Sept. 13, 1949. M. CAMRAS 2,481,904

BIFILAR MAGNETIC RECORDING SYSTEM

Filed March 17, 1945

Fig. 1.

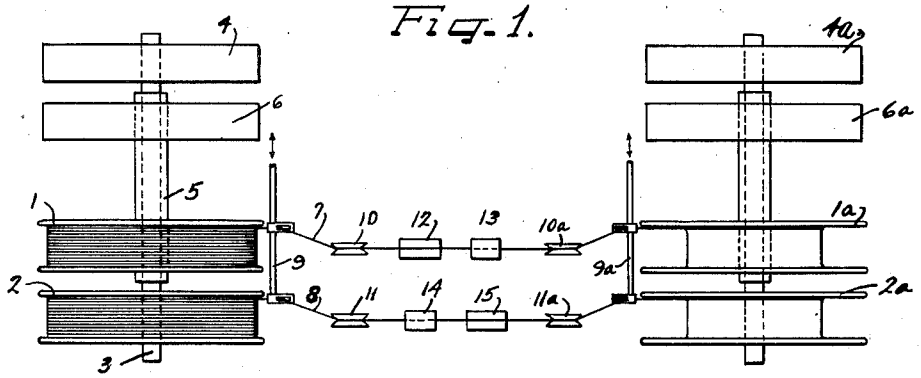



Fig. 2.

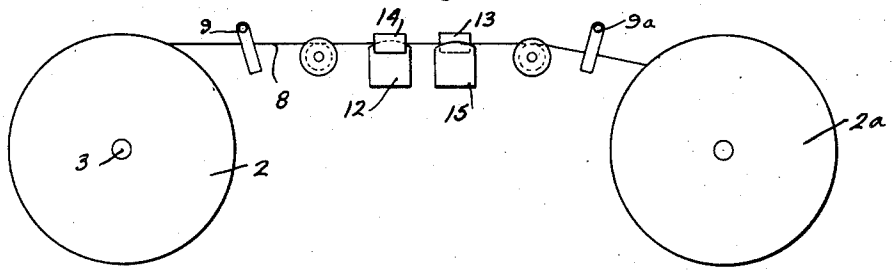
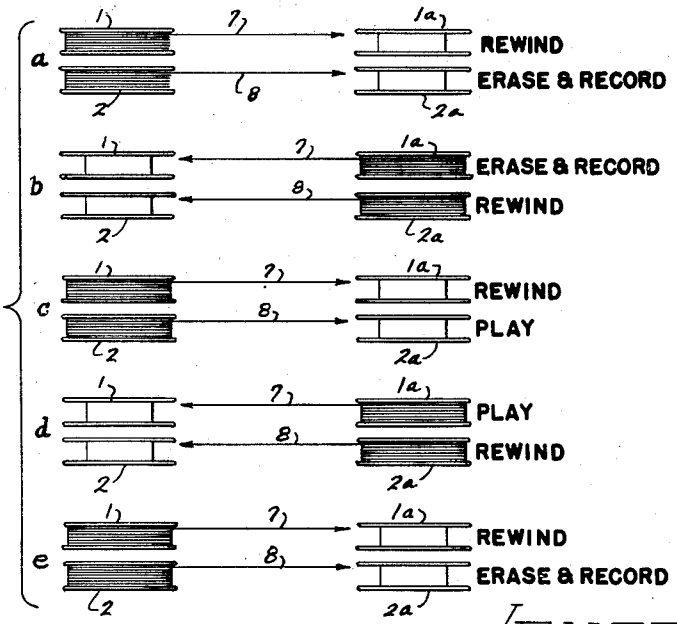



Fig. 3

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2,481,904

## BIFILAR MAGNETIC RECORDING SYSTEM

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3 Claims. (Cl. 179—100.2)

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The present invention relates, in general, to the recording and reproduction of vibrations, and is more particularly concerned with an improved means and method for the recording and reproduction of sounds, signals, and the like magnetically on a magnetic wire recording apparatus.

In magnetic recording devices wherein a sound recording is made upon an elongated paramagnetic recording medium, such as a metallic tape or wire, a recording head may be used to apply successive magnetizations to the recording medium as it travels past the recording head, which magnetizations vary in accordance with variations of the sound being recorded. During recording, the wire is unwound from a first spool onto a second spool, and after the recording process has been completed, it is rewound from the second spool onto the first spool, and thereafter, the wire is played by moving through the same recording head by again unwinding from the first spool onto the second spool. After completion of the playing operation, or a series of playing and rewinding operations, the wire is passed through an erasing head for demagnetization or erasure of the record and is again wound onto the first spool from the second one. Reference is made to my prior Patents No. 2,351,004, entitled "Method and means of magnetic recording," issued June 13, 1944, and No. 2,351,005, entitled "Magnetic recorder," issued June 13, 1944, showing such recording and erasing apparatus. An objection of such method and means of operation of a magnetic wire recorder is that after the recording is made, it is necessary to rewind the wire, therefore causing an appreciable time delay before the wire can be played. Also, after the wire is played, there is considerable time delay in rewinding before the wire may be played again, since several miles of wire may be wound on one spool. It is accordingly an object of the present invention to eliminate the above described time delays normally required for the rewinding operation following either the recording or playing operation.

A more specific object of the present invention is to provide a method and apparatus for simultaneously rewinding and recording and thereafter simultaneously rewinding and playing a plurality of sections of paramagnetic wire in order to eliminate any delay between the recording and playing operations or vice versa or between successive playing operations.

A more specific object of the present invention is to employ a pair of spools of paramagnetic wire and simultaneously effect bifilar winding of said spools onto a pair of other spools, and vice versa, in a manner so that half of the recording is made on one of a pair of spools and the other half made on the other, and so that the recording and rewinding operations as well as the playing and rewinding operations may be simultaneously effected so as to eliminate any time delay between the recording and playing operations, and vice versa, or between successive playing operations as will appear more clearly hereinafter.

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Other objects and advantages will become apparent from the following detailed description of an illustrative embodiment of the present invention wherein,

Figure 1 is a top view of a wire recording apparatus embodying the principles of the present invention;

Figure 2 is a front view of the structure shown in Figure 1; and

Figure 3 is a schematic showing of the successive steps in the operation of the structure shown in Figures 1 and 2 for carrying out the principles of the present invention.

Referring more particularly to Figure 1, numerals 1 and 2 denote spools of wire or tape of paramagnetic material of extremely small diameter, perhaps in the neighborhood of .005 inch in diameter, suitable for magnetic recording purposes. A shaft 3 is rigidly secured to spool 2 and is driven by a wheel 4 which, in turn, is driven frictionally by a clutch or other driving element (not shown). Likewise shaft 5 is rigidly secured to spool 1 and is driven by a wheel 6 which, in turn, is driven by either the same clutch element that drives spool 1 or a different element (not shown). Lengths of wires 7 and 8 are unwound from spools 1 and 2 and wound onto spools 1*a* and 2*a*, respectively. In such winding operation wires 7 and 8 traverse a level winding device 9, thence a pair of tensioning idlers or pulleys 10 and 11, and thereafter wire 7 successively traverses a recording head 12, and erasing head 13, a tensioning idler 10*a* and a level winding device 9*a*, and finally it is wound on spool 1*a*. Similarly wire 8, after traversing idler 11, extends through erasing head 14, recording head 15, tensioning idler 11*a*, level winding device 9*a*, and finally it is wound on spool 2*a*. To effect the above described unwinding of wires 7 and 8 from spools 1 and 2 onto spools 1*a* and 2*a*, respectively, wheels 6*a* and 4*a*, which correspond to wheels 6 and 4 in construction, are driven by separate driving elements or, if desired, may be

coupled together by driving them by a single driving wheel frictionally engaging both wheels 6a and 4a (not shown), while wheels 6 and 4 are free from driving engagement with their respective driving elements.

Conversely, when it is desired to wind wires 7 and 8 onto spools 1 and 2 from spools 1a and 2a, respectively, wheels 4 and 6 may be either separately driven or coupled together and driven by a single driving wheel or friction disk (not shown), while wheels 6a and 4a are free. As is well known in the art, the recording heads 12 and 14 each comprises an electromagnet, preferably of horseshoe shape with closely confronting pointed pole faces, with the wire traversing either a groove extending longitudinally through the poles or extending along a U-shaped groove at the top of the poles. The erasing heads 13 and 15 are also well-known in the art and may comprise coils energized by high frequency currents to cause uniform magnetization of the wire so as to erase variations in magnetism resulting from the recording process. The constructions of the recording head and erasing head are clearly described in my above mentioned patents and form no part of the present invention. Idlers 10, 10a, 11 and 11a are for the purpose of resiliently tensioning the wires so as to form a loop to take up any slack that may occur in the wire during the winding or rewinding process. Level winding devices 9 and 9a are for the purpose of accurately leveling the wire as it is being wound onto empty spools so as to insure proper and even winding and provide successive uniform and complete layers.

The bifilar recording process embodying the teachings of my invention may be best understood by reference to Figure 3 which diagrammatically shows the successive steps or successive operatione necessary to complete a cycle, that is, one involving recording, rewinding, playing and erasing. For the sake of simplicity, all the intermediate stucture between the two pairs of spools, shown in Figures 1 and 2, have been eliminated in Figure 3.

Figure 3a shows the wires being unwound from spools 1 and 2 onto spools 1a and 2a for effecting rewinding of wire 7 and simultaneous erasing and recording on wire 8.

The next operation illustrated in Figure 3b shows wires 7 and 8 being unwound from spools 1a and 2a onto spools 1 and 2, respectively, for effecting erasing and recording on wire 7 and rewinding of wire 8.

Figure 3c shows the next step, namely, that of unwinding wires 7 and 8 from spools 1 and 2 and winding thereof onto spools 1a and 2a, respectively, to effect simultaneous rewinding of wire 7 and playing of the record on wire 8.

Figure 3d shows the next step, namely, that of winding of wires 7 and 8 onto spools 1 and 2 while unwinding the wires from spools 1a and 2a, respectively, so as to effect simultaneous playing of wire 7 and rewinding of wire 8.

Figure 3e shows the next successive step, namely, that of unwinding wires 7 and 8 from spools 1 and 2 onto spools 1a and 2a, respectively, to cause rewinding of wire 7 and erasing and recording of wire 8. It will be seen that the operation shown in Figure 3e is identical to that shown in Figure 3a illustrating that the cycle is being repeated.

The successive steps shown in Figure 3 are illustrative of a complete cycle in the event only a single playing operation is desired before erasing and recording anew. However, the more common method of use of the device is to record and then play and re-play a number of successive times. In other words, after the step in Figure 3d has been completed the step shown in Figure 3c will be started, and after completion the step shown in Figure 3d will be started and after completion the step shown in Figure 3c will be started and so on so as to play, rewind and re-play many successive times. Of course if the recording operation is already performed such as by a manufacturer, then the operator merely plays and re-plays the wires.

It will be seen, therefore, that there is no delay period whatsoever between the recording operation and the playing operation, or vice versa, or between successive playing operations because the rewinding of the wires is effected simultaneously during both the recording and playing processes as illustrated in the successive operations shown in Figure 3.

Thus it will be seen that a continuous message or program of any length can be recorded, for example, by running half the recording on one spool and the other half on the other, hence providing a method which is particularly useful for recording continually repeated messages such as advertisements, weather reports, and the like.

While the above described system shows merely manually controlled successive method steps for selectively energizing the recording head and erasing head when needed for carrying out the recording and reproducing steps described, it will be apparent that the successive steps of the method, as shown in Figure 3, may be carried out by an automatic electrical control circuit (not shown) which may be readily built by persons skilled in the art. For example, the spools may be automatically reversed by a switch operated as the result of reaching of the ends of the wire in the spools, and the corresponding erasing head and electromagnetic recording heads may be placed in the circuit at the proper times to effect their respective functions as the result of such reversal.

It will be noted that modifications coming within the scope of the present invention may be readily suggested to those skilled in the art as the result of the teachings of the present specifications. For example, instead of using two spools 1 and 2, a single spool with a partition in the middle may be substituted in which case a single driving wheel may be used. Such a middle partitioned spool may also be substituted for spools 1a and 2a if so desired. Similarly other modifications may be made.

Thus it will be seen that I have provided an efficient apparatus and method for wire recording and reproducing of sound which eliminates delay between the recording and playing processes or vice versa.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention, and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. In a magnetic recording and reproducing device for simultaneously rewinding and erasing and recording and thereafter simultaneously rewinding and playing a plurality of sections of paramagnetic record medium in order to eliminate any delay between erasing and recording

and playing operations or vice versa or between successive playing operations including a first pair of spools, each having a paramagnetic elongated record medium wound thereon, a second pair of spools upon which the elongated record mediums are to be wound, a pair of independent concentric shafts upon which said first spools are respectively mounted, a second pair of independent concentric shafts upon which said second spools are respectively mounted, means for selectively driving said second spools independently of each other to transfer simultaneously said record mediums from said first spools to said second spools, and means for selectively driving said first spools independently of each other to transfer simultaneously said record mediums back to said first spools, said spool shafts and said drive means including sufficient frictional drag to at all times tension said record mediums independently of each other while they are being unwound, a magnetic transducer head associated with each of said record mediums and over which each of said record mediums pass as they are being wound and unwound, one of said magnetic transducers being arranged to be rendered operative when said mediums are being unwound from said first spools and wound onto said second spools, and the other of said magnetic transducers being arranged to be rendered operative when said record mediums are being unwound from said second spools and rewound on said first spools, and separate level winding means respectively for each of the first and second pairs of spools upon which each of the paramagnetic media are to be simultaneously level wound and unwound.

2. A magnetic recording and reproducing device for simultaneously rewinding and erasing and recording and thereafter simultaneously rewinding and playing a plurality of sections of magnetic recording media in order to eliminate any delay between erasing and recording and playing operations or vice versa or between successive playing operations comprising, a first spool, elongated magnetic recording medium wound on said first spool, a second spool adjacent and coaxial with said first spool, elongated magnetic recording medium wound on said second spool, a third spool aligned with said first spool, and adapted to receive the recording medium from said first spool, a fourth spool aligned with said second spool and adapted to receive the recording medium therefrom, a first recording head mounted between said first and third spools, a first erasing head mounted between said first spool and said first recording head, a second recording head mounted between said second and fourth spools, a second erasing head positioned between said second recording head and said fourth spool, means to guide and tension the recording medium from said first spool through said first erasing head and said first recording head to said third spool, means to receive and tension the recording medium from said second spool through said second erasing head and said second recording head to said fourth spool, means to rotate simultaneously said third and fourth spools to wind the recording medium from the first onto the third spool and to wind the recording medium from said second to said fourth spool while erasing and recording sound thereon, means to rotate simultaneously said first and second spools to rewind the recording medium from said third and fourth spools onto said first and second spools while reproducing sound recorded on the recording medium on the third and first spools, and separate level winding means respectively for the first and second adjacent spools and for the third and fourth adjacent spools upon which each of the magnetic recording media are to be simultaneously level wound and unwound.



3. A magnetic recording and reproducing device comprising a first spool, an elongated magnetic recording medium wound on said first spool, a second spool contiguous and coaxial with said first spool, an elongated magnetic recording medium wound on said second spool, a third spool aligned with said first spool, and adapted to receive the recording medium from said first spool, a fourth spool aligned with said second spool and adapted to receive the recording medium therefrom, means to rotate simultaneously said third and fourth spools to wind the recording medium from the first onto the third spool and to wind the recording medium from said second to said fourth spool, means to rotate simultaneously said first and second spools to rewind the recording medium from said third and fourth spools onto said first and second spools, and a single level winding means for the two spools of said first pair and a second level winding means for the two spools of said second pair upon which each of the magnetic recording media are to be simultaneously level wound and unwound.

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