No. 699,630. Patented May 6, 1902.

P. O. PEDERSEN.

METHOD OF RECORDING MESSAGES, SIGNALS, &c.

(Application filed Mar. 9, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

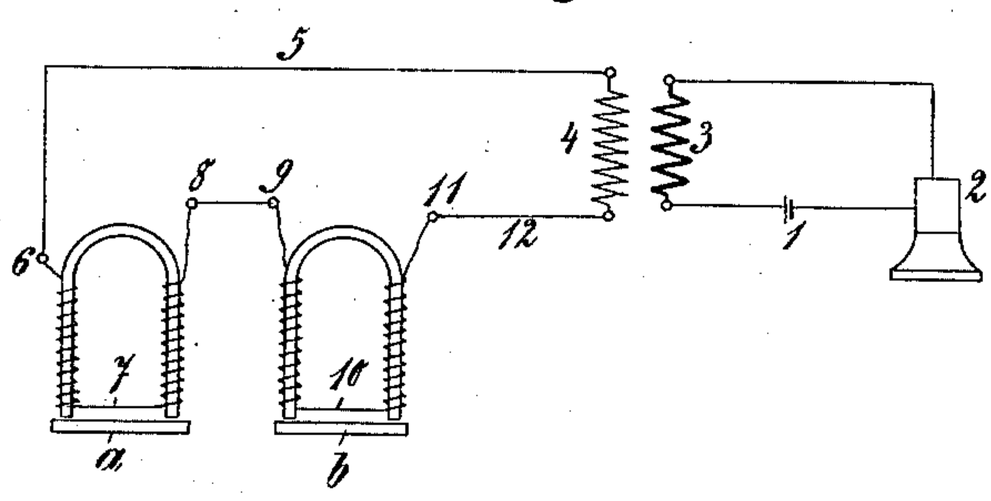

Fig. 2.

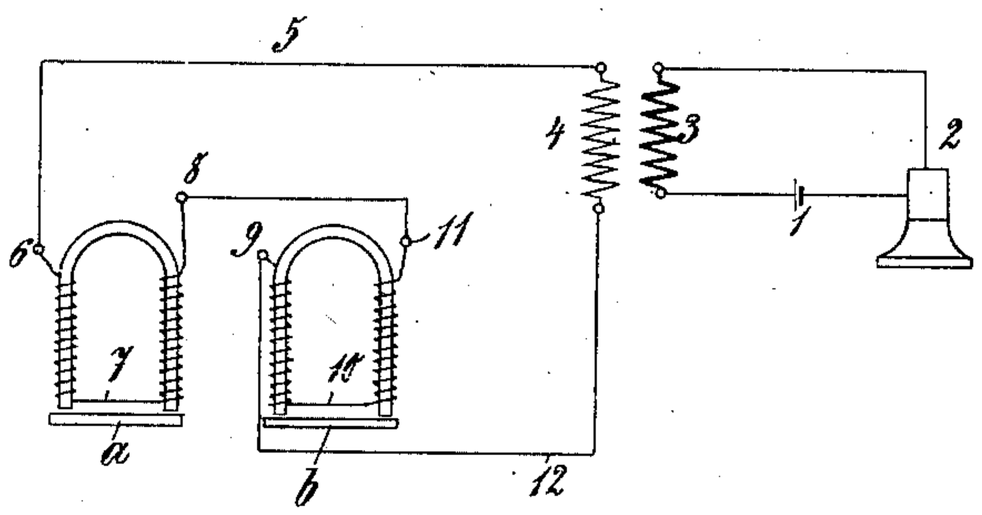

Fig. 3.

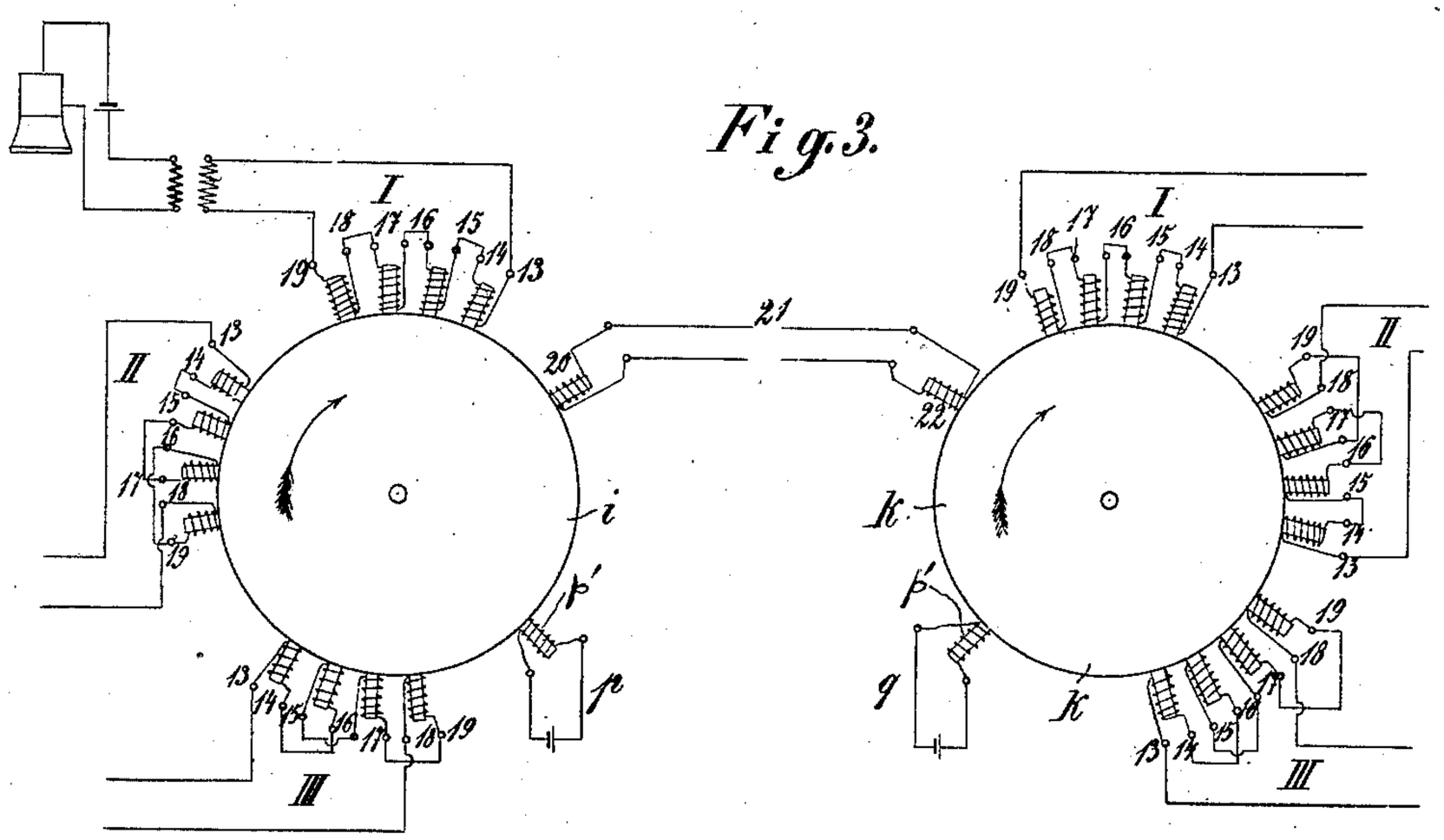

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Fig. 4.

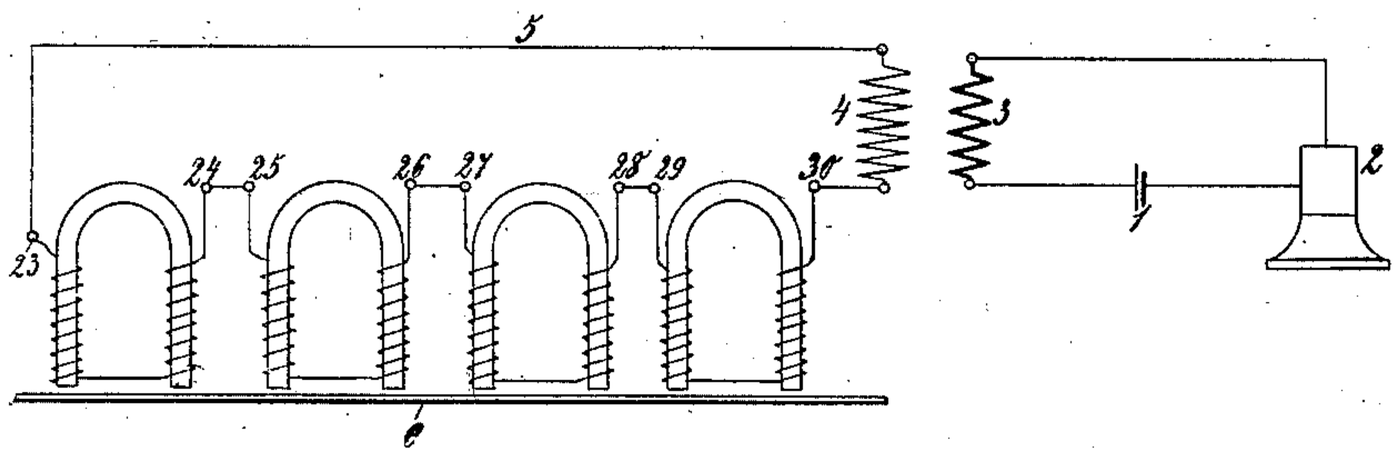


Fig. 5.

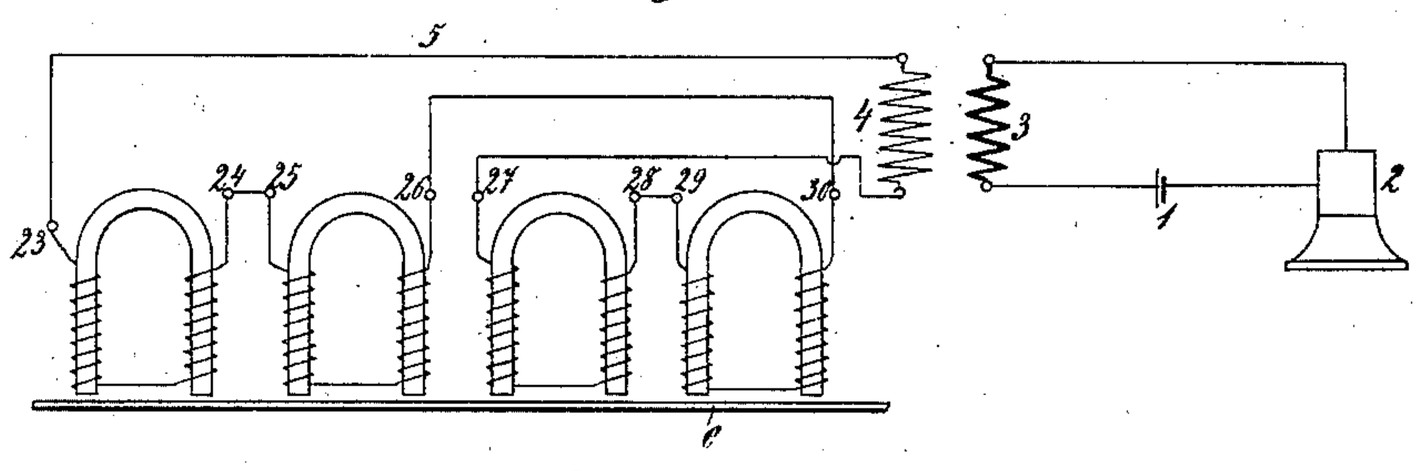


Fig. 6.

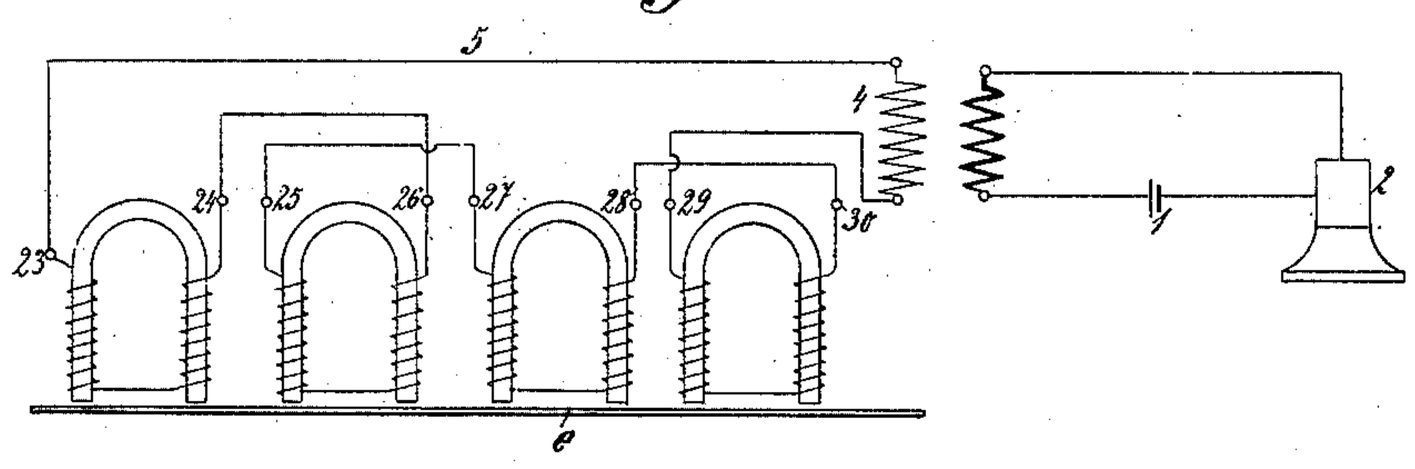
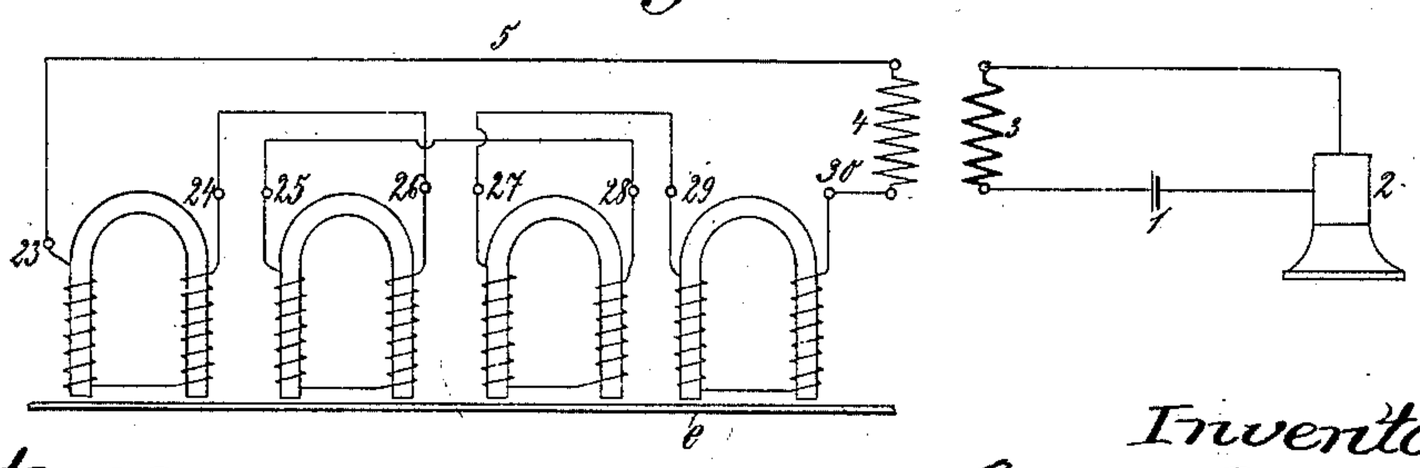


Fig. 7.



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UNITED STATES PATENT OFFICE.

PEDER OLUF PEDERSEN, OF COPENHAGEN, DENMARK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE AMERICAN TELEGRAPHONE COMPANY, A CORPORATION OF NEW JERSEY.

METHOD OF RECORDING MESSAGES, SIGNALS, &c.

SPECIFICATION forming part of Letters Patent No. 699,630, dated May 6, 1902.

Application filed March 9, 1900. Serial No. 8,017. (No model.)

To all whom it may concern:

Be it known that I, PEDER OLUF PEDERSEN, a subject of the King of Denmark, residing at Copenhagen, in the Kingdom of Denmark, have invented certain new and useful Improvements in Methods of Receiving, Temporarily Storing, and Reproducing Messages, Signals, and the Like, of which the following is a specification.

In Letters Patent No. 661,619, granted to V. Poulsen November 13, 1900, there is described a method of electromagnetically storing up speech or signals in a paramagnetic body and of reproducing the same at will, such method consisting, substantially, in causing the sounds produced by the speech or the undulations or irregularities produced by the signals to be transformed into electrical waves or undulations traversing an electric circuit and causing such electrical undulations or waves to traverse the coils of an electromagnet whose poles are in contact with a moving steel ribbon or strip. The varying magnetic conditions of the magnet are thereby transferred to successive portions of the steel ribbon or strip, which conditions remain permanent in said ribbon or strip, because of the nature of the material in which they are created. The said speech or signals may therefore be said to be stored up in the steel strip. To reproduce such stored-up messages or signals, it is only necessary, according to said invention, to again pass the steel strip along the poles of the magnet and connect in the circuit containing the magnet a receiving-telephone or other receiving apparatus. In this reproducing operation the varying magnetic conditions of the steel strip react upon the electromagnet, causing electric impulses of a corresponding nature to be sent over the line to the receiving telephone or instrument, producing therein the original speech, message, or signal.

The object of the present invention is to provide a method whereby several speeches, messages, or signals may be stored up on the same parts of a single paramagnetic body and be able to reproduce the same individually and without interference with each other. With this improvement upon the Poulsen invention it is obvious that the size of the drum or the length of the wire or ribbon used therein may be materially lessened, so that a long speech or a number of speeches or signals may be stored upon a comparatively short or small magnetic body.

My invention is described in the accompanying drawings, in which—

Figures 1 and 2 are comparative diagrams showing how two messages may be stored upon and reproduced from the same portions of two adjacent steel strips. Fig. 3 is a diagram illustrating how it is possible to simultaneously transmit several messages along a single conductor, which messages are first stored upon a paramagnetic body at one end of the line and then reproduced from a similar body at the other end thereof; and Figs. 4, 5, 6, and 7 illustrate how four electromagnets can be connected together in different ways to fix four different messages on one and the same paramagnetic body.

Referring first to Figs. 1 and 2, let it be assumed that *a* and *b* are two separate steel ribbons which are drawn by suitable means past the poles of two electromagnets 7 and 10 and that these magnets are connected in series in the circuit 5 and 12, which includes the secondary 4 of an induction-coil. 3 indicates the primary of said induction-coil, which is in circuit with a battery 1 and a telephonic transmitter 2. The terminals of the magnets 7 and 10 are tentatively connected to the plugs 6 8 and 9 and 11, whereby the particular arrangement of such connections may be altered at will, so that the relative polarity of the magnets can be changed to suit the conditions under which the instrument is to be used.

The operation is as follows: If speech or other sounds are delivered to the transmitter 2, the pulsations of current in the coil 3 will be amplified in the coil 4 and will traverse the magnets 7 and 10, causing them to magnetize successive portions of the magnetic strips *a* and *b* correspondingly. When the message is finished and it is desired to reproduce it, a receiving instrument can be inserted in place of the coil 4 and the strips *a* and *b* again passed across the poles of the magnets, with

the connections 6, 8, 9, and 11 remaining the same. In this operation the successive magnetic condition of the strips *a* and *b*, passing across the poles of their respective magnets, will react upon the coils of said magnets and induce in the circuit the same impulses that were before sent therethrough by the message. These impulses will be reproduced in the receiving instrument and repeat the original message. If now the polarity of one of the magnets 7 and 10 should be reversed by altering the connections 9 and 11, as in Fig. 2, it will be seen that the attempt to reproduce the original message will meet with failure, because each magnetic condition in one of the strips *a* and *b* will be equal to the corresponding condition in the other, so that the reacting result on the cores of the magnets 7 and 10 and on the circuit will be zero or no current, and the message will not be heard in the receiver; but while the magnets 7 and 10 are thus connected, as in Fig. 2, it is possible to fix upon the strips *a* and *b* an entirely new message, which will not in any way obliterate the first message and which can be reproduced while the connections remain the same and which will not prevent the reproduction of the first message when the connection has been again changed to the condition shown in Fig. 1 or the condition under which the said first message was recorded. To fix the second message upon the strips *a* and *b*, the same operation as before described is performed—that is, the message is delivered into the transmitter 2, and the pulsations in 3 are amplified in 4 and traverse the magnets 7 and 10. They in turn create the corresponding magnetic conditions in successive parts of the respective strips *a* and *b*, which conditions are maintained by the nature of the material of the strips for reproduction at any time. To reproduce the second message, the connections of Fig. 2 remain the same as when the message was recorded, and the strips *a* and *b* are again passed across the poles of the magnet, which causes the pulsations of current to traverse the receiver, which has been connected in the circuit 5 12 in place of the coil 4. Either the first or the second message can now be reproduced at any time by simply putting the connections 6, 8, 9, and 11 into the condition in which they were arranged when the desired message was recorded.

It is not necessary that separate paramagnetic bodies or strips be used for each electromagnet, as the desired result can be obtained as easily by allowing both electromagnets to act on the same paramagnetic body, it being necessary only that said magnet shall act at different locations upon a body or bodies.

When a wire spirally wound on the cylinder is used, as proposed by Poulsen in his said patent, the electromagnets should preferably be arranged to bear on two different convolutions of the spiral. However, to economize space they can be arranged to bear on the same convolution, but one behind the other. In the latter case the message will not be quite as clearly reproduced as in the former case, as a number of secondary sounds will be audible. The message, however, is still quite intelligible. It will be understood that from the fact that two messages can be stored upon one magnetic body in the manner above explained by using two electromagnets and changing their polarity a larger number of messages may be stored and reproduced independently of each other by using a correspondingly-larger number of electromagnets and by connecting them up in the circuit in various combinations. When the magnets are arranged behind each other on the same convolution of a spirally-wound wire, two magnets will be sufficient for several messages, as it is only necessary to alter the distance between the magnets for each message. It is, however, in general better to use several magnets, as the speech is then more distinctly reproduced.

Figs. 4 to 7 show the use of four electromagnets and various ways in which they can be connected together, so as to record four different messages on and reproduce the same without interference from one paramagnetic body, such as a steel ribbon *e*.

In Fig. 4 the four electromagnets are connected in series through the terminals 23, 24, 25, 26, 27, 28, 29, and 30. On delivering the message into the transmitter 2 a variation of the current will be reproduced in the primary coil 3 in accordance with the sound-waves of the message in the usual manner. This variation will be reproduced in the secondary circuit 5 and in all of the electromagnets. If during the delivery of the message into the transmitter the paramagnetic body *e* is moved along in contact with the electromagnets, the body *e* will then record the message. To audibly reproduce the message, the body *e* is again moved past the magnets with the same connections, whereupon the telephone-receiver substituted for the secondary coil 4 will reproduce the message. If now the connection is altered to correspond with Fig. 5, so that the action of the two electromagnets on the left is neutralized by the action of those on the right, then the message that has been fixed on the paramagnetic body with the connection shown in Fig. 4 will not be reproduced by a telephone-receiver substituted for the secondary coil when the said magnetic body is again moved past the electromagnets. With the connection shown in Fig. 5, however, a second message can be fixed to the paramagnetic body, and this speech can be reproduced when the connections remain the same without interference with the first message. Again, if the connection is altered to correspond with Fig. 6, so that the first and third and second and fourth electromagnets have the same direction of current, one pair of the magnets will neutralize the other pair

and a third message can be fixed upon the paramagnetic body, the two messages recorded with the connections of Figs. 4 and 5 being meanwhile suppressed. The same is the case with the connections as shown in Fig. 7, where two middle electromagnets neutralize the outer magnets.

It has been discovered that by means of the invention heretofore described it is possible to simultaneously transmit several messages along the same conductor, and this is accomplished by adopting the apparatus diagrammatically represented in Fig. 3. In this drawing it is assumed that three messages are to be simultaneously transmitted along the conductor 21. The apparatus includes a steel disk *i* at the transmitting-station and a corresponding steel disk *k* at the receiving-station. Both disks are to be simultaneously rotated. At both stations are provided the local circuits I II III, each of which includes four electromagnets. For each series of electromagnets there is a set of terminals 13, 14, 15, 16, 17, 18, and 19. The magnets in the set I are connected, say, in series. Those in the circuit II are connected in a different way, while those in the circuit III are connected in still another way. The magnets in corresponding local circuits at the two stations are connected in identically the same way—that is, the connections of the magnet in the local circuit I in the transmitting-station is the same as the connection of the magnets in the circuit I at the receiving-station, and so on. The circuit 21, over which the messages are to be simultaneously transmitted, contains at each station an electromagnet which faces up the respective disks, one magnet being indicated by 20 and the other by 22. With the apparatus equipped thus in operation the magnetism created in the disk *i* by the three different sets of magnets acting simultaneously thereon will affect the magnet 20 and send impulses over the circuit 21, which will be received by the magnet 22 and impressed upon the disk *k*. Those impulses which were created by the circuit I at the transmitting end will be picked up and delivered to the receiver in the circuit I at the receiving end, and in like manner the receiving-circuits II and III will select the messages delivered through the circuits II and III at the transmitting-station. After the disk has passed all of the recording and reproducing magnets it passes an obliterating-magnet *p'*, which cleans off the record so that it may be presented to the recording-magnets in condition to receive a new portion of the message.

As pointed out hereinbefore, it will be seen that it is possible to isolate or individualize each message either by changing the connections of the magnets or by changing their distance apart. Hence in the claims which follow the expression "altering the relation of the electromagnets" refers to either of these methods of isolating or individualizing. It is also pointed out that since the magnets may act upon the same or different magnetic bodies without producing a change in the mode of operation a plurality of bodies is quite the practical equivalent of a single body, and while the claims refer only to a single magnetic body it is to be understood that a plurality of bodies are to be considered merely as parts or divisions of a single body and as such covered by the claims.

Having described my invention, I claim—

1. The method of storing a plurality of messages or signals for subsequent reproduction, which consists in establishing in a paramagnetic body a series of magnetic conditions corresponding to a message or signal and then superposing or establishing another series of magnetic conditions in said paramagnetic body within the range of the first series of magnetic conditions and corresponding to a second message or signal and so on superposing series of magnetic conditions corresponding to respective messages or signals.

2. The method of storing a plurality of messages or signals for subsequent reproduction, which consists in establishing in a paramagnetic body two series of magnetic conditions similar in all respects to each other and corresponding to one message or signal and then superposing or establishing two other series of magnetic conditions in said paramagnetic body within the range of the first-mentioned two series, the second two series being similar to each other in every respect and corresponding to a second message or signal, and so on superposing or establishing two corresponding series of magnetic conditions for each message all within the same range on the paramagnetic body, substantially as described.

3. The method of storing a plurality of messages or signals for subsequent reproduction which consists in establishing in a paramagnetic body, two series of magnetic conditions similar in all respects to each other and corresponding to the message or signal, then superposing or establishing two other series of magnetic conditions in said magnetic body similar in all respects to each other but differing in relation to each other from the relation existing between the two series first mentioned, said second two series being established in the said paramagnetic body within the range of the two series first mentioned and so on superposing or establishing two corresponding series of magnetic conditions for each message all within the same range on the paramagnetic body and the relation between each two series differing from that between every other two, substantially as described.

4. The method of storing a plurality of messages or signals for subsequent reproduction which consists in simultaneously causing a plurality of electromagnets to establish like

magnetic conditions at a plurality of different locations on a moving magnetic body, said magnetic conditions corresponding to and being produced by one message, then altering the relation of the electromagnets and again causing them to establish like magnetic conditions at a plurality of different locations on said moving body, said magnetic conditions corresponding to and being produced by a second message, and so on, for each message altering the relation between the magnets and then establishing the magnetic conditions therewith, substantially as described.

5. The method of storing a plurality of messages or signals and subsequently reproducing the same which consists in establishing in a paramagnetic body a series of magnetic conditions corresponding to a message or signal and then superposing or establishing another series of magnetic conditions in said paramagnetic body within the range of the first series and corresponding to a second message or signal and so on superposing different series of magnetic conditions corresponding to respective messages or signals, and then causing any one of said respective series of magnetic conditions to influence a receiving apparatus sensitive thereto.

6. The method of storing a plurality of messages or signals and subsequently reproducing the same, consisting in establishing in a paramagnetic body two series of magnetic conditions similar in all respects to each other and corresponding to one message or signal and then superposing or establishing two other series of magnetic conditions in said paramagnetic body within the range of the first-mentioned two series, the second two series being similar to each other in every respect and corresponding to a second message or signal, and so on superposing or establishing two corresponding series of magnetic conditions for each message all within the same range on the paramagnetic body and then causing any one of said pairs of series of magnetic conditions to influence a receiving apparatus sensitive thereto.

In testimony whereof I have hereunto set my hand in the presence of two witnesses.

PEDER OLUF PEDERSEN.

Witnesses:

EINAR G. LÜBCKE,

EMIL SCHACK HAGEMANN.