No. 773,985. PATENTED NOV. 1, 1904.

E. E. RIES.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH, &c.

APPLICATION FILED FEB. 26, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

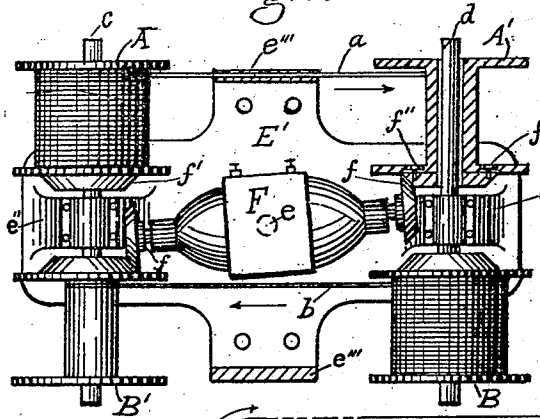


Fig. 2.

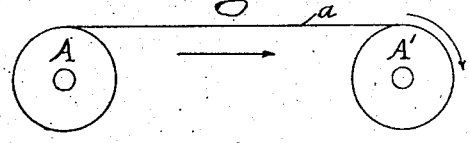


Fig. 3.

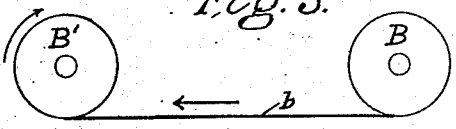


Fig. 4.

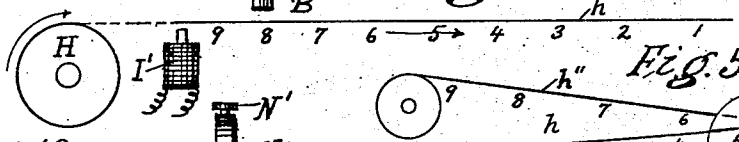


Fig. 5.

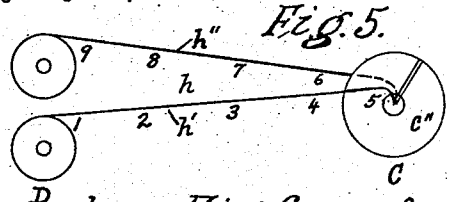


Fig. 10.

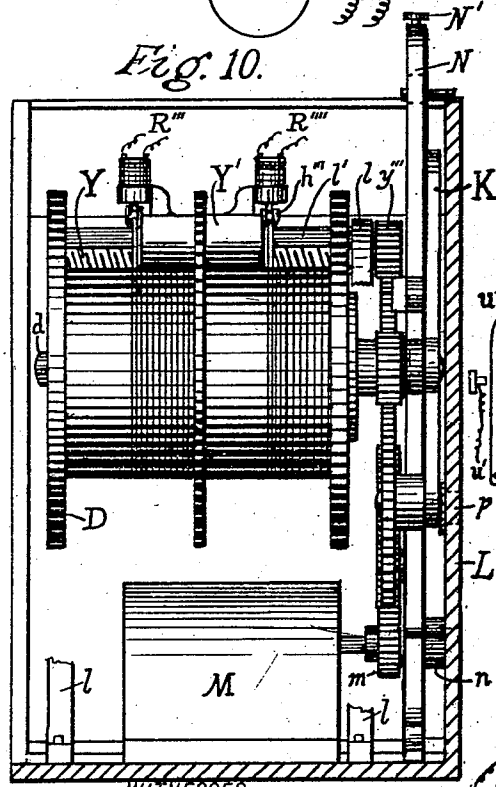


Fig. 6.

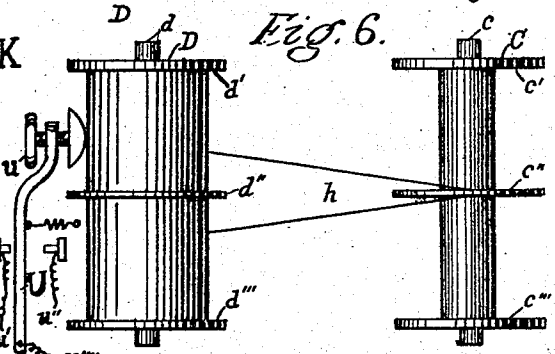


Fig. 7.

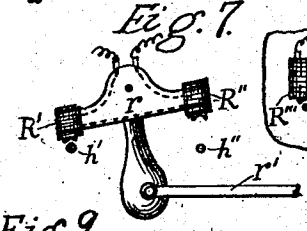


Fig. 8.

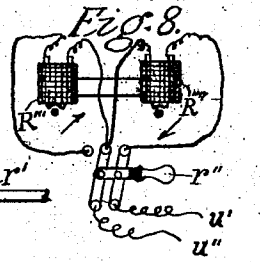
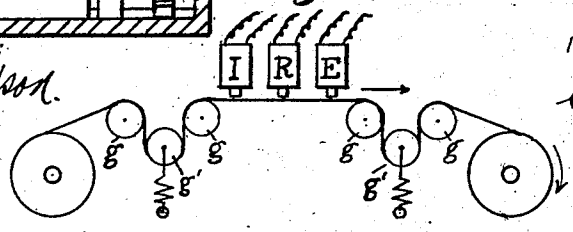


Fig. 9.



WITNESSES:

J. E. Davidson.

M. C. Bell.

INVENTOR

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APPLICATION FILED FEB. 26, 1903.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 11.

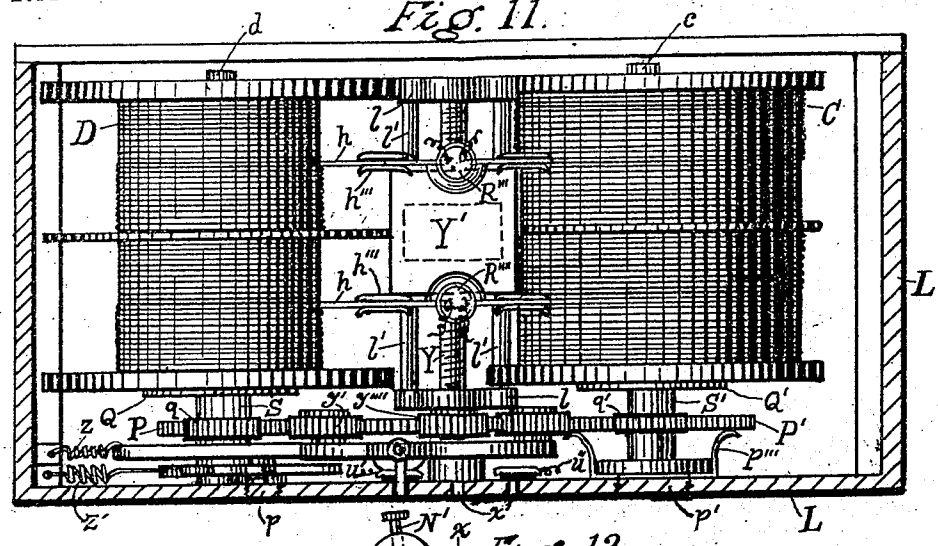
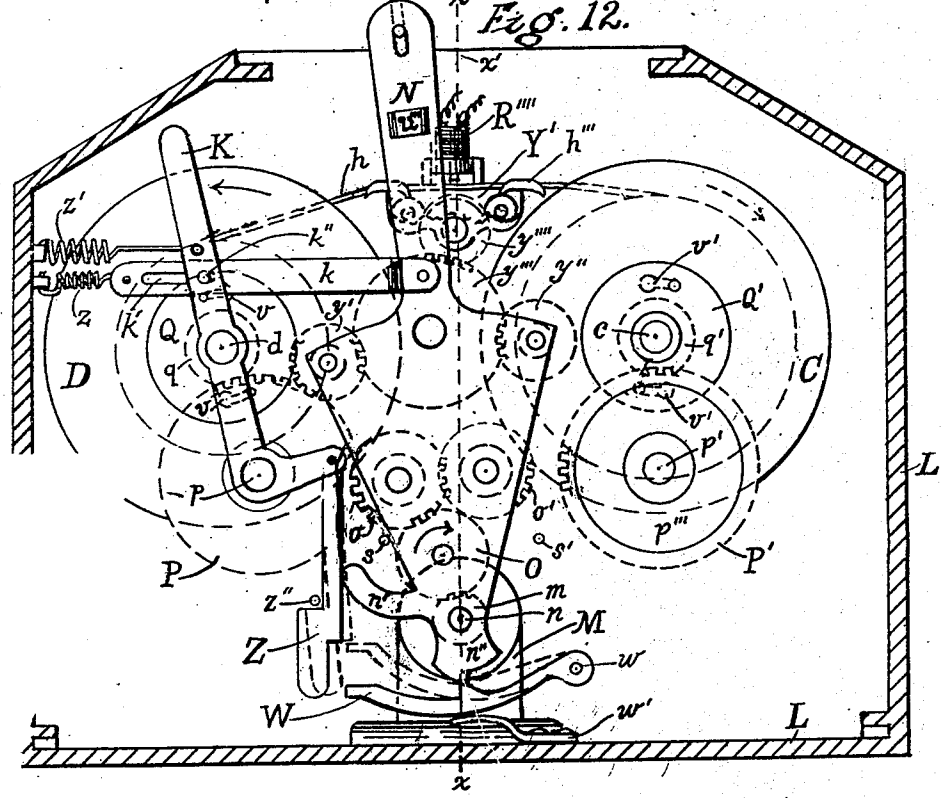


Fig. 12.



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No. 773,985. Patented November 1, 1904.

UNITED STATES PATENT OFFICE.

ELIAS E. RIES, OF NEW YORK, N. Y.

APPARATUS FOR RECORDING AND REPRODUCING SPEECH, &c.

SPECIFICATION forming part of Letters Patent No. 773,985, dated November 1, 1904.

Application filed February 26, 1903. Serial No. 145,267. (No model.)

To all whom it may concern:

Be it known that I, ELIAS E. RIES, a citizen of the United States, and a resident of the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Apparatus for Recording and Reproducing Speech, &c., of which the following is a specification.

My invention embraces certain new and useful improvements in apparatus for recording and reproducing speech and other sounds or impulses electromagnetically, by which various new and useful results, as well as economies in operation, are produced and by means of which the apparatus is better adapted to commercial requirements than has heretofore been possible.

My present invention relates more particularly to magnetic phonographs, telegraphones, or telephonographs of that class in which a magnetizable steel wire or ribbon that is wound from one spool or drum onto another is employed as a carrier or base for the magnetic record. When such records are in the form of an endless band or belt, their capacity for receiving vocal or other records is greatly limited, although their capacity for reproducing or repeating their contained records is practically unrestricted, owing to the endless nature and uniform direction of motion of the band. Such capacity for repetition of a record either after its original impression or subsequently thereto is in many cases highly desirable and for certain commercial purposes indispensable. Yet in view of the high speed of the wire or ribbon necessary in phonographs of this type such band or belt records are impracticable for most commercial purposes in which voice-records are employed. On the other hand, when a long record-wire is wound upon a spool or drum capable of containing, comparatively speaking, an unlimited length and is from thence wound upon a receiving spool or drum either in the process of receiving or of reproducing its record several new and serious difficulties arise that for many purposes make also this method commercially impracticable. Among these difficulties I may mention the following:

First. If such "long" containing-wire be unwound from its original containing-spool for the purpose of receiving or being charged with a vocal, musical, or other record and then wound upon the receiving-spool, it cannot be immediately utilized to reproduce the record thus impressed upon it, but must first be unwound from the receiving-spool back onto the containing-spool and must then again be started on its forward journey until it has again been fully or to the desired extent wound upon the receiving-spool, which operation, it will be evident, consumes considerable time.

Second. If during such return operation the reproducing-electromagnet or one or more reproducing-telephones are allowed to remain in circuit, the impressed record will be reproduced in a backward or reversed direction, which is highly objectionable and irritating, particularly where a number of telephone subscribers, for example, are served from a central transmitting-telegraphone. If the reproducing-magnet or transmitter be cut out of circuit during the rewinding of the wire, the blank interval resulting may be mistaken by distant auditors as a cessation or as a non-operative condition of the service.

Third. In the case of coin-operated or "nickel-in-the-slot" apparatus, in which permanent records only are employed the inability of providing a continuous and uninterrupted succession of reproductions (for which, owing to its purity of expression, my magnetic phonograph or "telegraphone" principle is peculiarly well adapted) militates seriously against its adoption. In view of the high initial speed of the record-wire and its feeding mechanism a very much higher return speed or reverse feed for the purpose of cutting down the time consumed in resetting the instrument is inadvisable, because of the increased wear and tear on the feeding mechanism and the danger of breaking the record-wire, which latter for selections of considerable length must be made quite thin.

Fourth. For phonograph-records containing instrumental selections consisting of alternate parts (such as a main theme and refrain or chorus) that requires several repetitions in order to render the production complete—as, for example, records containing

dance-music whose proper rendition might consume a considerable period of time—a very long, cumbersome, and expensive record-wire and containing-spool would be required, whereas by means of the apparatus forming the subject-matter of my present invention, as will shortly be apparent, only a fractional part of the total length of the record-wire will be requisite.

Fifth. In instances where very long wires are used, particularly on phonograph instruments designed principally for use with shorter records, such long wires are objectionable owing to the distortion of the record when wound and unwound on spools the operative diameter of which is continually changing in an inverse direction with respect to each other, to overcome which would require special differential gearing or other compensating devices of greater or less complexity.

Sixth. Under the existing long wire or reel method of operation, more especially in telephonograph work, if it is desired to impress only part of the carrier-wire with a record or message such part must first be retraced or rewound before it can be read to its original starting-point, which must generally be ascertained by experiment or conjecture. If the length of blank wire remaining on a partially-charged reel is too short to receive an additional message, the entire charged portion will have to be wound back and the older or obsolete records at the commencement of the coil be expunged before additional matter can be received.

Seventh. While part of the length of the telephonograph-record wire is in use, the greater bulk of it (that wound upon the spools or reels) is inaccessible. A single message of only ephemeral value or perhaps of no interest whatever to the recipient cannot very well be omitted or wiped out from the tape as it is being received, but must take its place or its equivalent in space among the more valuable or permanent despatches or records. While one message is being "reproduced" or "retransmitted" from the wire another cannot be simultaneously "recorded" and "stored" therein, should this be desirable, since only a small portion of the total length of the coil is exposed.

In short, the existing types of telephonographs or telegraphones of the class at present under consideration while possessing many features of scientific interest in their development up to the present time are yet lacking in certain important features, more especially in connection with their use as magnetic phonographs that are thought to be more or less essential to their successful commercial exploitation and which it is the object of my present invention to supply.

By means of my invention I am enabled to retain all the practical advantages of the endless band or belt variety of telegraphone in so far as immediate and unrestricted repetition and accessibility of the record or any desired portion of the same is concerned, while at the same time securing all the benefits of the long wire or spool system. In fact, I am enabled in addition to the foregoing to obtain certain other valuable advantages and economies which have not heretofore been possible of attainment with either the belt or coil type of apparatus.

This invention not only permits me to overcome the various difficulties, among others, hereinbefore specifically enumerated, in a simple, ingenious, and inexpensive manner, but it is believed will elevate the instrument from its present restricted field to a practically unlimited range of usefulness. These various advantages I obtain according to one form of my apparatus by the simple expedient of employing two oppositely running coils of wires or ribbons designed to serve as the carrier or base for the record or records, each of said wires or ribbons being separately mounted upon its own containing and receiving drums, spools, or reels in such a manner that one wire of the pair is being wound up on its receiving-drum while the other wire is being unwound from its containing-drum, the two sets of drums being simultaneously actuated or driven by a motor of any suitable form that is preferably common to both and to which the drums may be geared or otherwise connected. A reversing switch or gear is provided for changing the relative directions of motion of each set of drums when the wire on one set has been unwound, and vice versa, this being preferably accomplished automatically, means being provided, however, to permit of changing or reversing the direction of motion of the two sets of spools or drums manually whenever desired or for reversing the direction of motion of the record wires or ribbons at any intermediate portion of their travel, so as to permit of the recording, reproduction, or elimination of any intermediate portion of the record or records at will, as hereinafter more fully set forth.

In another form of my apparatus, which I have designed more especially for use as a magnetic phonograph—that is to say, an instrument designed chiefly for the reproduction of portable or interchangeable records previously impressed upon a wire and carried upon a suitable containing spool or drum—I make use of a simplified arrangement. It will be clear from a further consideration of the underlying principle of my present invention that its objects may be carried out equally well whether the two wires themselves run in opposite directions or whether the two wires run in the same direction, but have their respective records oppositely impressed thereon. It follows from this that instead of using two separate containing-spools I can place my entire record-wire on a

single spool, thus greatly simplifying the construction, which is particularly advantageous in the case of phonographic instruments of the type referred to that are designed for use with portable or interchangeable records. In other words, I simply take a record-wire of any desired length, which may previously be impressed or charged with a magnetic record or series of such records, bend this wire at or near its center, fasten the bent portion to a containing spool or drum having preferably a slotted central dividing-diaphragm, place the spool on a revolving shaft, and simultaneously wind both halves of the record-wire upon the spool, one at each side of its central diaphragm, respectively. This containing-spool may then be placed in my improved magnetic-phonograph apparatus, the two loose ends of the wire being clamped or otherwise attached to the two halves of a similar receiving-spool, and the instrument is then ready for operation. To insure uniform feeding, the apparatus is provided with guides for evenly laying on the record-wire as it is wound upon the two halves of the spools.

The features above set forth, together with various other modifications and details of my invention, will now be more particularly described and will be readily understood by reference to the drawings, in which—

Figure 1 is a plan view, partly in section, of my improved telephonograph or telegraphone apparatus provided with a double set of spools, the wire-feeding mechanism and the recording, reproducing, and eliminating electromagnets being omitted for clearness of illustration. Figs. 2 and 3 illustrate diagrammatically the direction of travel of the two wires and their respective spools when the type of driving-gear shown in Fig. 1 is employed, the lower wire shown in Fig. 3 being in practice maintained horizontally parallel with that of Fig. 2 by means of suitable guides (not shown in the diagram) over which it is passed. Fig. 4 is a diagram showing the method of impressing a record or records upon a long wire designed for use with a single containing-spool. Fig. 5 is a diagram, and Fig. 6 a plan view, showing the impressed wire of Fig. 4 attached at its center to a containing-spool, with its loose ends wound upon a receiving-spool, said spools being of the subdivided form, such as preferably employed by me in using my invention for phonograph work. Figs. 7 and 8 are detailed views, partly in diagram, of two types of reproducing-magnets adapted for operation with my duplex-wire phonograph instrument. Fig. 9 is a detailed diagrammatic view showing one of the two sets of recording, reproducing, and eliminating electromagnets and guiding-rolls employed by me when my invention is used as a telephonograph or telegraphone instrument as in Fig. 1. Figs. 10, 11, and 12 are respectively an end elevation, a top or plan view, and a side elevation of one form of my improved duplex-wire magnetic phonograph, parts of casing in each view being removed for clearness of illustration.

Like characters of reference indicate similar or corresponding parts in all the views.

Referring now to Fig. 1, A and B are the containing spools or drums carrying the magnetizable record-wires *a* and *b*, respectively, while A′ and B′ are the receiving spools or drums upon which these wires are wound when the instrument is in operation. It is to be understood that the terms "containing" and "receiving" as here used, especially when my instrument is used both as a recording and reproducing apparatus or telephonographophone, as in Fig. 1, are relative terms only, since these spools are alternately both containing and receiving spools. By the term "containing-spool" as herein employed is therefore meant the spool, reel, or drum that originally contains the wire which is to receive a magnetic record when the instrument is used for the reception of distant messages in the capacity of a recording apparatus or telephonograph or that which originally carries the charged wire containing a magnetic record that is to be locally reproduced when the instrument is used merely as a reproducing apparatus or magnetographophone. By "receiving-spool" is meant the spool, reel, or drum upon which the wire or other record-carrier is temporarily wound when the apparatus is in operation and from which it is ultimately wound back upon the containing-spool.

In Fig. 1 the spools A and B′ are mounted so as to revolve loosely upon a common supporting-shaft *c*, while spools A′ and B are similarly mounted upon a shaft *d* parallel therewith and at a short distance therefrom. These shafts are clamped or otherwise supported at their center upon uprights or brackets *e″ e″*, forming part of a base plate or frame E′. Pivotally mounted upon the frame E′ by means of upper and lower trunnions, the upper one of which, *e*, extends through and has its bearing in a central bridging-piece (not shown) extending across the frame, is a driving-motor F of any suitable type—as, for example, an electric motor of light construction. The armature-shaft of this motor is provided with beveled friction wheels or pinions *f f*, that are capable of being brought into operative relation with similar friction wheels or gears *f′ f′ f′ f′*, to which the inner heads of the several spools may either be permanently fixed or are preferably removably attached by means of bayonet-slots engaging with the heads of studs *f″ f″*, as shown in connection with the spool A′. Suitable means, such as grooves or collars on the shafts *c* and *d*, are employed to retain the beveled wheels in fixed position upon their respective shafts.

The beveled pinions *f f* in the position of the motor, as illustrated, have been brought into contact or engagement with the beveled wheels or gears to which the receiving-spools A′ and B′ are secured. These spools are now revolved by the motor, (whose direction of motion is preferably constant,) so as to cause the wires *a* and *b* to be wound thereon in the directon of the arrows from the containing-spools A and B. These latter being now free from contact with the pinions *f f* are at liberty to unwind, the arrangement of the parts being such that there is just sufficient friction between the containing-spools and shaft to keep the wire reasonably taut while it is being unwound. When the two wires have been fully or to any desired extent wound upon the receiving-spools, the motor is turned about its pivoted axis, so that its pinions come into contact with containing-spools A and B, which we will assume are now empty, and the wires will thus again be wound upon the containing-spools, the receiving-spools being now the trailing instead of the driven spools.

Fastened to the upright lugs *e‴* of the frame E′ and extending across or bridging the same at a point below the line of travel of the wires *a* and *b* is a removable supporting-plate upon which are mounted two sets of the guide-rolls and two sets of the electromagnets that are shown diagrammatically in Fig. 9. The two sets of rolls and electromagnets are mounted upon a sliding base capable of a transverse motion along the bridging-plate, each set being directly over its respective wire *a* or *b*. Inasmuch as one form of sliding base containing guides and electromagnets is shown in and will be described with respect to the apparatus represented in Figs. 10, 11, and 12, it has not been deemed necessary to illustrate this feature as employed in connection with the type of apparatus represented in Figs. 1 and 9, as the construction and operation of the same will be readily understood. In fact, no special transverse feeding mechanism for the sliding base other than that furnished by the wire-guiding rolls will be necessary, since the natural coiling of the successive turns and layers of wire on the two receiving-spools will ordinarily insure a uniform to-and-fro feed and produce an evenly-distributed deposit of the wires in regular layers upon the spools.

From an inspection of Fig. 9 it will be seen that the wire *a*, moving in the direction of the arrow, passes in succession under three separate electromagnets, I being the impressing, R the reproducing, and E the eliminating magnet. One, two, or all three of these magnets may under certain conditions be in use at one time, as hereinafter explained, although in describing the operation of the instrument it will be well for the present to consider them singly. It should be furthermore understood that, as a rule, when either one or more of the magnets over one wire—say *a*—are active the magnets over the opposite wire *b* are cut out of circuit or rendered inactive. This operation of cutting in and out of the opposite sets of electromagnets is preferably accomplished automatically by means of suitable switch-contacts, such as shown in Fig. 8, whenever the direction of motion of the spools is changed, as by the action of turning the driving-motor F upon its pivoted support when the end of a record or that portion of the record contained upon the wire of one spool is reached. Means may be and preferably are provided, however, for manually including one or more of the cut-out magnets in circuit whenever this is desirable. In specific applications of my invention where such manual switching in of the temporarily-idle magnets is unnecessary or undesirable the two opposite magnets or sets of magnets may be mounted upon a rocking lever, as shown in Fig. 7. This lever may likewise be operated either automatically or by hand, so as to alternately bring one or the other magnet or set of magnets into operative relation to their respective wires.

The operation of my improved telephonograph instrument as far as described will now be understood. Assume that the spools A and B are each loaded with a blank wire upon which it is desired to impress a record consisting, say, of a series of messages arriving over a telephone from some distant transmitting station or stations. The impressing or recording electromagnet I over the wire *a* is included in the local telephone receiving-circuit in the usual manner and the instrument being started in motion proceeds to impress a magnetic record of the message or messages upon the moving wire as it is being wound upon the receiving-spool A′, this process continuing until the whole of the wire originally upon spool A has been transferred to spool A′. In the meantime the blank wire *b* has been transferred from its original spool B to the spool B′. When this double transfer has taken place, the motor F, with its friction wheels or pinions *f f*, changes its position, (by means of one of several agencies that I may employ for this purpose, as hereinafter described,) so that said friction wheels or pinions *f f* disengage themselves from the wheels or gears *f′ f′* of spools A′ and B′ and are brought into engagement with the opposite wheels or gears *f′ f′* of the emptied spools A and B′, which now become receiving-spools in their turn and draw the wires *a* and *b* upon them from the spools A′ and B′, respectively, said wires now traveling in an opposite or reverse direction from that indicated by the arrows. The change in position of the motor F has at the same time caused the magnet I over the wire *a* to be cut out from and the corresponding magnet I over the wire *b* to be cut into the telephone receiving-circuit, so

that now the wire *b* is being impressed with the transmitted messages, while the wire *a* is being idly wound back upon its original containing-spool A. This process continues until wire *b*, which may thus be regarded as a continuation of wire *a*, has been fully impressed, whereupon the parts will again have assumed their original position, with the difference that the wires upon both spools are now charged. If it be now desired to reproduce the record thus impressed upon the wires, the reproducing-electromagnet R, located over the wire *a*, is cut into circuit with a suitable local telephone or is included in a telephonic transmission-circuit if the record is to be transmitted to one or more distant points or stations in the usual manner or in one of several ways heretofore invented by me, which need not here be described, since these form no part of my present invention. The circuit of the reproducing-magnet R of wire *a* having been closed, the motor F is started, and the wire *a* is thereby wound upon spool A′, traveling once more in the direction of the arrow. The record previously impressed upon the wire is now rendered audible by the telephone or telephones that are included in circuit with the reproducing-magnet, and the messages impressed on the wire are thus successively reproduced in proper order precisely the same as they were originally recorded. When wire *a* has been fully wound on spool A′, the motor F is again shifted, as before, causing wire *b*, which has in the meantime been again wound upon its receiving-spool, to move from spool B′ to spool B and to thus reproduce its half of the record by means of the reproducing-magnet R over the wire *b*, which has succeeded or taken the place of the first-mentioned reproducing-magnet in the telephone-circuit. Now it will be evident that by the time the last half of the total record, that on wire *b*, has been fully reproduced the first half of the record, that on wire *a*, will have been returned to its starting position or, in other words, will have reset itself. The instrument is therefore once more in a position to immediately and without a moment's delay go through the operation of repeating its record and if left to itself would continue to do so indefinitely. It will be clear, therefore, that in the operation of my improved telephonograph, as hereinbefore stated, no time is lost in rewinding or resetting the instrument, that it is always ready to receive or reproduce a message or messages, and that record-wires of any desired length may be used thereon without the disadvantages inherent in all previous apparatus of this type hitherto employed.

If it be desired to use the instrument for simultaneous recording and reproducing, the circuits of the magnets I and R at one side of the instrument are both closed, so that the magnetic waves or charges impressed by I are immediately reproduced by R, either locally or at a distant point, as desired. If only one reproduction of the messages or other record is required, the circuit of magnet E is also closed, so that the record is eliminated or expunged from the wire immediately after its reproduction, as has been the practice heretofore, leaving the wire free to receive other records. It is frequently desirable, however, to wipe out a portion of the contained record without interfering with another or later portion and to do this, if possible, without subjecting either the operator or auditors to the time-consuming practice and incidental delays and other objections arising from the necessity of retracing or rewinding the wire or of leaving blanks therein as a result of such elimination that cannot be immediately or satisfactorily filled. By my invention I am enabled to readily accomplish this result, since by means of my duplex-wire instruments I am given immediate access for this purpose to practically one-half of the total length of the record-wire instead of to only a few inches of exposed wire, as was the case prior to my invention. I am furthermore enabled by my invention to simultaneously impress a message on one wire while the other is reproducing a different message previously impressed thereon and to accomplish other novel results of greater or less importance. In other words, suppose it is desired to eliminate the record or part of the record contained on wire *a* of Fig. 1 while wire *b* is reproducing or rendering its record. All that is necessary is to manually close the circuit of the eliminating-magnet on that side (*a*) for the necessary space of time and at the point where the desired erasure is to be made. If the entire record on wire *a* is to be expunged, such as might be the case if the wire were required for the reception of new impressions, the old record can be eliminated and the wire simultaneously charged with such new impressions without reversing or stopping the instrument or in any way interfering with the rendition of the record on wire *b*. By reference to Fig. 9 it will be seen that the order of arrangement of the magnets I R E with respect to the normal direction of travel of the respective wires is such that as the wire *a*, for example, travels forward in the direction of the arrow any given point thereon first passes under the impressing, then under the reproducing, and finally under the eliminating magnets. When the wire travels backward, however, it approaches the eliminating-magnet before the impressing-magnet, so that the results just recited become practicable—that is to say, the old record is expunged from and a new one impressed on one wire while the other is reproducing or repeating its record. Although such new or filled-in record is impressed under the conditions just named in a direction opposite from the normal, this makes no material difference

in the operation of the instrument, provided the record on the second wire is also expunged after its reproduction in order that the direction of the new record to be impressed on both wires as a whole will be uniform when subsequently reproduced by the instrument. Should it be desired to frequently use the instrument in this manner, a supplemental reproducing-magnet R′ may be placed in front of the impressing-magnet I at both sides of the instrument, so as to permit of simultaneous recording and reproduction when the normal direction of travel of the wires is reversed, as just described.

When the driving arrangement shown in Fig. 1 is employed by me, the position of the wires *a* and *b* with relation to their respective spools is as illustrated in the diagrams in Figs. 2 and 3—that is to say, wire *a* travels to and fro along the upper and wire *b* along the lower portion of their respective spools. As already stated, both wires are passed over guiding-rolls *g g g g*, (see Fig. 9,) which raise them to the same level and maintain them at a fixed distance from and parallel with each other. I am, however, by no means restricted to this method of driving nor to the diagonal disposition of the containing and receiving spools on opposite shafts, as shown, nor am I limited to the use of only two pairs or sets of such spools. I may be permitted, therefore, before proceeding to a description of the remaining figures to dwell a little further upon these features of my present invention and to explain the arrangement and advantages of the same in the light of what has already been said when applied to that class of apparatus which I have termed "telephonographs" or "telephonographophones."

Under ordinary circumstances when my instruments are used for the reception, recording, and reproduction of signals, messages, or other intelligence from a distance—that is to say, when employed as a telephonographophone—it is not necessary that the spools or the wire contained on the same should be removable, since such records are usually of a transient character and are expunged or obliterated after a certain interval to make room for later messages. In such cases, however, it is desirable to provide a sufficiently long wire to contain the messages, stock-quotations, or other information that may be received, say, during a business-day of six hours, and, furthermore, to permit of ready access to or permit of the occasional reproduction of the messages or quotations that may have been received during any specified time or hour. It will be apparent that for obvious reasons this cannot be accomplished with the ordinary type of long-wire telegraphones heretofore employed. To accomplish this result in accordance with the principles of my invention hereinbefore set forth, I make use of an apparatus substantially similar to that shown in Fig. 1, except that the containing-spools are mounted on one shaft and the receiving-spools on the other. Moreover, I employ any desired number of pairs or sets of such spools, all the containing-spools being on one shaft and all the receiving-spools on the other. A suitable driving-motor is provided, the transmitting-gear of which is so arranged as to drive first one and then the other shaft, so that the direction of travel of the several wires (which in this arrangement have the advantage of all running parallel and in the same plane with one another) is alternately reversed, as already described.

The several sets of spools when more than one set is employed may all be permanently secured to their respective shafts, so as to simultaneously revolve therewith, or, if desired, they may be loosely mounted thereon in pairs, so that each pair is capable of being brought into action successively by means of a suitable shifting device operated by the reversing-gear in any well-known or desirable manner. The objects in view are, however, attained in a more simple and in some respects a more desirable manner by means of an instrument of the former type, in which the series of spools are rigidly secured to their respective shafts and revolve simultaneously, and I will therefore limit the further description of the apparatus to an instrument of this type.

Let us assume that the instrument is provided with two shafts, such as *c* and *d* in Fig. 1, of sufficient length to contain six (6) sets of spools, the four spools shown in Fig. 1 being considered one set. Shaft *c* will then carry twelve (12) "containing-spools" and shaft *d* twelve (12) "receiving-spools." The two driving-gears may be located either at the center or at one end of their respective shafts, which latter are journaled at or near their ends in suitable bearings. The twelve wires are carried over suitable guiding rolls or grooves formed in the transverse sliding frame already described, which is mounted on a fixed frame extending below the wires across the entire width of the instrument. The electromagnets employed by me with an instrument of this description vary somewhat according to the particular uses to which it is to be put. Preferably, however, I provide a principal set of electromagnets comprising two rows, such as shown in Fig. 9, each row consisting of an impressing, reproducing, and eliminating magnet, the order of arrangement of the *a* and *b* rows being reversed. In addition to these I provide an auxiliary set of twelve (12) reproducing-magnets, one for each wire. The principal and auxiliary magnets are independently mounted upon the sliding guide-frame, so as to partake of its to-and-fro feeding motion, and thus maintain their position of alinement over their respective wires. The auxiliary magnets in other

respects are stationary; but the twin row or set of principal magnets, which are together mounted upon a supplemental sliding support, are capable of traversing the entire width of the carriage and are so arranged as to be automatically moved across the same by a step-by-step motion in such a manner as to be brought in succession over each pair of the six sets of wires as the same are successively impressed. The length of wire on each of the twelve containing-spools is substantially the same, the total length of wire on the machine being thus divided into twelve equal parts. In order to permit of slight differences in length of the various wires, due to unequal expansion or other cause, as well as to relieve the wires of undue strain and possible danger of breaking when the instrument is started in motion or reversed in direction, I pass each wire in the form of a loop over a suitable compensating pulley or pulleys, as indicated at $g' g'$ in Fig. 9, these pulleys being adapted to yield to slight inequalities in tension of the wires and to take up any slack at the time of the commencement of the winding and rewinding operations. It may be here stated, however, that in this type of my apparatus it is not necessary that the spools shall be entirely unwound, as it is perfectly feasible, as will hereinafter appear, to leave a few turns or any desired number of layers of wire on each spool without interfering with the proper reversals of the instrument. The operation of this enlarged type of my improved telephonograph or telephonographophone will now be readily apparent from what has been previously said with reference to the single-unit or duplex type represented in part by Fig. 1 and need not, therefore, be described at length. It will suffice to say that when the instrument is started and continued in operation the primary impressing-magnet on the first or *a* wire will record its messages or message thereon, the corresponding magnet on the second or *b* wire being idle. As the first wire is being wrapped upon its receiving-spool during the process of receiving its charge all the other wires are being similarly (and for the time being idly) wound upon their respective receiving-spools. During the reverse travel or rewinding of the first wire its record is continued on the second wire by the secondary impressing-magnet of the principal set, the primary impressing-magnet being then cut out. The first wire, as well as the second and all the remaining wires, are at the end of this operation restored to their containing-spools. The next reversal of direction causes the carriage that supports the principal magnets to be shifted one double step, so that the primary magnet (active) is over the third wire and the secondary magnet (inactive) over the fourth wire of the series, and this recording process is repeated until the whole of the twelve wires have been charged, whereupon the carriage is shifted back to its position over the first pair of wires, and if further messages are to be received the recording process is repeated, this time with the eliminating-magnets energized, so as to expunge the first record by clearing the wire directly in front of the impressing-magnets. In the meantime, while the machine has thus been acting as a receiver and recorder of transmitted intelligence—as, for example, stock or market quotations in the shape of magnetic waves or charges impressed upon the wire or wires—this intelligence may not only be immediately translated upon its receipt into audible form by means of the reproducing-magnets of the principal set for the information or benefit of customers and others who are present at the time, but the whole of the previously-recorded intelligence or any desired portion or section thereof can be at once referred to and is independently accessible for immediate reproduction for purposes of comparison or for the benefit of late comers who may have missed the original announcement. In other words, notwithstanding the great total length of the record-wire or "magnetic tape" that is needed for this kind of service and which by my invention as exemplified in the particular type of my apparatus now under consideration, the information recorded thereon is at all times accessible for purposes of reference, comparison, or repetition at any one or more of twelve separate and substantially equidistant points or subdivisions, each of which is readily distinguishable from the other, not only in point of time or precedence, but also for certain classes of work in the nature or character of the recorded information, and accordingly permits of prompt and ready reference to such information in a manner and with a facility analogous to or even exceeding that afforded in consulting the various subdivisions, chapters, or pages of a printed book. It thus becomes possible, for instance, without stopping or in any wise interfering with the regular operation of the instrument in its work of recording and reproducing new or additional matter, to cause it to simultaneously and independently repeat or reproduce any desired portion or several distinct portions of the previous record for the benefit of one or more individuals. All of this, it will be evident, can be easily accomplished by the simple expedient of closing the circuit of, and thereby cutting into circuit with, a telephone receiver or receivers any one or more of the twelve auxiliary reproducing-magnets, six of the wires of which are constantly running in the proper direction for reproducing their respective portions of the record.

When my apparatus is used for recording and reporting stock or market quotations, as above cited, the spools may be conveniently divided, so that each pair will hold sufficient

wire to contain the record of a separate hour or other convenient time unit of a regular business day, so that the transactions pertaining to any given portion of the session may with certainty be referred to within the limit of even a fractional part of such time unit by closing the circuit of the proper auxiliary or reproducing magnet at any time or time multiple when the series of spools as they revolve together are approximately in the position occupied by them when the desired transactions were originally recorded.

To illustrate: Let it be assumed that the daily session during which such market reports are received occupies a period of five hours, extending from ten a. m. to three p. m., and that an additional hour, from three to four p. m., is to be devoted to the recording of news of a miscellaneous character. The apparatus, we will assume, is therefore provided with six pairs or twelve containing-spools, each spool carrying a length of wire that, with the machine running at a uniform speed, will record the transactions received during a time unit of half an hour. It will be evident that while one division of the apparatus is recording quotations received by it from a distant transmitting-station at, say, 2.15 o'clock p. m. the other spools or subdivisions are in position to present for immediate available reproduction the transactions recorded at 10.15, 11.15, 12.15, and 1.15 o'clock, respectively, any one or all of which may be rendered audible by closing the circuit of the corresponding auxiliary reproducing-magnet. Similarly, if reference to a sale or series of sales recorded at 11.25 o'clock is desired it is only necessary for the customer at 2.25 o'clock to press the listening-key of the telephone-receiver that is in connection with the "11-o'clock division" of the apparatus in order to have the transaction repeated to him. With a little practice it is unnecessary to consult a clock for this purpose, since the amount of wire laid on or taken off the series of spools will visually indicate to an observer with a fair degree of accuracy the subdivision of the hour or other time unit represented at any given moment by the appearance of the several sets of spools, although I may employ a special indicating device for this purpose where greater accuracy is desirable.

Under existing methods of recording stock and market quotations and news items or similar intelligence the record is usually printed upon a continuous roll of paper tape, which generally becomes unwound into a tangled mass and must be carefully and laboriously passed through the fingers in order to ascertain the nature of the information contained thereon, and from the manner in which the tape has been fed out by the ticker references to transactions or information recorded earlier in the day are not only difficult to locate and find, but the act of looking for them usually involves reading the transactions backwardly or in a reverse direction from the order in which they were received. Furthermore, the tape when once impressed cannot be again used for new matter and must be thrown away when the business for the day is over. It will be obvious from what has been said that by means of the apparatus just described, which forms but one of a number of applications of my invention, these difficulties are overcome and avoided and that the same record-wires may be used repeatedly day after day, and therefore do away with the expense and trouble of feeding the recording apparatus with new record-carrying material, since the record impressed upon the wires is expunged either at the end of the day's business or concurrently with the beginning of business on the following day, as may be preferred, by the action of the eliminating magnet or magnets provided for this purpose. Moreover, this apparatus has the advantage of producing an intelligible audible record, thereby avoiding the strain upon the eyes that results from reading a printed slip the characters of which are oftentimes poorly impressed and are of necessity greatly abbreviated or in the form of arbitrary symbols that are intelligible only to an experienced observer and are decipherable even then with more or less difficulty.

By further subdivision of the record-wire in the manner described any desired increase in total capacity or any desired reduction in the length of wire in each reference-division may be easily obtained. It is not essential that the principal set or group of impressing, reproducing, and eliminating magnets shall be duplexed, as above described, since it will be evident that a single row of such magnets, such as shown in Fig. 9, if moved from one wire to the next by a single step-by-step action will accomplish the same purpose in view of the fact that in the type of apparatus now under consideration each wire is already provided with its individual auxiliary reproducing-magnet. It will, moreover, be understood that if the apparatus is to be employed for simultaneously recording telephonic or other intelligence transmitted to it from a number of separate circuits or sources of information the same may be readily accomplished by providing it with two or more impressing-electromagnets, the number of which that may be effectively used being limited only by the number of double sections (six in the present instance) into which the total length of wire is divided.

Referring now to Figs. 4, 5, and 6, a somewhat different method as well as arrangement of apparatus from that just described is disclosed. I have hereinbefore stated that from a consideration of the underlying principles of my invention it will be clear that its objects may be carried out equally well whether

the two wires themselves run in opposite directions or whether the two wires run in the same direction, but have their respective records oppositely impressed thereon. I further stated that accordingly I can place my entire record-wire on a single containing-spool, this not only simplifying the construction of the apparatus, but being particularly advantageous in the case of magnetic phonograph instruments that are designed to be used with portable or interchangeable records. The figures of the drawings now referred to will make this arrangement clear.

In the diagram Fig. 4, H is a reel or spool containing a blank steel wire *h*, which in the act of being unwound therefrom is drawn over the pole-piece or pole-pieces of an impressing-electromagnet I', that is included in circuit with any suitable telephone-transmitter which is set into vibration by speech, vocal sounds, musical selections, or any other desired succession of sound-waves or other impulses that are to be permanently recorded upon the wire *h*. The successive portions of the record thus impressed or the sound-waves or magnetic charges constituting the same are for clearness designated on the wire by the numerals "1, 2, 3, 4, 5, 6, 7, 8, 9." When the proper length of wire for any complete record has been impressed, it is cut off from the reel H and bent or doubled upon itself at its center, as at the point marked "5." As will be seen from Figs. 5 and 6, this bent portion of the wire *h* is then secured to a containing-spool C, that is provided with a radially-slotted centrally-disposed diaphragm *c''*, that serves to partition the spool off into two equal portions, upon which the two lengths of the wire are respectively wound in the same direction. From this containing-spool the two ends of the wire are together led through or over the proper guide rolls or grooves onto the two halves of the receiving-spool D, provided with a similar separating-diaphragm *d''*.

The receiving-spool D is in practice preferably provided with suitable clamps or receiving-studs adapted to promptly engage the loose ends of the wire *h*, or these loose ends may be joined and slipped over the slotted diaphragm *d''* prior to being wound upon the receiving-spool. To secure evenness in the layers and in feeding the wire, the hubs of the two spools are provided with a shallow groove extending along one-half of each spool from its intersection with the radial slot in the diaphragms *c'' d''* to the inner surfaces of the upper or outer heads *c' d'* of the containing and receiving spools C D, respectively, the construction of the slotted and outer heads being such as to direct and hold the looped portion of the wire in proper place, and thereby secure a perfectly clear feeding-space for the wire the moment the looped end or ends thereof are slipped into position. I am thus enabled, particularly when the spools are to be used for graphophonic or reproduction work exclusively, to secure a greater degree of flexibility and simplicity in handling the apparatus, since only the containing-spool that carries the record need be made portable or interchangeable, the receiving-spool remaining permanently in the instrument.

Referring now once more to Fig. 5, it will be seen that the records on the two halves *h' h''* of wire *h* now run in opposite directions. Assuming that the two halves of the wire are being wound upon the two sections of the receiving-spool D and that they be bridged, respectively, by the reproducing-magnets R' R'', mounted upon the rock-shaft *r*, (shown in Fig. 7,) then magnet R' will be in operative proximity to branch wire *h'*, while magnet R'' is out of contact or at a distance from branch wire *h''*, both magnets in this case being permanently connected in circuit with a telephone common to both. Under these circumstances wire *h'*, the magnetic record on which travels in a forward direction—that is, from "1" to "5"—will cause the audible reproduction of its record in the telephone, while wire *h''*, whose record is traveling backward—that is to say, from "9" to "5"—will be temporarily idle or inactive. When spool D is filled, the automatic reversing-switch, (one or two forms of which will be hereinafter described,) is brought into action, causing the reversal of the direction of motion of both spools C and D and at the same time moving the shifting-rod *r'* so as to bring magnet R'' into and move magnet R' out of proximity to wires *h''* and *h'*, respectively. The record impressed on wire *h'* is now moving backward from "5" to "1," while that on *h''* is moving forward from "5" to "9," thus causing the latter to reproduce its portion of the record on the telephone in continuation of that on wire *h'* already rendered by it. It will therefore be apparent that by means of this simple arrangement the record or records contained on any desired length of wire can be continuously reproduced without break in the rendition and without any loss of time occasioned by the practice formerly necessary of rewinding or resetting the instrument.

Figs. 10, 11, and 12 illustrate one organized form of apparatus that I have devised for the purpose of carrying into effect the method of recording and reproducing just described with reference to Figs. 4, 5, and 6. Although I have shown this apparatus as a magnetic phonograph or magneto-graphophone, it will be understood that with a slight change in the number and arrangement of the electromagnets it can also be used as a phonograph-ophone—that is to say, an apparatus for recording as well as reproducing local sound-waves, such as recitations, vocal and instrumental selections, &c. This apparatus consists of a casing or framework L, closed on the bottom, front, and ends, but preferably

open at the top and back, Fig. 12 being a front elevation with the front part of the casing removed to show the interior construction. The containing-spool C in this and in the top view, Fig. 11, is shown at the right and the receiving-spool D at the left. The shaft *a*, upon which the containing-spool is free to revolve, is rigidly secured to the front plate of the casing. The shaft *d*, on the other hand, which supports the receiving-spool, is secured to one arm of a movable bell-crank lever *k* in such a manner that the spool D is capable within certain limits of approaching and receding from the spool C when the machine is in operation. As shown in the drawings, spool D is represented at its farthest position to the left away from spool C. Pivoted to the front casing at its central lower portion is a reversing or controlling switch-lever N, having a triangular-shaped body portion that supports and carries a number of small driving-gears. In the position shown—that is to say, to the left of its central or neutral position, (indicated by the dotted line *x x*,) in which position it bears against a limiting-stop *s*—this lever causes its driving-gears to impart motion to the receiving-spool D in the direction of the arrow in the manner about to be described, thereby causing the two branches of the impressed wire *h* to wind itself thereon from the record-containing spool C. Secured to the bottom of the casing L is a driving-motor M, Figs. 10 and 12, of any suitable type, such as a spring or electric motor, whose shaft is provided with a driving-pinion *m*, that is directly behind and in line with the pivot *n*, about which the lever N moves. This pinion meshes with an intermediate pinion O, which in turn imparts motion to the left-hand driving-pinion *o*, which latter turns the right-hand driving-pinion *o'* in a direction opposite to its own. In the position of the lever as illustrated the left-hand driving-pinion *o* meshes with a gear-wheel P, which has its bearing on a stud *p*, projecting inwardly from the front wall of the casing L, this stud *p* also serving as a pivot for the bell-crank lever K. The gear-wheel P engages a pinion *q*, which, together with a disk or clamping-plate Q, forms part of a sleeve S, that is journaled upon the inner end of the shaft *d*, that supports the receiving-spool and which, as already stated, is secured to the longer arm of the bell-crank lever K. The clamping-disk Q is provided with bayonet-slots *v v* or their equivalent, that are adapted to engage with studs in the head of the spool to lock it in position. It will thus be seen that if motion is imparted to the motor, so as to rotate the intermediate pinion O in the direction of the arrow, the receiving-spool will be revolved, as indicated, in such a direction as to draw the wire from the containing-spool. If while the motor is thus running the lever N be moved to the right of the line *x x* as far as the limiting stop or pin *s'* will permit, the left-hand driving-pinion *o* will leave gear P and the right-hand driving-pinion *o'* will engage with the gear P', which in turn will drive pinion *q'*, which latter by means of a sleeve S' and clamping-disk Q' and its bayonet-slots *v' v'* imparts motion to containing-spool C in a reverse direction, as shown by the dotted arrow, so that the wire *h h* will be rewound upon the containing-spool C C. The right-hand gear-wheel P' is likewise free to revolve upon a stud *p'*, that is secured to the front of the casing. In order to put a slight tension upon he wire or wires *h h* and prevent the same from unwinding itself from the spool whose driving-gear P or P' happens to be disengaged, I provide a spring friction-disk for each of said gears P P', such as shown at *p'''*, said friction-disk being clamped between a shoulder on the stud *p'* and the casing L, and which may have its periphery slotted or divided into two or more spring-fingers that bear with a slight frictional pressure upon one side of the gears P P'. As already stated, the friction thus imposed will, while not interfering with the free operation of the machine, serve to maintain a slight tension on the wire or wires *h h*, and thus hold them reasonably taut when one or both of the driving-pinions *o o'* are out of contact with their respective gears P P', such as would be the case when the lever N occupies the neutral position, (indicated by the dotted line *x x*.) To the controlling and reversing lever N is pivoted a link bar *k*, which is provided with a slot *k'*, within which a pin *k''* on the bell-crank lever K is free to move. A spiral spring *z*, secured at one end to the link bar *k*, tends to normally hold the lever N in the position shown—that is to say, into operative engagement with the left-hand spool D—while a similar spring *z'*, attached to the upper end of the bell-crank lever K, tends to draw said lever and its shaft *d*, that carries the receiving-spool D, into its leftward position, as shown—that is to say, away from the spool C. A pin or stop *z''*, that engages with a shoulder on a pendent gravity link or catch Z, whose upper end is loosely pivoted to the shorter arm of the bell-crank lever K, serves to limit the backward sweep of the bell-crank lever under the influence of the spring *z'*. The lower end of the lever N has a projecting cam *n'*, which when the lever occupies the position shown comes into contact with the face of the pendent catch Z and holds it back from its normally vertical or forward position, but when the lever is moved to the right allows the catch Z to swing forward into the position shown in dotted outline. The lever N also has at its lowest extremity a cam *n''*, provided with a tooth, as shown, which is adapted to be engaged and locked by a corresponding tooth on the upper face of a pawl W, that is pivoted at *w* and is normally pressed upward by a spring *w'* when the lever N is moved to the right. Secured to the bottom

of the casing L, midway between the spools C and D, are two inner upright frames or supports *l l*, (shown broken away in the end view, Fig. 10,) that are united at the top by a pair of transverse guide rods or ways *l' l'*, which, together with the frame, serve as a support for the wire-feeding mechanism and for the carriage containing the reproducing-magnets or translating apparatus. This feeding mechanism consists of a feed-screw Y, provided, preferably, with duplex or reverse threads that engage with suitable nuts (not shown) on the under side of the carriage Y', which nuts, respectively, are alternately thrown into and out of gear with one or the other of said threads when the carriage has reached one or the other end of its travel along the guide-rods *l l*. The feed-screw Y receives its motion through a pinion *y''''*, that meshes with a large intermediate gear *y'''*, which in turn is driven by either one of two pinions *y'* or *y''*, that derive their power from the gear-wheels P and P'. The pinions *y'*, *y''*, and *y''''*, as well as the pinions *q'* and *q''*, are, as illustrated, all of equal diameter or pitch. The result of this is that when the gear P, for example, is driven by the motor M, through the intervening gears *m*, O, and *o'*, the spool D and the feed-screw *y* will each complete one revolution in the same time. If, therefore, the pitch on the feed-screw thread or threads is made equal to the thickness of the wire *h h*, the turns of the wire will be evenly deposited upon the receiving-spool by the feeding mechanism both in a to and fro direction.

In applying my invention to magnetic phonographs in which permanent and interchangeable records are to be used, as in the type of apparatus under consideration, I find it desirable for several reasons to employ a somewhat heavier or thicker record-wire than in the case of telephonographic apparatus such as hereinbefore described. In other words, I have found that a thick wire if properly magnetized will hold its record for a much longer time than a thin wire and can likewise be more strongly impressed. At the same time a very slight increase in diameter of the wire adds materially to its strength, so that the records can be more readily transported and more roughly handled without injury. On the other hand, very thin wires are more desirable for that class of apparatus in which recording, reproducing, and eliminating magnets are used, as hereinbefore described, and in which the record, while perhaps of considerable length, is usually of a more or less transient character and in which, therefore, the spools containing the wire or wires are not ordinarily intended to be removed from the instrument. Consequently in the type of my reproducing apparatus illustrated in Figs. 10, 11, and 12 the wires *h h* are led directly from the containing to the receiving spool without being first passed over friction-rolls and compensating pulleys, such as shown in Fig. 9, (although these may of course be employed,) and I furthermore make use of the increase of tension on the wire when it is fully unwound, as will presently appear, as a means for automatically operating the shifting or reversing mechanism.

The operation of the instrument may now be described and will be readily understood. Assume that the instrument is idle and that it is desired to insert and reproduce a phonographic record. A containing-spool C, carrying the desired record, is selected, slipped through the open back of the instrument, over the shaft *c*, and locked in position against the carrying-disk Q' by the bayonet-slots or other means provided for that purpose. The looped ends of the wire *h h* are carried over the grooved brass guides *h''' h'''*, that form part of the carriage Y', and under the reproducing-magnets R''' R'''', that are mounted upon the same, and are then placed in position on the receiving-spool D, as previously explained. The controlling-lever N is then moved toward the left against the limiting-stop *s*, as shown, (provided it does not already occupy this position,) and the motor M is started in operation. The power of the motor is now transmitted, through gears *m*, O, *o'*, P, and *q* and through the sleeve S and carrying-disk Q, to the receiving-spool D, which is thereby caused to revolve toward the left, as indicated by the arrow. At the same time the carriage-feed screw Y is caused to revolve by the meshing of the pinion *y'* with the gear P. The spool C being out of engagement with the now idly-revolving pinion *o'*, and therefore free to unwind except for the slight tension put upon it by the braking-disk *p'''*, the wires *h h* are drawn over the guides *h''' h'''* and under the magnets R''' R'''' and through the feeding action of the screw Y are gradually deposited in even layers upon the two halves of the spool D, as shown. While this is taking place the record carried by one half of the wire—that passing under the magnet R''''—is being reproduced, the opposite magnet R''' being open-circuited, as more clearly shown in the detail view Fig. 8. This operation of opening and closing or of alternately including and excluding the opposite magnets from the translating or reproducing circuit or circuits is preferably automatically accomplished by the action of the reversing-lever, as will hereinafter appear. Now when the wire has been unwound from the containing-spool C as far as it can go the continued action of the motor M will cause a tension to be placed upon the wire *h h*, that still connects the two spools C and D. The effect of this tension is to immediately draw the spool D (which is mounted on the bell-crank lever K) toward the spool C. In doing this the bell-crank lever K, swinging on the pivot *p* and

assisted in part by the momentum of the loaded spool D, pushes forward the link k against the tension of the spring z, thereby forcing the lever N, with its train of gears, against the right-hand stop s', thus permitting the pawl W to at once engage with the tooth of the cam n'', so as to prevent its return. This action has likewise served to disengage the gears o and y' from the gear P and to cause the engagement of gears o' and y'' with the gear P', which in turn immediately rotates the spool C in the direction of the dotted arrow and causes the rewinding of the wire $h\,h$ thereon. The extra tension on the wire having been relieved by the freeing of the gear P from its driving-pinion o, the bell-crank lever K and its spool D are gradually drawn back to normal position under the influence of spring z', the slot k' in the link k permitting the pin k'' to return freely for this purpose. During this rewinding operation the reproducing-magnet R'''' is cut out and magnet R''' cut into the circuit, so that the second or remaining half of the record is now being reproduced. The lever N has an adjustable stop N', that may be manually set so as to come into engagement with the casing at its central point, as at x', (as well as at other points,) and thus to cause the stopping of the instrument when the record has been completely rendered. If, however, it is desired to repeat a record one or more times, the stop N' is not set, thus permitting the movements of the reversing-lever N to be controlled by the instrument itself. This self-repeating operation is performed as follows: When the wire has been entirely rewound upon the spool C, there will once more be a tension upon it that will draw the spool D forward. When this occurs, the pendent link Z will descend in the position shown in dotted line, so that it will engage and carry with it the projecting nose of the pawl W, that lies in its path, thereby immediately releasing the lever N, which is at once drawn back by means of spring z into operative engagement with spool D, as before. The cam n' now again projects itself against the gravity-link Z and causes its further movement to be clear of pawl W.

It will be evident from what has been said that with this apparatus any given phonographic record or selection can be reproduced as often as desired without loss of time in rewinding or resetting and without the attention of the operator. One advantage resulting from this is that I am enabled for certain classes of work, such as the reproduction of vocal selections or dance-music having a number of similar parts, to employ comparatively short and inexpensive wires, by recording said parts but once, instead of the long record-wires that would otherwise be found necessary for a complete and uninterrupted rendition. Moreover, my records are far more compact and durable than and infinitely superior in clearness and quality to, the ordinary phonograph-cylinders or gramophone-disks and permit of equal facility or accessibility for repeating intermediate portions of a given record that has already been partially rendered. For example, if the desired portion of the record happens to be equally distributed between, say, the last half of the first wire and the first half of the second wire then by manually throwing the reversing-switch at the completion of the first rendering of the desired section it will instantly proceed to repeat itself, after doing which the record will continue to its natural termination.

Another advantage of this instrument, especially when applied to coin-operated apparatus, to which it readily lends itself and for which purpose it likewise has a useful field, is that when the record has been rendered the instrument has been rewound and is thus immediately ready for a fresh start. Moreover, the records are not all limited to a given area or surface, or, in other words, restricted to a certain uniform time interval in delivery, which necessitates the undue abridgment of many selections. On the other hand, the instrument is capable of reproducing interchangeable records varying greatly in their respective lengths and limited only by the amount of wire on the containing-spool, while at the same time the feeding mechanism is so arranged as to bring the instrument to a stop upon the completion of the selection or selections whether the record-wire be a long or short one. Still another advantage of this construction is that the record-carrying spool is "self-contained," thus requiring but a single spool that is both portable and capable of prompt insertion and removal and which at the same time fully protects the record against mechanical injury in transportation and handling.

Referring to the diagram Fig. 8 it will be seen that the reproducing-magnets R''' and R'''' are alternately cut into the circuit containing the reproducing-telephone or other translating device, to which the wires u' and u'' are led by the movement of the switch-handle r''. This switch may be mounted upon the carriage Y' within the area shown by the dotted rectangle, which carriage may also, if desired, carry the reproducing-telephone and sound-magnifier. In practice, however, I prefer to connect this switch-lever with the controlling-lever N in such a manner that the movements of the latter will automatically control the same, or, preferably, the controlling-lever N may itself constitute the switch-lever, as shown in Fig. 11, where the inside of the front casing L is provided with two insulated contacts, from which wires u' and u'' lead, one contact being at each side of the center line of the controlling-lever N. A projection or wiper u''' on the handle portion of the lever N makes connection with one or the

other of said contacts when at its extreme right or left position and is out of connection with said contacts when in its central position. One of the two terminals of magnets R''' and R'''' are joined together as in Fig. 8 and led to one terminal of the translating or reproducing device. The other terminals of R''' and R'''' are connected with u'' and u', respectively, while the controlling-lever or its wiper u''' is in electrical connection with the other terminal of the translating device. By this arrangement neither the translating device nor the reproducing-magnets are active when the lever N is in its neutral position, while said translating device and its proper reproducing-magnet are active when the lever is at one or the other side of its neutral position.

Although in Figs. 10, 11, and 12 I have illustrated a type of reversing mechanism depending for the operation upon the increased tension placed upon the wire when the latter has reached the end of its travel, I am by no means limited to this method of reversing, as I may employ various other means for accomplishing this result without departing from the scope of my invention. In Fig. 6, for example, I have shown an arrangement in which I utilize the increase and diminution in the number of layers of wire on the receiving-spool for reversing the direction of travel of the wires or of the rotation of the spools or motor. Referring to this figure, it will be seen that a pivoted or resilient rod U supports at its free upper end an adjustable threaded screw u, having a rounded bearing-surface that is normally pressed against the wire on the receiving-spool D either by virtue of the resilience of the rod U or by the tension of a special spring that may be provided for this purpose, as shown. Two limiting-stops, which may be either fixed or movable, are adapted to make electrical contact with the rod U. These stops are respectively connected by wires u' u'' with the right and left hand magnets of a suitable electrically-controlled reversing switch or device, (not shown,) the other terminals of said magnets being connected through a suitable battery with the rod U by wire u''''. The magnets that operate the reversing-switch also cut into and out of circuit the respective reproducing-magnets corresponding to the wires u' and u'', or the rod U, with its contacts, may itself be so arranged as to perform this function directly through the wires u', u'', and u''''. It will be evident that when the arrangement of the device is as shown the reversing switch or device is automatically operated both when the receiving-spool D is full and when it is empty. By turning the screw u the device may be adjusted to suit records of different lengths and also to cause a reversal of motion at any desired portion or portions of a given record.

Although I have illustrated and described herein various types of instruments and apparatus that I have devised for carrying out my improved method of recording and reproducing speech and other sounds or impulses magnetically or electromagnetically and have specifically pointed out how the same may be employed for various purposes, I desire it to be understood that I do not limit myself either to the particular types or to the precise construction of the apparatus or instruments herein set forth or to the manner of their use as herein described, since the same may, as will be evident, be widely varied or modified without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A magnetic phonograph or telephonograph apparatus having two sets of records designed and adapted to simultaneously move in opposite directions.

2. A magnetic phonograph or telephonograph apparatus having a record divided into two portions, one portion being designed and adapted to move in a direction opposite to that of the other.

3. A magnetic phonograph or telephonograph apparatus having a subdivided record whose subdivisions travel in opposite directions.

4. A magnetic phonograph or telephonograph apparatus having a substantially continuous record-wire divided into consecutive sections or lengths, parts of the wire of each section being permanently exposed so as to render the several sections independently accessible for operation or reference.

5. A magnetic phonograph or telephonograph apparatus having a record media in the form of multiple sections or divisions designed and adapted to receive portions of a record or a series of records, in combination with reproducing means arranged to be selectively brought into operative relation with any one or more of said multiple sections for the purpose of causing the reproduction of the record impressed thereon.

6. A phonograph or telephonograph apparatus having a subdivided record media whose subdivisions are designed and adapted to contain or receive records or parts of a record differing in character from one another, in combination with a separate reproducing device for each subdivision of the record media, and means for independently bringing any one or more of said reproducing devices into operative relation with their respective subdivisions of the said record media, whereby any one or more of the records or record parts contained by the several subdivisions may be reproduced at will independently of the others and without mutual interference while the apparatus is in operation.

7. A magnetic phonograph or telephonograph apparatus having a continuous record-

wire subdivided into two or more alternately-operative sections or lengths.

8. A magnetic phonograph or telephonograph apparatus having a continuously-moving record-wire subdivided into two or more alternately-operative sections or lengths.

9. A magnetic phonograph or telephonograph apparatus having two or more record-wires moving in opposite directions.

10. A magnetic phonograph or telephonograph apparatus having one or more pairs of record-wires, the wires of each pair moving in opposite directions with respect to each other.

11. A magnetic phonograph or telephonograph apparatus having a continuous record-wire subdivided into two or more alternate or successive sections, each section being alternately operative with respect to its preceding or succeeding section.

12. A magnetic phonograph or telephonograph apparatus having one or more pairs of moving record-wires, one wire of a pair being in a condition of operativeness while the other is in a condition of inoperativeness.

13. A magnetic phonograph or telephonograph apparatus having one or more pairs of moving record-wires designed and adapted to receive or to reproduce a record or series of records, or to simultaneously receive and reproduce a record or series of records, one wire of a pair being adapted to receive one or more records or part of a record while the other is reproducing the records or parts of a record contained by it.

14. A magnetic phonograph or telephonograph apparatus having a record-wire subdivided into sections or lengths, said apparatus being provided with an operating coil or magnet or set of operating coils or magnets for each subdivision of said wire, substantially as set forth.

15. A magnetic phonograph or telephonograph apparatus having two or more record-wires moving in opposite directions, said apparatus being provided with an operating coil or electromagnet or set of operating coils or electromagnets for each of said wires, substantially as and for the purpose or purposes set forth.

16. A magnetic phonograph or telephonograph apparatus having two sets of magnetic records or impressions designed and arranged to simultaneously move in opposite directions, said apparatus being provided with an operating helix or set of helices for each set of records or impressions, one or more of the helices of one set being thrown out of operation while one or more of the helices of the other set are in operation, substantially as and for the purpose or purposes set forth.

17. A magnetic phonograph or telephonograph apparatus having two sets of magnetic records or impressions designed and arranged to simultaneously move in opposite directions, said apparatus being provided with a reproducing helix or electromagnet for each set of records or impressions and a translating device in circuit with such reproducing helices or electromagnets, said apparatus being also provided with means for throwing out of action one of said reproducing helices or magnets when the other helix or magnet is in operation, and vice versa, substantially as and for the purpose set forth.

18. A magnetic phonograph or telephonograph apparatus having a looped or subdivided record-wire containing two or more records or parts of a record running or extending in reversed directions with respect to each other, said apparatus being provided with a translating device or devices, substantially as described, designed and arranged to be alternately operated first by one and then by the other of such records or parts of a record, substantially as set forth.

19. A magnetic phonograph or telephonograph apparatus having one or more pairs of spools or reels upon which a record wire or wires are wound and unwound, respectively, and provided with means for changing or reversing the direction of motion of the spools or reels, substantially as and for the purpose or purposes set forth.

20. A magnetic phonograph or telephonograph apparatus having one or more pairs of spools or reels upon which a record wire or wires are wound, respectively, a driving-motor for imparting motion to said spools in one direction and a reversing device for automatically changing the direction of motion of said spools, substantially as and for the purpose or purposes set forth.

21. A magnetic phonograph or telephonograph apparatus provided with a containing and receiving spool designed and adapted to contain and receive, respectively, one or more record-wires, a driving-motor arranged to normally impart motion to the receiving-spool, and an automatic reversing device or gear for causing said motor to drive the containing-spool when the receiving-spool is filled, substantially as set forth.

22. A magnetic phonograph or telephonograph apparatus having containing and receiving spools for the record-wire, and means, substantially as described, for alternately driving the containing and receiving spools at approximately the same rate of speed.

23. A magnetic phonograph or telephonograph apparatus having a subdivided record-wire and one or more containing and receiving spools therefor, and means, substantially as described, for imparting an approximately uniform rate of motion to each subdivision of the record-wire.

24. A magnetic phonograph or telephonograph apparatus having a record wire or wires and one or more containing and receiving spools therefor, means for causing the wire

or wires to be wound from the containing spool or spools onto the receiving spool or spools and vice versa, and means, substantially as described, for feeding the wire or wires in even and uniform layers upon the spool or spools upon which it is being wound, substantially as set forth.

25. A magnetic phonograph or telephonograph apparatus having a record wire or wires and one or more containing and receiving spools therefor, means for causing the wire or wires to be wound from the containing to the receiving spool or spools and vice versa, and means, substantially such as described, for compensating for variations in length and taking up the inertia of the wire or wires, substantially as and for the purpose set forth.

26. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with a moving record-wire and its containing and receiving spools, of a yielding take-up device or devices for the wire designed and arranged to put it under a slight tension, substantially as and for the purposes set forth.

27. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with the record wire or wires and its containing and receiving spools, of a laterally-movable guide-frame for the wire or wires, said frame containing also the operating helices or magnets, substantially as described.

28. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with the record wire or wires and its containing and receiving spools, of a laterally-movable guide-frame for the wire or wires, said frame containing also the operating helices or magnets, and carrying a yielding take-up device or devices around which the record-wire is adapted to pass, substantially as described.

29. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with the record wire or wires and its containing and receiving spools, of a laterally-movable guide-frame for the wire or wires, said frame containing also the operating helices or magnets, and a to-and-fro feeding mechanism or device for imparting motion to said guide-frame and cause it to deposit the record-wire upon the receiving spool or spools in even layers.

30. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with the record wire or wires and its containing and receiving spools, and its driving mechanism, of means actuated by the deposit of the wire upon the receiving spool or spools to cause a reversal of the direction of travel of the wire or wires, substantially as set forth.

31. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with the record wire or wires and its containing and receiving spools, of a driving-motor revolving constantly in one direction and gearing or friction devices driven thereby and designed and adapted to impart motion to the spools alternately so as to cause the record wire or wires to travel first in one and then in the other direction, substantially as set forth.

32. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with the record wire or wires and its containing and receiving spools, of a supporting shaft or shafts for said spools, driving mechanism for said shafts or for the spools supported thereon, arranged and adapted to cause the rotation of said spools first in one and then in the other direction, and means for rapidly and removably securing said spools or either of them to said shafts or to the driving mechanism thereof, substantially as set forth.

33. In a magnetic phonograph or telephonograph apparatus of the class described, the combination with a suitable driving mechanism of two substantially parallel shafts carrying several pairs or groups of spools containing the record wire or wires of the apparatus, said wires being normally passive but arranged and adapted to be brought into active operation successively when the apparatus is set in motion, substantially as set forth.

34. In a magnetic phonograph or telephonograph apparatus of the class described, the combination with a suitable driving mechanism, of two substantially parallel shafts, carrying several pairs or groups of spools containing the record wire or wires of the apparatus, an impressing or recording electromagnet or its equivalent common to all the wires and a separate reproducing-electromagnet or its equivalent for each separate wire or subdivision thereof, substantially as set forth.

35. In a magnetic phonograph or telephonograph apparatus of the class described, the combination, with the supporting-shaft and driving mechanism, of a record-carrying spool having a centrally-disposed slotted diaphragm dividing it into two portions each adapted to receive one-half of the record-wire, substantially as set forth.

36. In a magnetic phonograph or telephonograph apparatus, a portable record-carrying spool having two heads and a central separating-diaphragm dividing it into two portions each adapted to receive one-half of the record-wire, the said heads and diaphragm serving as protecting and confining guards for the record-wire, substantially as set forth.

37. In a magnetic phonograph or telephonograph apparatus, a portable record and carrying-spool consisting of a subdivided spool carrying or containing the two halves (or other subdivisions,) of a record-wire whose central portion is secured to the body of the spool

and its two halves, commencing from said central portion, wound simultaneously upon either side or subdivision of the spool and having its terminals preferably joined in the form of a loop, substantially as set forth.

38. In a magnetic phonograph or telephonograph apparatus, a portable record consisting of a subdivided wire wound upon a suitable containing spool in two simultaneously-accessible sections, one section of the wire containing or adapted to receive a magnetic record or impression which, when the wires are unwound from the spool, runs in a reverse direction to that contained or received by the other section, substantially as and for the purpose set forth.

39. In a magnetic phonograph or telephonograph apparatus, the combination, with a driving mechanism having a substantially uniform rate of speed, of a series of spools arranged to be driven thereby and each containing a record-wire adapted to be impressed by magnetic waves or lines of force that are locally set up therein by the operation of a distant transmitter and representing a record translatable into audible sounds or signals comprising news items or other intelligence corresponding to that spoken into or otherwise impressed upon the said transmitter, the wires contained on the several spools of the series being arranged and adapted to be impressed in successive order and each within a predetermined period of time, substantially as and for the purpose described.

40. In a magnetic phonograph or telephonograph apparatus, the combination of a series of spools or sets of spools each containing a record-wire, a recording-magnet common to the several wires and adapted to energize or impress each of the same in succession, a reproducing-magnet for each of the said record-wires, and a telephone receiver or receivers adapted to be cut into circuit with the several reproducing-magnets, substantially as and for the purpose described.

41. In a magnetic phonograph or telephonograph apparatus, the combination of a series of spools or sets of spools rotating together upon a common shaft or shafts and each containing a separate section or subdivision of the record-wire of said apparatus, a recording-magnet for said record-wire in circuit with or otherwise arranged to be operated by a distant telephonic transmitter for the purpose of producing a magnetic record upon said wire, means for independently reproducing the record or portions thereof impressed upon the several sections or subdivisions of said wire, and means for operating the various portions of said apparatus upon a "time-unit" basis, whereby reference to the information or intelligence recorded thereby, for the purpose of reproduction thereof, is facilitated.

Signed at New York, in the county of New York and State of New York, this 21st day of February, A. D. 1903.

ELIAS E. RIES.

Witnesses:
WM. GOLDBURG,
M. E. BELL.