Aug. 8, 1950 W. W. BIRKES ET AL 2,518,117

MAGNETIC WIRE PLAYING DEVICE

Filed Nov. 30, 1948 3 Sheets-Sheet 1

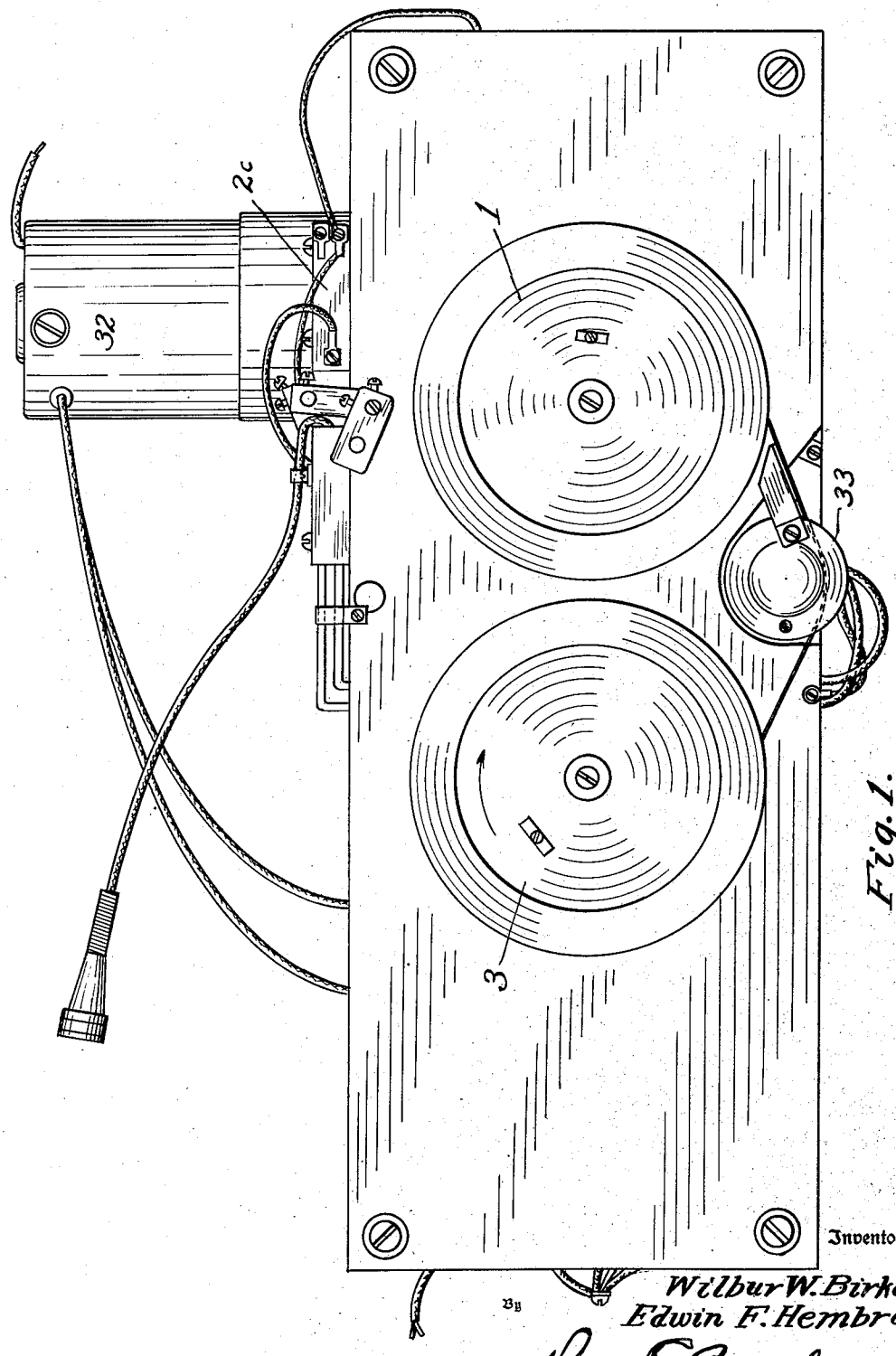


Fig. 1.

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Filed Nov. 30, 1948 3 Sheets-Sheet 2

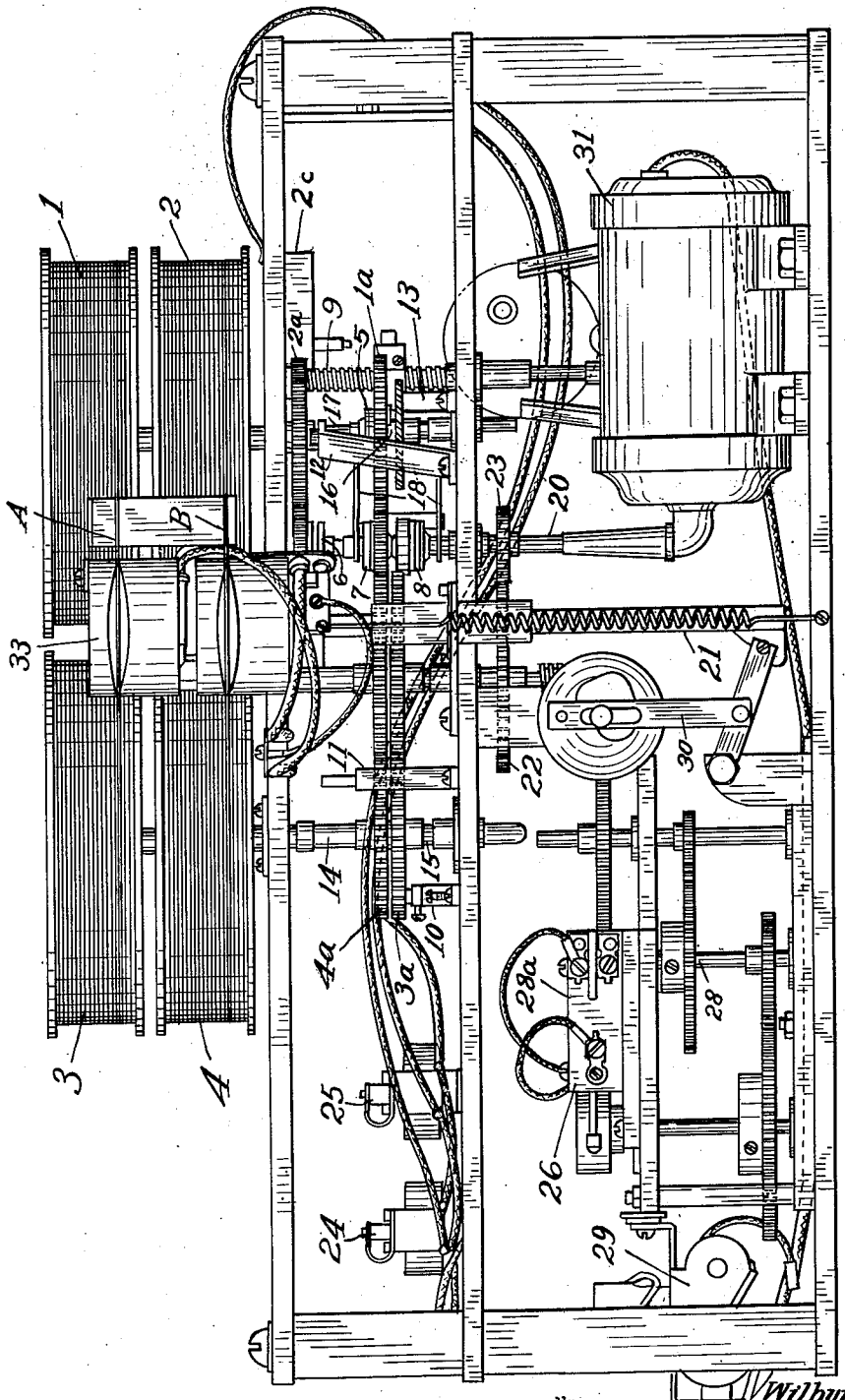


Fig. 2.

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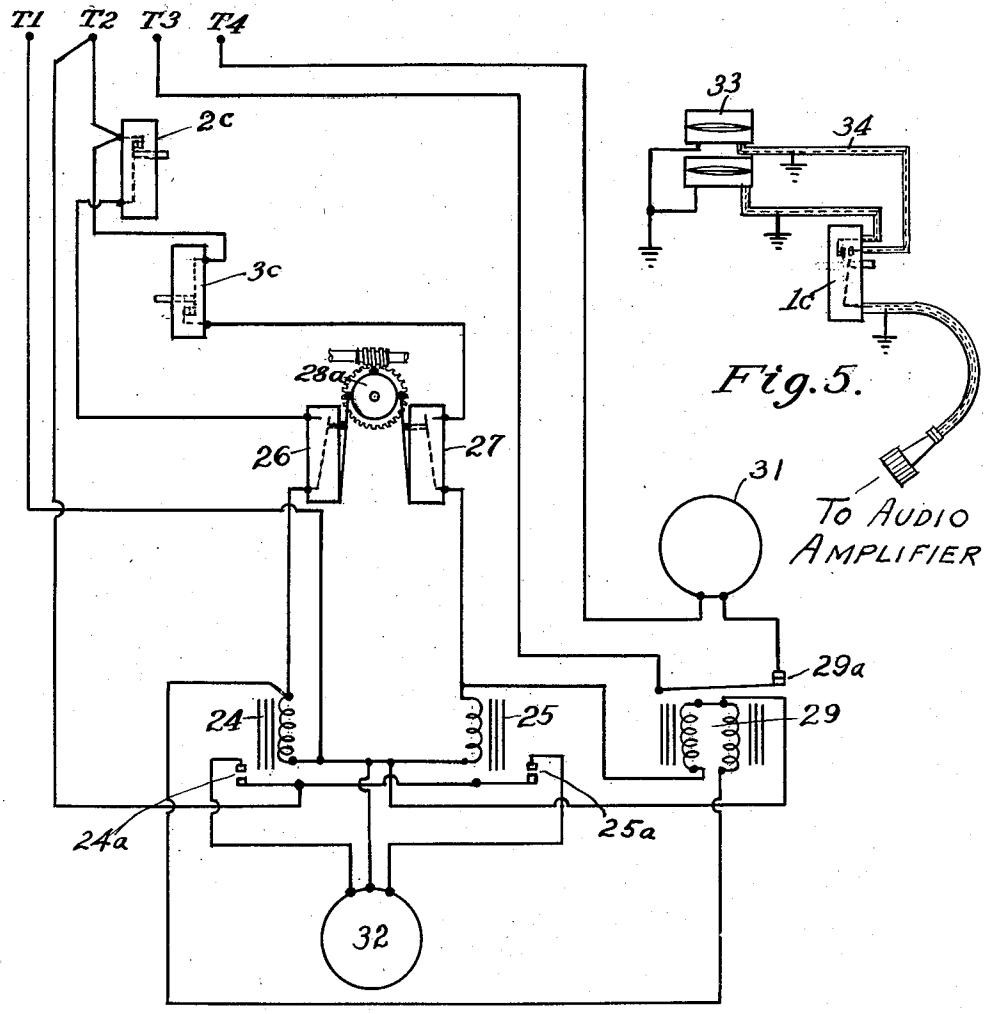


Fig. 3.

Fig. 5.

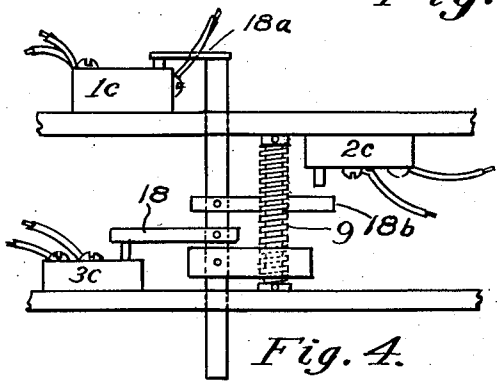


Fig. 4.

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MAGNETIC WIRE PLAYING DEVICE

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5 Claims. (Cl. 179—100.2)

1

This invention relates to a magnetic wire playing device and, more particularly, to a device for reproducing music or speech that is impressed upon a wire record by a magnetic wire recorder.

As is well known in the art, a wire of magnetizable material, such as steel, of the order of $^1/_{1000}$ of an inch in diameter, or approximately the diameter of a human hair, when moved longitudinally through an air gap formed by two opposing pole pieces of an electromagnet whose flux varies in accordance with the variations of voice or speech impressed on a microphone connected to the electromagnet will become magnetized in longitudinal incremental portions in accordance with variations of the sound falling on the microphone, thereby impressing a magnetic record on the wire. Thus when the wire is rewound and passed again between the same opposing poles, but this time being connected through an amplifier to a loudspeaker, speech or music corresponding to the magnetic wire record will be played.

An outstanding disadvantage in the use of common types of magnetic wire recorders or reproducers has been that after a program of music or speech has been recorded on the wire, it is necessary to rewind the wire on a spool which, of course, requires considerable time, before the wire may be played or reproduced through an amplifying system as described hereinabove.

Attempts have been made heretofore to devise wire playing devices for use exclusively to reproduce sound or music records already impressed upon a magnetic wire. Such devices have had the outstanding disadvantage of requiring lapse of an appreciable time period for rewinding purposes after a record has been played. A further disadvantage of such devices has been that they were not fully automatic, hence did not permit automatic replaying of a continuous program of music or speech.

An object of the present invention is to provide a novel wire playing device which is devoid of the above named disadvantages and which is capable of automatically playing and replaying, continuously, a given program of speech or music impressed on the wire record.

A further object of the present invention is to provide a novel automatic electrical control system for automatically playing and replaying a given magnetic wire record and which has switching means which are not operable by jarring movements of a vehicle on which the playing device and control system may be supported.

A more specific object of the present invention is to provide a magnetic wire playing device in-

2

cluding two pairs of spools, each pair having a wire wound thereon having one-half of the total recorded program to be played, the spools being so arranged that when one pair of spools is winding its wire and playing it, the other pair of spools will simultaneously rewind the other wire which carries the other half of the program, to bring it to the play position (that is, wound completely on one spool of the pair) so that upon completion of playing of the first mentioned wire, an automatic reversal of the drive will be effected so as to effect rewinding of the first mentioned wire and playing of the second mentioned wire so as to allow reproduction of the second half of the program.

A still more specific object of this invention is to provide a magnetic wire recording device wherein two pairs of spools are employed, one spool of each pair being coaxially disposed with respect to a spool of the other pair, there being one wire having its ends connected to the spools of the respective pairs, and a dual magnetic pick-up head through which said wires are traversed, and, wherein a motor driving in a given direction will simultaneously drive one spool of a pair of spools in a clockwise direction to effect winding of one wire thereabout and playing of the same, while driving another spool of the other pair in a counterclockwise direction to effect rewinding of a second wire thereabout, and continuing said simultaneous playing and rewinding of the respective wires until one-half of the program has been played, automatic means being provided thereafter for automatically stopping the driving motor and reversing the direction of drive of the respective pairs of spools so as to play the aforementioned rewound wire and rewind the wire that has been played, thereby playing the second half of the program; and on completion of the second half, then automatically repeating the above cycle and replaying both halves of the program in succession. The device is therefore especially adapted for continuous playing of a program of dinner music or the like, where perhaps a series of selections are played over a period of a few hours, and then the series is repeated over and over again.

Other objects and advantages of our invention will become apparent from a study of the following specification, taken with the accompanying drawings wherein:

Fig. 1 is a top plan view of a magnetic wire playing device embodying the principles of the present invention;

Fig. 2 is a side elevational view of the device shown in Fig. 1;

Fig. 3 is a schematic electrical wiring diagram showing the electrical control circuit of the device illustrated in Figs. 1 and 2;

Fig. 4 is an enlarged side view of the timing mechanism, and

Fig. 5 is a schematic wiring diagram of the circuit extending through the dual magnetic head.

Referring more particularly to Figs. 1 and 2 of the drawing, numerals 1, 2, 3 and 4 denote separate spools for the level winding or rewinding of a pair of magnetic wires A and B. Wires A and B may be of steel or other magnetizable material and may have a diameter of the order of 0.001 inch, or approximating that of a human hair. Opposite ends of magnetic wire A are connected to spools 1 and 3. Wire A is adapted to move longitudinally through the gap between confronting pole pieces of one-half of a dual magnetic pick-up head 33. Upon wire A there is recorded one-half of the entire program so that as wire A is wound onto spool 3 and unwound from spool 1, such half of the program is played. The other half of the program is recorded on magnetic wire B whose ends are connected to spools 2 and 4 so that when the wire B is wound onto spool 2 while being unwound from spool 4 and played by passing through the lower opposing poles of the magnetic head 33, the second half of the program will be played. As each wire is being played, the other wire is being simultaneously rewound. Mechanically coupled to spools 1, 2, 3 and 4 are the operating gears 1a, 2a, 3a and 4a, respectively. Clutch 5 is adapted for driving spool 1; clutch 6 for driving spool 2, clutch 7 for driving spool 4, and clutch 8 for driving spool 3.

Assume that spool 3 is empty and spool 1 has all of wire A wound therearound. Spool 3 may then be driven in a clockwise direction and spool 2 driven in a counterclockwise direction provided that clutches 8 and 6, respectively, are engaged and clutches 5 and 7 disengaged. Disengagement of the latter mentioned clutches permits spools 1 and 4 to turn freely. After all of wire A has been played and wound onto spool 3, automatic means, which will be described more fully hereinafter, will effect disengagement of clutches 6 and 8 and engagement of clutches 5 and 7, therefore allowing spools 1 and 4 to become the driving spools for effecting rewinding of wire A and playing of wire B, respectively. Thereafter, when all of wire B has been played, the automatic mechanism will again cause reversal of drive of the spools, causing spools 2 and 3 to rotate in opposite directions and to become the pulling or driving spools and spools 1 and 4 the trailing or driven spools.

A worm thread 9 is provided for effecting translating motion of a switch operating mechanism which is connected to the clutch shifting mechanism. Brakes 10, 11, 12 and 13 are provided for braking or retarding the rotation of the trailing spools when such spools are driven by pulling of the wire so as to prevent rotation of such spools at an excessive speed which might otherwise cause unreeling of the wire. Shafts 14, 15, 16 and 17 are mechanically coupled to spools 4, 3, 1 and 2, respectively. Numeral 18 denotes a clutch control arm which is reciprocated by worm thread 9. A drive shaft 20 is connected to the driving motor 31, which motor rotates in a single direction for driving the respective spools. An oscillating shaft 21 driven by cam-operated link 30 is also provided for oscillating head 33 to follow the respective wires as they are wound or unwound on the respective spools. Numerals 22 and 23 denote gear drives for operating timing mechanism 28 and for oscillating link 30. A relay 24 is adapted to be operated by a microswitch 26 and a relay 25 is adapted to be operated by a microswitch 27.

In operation, as mentioned previously, when clutches 6 and 8 are engaged and motor 31 is running, spool 3 will drive in a clockwise direction, pulling wire A from spool 1 and at the same time playing wire A. Spool 1 is disengaged from any drive gear and is free to rotate except for the retarding action provided by brake 13 which causes sufficient drag to keep the wire from running too freely and unwinding from the spool. At the same time, spool 2 will drive in a counterclockwise direction, pulling wire B from spool 4, the latter spool being free to rotate except for the retarding action provided by brake 11. Wire B which is contained on spool 4, having been wound thereon in a reverse direction, does not play during this period and is merely rewinding itself onto spool 2. Clutches 7 and 5 are disengaged during this period so as to uncouple spools 4 and 3, respectively, from the gear drive. Also, during this period of time, an arm 18 fastened to the clutch shifting assembly will depress the actuating pin of the limit microswitch 2c, effecting opening of the switch contacts and thereby preventing application of potential to the relays 24 and 29.

Microswitch 1c, as will appear in Fig. 5, has two switches, one normally open and one normally closed. With clutches 6 and 8 engaged and wire A playing, the normally closed contacts of switch 1c are connected by shielded wire 34 to the top section of magnetic pick-up head 33 and to an audio amplifier and loudspeaker (not shown). Switch 1c is actuated by an arm 18a fastened to the clutch shifting mechanism.

After all of wire A has been played and wire B rewound, the following operation occurs: the timing mechanism 28 drives a cam 28a (see Fig. 3) which engages the pin of a microswitch 27, effecting closing of its contacts, thereby completing a circuit which extends from terminal T2 through limit microswitch 3c, microswitch 27, the coil of relay 25, to terminal T1, thereby energizing the relay coil. A parallel circuit will extend from microswitch 27 to the left-hand coil of relay 29, thence to line T1. Energization of the coil of relay 29 effects opening of the driving motor contacts 29a to stop the rotation of the spools and the oscillation of the dual pick-up head which in turn stops the emission of sound from the audio amplifier. Energization of the coil of relay 25 effects closing of the contacts 25a, thereby completing a circuit from terminals T1 and T2 through the right-hand pair of terminals of motor 32 which causes turning of worm thread 9 in a direction so as to move the clutch shifting assembly and control arm 18 downwardly. Stoppage of driving motor 31 is provided to prevent breakage of the wire by excessive pull on reversal.

As the clutch shifting assembly moves downwardly, clutches 6 and 8 are disengaged. Upon continued downward movement, clutches 7 and 5 become engaged. As clutches 7 and 5 become engaged, arm 18 fastened to the clutch shifting assembly engages the actuating pin of limit microswitch 3c (see Fig. 4) opening its normally closed contacts, therefore interrupting the ener-

gizing circuit through the clutch shifting reversible motor 32, effecting stoppage of the motor and of the clutch shifting movement. Likewise, relay 29 becomes deenergized, allowing contacts 29b to close, thereby closing an energizing circuit from terminals T3 and T4 to driving motor 31. The spools are thus reversed, spools 1 and 4 becoming the driving spools which drive in such direction that spool 1 is now pulling in a counterclockwise direction, winding wire off spool 3 which is free to turn except for the retarding action of brake 10, which prevents the wire from running too freely. Thus, wire A is rewound with no audio sounds. Simultaneously, spool 4 is driven so as to pull in a clockwise direction, playing wire B at it is unwound from spool 2, which latter spool is free to run except for the retarding action of brake 12 which prevents the wire unreeled from spool 2 from running too freely. At the same time, microswitch 1c is closed by depression of its actuating pin by an arm 18a of the clutch assembly which will open the circuit through the top pick-up head section, thereby preventing wire A from operating in the circuit, and will complete a circuit through the lower section of the pick-up head 33, permitting wire B to control the electromagnet so as to transmit sounds through the audio amplifier.

After all of wire B has been played and wire A rewound, the timing mechanism 28 again will have rotated cam 28a to such position that it will depress the pin of microswitch 26 which completes an energizing circuit extending from terminal T2, limit microswitch 2c, microswitch 26, the coil of relay 24 to terminal T1, thereby energizing the coil of relay 24 and effecting closing of its contacts 24a which will apply energizing potential from terminals T1 and T2 to the left pair of terminals of motor 32 so as to drive the motor in an opposite direction. A parallel circuit will extend from microswitch 26 to the right-hand coil of relay 29 to terminal T1, which will effect downward movement of the armature associated with relay coil 29, effecting opening of contacts 29a, interrupting energization of driving motor 31, thereby stopping the rotation of the spools. Starting of motor 32 drives the clutch shifting assembly and arm 18 upwardly, thereby engaging clutches 6 and 8 and disengaging clutches 7 and 5. Arm 18b of the clutch shifting assembly will depress the actuating pin of limit microswitch 2c, thereby deenergizing relays 24 and 29. This will stop motor 32 and start motor 31. Thus audio sound will again be emitted while wire A is again played, and the program will be restarted. The machine will therefore continue to play wire A and then wire B, in succession, simultaneously rewinding the wire that has been played, and will automatically repeat the entire program by replaying wires A and B in succession as long as potential is applied at the terminals.

The control circuit may be energized either by alternating or direct current, or a combination of both, at the same or different values of voltage. For example, low potential D. C. voltage may be applied across terminals T1 and T2 and high potential A. C. may be applied across terminals T3 and T4. Or perhaps both pairs of terminals may be energized by an ordinary household 110 volt, 60 cycle A. C. source.

The dual magnetic pick-up head 33 may be either in the form of an electromagnet having two pairs of opposing poles in a single unit, or in the form of two separate magnetic pick-up heads fastened together.

While wires A and B have been disclosed, if desirable, magnetic tapes may be used instead, including either a single record or a plurality of records along the width of the respective tapes to make it possible to play different programs, depending upon which of the records are interposed between the opposing poles of the magnetic head. Also, while the device has been described as a wire playing device, it is conceivable that it would find usefulness for magnetic recording, or perhaps for both recording and playing. However, its greatest usefulness is for automatic playing of continuous records.

Thus it will be seen that we have provided an efficient, highly useful and fully automatic wire playing device which enables playing of a program on a pair of wire records wherein half of the program is impressed on each record, and wherein the records are played in succession in a manner so that as one wire is played, the other is simultaneously rewound, thereby eliminating any lost time for rewinding, also, we have provided an automatic magnetic wire playing device wherein the program, such as a series of songs, is played continuously without interruption and replayed over and over again automatically, also without interruption, so long as energizing potential is applied to the electrical control system of the device.

While we have illustrated a certain specific embodiment of our invention, it will be apparent that this is by way of illustration only, and that various changes and modifications may be made within the contemplation of our invention and within the scope of the following claims.

We claim:

1. Sound reproducing means including two pairs of spools, one spool of each pair being coaxially disposed with a spool of the other pair, each pair adapted to selectively wind or unwind magnetizable wire from one spool of the pair onto the other, a double magnetic pick-up head having two pairs of opposing poles and arranged so that each of said wires travels through the magnetic air gap formed by one set of poles, means including a stationary electric motor and gear means, together with a clutch shifting mechanism, for simultaneously driving one pair of spools in one direction and the other pair in an opposite direction and for reciprocating said head so as to follow up wires being unwound from the other spools of said pairs of spools, and timing means for operating said clutch shifting mechanism after a predetermined time period sufficient for allowing completion of the playing of one wire and rewinding of the other wire, to effect reversal of the drive of the respective pairs of spools so as to rewind the wire that has been played and play the wire that has been rewound, simultaneously.

2. An automatic drive for a wire playing or recording device comprising in combination, two pairs of spools, each pair being coaxially mounted and arranged so that one of the spools of each pair is coextensive with one of the spools of the other pair, two magnetizable wires, each having its ends connected to the spools of the respective pairs in side by side relationship, a magnetic pick-up head having two pairs of opposing poles and disposed so that one of said wires will move longitudinally between one pair of poles and the other, between the other pair of poles, means for driving all of said spools simultaneously, including gear means driven by an electric motor, cam actuated linkage means

also driven by said motor for reciprocating said head along an axis parallel to that of said spool so as to follow up said wires as they are being unwound and wound on the respective pairs of spools clutch means including a separate clutch for each of said spools, clutch shifting means for altering the direction of drive of said gear means by disengaging the two trailing spools and engaging the two leading spools, an electrical reversible motor for shifting such clutch means first to one position for driving one set of spools in one direction to effect playing of the wire connected thereto and simultaneously driving the other pair of spools in the other direction to effect rewinding of the associated wire, and timer means which, upon completion of the simultaneous playing and rewinding of the respective wires, automatically effects stoppage of the driving motor, shifting of said clutch means and driving of said respective spools in an opposite direction to that previously driven so as to rewind the previously played spool and play the previously wound spool simultaneously, and means for automatically reversing the direction of drive of said respective spools upon completion of said last mentioned playing and rewinding operation.

3. An automatic playing device comprising two pairs of spools, each having a magnetizable wire wound therearound in a manner so that as one spool is driven, it will wind wire therearound while pulling and unwinding it from the other spool, a double magnetic pick-up head through which said respective wires are adapted to travel, electric drive means for reciprocating said head so as to follow up said wires and for rotating all of said spools simultaneously and including gear means and clutch shifting mechanism so as to positively drive one of each pair of spools simultaneously in opposite directions for winding wire thereabout and for selectively effecting reversal of said drives, said clutch shifting means including a reversible electric motor, timer means for actuating said clutch shifting mechanism upon completion of simultaneous winding and rewinding operations of said respective wires, means operable by said clutch shifting mechanism for stopping the drive of said spools and thereafter effecting reversal of the drive so as to effect playing of the previously wound wire and rewinding of the previously played wire, and switching means operable by said clutch shifting mechanism so as to automatically complete a recording circuit including only the wire that is being played and automatically interrupting the circuit through the wire that is being simultaneously rewound.

4. Apparatus recited in the next previous claim wherein said timer means includes a cam driven by said gear means and a pair of normally open limit switches which are automatically closed by said cam to complete a circuit so as to drive said reversible motor in either one direction or an opposite direction for effecting shifting of said clutch shifting mechanism, and a pair of normally closed limit switches operable after predetermined travel of said clutch shifting mechanism to interrupt the energizing current to said reversible motor to effect stoppage thereof and to energize the driving motor to effect driving thereof so as to rotate all of said spools in a direction opposite to that previously rotated.

5. In a wire playing device comprising two pairs of spools in side by side relationship, one of the spools of each pairs being disposed in coaxial relationship with the other, magnetic pick-up head means comprising two pairs of opposing poles for providing air gaps of fluctuating magnetic density, a pair of magnetized wires, each having its ends connected to the respective pairs of spools disposed in side by side relationship and movable through one of said air gaps; the combination of driving means for driving said pairs of spools in opposite directions, simultaneously, including an electric driving motor, gear means, clutch means, and clutch shifting means, a sound reproducing system selectively connected so as to be controlled by either one or the other of said wires in response to movements of said clutch shifting means, a timer mechanism operable after a predetermined period of time sufficient to allow playing of one wire and rewinding of the other, said timer mechanism including a cam and a pair of microswitches, each having actuating pins which are operable automatically after predetermined rotation of said cam, a reversible motor including a pair of reversing switches and operating relays, which relays are automatically and selectively energizable, depending upon which of said microswitches is actuated by said cam, for driving said reversible motor in one direction or an opposite direction to cause shifting of said clutch shifting means, a relay operable in response to operation of said timer mechanism actuated microswitches to effect stoppage of said driving motor, one of said first mentioned operating relays also being operable thereby to effect operation of said reversible motor to operate said clutch shifting means, a pair of limit switches which are normally closed and are disposed at the ends of travel of said clutch shifting means so as to become opened after predetermined travel and thereby effect stoppage of said reversible motor and retarting of said driving motor, the latter thus effecting driving of said spools in opposite directions to that previously driven so as to rewind the previously played wire and play the previously rewound wire, and switching means also responsive to movements of said clutch shifting means for automatically completing a recording circuit controllable either by one of said wires or the other, depending upon which is being played; whereby after said wires are played in succession, they may be automatically replayed while the other of said wires is simultaneously rewound.

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