

Sept. 7, 1943.

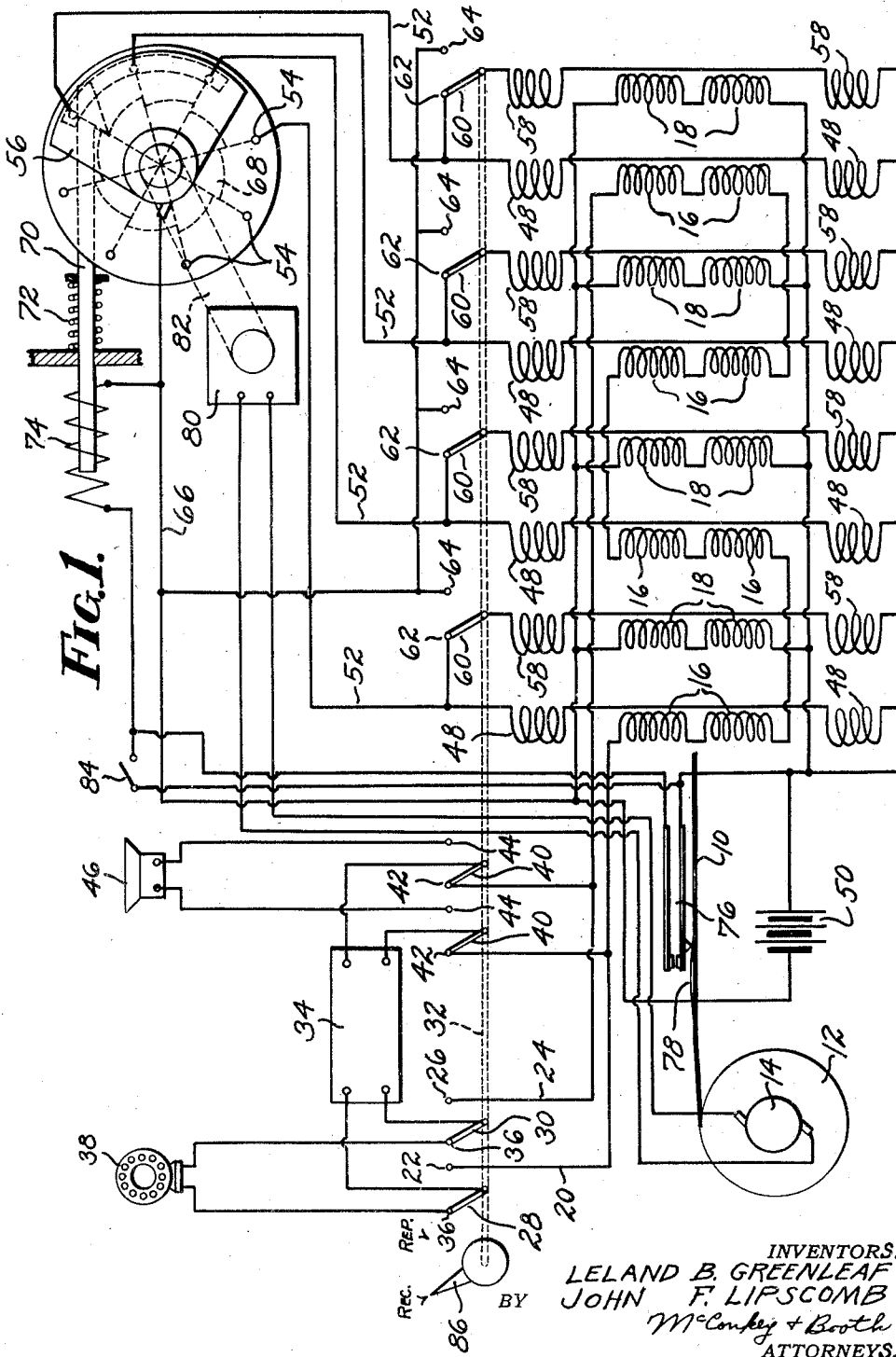
L. B. GREENLEAF ET AL

2,328,539

ELECTROMAGNETIC RECORDER

Filed Jan. 24, 1941

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

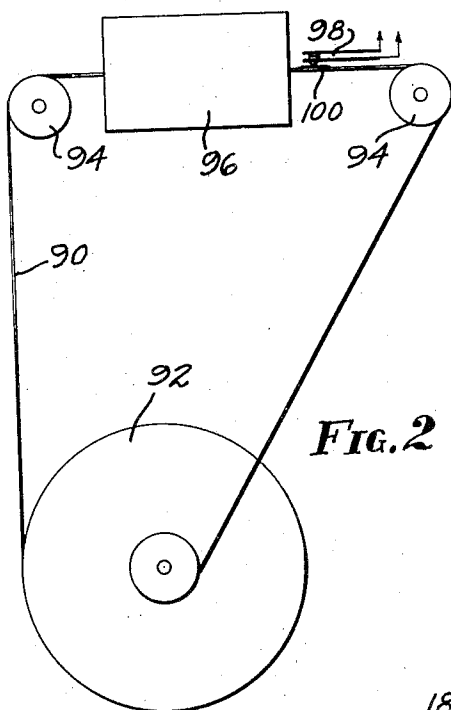


FIG. 2

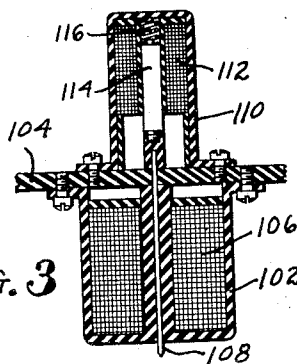


FIG. 3

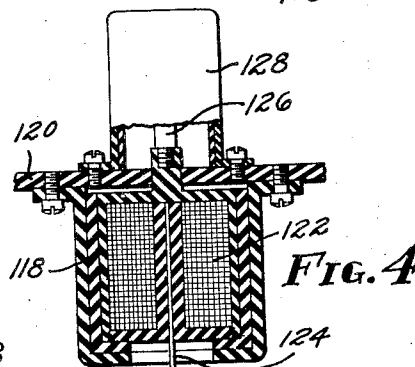


FIG. 4

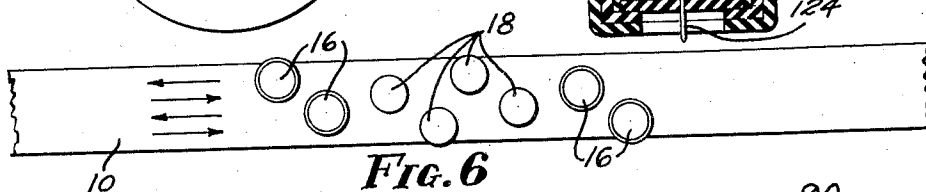


FIG. 6

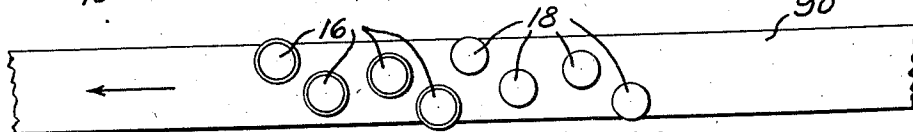


FIG. 7

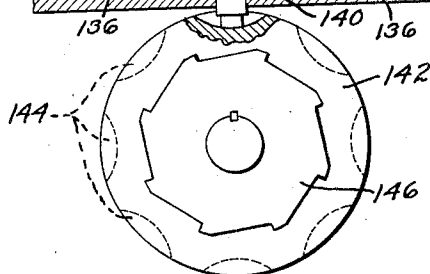
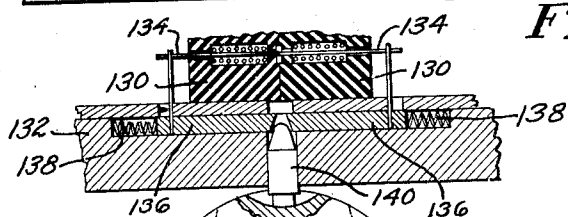


FIG. 5

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2,328,539

ELECTROMAGNETIC RECORDER

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10 Claims. (Cl. 179—100.2)

This invention relates to recording method and apparatus and more particularly to a method and apparatus for magnetically recording on and reproducing from a movable magnetic tape.

One of the objects of the invention is to provide a recording method and apparatus in which a plurality of magnets are spaced across a tape and the cores of the magnets may be raised from the tape. In this way, only one set of cores engages the tape at any one time, and wear on the cores and tape is avoided while enabling a plurality of lanes of recording to be placed on the same tape.

Another object of the invention is to provide a recording method and apparatus of the type referred to in which the set of magnets whose cores engage the tape may be changed to change from one lane of recording to another. According to one construction the direction of travel of tape is reversed, either automatically at the ends of the tape, or manually at will, and the set of magnets whose cores engage the tape is changed upon each reversal. Another desirable construction employs a continuous tape with which the magnets are changed at each revolution of the tape, or at will, at any point in the tape travel.

Still another object of the invention is to provide a recording method and apparatus including sets of recording and erasing magnets having cores engaging a movable tape in which all but one set of cores are raised from the tape during recording, and all of the erasing cores are raised from the tape during reproducing.

Other objects and advantages of the invention, including novel combinations and structural features will be apparent from the following description of the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a recording and reproducing apparatus embodying the invention;

Figure 2 is a diagrammatic view illustrating a continuous tape apparatus;

Figures 3, 4 and 5 are detailed sections illustrating various methods of raising the cores from the tape; and

Figures 6 and 7 are plan views of the tape illustrating the spacing of the magnets thereacross.

In the diagram of Figure 1 a tape 10 wound on one or more spools or reels 12 driven by reversible motors 14 is adapted to be moved longitudinally in reverse directions as the motors 14 are reversed. While only one spool and motor are shown, it will be apparent that two spools are provided to which opposite ends of the tape are

anchored, and that these spools may be driven by the same motor 14, or by separate motors as desired.

The tape is adapted to move between sets of recording magnets indicated at 16 and sets of erasing magnets indicated at 18. Each of the magnets is provided with a core engageable with the tape and it will be noted that the magnets are arranged in series so that their cores will engage the tape on opposite sides thereof. The recording magnets 16 are shown connected in series with a wire 20 leading to a contact 22 and with a wire 24 leading to a contact 26. The contacts 22 and 26 are engageable by switch blades 28 and 30 on a shaft 32, which blades are connected to the input side of an amplifier 34. The blades 28 and 30 are also engageable with a pair of contacts 36 connected to a microphone 38. The output side of the amplifier 34 is connected to a pair of switch blades 40 engageable alternately with a pair of contacts 42 which are connected to the wires 20 and 24, or with a pair of contacts 44 which are connected to a loud speaker 46.

The cores of the recording magnets 16 are adapted to be raised out of engagement with the tape by solenoids 48 associated respectively with the several recording magnets. The solenoids are connected in parallel with one side of a source of electric current indicated as a battery 50 and through wires 52 to contacts 54 on a selector switch. It will be noted that four sets of recording magnets have been shown, and that the selector switch is illustrated as having eight contacts 54, the diametrically opposite ones of which are connected together. The switch includes a segmental wiper adapted to engage three of the contacts 54 simultaneously so that three of the four sets of solenoids 48 are simultaneously energized. Thus only one set of solenoids 48 is deenergized at any one time, and only one set of recording magnet cores will engage the tape at any one time.

The erasing magnets 18 have associated therewith solenoids 58 for raising the cores thereof out of engagement with the tape. The solenoids 58 are connected in parallel in sets to one side of the battery 50 and the other side of each set is connected to a switch arm 60 carried by the shaft 32. The switch arms 60 are alternately engageable with contacts 62 connected to wire 52 of the corresponding recording magnets or with contacts 64 connected in parallel to a wire 66 leading from the other side of the battery 50 to the contactor 56. The erasing coils 18 are connected in

parallel in sets across the battery 50 so as to be energized at all times.

The contactor segment 56 is turned by means of a ratchet mechanism shown as including an eight-tooth ratchet wheel 68 and a reciprocating pawl 70 urged in one direction by a spring 72 and in the other direction by a solenoid 74. Each time the solenoid 74 is energized the ratchet 68 and the contactor segment 56 will be moved through one-eighth of a revolution to change the contacts 54 engaged by the segment 56, so as to change the set of coils whose cores engage the tape.

The solenoid 72 is connected at one side to the wire 66, and at its other side to one blade of a switch 76. The other blade of the switch 76 is connected to the side of battery 50 opposite that to which the wire 66 is connected. The switch 76 is adapted to be closed by operation of the tape and for this purpose the tape 10 is shown as provided at one point in its length with a projection 76 adapted to engage and close the switch 76. The projection 76 may, if desired, be formed either on the face of the tape, as shown, or on the edge thereof, and in the case of a reversible tape a separate projection and switch controlled thereby is preferably provided adjacent each end of the tape so that the projection need not be fed through the magnets.

The ratchet mechanism 70 also serves to reverse the direction of the motor 14 through a reversing switch 80 electrically connected to the motor and operated by a shaft 82 connected to the ratchet 68. Thus, each time the switch 76 is closed by engagement of the projection 76 therewith the motor 14 will be reversed to reverse the direction of the tape, and the segment 56 will be turned to change the set of magnets whose cores engage the tape. In this way, several lanes of recordings spaced across the width of the tape may be obtained without any danger of overlapping. In order that the tape may be reversed and the lane changed at will, a manually operable switch 84 is provided in parallel with the switch 76.

In utilizing the device so far described for recording, the shaft 32 is turned to the position shown by a suitable handle 86 so as to connect the microphone 38 with the input side of the amplifier and the output side of the amplifier with the recording magnets 16. As the tape moves through the magnets any previous recording thereon will be erased by the erasing coils 18, and the desired new recording will be impressed on the tape through the microphone 38 and amplifier 34. As the tape reaches the limit of its travel in one direction the switch 76 will be closed to energize the solenoid 74 and turn the ratchet 68 one-eighth of a revolution. This will change the set of recording and erasing coils whose cores engage the tape and at the same time will reverse the motor 14 so as to move the tape in the opposite direction. During this time a recording will be impressed on a different lane in the width of the tape and will not interfere with the recording previously made. This operation will continue until all lanes of the tape have been completely recorded. If it should be desired at any time to reverse the direction of the tape, for example, to go back to a previous point in the recording to make a correction, the switch 84 may be depressed for an instant. This will reverse the tape and change the magnets to the next lane, but by depressing the switch

84 the proper number of times any point in the recording may be easily arrived at.

For reproducing, the shaft 32 is turned through a handle 86 to connect the speaker 46 with the output of amplifier 34 and to connect the recording coils 16 with the input side of the amplifier. At the same time, the switches 60 are engaged with the contacts 64 to energize all of the solenoids 58 so that the cores of all of the erasing magnets will be raised from the tape. As the tape moves between the recording magnets it will induce a current in that set of magnets whose cores engage the tape and this induced current will be amplified in the amplifier 34 and will operate the speaker 46. During reproduction the tape will reverse as described above in connection with the recording operation, and the solenoids 48 will be successively energized to vary the set of magnets 16 whose cores engage the tape.

Figure 2 illustrates a slightly modified construction for utilizing a continuous tape. As shown in this figure, a continuous tape 90 is fed from the outside of a reel 92 and is fed into the center of the reel as shown. The tape 90 passes over guide pulleys 94 and through a recording and reproducing unit embodying recording and erasing coils and core lifting means therefor, as shown in Figure 1. This unit is indicated in general at 96 and includes a switch 98 similar to the switch 76 and actuated by a projection 100 on the tape to change the set of coils whose cores engage the tape. Since the tape 90 rotates continuously in one direction the reversing mechanism is omitted, but every time the tape makes one complete passage through the recording unit the projection 100 will close the switch 98 to change the solenoid circuits so as to record on or reproduce from a different lane of tape. This mechanism may also include a manual switch similar to the switch 84 in parallel with the switch 98 to change the lane of recording or reproducing at will.

Figure 3 illustrates one desirable magnet and solenoid construction which may be utilized for either the recording coils 16 or the erasing coils 18 or both. As shown, a housing 102 is rigidly mounted on a support 104 and has therein a winding 106 which may correspond to one of the magnets 16 or 18. A core 108 is slidable in the central portion of the housing and extends through the coil so that its outer projecting end may engage the tape. A second housing 110 is supported on the support 104 and contains a winding 112 which may correspond to one of the solenoids 48 to 58. A core 114 connected to the core 108 extends into the coil 112. The spring 116 engages the core 114 and urges it in a direction to press the point of the core 108 against the tape. When the winding 112 is energized the cores 108 and 114 will be raised against the spring 116 to disengage the core 108 from the tape.

Figure 4 illustrates a modified construction in which a housing 118 is secured to a support 120 and has a magnet coil 122 slidably mounted therein. A core 124 adapted to engage the tape is rigidly secured in the coil 122 and a second core 126 is connected to the coil and extends through the support 120. A housing 128 on the plate 120 may contain a second coil similar to coil 112 of Figure 3. When the coil in the housing 128 is de-energized the core 124 will be pressed against the tape, but when this coil is energized magnet 122 and core 124 will be moved

bodily in the casing 118 to lift the core 124 from the tape.

Figure 5 illustrates a mechanical method of raising the cores from the tape through a cam mechanism. As shown, magnet blocks 130 are rigidly supported on a plate 132 and cores 134 are slidable therethrough. The cores 134 are connected to plates 136 slidable in the block 132 and urged together by springs 138. A cam pin 140 extends through an opening in the support 132 and has a tapered end between the plates 136. It will be understood that the above construction is duplicated for each separate set of magnets.

The several sets of magnets may be controlled by a single circular cam 142 having a series of axially and circumferentially spaced cam depressions 144 in the periphery thereof to engage the several sets of cam pins 140. The cam 142 is shown provided with a ratchet wheel 146 which may be operated by a pawl mechanism of the type shown in Figure 1.

When the cam plungers 140 rest in the corresponding depressions 144 the plates 136 will move together under the influence of springs 138 to move the cores 134 together against opposite sides of the tape. Due to the arrangement of the cam depressions 144 only one set of cores is permitted to engage the tape at any one time and as the cam 142 is turned the set of cores engaging the tape will be changed. It will be apparent that instead of moving the cores alone the entire coils 130 might be moved with the cores through a connection with the plates 136.

Figure 6 illustrates the spacing of recording and reproducing magnets for a reversible tape apparatus of the type illustrated in Figure 1. As shown, the tape 10 is of sufficient width to accommodate four lanes of recording. The recording coils 16 are spaced across the width thereof in such a way that their cores will engage areas of the tape corresponding to the several lanes and the erasing coils 18 are similarly spaced, it being noted that one erasing and one recording coil occupy each of the four lanes. The particular arrangement of the coils as illustrated is subject to slight variation, it being sufficient that one erasing coil and one recording coil lie in alignment in each lane, and that the lanes do not overlap. In operation, if the uppermost recording and erasing coils had their cores engaging the tape the direction of tape travel would be from right to left so that the erasing coil 18 would first act on the tape to remove the effect of any prior recording, and the recording coil 16 would then act on the same area of the tape to place a new recording thereon. As the tape reversed to travel from left to right, the second set of coils from the top would have their cores engage the tape and alternately from top to bottom of the tape.

In the arrangement shown in Figure 7, the tape 90 is similar to the tape 10 of Figure 6, but is arranged to travel at all times in a direction from right to left. Thus all of the erasing coils 18 are located to the right of the recording coils 16, so that they will always act on the tape in each lane prior to the corresponding recording coil.

While several embodiments and alternative constructions according to the invention have been illustrated and described in detail it will be understood that this has been done by way of example only and is not intended as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. Recording apparatus comprising an elongated flat tape, means for moving the tape lengthwise, a plurality of sets of magnets having cores engageable with the tape at points spaced across the width thereof, solenoids associated with the sets of magnets respectively to raise the cores from the tape, and control means for the solenoids to cause them to raise the cores of all but one set of magnets from the tape.

2. Recording apparatus comprising an elongated flat tape, means for moving the tape lengthwise, a plurality of sets of magnets having cores engageable with the tape at points spaced across the width thereof, and cam means associated with the magnets and operable simultaneously to raise all but one set of cores from the tape.

3. Recording apparatus comprising an elongated flat tape, means for feeding the tape lengthwise, a plurality of sets of recording magnets engaging the tape at points spaced across its width, a plurality of sets of erasing magnets corresponding respectively to the recording magnets and having cores engaging the tape at points spaced across its width, means for raising the cores of all but one set of recording and erasing magnets from the tape, and means for raising all of the erasing cores and all but one set of recording cores from the tape while leaving one set of recording cores in engagement therewith.

4. Recording apparatus comprising an elongated flat tape, means for feeding the tape lengthwise, a plurality of sets of recording magnets engaging the tape at points spaced across its width, a plurality of sets of erasing magnets corresponding respectively to the recording magnets and having cores engaging the tape at points spaced across its width, solenoids associated with the recording and erasing magnets to raise the cores thereof from the tape, circuits for said solenoids for selectively energizing all of the solenoids except those corresponding to one set of recording and erasing magnets, and additional circuits for the solenoids associated with the erasing magnets for simultaneously raising all of the erasing cores from the tape.

5. Recording apparatus comprising an elongated flat tape, means for feeding the tape lengthwise, a plurality of sets of recording magnets engaging the tape at points spaced across its width, a plurality of sets of erasing magnets corresponding respectively to the recording magnets and having cores engaging the tape at points spaced across its width, a rotatable selector device to select the set of magnets whose cores shall engage the tape, ratchet means for turning said selector device through a predetermined angle at each operation, and means on the tape for operating the ratchet means at a predetermined point in the tape length.

6. Recording apparatus comprising an elongated flat tape, means for feeding the tape lengthwise, a plurality of sets of recording magnets engaging the tape at points spaced across its width, a plurality of sets of erasing magnets corresponding respectively to the recording magnets and having cores engaging the tape at points spaced across its width, a rotatable selector device to select the set of magnets whose cores shall engage the tape, ratchet means for turning said selector device through a predetermined angle at each operation, means on the tape for operating the ratchet means at a predetermined point in the tape length, and manual means for operating the ratchet means at will.

7. In a recording apparatus having a longitudinally movable magnetic tape, a magnet including a coil fixedly mounted adjacent the tape, a core movably mounted in the coil and engageable at one end with the tape, and a solenoid associated with the core to move it out of engagement with the tape.

8. In a recording apparatus having a longitudinally movable magnetic tape, a magnet including a coil movably mounted adjacent the tape, a core rigidly connected to the coil and engageable with the tape, and a solenoid associated with the coil for moving it away from the tape to disengage the core therefrom.

9. In a recording apparatus having a longitudinally movable magnetic tape, a magnet including a coil movably mounted adjacent the tape, a core rigidly connected to the coil and

engageable with the tape, and cam means engageable with the coil to move it away from the tape to disengage the core therefrom.

10. Recording apparatus comprising an elongated flat tape, means for moving the tape lengthwise, a plurality of sets of magnets mounted adjacent the tape and having cores engageable with the tape at points spaced across the width thereof, means for simultaneously energizing said sets of magnets, means associated with the magnets respectively to raise the cores thereof from the tape, and control means for the last named means to operate the last named means selectively to raise the cores of all but one set of magnets from the tape.

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