a generally upwardly facing guide surface member supporting the tape-coil edges on one side of said coil and including a drive element driven at a speed at least equal to said linear speed and drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said convolution at least at said linear speed and thereby impart to the overlapping convolutions of said tape coil forces tending to expand said coil convolutions and tending to maintain the slippage forces between the adjacently moving coil convolutions below a disturbing level.

5. In a magnetic recording apparatus: an endless magnetic record tape; a center disc about which said record material is spirally wound in a coil with overlapping coil convolutions arranged in a layer, and having a cross-over loop connecting the inner and outer record material convolutions, guide means for guiding and impelling the tape at a desired linear speed in the direction from the inner convolution through the cross-over loop toward the outer convolution; magnetic record transducing means located along the path of motion of said tape for recording or reproducing magnetic signal records; said guide means having rotatably mounted guide surface portions arranged so that the edges of the record material convolutions are in engagement with and are guided by said guide surface portions; said guide means including a drive element driven at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along

the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed and thereby impart to the coil convolutions forces tending to expand said coil convolutions.

6. In a magnetic recording apparatus: an endless magnetic record tape; a center disc about which said record material is spirally wound in a coil with overlapping coil convolutions arranged in a layer, and having a cross-over loop connecting the inner and outer record material convolutions; said center disc forming part of guide means for guiding and impelling the record material at a desired linear speed in the direction from the inner convolution through the cross-over loop toward the outer convolution; magnetic record transducing means located along the path of motion of said record material for recording or reproducing magnetic signal records; said guide means having rotatably mounted upwardly facing guide surface portions arranged so that the edges of the record material convolutions are in engagement with and are guided by said guide surface portions; said guide means including a drive element driven at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed and thereby impart to the coil convolutions forces tending to expand said coil convolutions.

7. In a magnetic recording apparatus: an endless magnetic record tape; a center disc about which said record material is spirally wound in a coil with overlapping coil convolutions arranged in a layer and having a cross-over loop connecting the inner and outer record material convolutions, guide means for guiding and impelling the tape at a desired linear speed in the direction from the inner convolution through the cross-over loop toward the outer convolution; magnetic record transducing means located along the path of motion of said tape for recording or reproducing magnetic signal records; said guide means having rotatably mounted guide surface portions arranged so that the edges of the record material convolutions are in engagement with and are guided by said guide surface portions; said guide means including a drive element driven at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed and thereby impart to the coil convolutions forces tending to expand said coil convolutions; portions of said guide means constituting elements which maintain said coil convolutions confined within said layer and forming therewith parts of a substantially rigid detachable holder structure arranged for detachable coupling to a separate drive unit supplying the tape impelling forces without substantially disturbing the cooperative relation between the coil convolutions and the guide means engaged there-

8. In a magnetic recording apparatus: an endless magnetic recording tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a predetermined linear speed along the path of its coil convolutions in the direction

from the inner convolution toward the outer convolution; magnetic signal transducing means for recording or reproducing signals by magnetic flux variations interlinking said transducing means and a moving element of said tape; said guide means including rotatably mounted guide surface portions arranged so that the edges of said coil convolutions are in engagement with and are guided by said guide surface portions; said guide means including a drive element driven at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed and thereby impart to the coil convolutions forces tending to expand said coil convolutions and to maintain the slippage forces between adjacently moving coil convolutions below a disturbing level; said guide means including inner guide surface elements having outwardly facing circular surface portions located substantially within the region surrounded by said inner convolution and frictionally engaging tape elements of the inner convolution for guiding said tape outside said coil layer in the direction toward said outer convolution.

9. In a magnetic recording apparatus unit suitable for cooperation with a separate motor unit: an endless magnetic recording tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a predetermined linear speed along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution; magnetic signal transducing means located along the path of motion of said connection tape length for transducing recorded signals by magnetic flux variations interlinking said transducing means and a moving element of said tape; and a substantially rigid holder structure supporting said endless tape and elements of said guide means in a predetermined operative relation and constituting with said endless tape and said guide means a self-supporting bodily-movable unit arranged for detachable interconnection with said separate motor unit, and having means for detachably coupling said impelling means to said motor unit and causing said motor unit to supply to said impelling means mechanical power required to impel said tape past said transducing means.

10. In a magnetic recording apparatus: an endless magnetic recording tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a predetermined linear speed along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution; said guide means including an inner rotary member located substantially within the region surrounded by said inner convolution and having circular guiding surface portions frictionally engaging a sufficient length of said inner convolution for frictionally guiding said endless tape along the path of its inner convolution from the end of the inner tape convolution toward said guide means including a drive element driven

at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed; means located in the path of the motion of said connection tape length for recording and reproducing magnetic signals by magnetic flux variations interlinking said transducing means and elements of said endless tape.

11. In a magnetic recording apparatus: an endless magnetic recording tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape at a predetermined linear speed along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution; magnetic record transducing means for recording or reproducing signals by magnetic flux variations interlinking said transducing means and a moving element of said connection tape length; said guide means including a rotatably-mounted guide member having a generally-annular upwardly-facing guide surface supporting the tape-coil edges on one side of said coil and so arranged as to hold said tape coil in a position in which said tape-coil edges are maintained in frictional driving engagement with said rotatable guide surface; said guide means including a drive element driven at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed and thereby imparting means to said tape-coil convolutions forces tending to outwardly expand said coil convolutions and to maintain the slippage forces between adjacently moving coil convolutions below a disturbing level; said guide means including a rotatably-mounted inner guide member having an outwardly-facing circular surface located within the region surrounded by said inner convolution and frictionally engaging and guiding the tape elements of the inner convolution to positions outside said coil layer in the direction toward said outer convolution; at least one element of said guide means constituting a revolvingly mounted inertia member of relatively high inertia having circular surface which is in frictional engagement with a portion of said connection tape length so as to maintain substantially uniform speed of the tape elements moving past said transducing means.

12. In a magnetic record transducing device for transducing magnetic records, such as recording or reproducing magnetic signals by magnetic flux interlinkage between a magnetic record transducer means and elements of a relatively moving magnetic record tape: an endless magnetic record tape having a length spirally wound into a tape coil with overlapping tape coil convolutions arranged in a layer and a connection tape length interconnected between the inner convolution and the outer convolution of said coil; guide means including impelling means for guiding and impelling the elements of said tape along the path of its coil convolutions in the direction from the inner convolution toward the outer convolution so that a portion of the connection tape length moves past said record transducer means; said guide means including a guide member hav-

ing a generally upwardly facing guide surface supporting the tape-coil edges on one side of said coil said guide surface tapering outwardly in downward direction; said guide means including a drive element driven at a speed at least equal to said linear speed drivingly engaging at least a portion of the tape moving along the path of the outermost convolution of said coil for driving said outermost convolution at least at said linear speed and thereby imparting to the overlapping convolutions of said tape coil forces tending to expand said coil convolutions and tending to maintain the slippage forces between the adjacently moving coil convolutions below a disturbing level.

13. A magnetic recording apparatus defined by claim 4 in which the guide means include elements extending on opposite sides of the tape coil for maintaining edges of the tape coil convolutions in frictioned driving engagement with the guide surface.

14. A magnetic recording apparatus defined by claim 4 in which the guide means include means for holding at least a part of the tape coil in a predetermined radial region of the guide surface.

15. A magnetic recording apparatus defined by claim 4 in which the magnetic tape has a convex concave cross section and is so arranged that the side of the tape which faces the exterior of the coil is of convex shape when uncoiled.

16. A magnetic recording apparatus defined by claim 4 in which the edge of the magnetic tape engaging the guide surface is of a material having substantial friction resistance.

17. A magnetic recording apparatus defined by claim 4 in which the edge of the magnetic tape engaging the guide surface is of a non-metallic material having substantial friction resistance.

18. A magnetic recording apparatus defined by claim 4 portions of the guide means constituting elements which retain the coil convolutions confined within the coil layer and form parts of a substantially rigid detachable holder structure arranged for detachable coupling to a separate drive unit which supplies the impelling forces which drive the tape past the transducer means.

19. A magnetic recording apparatus defined by claim 4 in combination with a drive unit having a power take-off member for imparting driving forces to the tape impelling means of the guide means; portions of the guide means constituting elements which retain the coil convolutions confined within the coil layer and form parts of a substantially rigid detachable holder structure arranged for detachable coupling to a separate drive unit which supplies the impelling forces which drive the tape past the transducer means; said holder structure having a coupling element which automatically couples the impelling means to the power take-off member.

20. A magnetic recording apparatus defined by claim 4 in combination with a drive unit having a power take-off member for imparting driving forces to the tape impelling means of the guide means; portions of the guide means constituting elements which retain the coil convolutions confined within the coil layer and form parts of a substantially rigid detachable holder structure arranged for detachable coupling to a separate drive unit which supplies the impelling forces which drive the tape past the transducer means; said holder structure having a coupling element which automatically couples the impelling means to the power take-off member; in which the holder structure and the drive unit carrying co-operating detachable electric connector elements arranged to automatically establish electrical connections between electric elements of the holder structure and associated electrical elements of the drive unit when the holder structure is connected to the drive unit.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,288,983	Weiss	July 7, 1942