

May 30, 1950

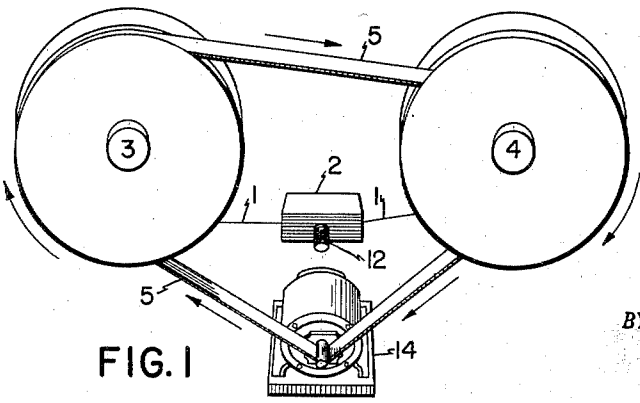
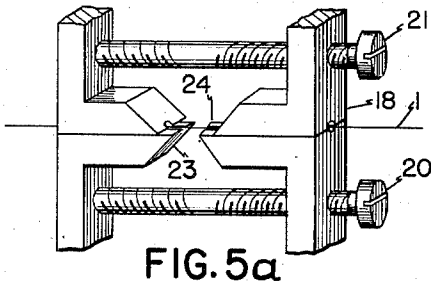
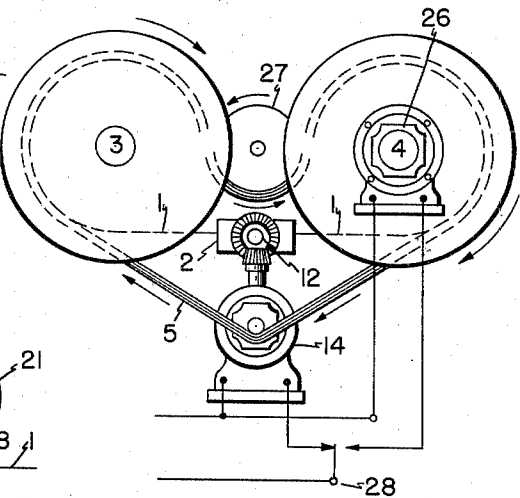
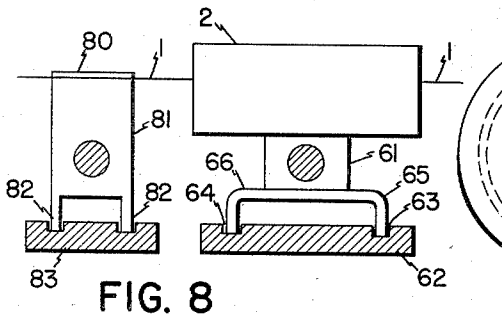
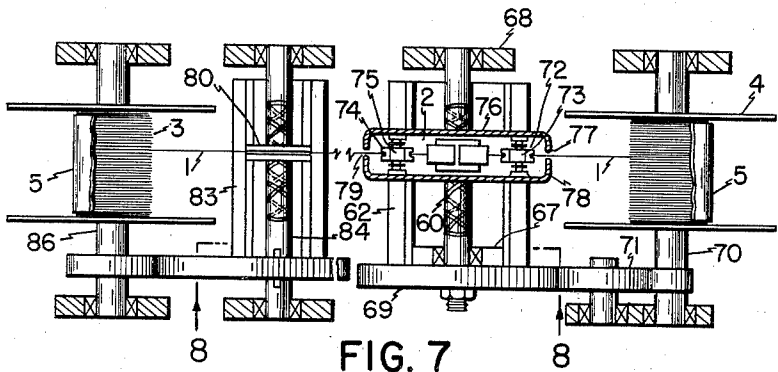
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2,509,500

REELING DEVICE FOR WIRE RECORDS

Original Filed Aug. 24, 1944

2 Sheets-Sheet 1



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REELING DEVICE FOR WIRE RECORDS

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2 Sheets-Sheet 2

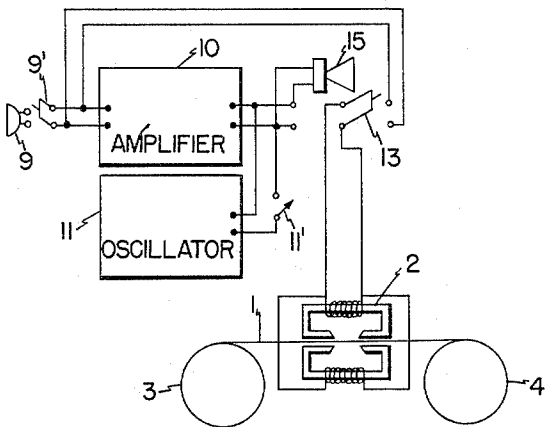


FIG. 4

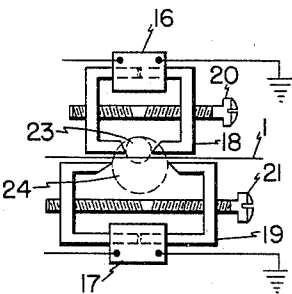


FIG. 5

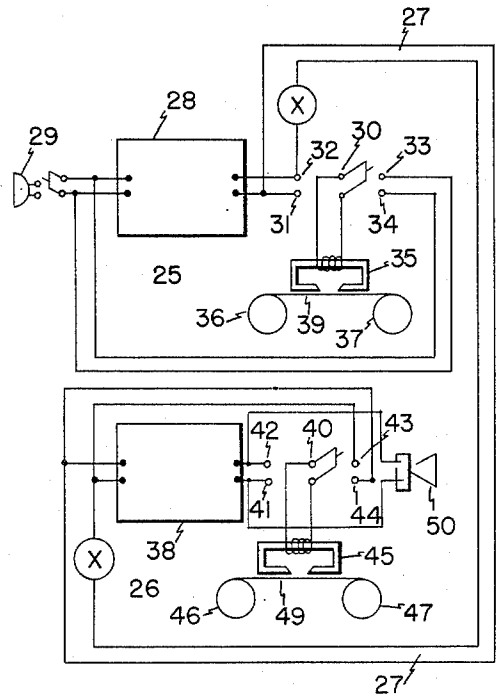


FIG. 6

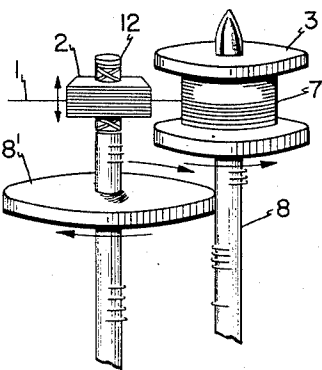


FIG. 3

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REELING DEVICE FOR WIRE RECORDS

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Continuation of application Serial No. 550,913,
August 24, 1944. This application March 30,
1945, Serial No. 585,773

3 Claims. (Cl. 179—100.2)

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The present invention relates to electromagnetic telegraphone recording and reproducing and provides many distinct advantages over any other known form of voice or sound recording such as adaptability to record erasure and re-recording, minimum weight and power required for records of long duration and continuous operation in any position.

This invention has for one purpose high quality recording and reproduction on fragile filaments of paramagnetic wire as fine as one, two or three one-thousandths or even fractions of a thousandth of an inch in diameter at constant velocity, free from snarls or breakage and rewind at ten or more times the speed at which wire is passed through an electromagnetic recording unit.

Heretofore rewind of paramagnetic wire ten mils thick consumed about half the time used in recording. This invention has for another purpose a new type electromagnetic sound unit and record reproduction process, which serves as a band pass filter and equalizer in extending the frequency and amplitude telegraphone range.

This application is a continuation of my pending application entitled Telegraphone, No. 550,913, filed August 24, 1944, now abandoned.

In that application means were disclosed for floating wire through a telegraphone soundhead by causing the wire to be pushed at approximate constant velocity by an unreeling spool at the approximate speed it was being pulled by a reeling spool irrespective of relative change in speed of the bobbins.

This invention is an improvement in the mechanical system disclosed by that invention which worked well with wire having the stiffness and diameter commonly used in telegraphone practice but not so well with finer wire. The weight of wire is reduced as the square root of its diameter for the same length.

In this invention both spools are driven by an endless belt passing around the spools but applying driving forces to each successive layer of wire wound by the spools rather than by driving the spools themselves directly.

The belt holds the fine wire tightly on the spools, affording rewind without snarls and rapid starting, stopping and reversal.

This invention discloses a new and novel method of providing a broad frequency range recording and reproduction in which the electromagnetic wire passes between two recording and reproducing electromagnets having four juxtaposed poles forming air gaps positioned transverse

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to the travel of the wire and acting in the same phase each with the other but differing each from the other in their width which is independently adjustable. This serves in effect as individual band pass filters, one filter discriminating against higher frequencies in favor of lower frequencies, and the other filter discriminating against lower frequencies in favor of higher frequencies.

The use of dual electromagnets with variably adjusted air gaps transversely juxtaposed between which the wire passes provides the additional advantage of combining longitudinal recording and transverse recording, both at the same time.

The use of dual electromagnets with phased transverse air gaps between which the wire is passed has the further distinct advantage of concentrating an improved flux field and making possible the ideal arrangement of a hole through which the fine wire may be passed at right angles to the dual air gaps. This provides magnetization by a closed field, avoiding saturation since the juxtaposed pole pieces of each electromagnet set up shunt flux paths in which the presence of like adjacent poles tend to crowd the magnetic flux in the space between the adjacent poles.

The mechanical system makes breakage impossible. Consequently the wire is not distorted by welds or knots and may be passed freely at high speed through the hole formed by the juxtaposed pole pieces of the two electromagnets.

Without further describing the merits and advantages of the present invention, the invention will be described in connection with the embodiments disclosed in the specification below taken in connection with the drawings in which:

Figure 1 shows the invention somewhat diagrammatically.

Figure 2 shows a modification of the arrangement of Figure 1.

Figure 3 shows diagrammatically a detail applicable to Figures 1 and 2.

Figure 4 shows a circuit diagram for a recording-reproducing circuit which may be used in the invention.

Figure 5 shows diagrammatically a detail of the soundhead which may be used in the present invention.

Figure 5a is a perspective of the detail shown in Figure 5.

Figure 6 shows a circuit diagram of the invention illustrating high speed transmission of code or voice.

Figure 7 shows somewhat diagrammatically

modifications in details applicable to the arrangements of Figures 1 and 2 and

Figure 8 shows fragmentary elevations of the details shown in Figure 7 on the line 8—8.

In Figure 1 wire 1, which is the magnetizable wire of the telegraphone and may be of the order of three or four mils in diameter, may be reeled onto spool 3 from spool 4 through soundhead 2. Motor 14 drives belt 5 which may be of flexible material as, for instance, rubber, leather, fabric, plastics or composition and serves to keep the wire in place at the same time relieving the wire of all tension strains. Belt 5, in this modification, drives spools 3 and 4 but, as will be shown later, either of the reels may be driven, the belts serving principally to distribute stresses which otherwise would distort wire 1 either in tension torsion or compression. Belt 5 is designed to apply frictional force to wire 1 through maintaining contact with the wire over substantially the greater portion of its length, except that section passing through the soundhead 2, particularly with each consecutively wound layer of wire forming the constantly changing outer layer of wire on both spools.

The drive pulley of motor 14 in Figure 1 draws belt 5 away from wire 1 between the point at which wire 1 leaves spool 4 to pass through soundhead 2 and the point at which wire 1 is wound by spool 3. The relative rotational speed of spools 3 and 4 vary constantly. Motor 14 preferably is made a clock or synchronous motor rotating at constant velocity though different velocities may be used at different operations, both for wind and rewind. This causes wire 1 to move at controlled constant velocity through soundhead 2. Constant wire velocity provides high fidelity, free from wows or flutter, which is a notable improvement of record quality over any system wherein wire is drawn at variable speed from an unwinding spool to a winding spool.

Wire 1 is laced in even turns by dual reverse threaded level winding unit 12, which is shown in more detail in Figure 7 where two such units may be used, rotating in the plane of spools 3 and 4. A reduction driven cam such as is used for winding thread on bobbins might be substituted for the reverse threaded level winding unit shown. Both are well known.

Figure 2 shows a method of using two motors to behave as high speed brakes or high speed reversal. Spool 4 is driven directly or through gearing by motor 26 to wind wire 1 from spool 3 in reverse of the direction used for recording and reproducing sound or for so-called rewind. Motor 26, for this purpose, may be a high speed starting motor. When motor 14 drives, motor 26 behaves as an idler and may be used as a brake by short circuiting the motor terminals after opening its power supply. When motor 26 drives, motor 14 is an idler and may be used in the same way as motor 26 was used above. There is nothing to be gained by rewind at constant velocity but high speed rewind enables wire recording to compete with phonograph processes requiring no rewind. Belt 5 and pulley 27 distribute stress in rewind, relieving wire 1 of strains and holding it tightly wound free from snarls. The arrangement of Figure 2 has the advantage that pulley 27 keeps the belt 5 in contact with practically the whole circumference of the spool, preventing the effect of centrifugal action at high speeds from exerting strains on the wire or throwing the wire out of contact with the belt.

As an example of the efficiency of this system,

a telegraphone was driven constantly at wind and rewind, using an automatic reversing switch not shown in the drawings. Motor 14 for wind was a synchronous motor driving belt 5 at 1800 R. P. M. Motor 26 for rewind was a shaded pole motor turning spool 4 at 3000 R. P. M., the reversing switch operating the motors alternately. Wire was wound and rewound many hundreds of times for many hours free from snarls and rupture. Wind, rewind and abrupt stopping of the telegraphone is controlled manually by switch 28.

Figure 3 shows a conventional type of level winding unit. The friction disc 8' is driven at a comparatively slow speed by the shaft 8 which is the bearing shaft for spool 3. Disc 8' drives reverse right and left threaded level wind unit 12 which freely supports the soundhead 2. Soundhead 2 rises and falls on the reverse threaded level wind shaft lacing wire 1 in even turns on hub 7 of spool 3.

Figure 4 shows one suitable method of wire recording and reproduction. Input microphone 9 feeds through switch 9', amplifier 10 shown as an audio frequency amplifier. Output of amplifier 10 may be monitored by loudspeaker 15 and at the same time impressed upon soundhead 2 when the switch 13 is thrown to the right to propagate a flux field magnetically recording sound images on wire 1 wound from spool 4 to spool 3. The output of oscillator 11 also may be impressed on soundhead 2 by closing the switch 11' and made to serve both as an eraser of previous history and conditioning medium operating through 2 or a separate coil.

A common fault of wire winding telegraphones which wind wire by pulling is wire entanglement, rupture and twisting. In this unit belt 5 holds wire 1 tightly laced on spools 3 and 4 to prevent this whether the unit be operated at high speed, low speed, or at rest. The belt also takes up and distributes the high stress which otherwise might be put on wire 1. In addition to the stress of pulling, a twisting stress and a tangential stress is taken up by belt 5 which purposely may be made slightly less than the approximate width of the distance between the flanges of spools 3 and 4 on which the wire is wound. No matter how much wire may be wound on either spool, the sum of the joint circumference of both spools remains the same.

Belt 5 may be used to exert traction and braking action, freeing wire 1 from strain during movement, abrupt stop or reversal of the motor in both winding and rewinding. Belt 5 causes wire 1 to float through soundhead 2, the only tension on the wire being that necessary to draw the short section of its length which is not in contact with the belt. This means that the wire is substantially free from all tension and torsion. This affords attributes of pronounced higher quality to wire records.

In Figure 2 the traction and grip of belt 5 on wire 1 is substantially increased because all the outward centrifugal force against the wire is taken up by the belt. Motor 14 is shown driving belt 5 in such manner as to free wire 1 between the point it leaves spool 4 to pass through soundhead 2 and the point it is wound upon spool 3, or vice versa.

Movement of wire 1 through soundhead 2 by design is at controlled constant velocity of clock motor 14. Instead of driving belt 5 directly, the idler 27 could be driven and the motor 14 permitted to idle, in which case a separate clock motor would be used for idler 27. Pulley 27 pur-

posely is made narrower than the distance between the flanges of spools 3 and 4. The width of belt 5 may be proportionate to that of pulley 27. Belt 5 and pulley 27 distribute the stress of winding at low or high speed, abrupt stopping, reversal of motion. Wire 1 evenly laced by reverse threaded level winding unit 12 is confined by belt 5 and pulley 27 free from snarls or rupture. Ruptural force has been known to break the flanges of winding spools when wire was wound by pulling.

Use of oscillator 11 is not essential to wire recording. For reproduction wire first is rewound from spool 3 to spool 4, soundhead 2 being taken out of the circuit. Switch 13 (Figure 4) is reversed (thrown to the right) to feed the output of soundhead 2, energized by the sound image fields of moving wire 1, into amplified 10.

If oscillator 11 was employed for recording, it is cut out of the circuit during reproduction by opening switch 11'. The amplified sound records may be impressed on loudspeaker 15. Switch 13 may be opened during rewind.

When a superheterodyne tuner is used to record broadcast messages, the common oscillator of the tuning circuit may be used for erasure. Part of the output of the intermediate frequency amplifier may be used for wire conditioning and sound recording. It is not necessary that this output be rectified. The output of the I. F. amplifier fed to the electromagnetic soundhead also may be augmented by output of the audio frequency amplifier of the superheterodyne. This in turn may be equalized.

Figures 5 and 5a show a high fidelity electromagnetic unit which may be used to extend the frequency range of wire recording and reproduction. Wire 1 is passed between two electromagnets arranged with their like poles adjacent each other. Each electromagnet is characterized by two poles separated by a gap.

The movement of the wire is at an angle to the gaps of each juxtaposed electromagnet and is, in fact, shown in Figure 5 to be moved through the flux fields of each gap at an angle normal to the gaps.

In Figure 5 coils 16 and 17 may serve as supports for cores of electromagnets 18 and 19. Cores 18 and 19 are further supported by micro-screws 20 and 21 which are threaded at right and left angles from the center so that rotation of a micro-screw in one direction will cause the poles of one electromagnet to separate in equal distances. To permit separation of the poles, the cores within the coils may be cut across or at an angle or one core may telescope in the other providing constant reluctance in any position. Extension of the poles is very slight so that the screw thread pitch is exaggerated in the drawing. Rotation in an opposite direction will cause the poles of each section of the electromagnet to move toward each other in equal distances. The gaps at the poles may be balanced by gaps within coils 16 and 17 or flexible connections may be provided between the side arms of the core and the back holding the coils to permit the gap widths to be adjusted.

By adjusting both electromagnets with micro-screws 20 and 21 it is possible to maintain flux fields 23 and 24 each in time phase with the other and symmetrical with respect to each other.

Gap 23, for example, may be set at approximately 1 mil or less to discriminate against low frequencies in favor of high frequencies. Gap

24, for example, may be set at approximately 2 mils or more to discriminate against high frequencies in favor of low frequencies. Under normal conditions, however, the air gaps may have the same width and be aligned together. Wire 1 is moved through the flux fields of both gaps, each set of poles being separate from the other by an oxidized coating, if desired. This provides the enhanced quality of longitudinal magnetism and transverse or perpendicular magnetism. This enhanced effect is to be had in recording sound images on the wire and in reproduction of sound images recorded on the wire. The two electromagnets may be energized from the same audio-frequency source and may be wound in series or in parallel. The two electromagnets perform the function of bank pass filters and may be used for extended telegraphic frequency range.

The pole pieces of each electromagnet may be fixed opposite wire 1 to form a dual flux path through which wire 1 may be moved. The pole pieces of each electromagnet may be placed in contact with the pole pieces of the opposite electromagnet and wire 1 moved through a hole formed by joining a symmetrical groove in each electromagnetic pole section, as shown more clearly in Figure 5a, so as to form the ideal arrangement wherein the wire moves at an angle to the gaps in a closed magnetic field. The shunt field of the two juxtaposed electromagnets in contact discriminates against saturation. It is not necessary to have the wire pass through a hole. The wire is shown passing through the dual flux fields of gaps 23 and 24. The use of micro-screws for gap adjustment is not essential but advantageous.

Figure 6 discloses a system of wire recording, transmission by wire or radio at high speed in code, recording in code at high speed at one or more receiving points and automatic decoding at normal slow speech speed immediately after the message has been received without recourse to any rewind whatsoever.

Two telegraphones 25 and 26 are shown in the circuit of a communications path 27. Path 27 may be a long distance telephone line or a radio broadcast path. The message may be dictated to microphone 29, the output of which, by means of switch 29', is boosted by amplifier 28 and recorded at normal speech speed upon wire 39 passed from spool 36 to spool 37 at the normal speed suitable for speech dictation which may be made about one to two feet wire speed per second. Switch 30 puts soundhead 35 in circuit with the output of amplifier 28 in the circuit 31 and 32.

After the message has been recorded, switch 30 thrown to the right puts soundhead 35 into the input of amplifier 28, causing soundhead 35 to behave as a pickup reproducing head, feeding the amplifier input circuit 33 and 34. Transmitting telegraphone 25 then is placed in circuit 27 with the receiving telegraphone 26.

Switch 40 is moved to the left to feed the output of amplifier 38 to soundhead 45 in circuit 41 and 42.

Wire 39 is moved in the reverse direction of movement used in recording the dictation. It is moved at high speed, double or treble the speed used for dictation if transmission is to be made over the common telephone line speech channel, having a range of about 3000 cycles. Much higher speed may be used over a high fidelity wide range line or by the wider frequency chan-

nels used; for instance, in frequency modulation broadcast transmission or microwave transmission.

Wire 49 of receiver 26 is moved in the same direction as wire 38 of transmitter 25 and at corresponding high speed, both for transmitting telegraphone and receiving telegraphone. The recording message then is transmitted backward at high speed over the transmitting network 27.

To the ear the transmitted sound appears a high pitched unintelligible chirping. As an example, a message of about one thousand words was dictated by three persons to a telegraphone at normal speech speed of about two feet a second. From New York city, Washington, D. C., was called by long distance. Washington called New York over another long distance pair. The line to Washington and the line from Washington were coupled. The message from the first telegraphone then was transmitted at a speed of more than a thousand words in three minutes, recorded backward in code upon a receiving telegraphone. The receiving telegraphone was then operated in reverse at slow speed without wire rewind. The thousand word message was reproduced by the receiving telegraphone at normal speed. There was no delay for rewind because the transmitted message had been recorded backward.

The transmitted message having been recorded by telegraphone 26, switch 40 is thrown to connect soundhead 45 to a reproducer, coupling soundhead 45 to input terminals 43 and 44 of amplifier 38. Movement of wire 48 from spool 47 to spool 46 at the slow normal speed suitable for speech automatically decodes the message by reversing it. The message may be heard reproduced by loudspeaker 50.

In Figures 7 and 8 an arrangement for lacing the wire on both spools 3 and 4 is shown. Here the lacing screw 60 with the forward and reverse track threads through the bracket 61 attached to the soundhead 2. The assembly of the bracket and soundhead are reciprocated over the plate 62 provided with grooves 63 and 64 in which dependent supporting arms 65 and 66 engage, providing a sliding fit and maintaining the head 2 in its proper position with uniform longitudinal motion along the lacing screw 60. The lacing screw 60 may be journaled in bearings 67 and 68 and driven by the friction disc 69 deriving its power from the shaft 70 through the idler 71. The lacing speed is, therefore, always proportional to the speed of the spool 4 so that when there is more wire on the spool and its speed is slower, the head 2 will reciprocate back and forth slower than when the spool is more emptied. This is on the assumption that the spool is driven by the friction belt 5, as in Figure 1 and Figure 2, when the motor 14 is the driving motor.

The wire 1 in Figure 7 may pass through pairs of guide rolls or plates 72, 73 and 74, 75 positioned on either side of the telegraphone magnet 76 which may be constructed as described in Figures 5 and 5a. The casing 77 for the soundhead is provided with suitable entrance and exit guide holes 78 and 79. The soundhead itself serves to act as the guide for lacing the wire on the spool 4 while a separate lacing means 81 having a wire guide 80 may be used for lacing the wire on the spool 3. The means 81 has guide supports 82, 83 moving in channels in the plate 83 and is reciprocated back and forth by the lacing screw 84 driven by the friction disc 85 from the shaft 86 of the spool 3.

This double lacing means may be dispensed with where the thickness of the wire on the spool is small as under these conditions approximately the same length of wire is wound per turn on one spool as is unwound on the other spool. However, where great accuracy is required, this expedient above may be used.

In the present invention considerable time is saved in transmission of messages over wires or by radio by the elimination of rewind after recording and transmitting the message backward or reverse from the order of recording. On the receiving end the message transmitted and recorded backward will be in position to be reproduced in a forward direction.

Having now described my invention, I claim:

1. A telegraphone device including a pair of spools having parallel rotational axes, a continuous wire wound in layers on said spools and adapted to be unwound on either spool and wound on the other spool, a soundhead positioned between said spools through which said wire passes, a belt overlaying said spools and applying frictional force to the outer layer of wire on said spool, and means for driving one of said spools directly for moving said wire and spools, and means alternately for driving said belt to drive said wire and spools, said last two means including driving motors, one of which adapted to be used as a brake for the other.

2. A telegraphone device including a pair of spools and a wire adapted to be wound on one of the spools as it is unwound on the other of the spools, the courses of the wire between the spools being on one side of the line between the axis of the spool, an endless belt passing externally around both spools and positioned to make contact with the surface of the outer wire layer on the spools, a pulley around which the belt passes, means for driving said pulley to move said belt, said belt being positioned externally of the wire going from one spool to the other and out of contact with the wire substantially from the point it leaves the spool, a second pulley externally of said belt on the side where no wire goes from one spool to the other for maintaining contact of the belt against the surface of the outer wire layer on the spools substantially to the line of the intersection of outer surface and the plane embracing the axis of the spools, means for driving one of said spools directly and switching means for selecting the means for driving the pulley or the means for directly driving one of said spools for operation.

3. A telegraphone device including a pair of spools and a wire adapted to be wound on one of the spools as it is unwound on the other of the spools, the courses of the wire between the spools being on one side of the line between the axis of the spool, and endless belt passing externally around both spools and positioned to make contact with the surface of the outer wire layer on the spools, a pulley around which the belt passes, said belt being positioned externally of the wire going from one spool to the other and out of contact with the wire substantially from the point it leaves the spool, a second pulley externally of said belt on the side where no wire goes from one spool to the other for maintaining contact of the belt against the surface of the outer wire layer on the spools, and means acting directly on the spool for driving the same.

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