Nov. 2, 1926. 1,605,023

R. V. L. HARTLEY

SIGNALING METHOD AND SYSTEM

Filed May 19, 1921 2 Sheets-Sheet 1

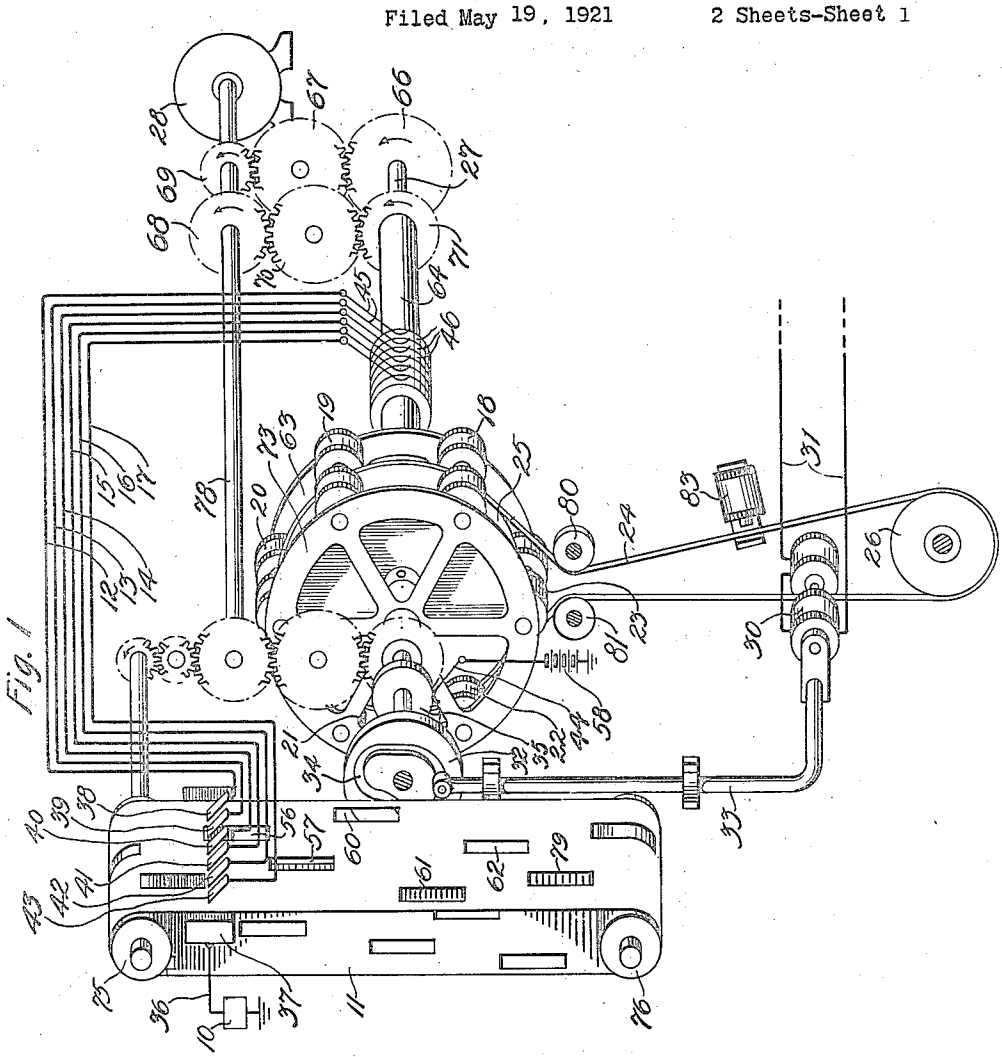


Fig. 1

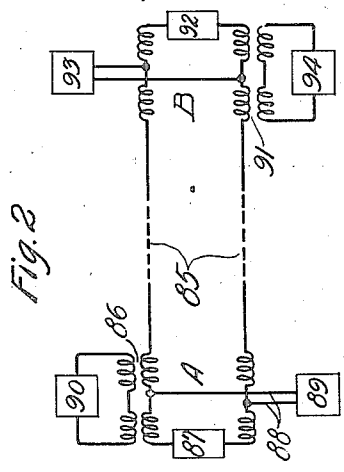


Fig. 2

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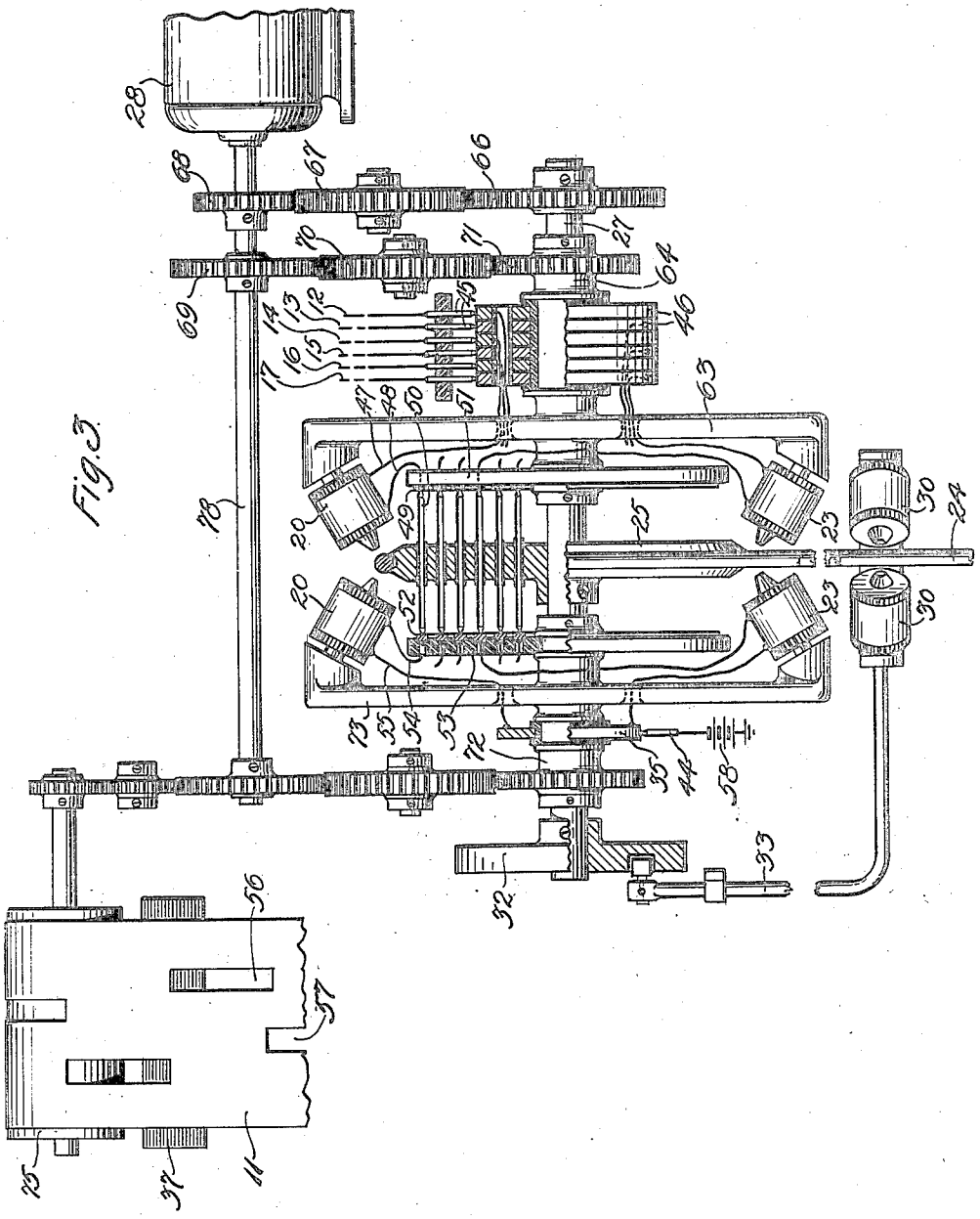


Fig. 3.

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UNITED STATES PATENT OFFICE.

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SIGNALING METHOD AND SYSTEM.

Application filed May 19, 1921. Serial No. 470,757.

This invention relates to signaling systems and more particularly it relates to secret signaling methods and systems.

One of the objects of this invention is to provide a signaling method and system whereby signals, such as telephone signals, may be transmitted without danger of the signals being understood by persons not equipped with special receiving apparatus.

Other objects of this invention will be apparent from the detailed description of this invention hereinafter given.

The preferred embodiment of this invention by means of which the objects of this invention are attained employs a telegraphone tape at both the transmitting and receiving stations. A plurality of recording magnets sequentially responsive in an arbitrary order to the source of signals, are preferably moved in the same direction as the direction of motion of the telegraphone tape with a velocity greater than the velocity of the tape. The reproducing magnet which impresses the signal waves upon the outgoing line will then not only receive the portions of the signal waves in an arbitrary order but will also receive each portion of the signal waves in reverse order from that in which they were generated. Still further complications may be introduced if desired by providing cam mechanism for giving an irregular movement to the reproducing magnet whereby the frequency of the signals is varied in an arbitrary manner. The receiving apparatus for such distorted signals would comprise similar apparatus except that the recording magnet would be given an irregular movement in synchronism with the reproducing magnet of the transmitting station and a plurality of reproducing magnets would be sequentially responsive to the magnetic record in the same manner as the recording magnets of the transmitting station. Synchronizing means, of course, should be provided for insuring absolute synchronism at the two stations.

This invention will be better understood by reference to the following detailed description taken in connection with the accompanying drawings in which Fig. 1 represents an embodiment of this invention which may be either a transmitting apparatus or a receiving apparatus; and Fig. 2 represents schematically, how two-way signaling may be obtained and employing apparatus of the type shown in Fig. 1; and Fig. 3 represents a top view of a portion of Fig. 1.

As previously stated, this invention preferably employs a telegraphone tape at both the transmitting and receiving stations whereby a magnetic record of the signals is made prior to impressing the signals upon the outgoing line and a similar magnetic record is made at the receiving station before impressing the signals upon the receiving device. The block 10 of Fig. 1 is intended at a transmitting station to represent a source of signals such as a telephone transmitter, which, by a perforated tape 11 is adapted to be connected by one of the leads 12 to 17 inclusive and other connections hereinafter described to one of the rotating pairs of recording magnets 18 to 23 inclusive, whereby a magnetic record of the signals may be made upon the telegraphone tape 24. Inasmuch as the perforated tape 11 is adapted to connect the transmitting device 10 in an arbitrary order to the recording magnets 18 to 23 inclusive, it follows that the signals will be recorded on the telegraphone in portions of the signal waves in a different order than they were generated by the transmitting device 10. The telegraphone tape 24 passes over two pulleys or disks 25 and 26, disk 25 being mounted on a shaft 27 which is driven by a suitable source of power such as a motor 28 in a counterclockwise direction. Associated with tape 24 is a reproducing magnet 30 for changing the magnetic record on tape 24 to variations in the electric current in the outgoing line 31.

In the preferred embodiment of this invention, the recording magnets 18 to 23 inclusive, are rotated about shaft 27 at a speed twice the speed of rotation of disk 25 whereby the recording magnets travel in the same direction as the telegraphone tape but with twice the speed. When, therefore, transmitting device 10 is connected at any particular instant to one of the recording magnets, the magnetic record produced on the

telegraphone tape is impressed on the tape in the opposite direction to the manner it would be impressed thereon if the recording magnets were stationary, for example. It follows, therefore, that as tape 24 passes the reproducing magnet 30, each segment of the signals impressed on the tape by one of the recording magnets is actually transmitted to line 31 in reverse order with respect to the order the signals were generated by source 10.

If desired, the signals before being impressed on the outgoing line 31 may be still further distorted by having the reproducing magnet 30 moved cyclically in an irregular manner whereby the frequency of the signals is varied. As shown in the drawing, reproducing magnet 30 is attached to an arm 33, the other end of which is adapted to travel in a grooved path 34 in disk 32 whereby the reproducing magnet 30 is given the irregular motion desired.

The above description of the manner in which the apparatus of Fig. 1 operates, will be better understood by the following detailed description. The transmitting device 10 is shown connected by a lead 36 to a stationary block 37 of conducting material. Contact fingers 38 to 43 inclusive, are adapted to contact with block 37 whenever the perforations of tape 11 permit. It is desirable, of course, that only one of the contact fingers should make electrical connection with block 37 at one time. The leads 12 to 17 inclusive from the contact fingers are connected to a plurality of brushes 45 which are in electrical contact with a plurality of slip rings 46. Each of the slip rings 46 (Fig. 3) is connected through one of the recording magnets 18 to 23 inclusive to the slip ring 35, brush 44, to battery 58 and ground. Inasmuch as this connection is similar for each of the slip rings only the connections through magnets 20 and 23 are shown in detail in Fig. 3. The connection between lead 14 through magnet 20 to battery may be traced through one of the slip rings 46, conductor 47, one of the windings of magnet 20, conductor 48, the circular strip 49 of conducting material mounted on a rotatable disk 51, a contact finger 50 carried by disk 25, a corresponding circular metallic strip 52 on a disk 53, conductor 54, winding of other part of magnet 20, conductor 55, slip ring 35 to battery 58. In a similar manner, the connection of lead 17 may be traced through magnet 23 to battery 58 and ground. It will hereafter be assumed that leads 12, 13, 15 and 16 are similarly connected through magnets 18, 19, 21 and 22 respectively to battery 58. Since, at the particular instant illustrated in the drawing, (Fig. 1) contact finger 39 is in contact with block 37, it follows that the transmitting device 10 is adapted to impress signaling currents therefrom upon the recording magnet 19 by the following circuit: ground, transmitting device 10, block 37, finger 39, lead 13, one of the brushes 45 and one of the slip rings 46, to a connection (not shown) through magnet 19, and slip ring 35 to battery 58 and ground. As long, therefore, as contact finger 39 is in contact with the block 37 it follows that the signals from source 10 will be recorded on the telegraphone tape 24 by the recording magnet 19. After the perforation 56 has been passed over, perforation 57 will allow contact finger 41 to contact with block 37 thereby connecting the transmitting device 10 through lead 15 to magnet 21, so that magnet 21 records the signals on the telegraphone tape. The subsequent perforations 60, 61, 62 and 79 will allow contact fingers 38, 43, 40, and 42 to cause magnets 18, 23, 20, and 22 to be energized respectively by the source of signals 10, after which the six recording magnets may be energized in another cycle in the order outlined above,—namely 19, 21, 18, 23, 20 and 22. It has been found that when the six recording magnets are operated in this sequence, each being energized long enough during each cycle to record on the tape a distance equal to half the distance between two adjacent magnets as measured along the circle circumscribed by the magnets, that all of the message from source 10 will be recorded on tape 24 without overlapping the portions of the signal waves of the record. If we assume that the recorded portions of the signal waves are generated at source 10 in the order of 1, 2, 3, 4, 5, 6, 7, 8, etc. the order in which these segments will be impressed on outgoing line 31 on account of the arrangement of the perforations in the tape 11 will be 2, 5, 7, 9, 10, 1, 12, 3, 14, 17, 4, 19, 6, 21, 8, 11, 22, 13, 24, 15, 26, 29, 16, 31, etc. It is to be understood of course that this invention is not limited to the particular cycle in which the magnets are energized as described above. It has been found satisfactory for example to energize magnets 18 to 23 inclusive in the following order: 22, 18, 21, 20, 23, 19. It is also obvious that if desired the perforations in the tape 11 need not all be of the same length but each may be of a different length thereby increasing the confusion.

The manner in which the recording pairs of magnets 18 to 23 inclusive, are rotated in the same direction as the rotation of the telegraphone tape but at twice the speed, may be explained as follows. The disk 63 (Fig. 3) upon which one of each pair of the recording magnets are mounted is fastened to a sleeve 64 which is capable of being rotated at a speed different than the speed of the shaft 27. Shaft 27 is driven by motor 28 by means of the three gears 66, 67, and 68, gear 66 being rigidly mounted on shaft 27.

The sleeve 64 however is driven by motor 28 by means of gears 69, 70, and 71, the latter of which is rigidly fastened to sleeve 64. The set of gears 69, 70, and 71 should be so designed that disk 63 which carries the magnets is rotated at twice the speed but in the same direction as disk 25 which carries the telegraphone tape. Sleeve 72 which is attached to the other magnet carrying disk 73 should be similarly geared to rotate disk 73 at the same speed as disk 63. Disks 51 and 53 which carry the circular strips of conducting material are also mounted respectively on sleeves 64 and 72. It therefore follows from this arrangement that, since disk 25 which carries the tape in a groove around its periphery is fastened to shaft 27, the recording magnets will be rotated with twice the speed of rotation of the tape.

It is obvious that disks 63 and 73 may carry as many recording magnets as desired although only six are shown in Fig. 1.

If desired, the perforated tape 11 may be driven by the source of power 28. As shown in Fig. 1, the tape 11 is stretched between two rollers 75 and 76, the roller 75 being suitably geared to the shaft 78, which is driven by motor 28.

In order that telegraphone wire 24 may contact with more than half of the circumference of disk 25, it may be found preferable to employ a plurality of rollers 80 and 81. Such an arrangement obviously increases the range over which any of the recording magnets may be energized to produce a magnetic record on the wire 24. For obliterating the magnetic record on the wire 24 after it has been recorded by one of the magnets and reproduced by the magnet 30 a suitable wiper magnet 83 is provided.

The apparatus of Fig. 1 has been described above as to how the system would operate for the transmission of signals. The system of Fig. 1, however, will operate equally well as a receiver of the distorted signals. If the arrangement of Fig. 1 is to be used at a receiving station, block 10 should represent a suitable receiving device such as a telephone receiver. The incoming currents from line 31 impressed on the recording magnet 30 would cause a magnetic record of the incoming signals to be made on the telegraphone tape 24 and magnet 30 being given an irregular motion by an arm 33 similar to the motion given to the reproducing magnet at the sending station, the record made on the telegraphone wire would, therefore, be without the distortion produced by the irregular motion given the reproducing magnet at the transmitting station. The magnets 18 to 23 would constitute reproducing magnets and each of the magnets 18 to 23 inclusive, would, by a perforation in tape 11 driven in synchronism with a corresponding perforated tape at the transmitting station, be connected to a receiving device 10 sequentially in such an order that the receiving device 10 receives the signals in the order they were originally generated at the transmitting station. The reproducing magnets 18 to 23 inclusive, of course, should be driven in synchronism with the recording magnets of the receiving station and at twice the speed of the motion of the telegraphone wire. It follows, therefore, that if the motor 28 at a receiving station is properly synchronized with a similar motor at a transmitting station, the device of Fig. 1 will serve to remove the distortion from the signals and render them intelligible in the receiving device 10. It is obvious, of course, that the wiper magnet 80, in case the apparatus of Fig. 1 is employed at a receiving station, should be so positioned as to wipe out the magnetic record produced by magnet 30 only after it has been reproduced by one of the magnets 18 to 23 inclusive.

A signaling system employing the apparatus of Fig. 1 for two-way transmission between stations may be connected up, for example, in the way illustrated schematically in Fig. 2. 85 represents a transmission line interconnecting a station A and a station B. Line 85 at station A terminates in a three-winding transformer 86 and an artificial line 87. The midpoints of the line winding of transformer 86 may be connected by leads 88 to leads 31 of apparatus of Fig. 1, shown as block 89, the block 10 of Fig. 1 being, of course, a suitable source of signals such as a telephone transmitter. Block 90 which is connected to the third winding of the transformer 86 is intended to represent the apparatus of Fig. 1, adapted to receive the distorted signals from station B. Similarly line 85 at station B terminates in a three-winding transformer 91 and an artificial line 92. Block 93 is connected to the mid-points of the line windings of transformer 91 and is intended to represent transmitting apparatus such as that shown in Fig. 1, while block 94 is connected to the third winding of transformer 91 and is intended to represent the apparatus of Fig. 1 adapted to receive distorted signals from station A.

It is to be understood that this invention may be variously modified from the form above described without departing in any wise from the spirit of this invention as defined in the appended claims.

What is claimed is:

1. The method of signaling which comprises dividing the signals into portions of signal waves, arbitrarily arranging said portions of the signal wave in a different order, and impressing upon a signaling line certain of said portions of the signal wave in reverse order from that in which they were generated.

2. The method of signaling which comprises dividing the signals into arbitrary

portions of signal waves with respect to the order in which they were generated, arranging said portions in a different order, reversing the order of each portion of the signal waves with respect to the order in which they were generated, changing in an irregular manner the frequency of each portion of the signal wave, and impressing the modified signals upon an outgoing line.

3. The method of signaling which comprises dividing the signals into portions of signal wave, changing the frequency of each portions of the signal waves in an irregular manner, and impressing such portions on a signaling line in an irregular order with respect to their origination.

4. The method of signaling which comprises dividing the signals into groups, rearranging said signals in an arbitrary order with respect to their natural sequence, reversing a plurality of said groups with respect to their original order and impressing the modified signals upon a line.

5. The method of signaling which comprises, at a transmitting station, dividing the signals into portions of signal waves, rearranging said portions of the signal waves in an arbitrary order with respect to their natural sequence, reversing a plurality of said portions of the signal wave with respect to the order in which they were generated, and, at a receiving station, reversing the reversed portions of the signal wave with respect to their original order, rearranging said portions of the signal wave in their natural sequence, and impressing the signals upon a receiving device.

6. The method of signaling which comprises transmitting signals reversed with respect to the order in which they were generated, and irregularly varying the frequency of said signals.

7. The method of signaling which comprises dividing the signals into groups, reversing the order of said groups with respect to their original order, and arbitrarily varying the frequency of said groups.

8. The method of signaling which comprises generating a train of electric waves, reversing with respect to time certain portions of said waves, and arbitrarily varying the frequency of said waves.

9. The method of signaling which comprises generating a train of signals, changing the order of said train with respect to its original order, reversing with respect to the order in which the portions of said train were generated, and cyclically varying at a low frequency the frequency of said train.

10. A signaling system comprising a source of signals, a line, a wire of magnetic material, a plurality of recording magnets for said wire, means for causing said magnets to be responsive in an arbitrary order to said source, means for moving said wire, means for moving said recording magnets in a direction of the motion of said wire at a greater speed than said wire, and means for impressing the recorded signals upon said line.

11. A signaling system comprising a source of signals, a line, a plurality of means for making a record of said signals, means for causing said recording means to be responsive in an arbitrary order to said source, means for impressing the recorded signals upon said line, and means for moving said last means in an arbitrary manner.

12. A signaling system comprising a source of signals, a line, a wire of magnetic material, a plurality of recording magnets for said wire, means for causing said magnets to be responsive in an arbitrary order to said source, a reproducing magnet for impressing the recorded signals upon said line, and means for causing the moving of said reproducer while reproducing.

13. A signaling system comprising a source of signals, a line, a wire of magnetic material, a plurality of recording magnets for said wire, means for causing said recording magnets to be responsive in an arbitrary order to said source, means for moving said wire, means for moving said recording magnets at a speed twice the speed of said wire, a reproducing magnet for impressing the recorded signals upon said line, and means for imparting an irregular motion to said reproducing magnet.

14. In combination, a signaling line, a source of signals, a plurality of electroresponsive devices sequentially responsive in an arbitrary order to impress signals upon said line, and means for rotating each of said devices while in operation.

15. In combination, a signaling line, a source of signals, a plurality of electroresponsive devices sequentially responsive in an arbitrary order to impress signals upon said line, and means for moving said devices continuously.

16. In combination, a source of signals, a plurality of electroresponsive devices selectively responsive in an arbitrary order to said source for reproducing a record of said signals, means for causing said devices to record portions of said signals in an order reversed wtih respect to that in which they were generated, a line, and means for cyclically varying at a low frequency the frequencies of the recorded signals before impressing the signals upon said line.

17. A method of signaling which comprises continuously generating a signal wave, dividing said signal wave into arbitrary portions and transmitting successively generated portions in successively different orders.

18. A method of signaling which comprises generating a signal wave, dividing

said wave into arbitrary portions, reversing the order of the components within certain portions and transmitting successively generated portions in successively different sequence.

19. A method of signaling which comprises generating a signal wave, dividing said wave into arbitrary portions, reversing the order of the components within certain of said portions and transmitting the resultant wave to a distant point.

20. The method of signaling which comprises generating a signal wave, dividing said wave into arbitrary portions, reversing the order of the components within each of said portions and transmitting said portions to a distant point in a different sequence from that in which they were generated.

21. A method of signaling which comprises generating a signal wave, dividing said wave into arbitrary portions, rearranging the sequence of said portions and transmitting the resultant wave to a distant point at a continuously varying frequency.

22. A method of signaling which comprises generating a signal wave, dividing said wave into arbitrary portions, reversing the order of the components within each of said portions, changing the sequence of said portions and transmitting the resultant waves at varying frequency.

23. A metnod of sound recording which comprises generating a signal wave, dividing said wave into portions and recording said portions in such manner that the arrangement of the components within each portion is reversed.

24. A method of signaling which comprises generating a signal wave, dividing said wave into portions, rearranging the sequence of said portions, reversing the arrangement of the components within said portions, recording the resultant wave and transmitting the recorded wave to a distant point.

25. A sound record, means to move said record continuously in the same direction and means for recording sound on said record, said recording means being movable in the same direction as said sound record but at a substantially greater speed.

26. A sound record, means to move said record continuously in one direction, a sound reproducing means cooperating therewith and means for moving said sound reproducing means continuously in the same direction and at a greater speed.

27. A method of signaling which comprises dividing the signals into portions of the signaling wave in an irregular manner, reversing the arrangement of the components within each portion and impressing said portions on a signal line in a different sequence from that in which they were generated.

28. A system for receiving a signal wave composed of a plurality of individual portions, comprising means for separating said portions, means for reversing the arrangement of the components within certain of said portions and means for impressing the resultant waves on a sound reproducing device in a sequence different from that in which they were received.

29. A signal receiving device comprising a movable wire of magnetic material, a plurality of reproducing magnets for said wire, means for moving said magnets in the same direction and at a greater speed than said wire, a sound reproducing means and means for connecting said sound reproducing means with said reproducing magnets in an arbitrary order.

In witness whereof, I hereunto subscribe my name this 14th day of May A. D., 1921.

RALPH V. L. HARTLEY.