June 19, 1923. 1,459,202

L. F. FULLER

METHOD OF SENSITIZING THE TELEGRAPHONE

Filed Aug. 26, 1918

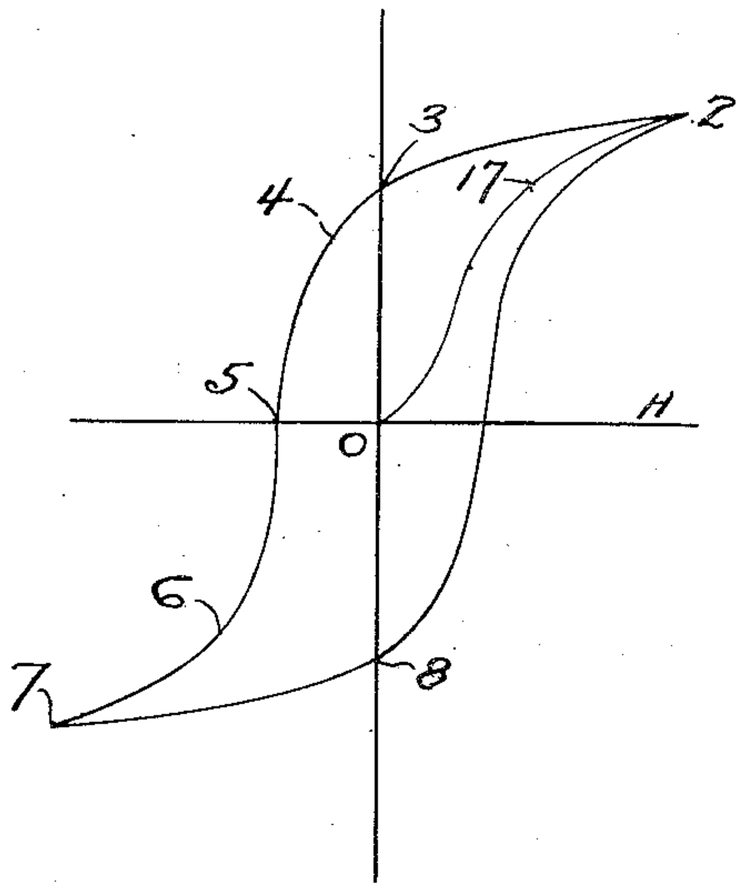


Fig. 1

Fig. 2

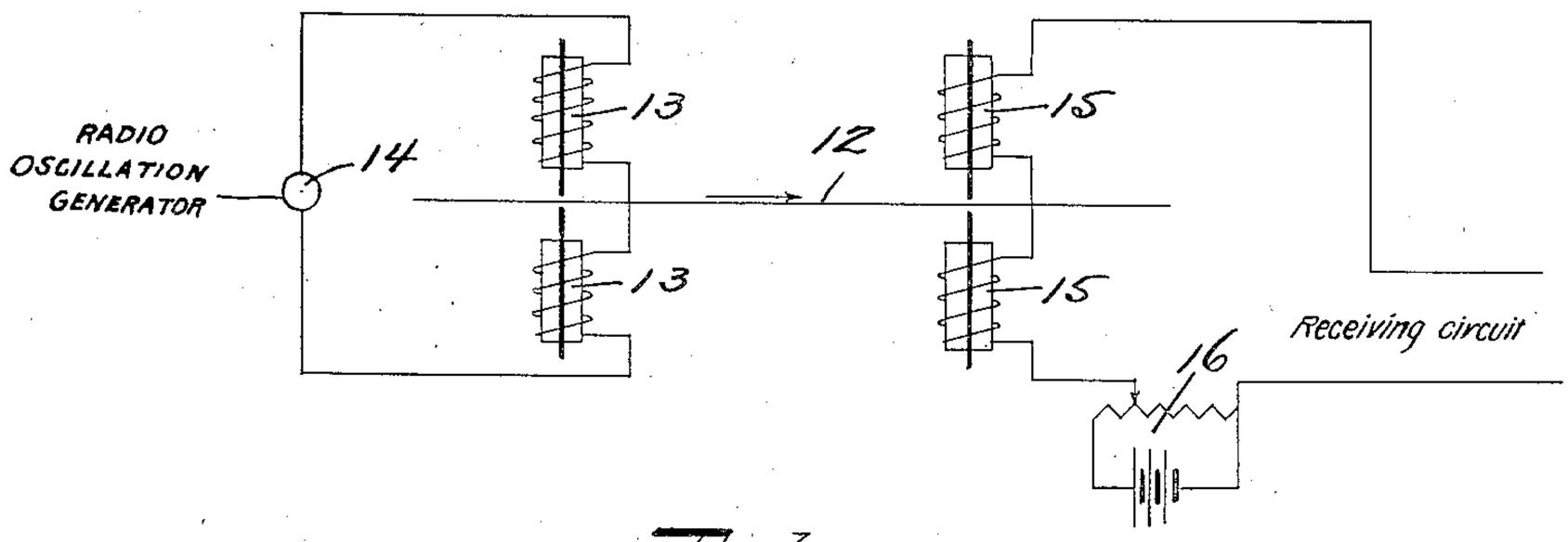
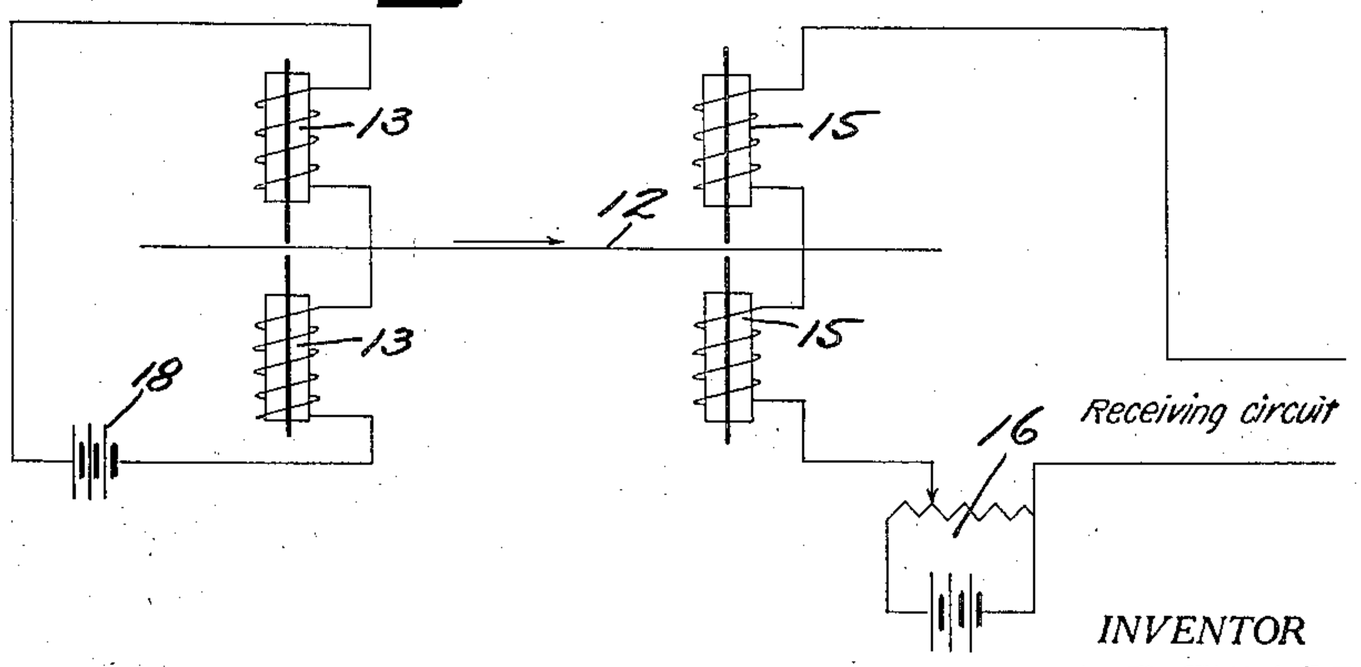


Fig. 3



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Patented June 19, 1923. 1,459,202

UNITED STATES PATENT OFFICE.

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METHOD OF SENSITIZING THE TELEGRAPHONE.

Application filed August 26, 1918. Serial No. 251,372.

To all whom it may concern:

Be it known that I, LEONARD F. FULLER, a citizen of the United States, and a resident of Palo Alto, county of Santa Clara, and State of California, have invented a new and useful Method of Sensitizing the Telegraphone, of which the following is a specification.

The telegraphone, as is well known, comprises an instrument in which a magnetizable wire or surface is locally magnetized in varying degrees at successive points along the wire or surface and at this spot magnetization persists, so that a record is produced on the wire or surface which may be subsequently reproduced. An object of this invention is to sensitize the telegraphone so that it will record magnetically on its wire very much weaker electrical impulses transmitted to its magnetizing coils than is at present possible.

The invention possesses other advantageous features, some of which, with the foregoing, will be set forth at length in the following description, where I shall outline in full that form of the invention which I have selected for illustration in the drawings accompanying and forming part of the present specification. In said drawings I have shown two forms of apparatus for carrying out the method of my invention, but it is to be understood that I do not limit myself to such forms, since the method may be performed with other forms of apparatus.

An object of the invention is to sensitize the telegraphone so that it may be used for high speed radio signal recording, submarine cable signal recording, long distance telephone message recording and the recording of other weak electrical impulses.

Attempts have been made in the past to use the telegraphone for high speed receiving, but these attempts have been mostly unsuccessful, due to the insensitiveness of the telegraphone, which required abnormally strong signals to cause a record on the telegraphone wire. In the use of the telegraphone as a high speed receiving instrument, the wire is run through at high speed while the signals or message is coming in and the magnetic record is put on the wire. Later, the wire is run through at low speed and the operator, wearing a pair of telephone receivers, may take the signals off by ear and type the message directly on a typewriter.

Referring to the accompanying drawings:

Figure 1 is a hysteresis loop which I employ in describing the method of my invention.

Figure 2 is a diagrammatic representation of an apparatus for carrying out the method of my invention.

Figure 3 is a diagrammatic representation of an apparatus for carrying out a modified method.

Referring to the hysteresis loop, the curve 0—2 is known as the virgin curve. If the magneto motive force is raised from zero to some definite value, corresponding to the projection of 2 on the H axis, the flux density or the intensity of magnetization in the wire or iron sample follows the curve 0—2 when the wire or iron sample was completely demagnetized at the start. If, however, the iron was previously magnetized, or as it is commonly stated, had some previous history, the curve 0—2 is not followed, but rather, the hysteresis loop 2—3—4—5—6—7—8—2 or some other hysteresis loop, larger or smaller than this, depending upon the previous history of the wire or iron sample.

The telegraphone may be sensitized by either of two methods. The first method involves the elimination of all previous history from the telegraphone wire 12 by passing it through a radio frequency magnetic field, produced in the magnets 13 by continuous radio frequency oscillations from the source 14 which may be a Poulsen arc, an oscillating audion or a high frequency generator. The high frequency magnetic field completely erases all previous magnetization on the wire and reduces its magnetic condition to point 0 on the hysteresis loop diagram. The wire after passing through the high frequency magnetic field, then passes through the field of recording magnets 15. By allowing direct current from a storage battery slide wire potentiometer 16, or other source of supply, to flow through the coils of the recording magnets 15, the flux density of the wire may be brought up to the point 17 on the virgin curve 0—2. The receiving circuit is connected to the

coils of the receiving magnets, preferably in series with the storage battery 16, so that the current of the signals is superimposed upon the battery current. Since the current of the signals is alternating, the flux density on the wire will be raised over the knee of 0—2 curve from 17 toward 2, when the alternating current signal is in one direction, and will be depressed down the 0—2 curve from 17 toward 0 when the signal current is in the opposite direction. No considerable permanent set of the molecules in the wire will occur until it is magnetized over the knee of the 0—2 curve, that is, above 17. The battery current is such that the point 17 occurs just below or at the knee. The negative half of each signal or alternating current cycle produces no record on the wire, but the positive half of the cycle raises the flux density over the knee toward 2 and gives the molecules of the wire a permanent set. Heretofore it has been necessary for the rceived current to carry the flux density from 0 to 2 before a record was obtained on the wire, but by using a storage battery or other source of direct current to bring the flux density to the point 17 on the curve, it is necessary for the received current to be only strong enough to raise the flux density from the point 17 over the knee toward 2.

This method therefore involves spot magnetizing a wire, the spots being formed by the positive half of each A. C. cycle of the received current. According to the Ewing theory of magnetization the molecules of the iron at the point 0 are lying in all directions, that is, their poles all neutralize. By subjecting the wire to the magnetomotive force produced by the current of the polarizing battery and bringing the flux up to the point 17 on the curve, the molecules are swung around into position so that they nearly line up, but due to hysteresis they are very willing to spring back into their neutral position unless some additional flux is applied which will spring them permanently into alined position. This additional flux is supplied by the received current.

The alternative method consists in not eliminating all past history by demagnetizing the wire with radio frequency continuous oscillations, but by erasing all past records on the wire by subjecting it to a direct current magnetic field produced in the magnets 13 by current from the polarizing battery 18, Figure 3. As the wire passes the erasing magnet 13 the wire will be magnetized permanently and equally at all points by the direct current magnetomotive force bringing a spot on the wire up to the point 2 on the hysteresis curve when the said spot is directly under the magnets 13. As the wire continues to travel, the spot withdraws from the magnet and the magnetizing force becomes less and less until it reaches a point 3 on the hysteresis curve, but reversal of polarity does not occur. The battery 18 which I have termed the polarizing battery puts the iron of the wire in the condition indicated by the point 3 on the hysteresis loop regardless of the previous history of the wire. The recording magnets 15 are energized by direct current from the storage battery potentiometer 16 and the received signal currents as before, the direct current being such that the wire is in the condition indicated by the point 4 on the curve. When the signals are received, the negative half of each cycle will trip the molecules down the steep part of the curve from point 4 down to points 5 and 6, but during the positive half cycle no change in magnetization results. This method is therefore the reverse of the former, in that the wire is magnetized and spots erased from it while in the former case all magnetization was erased and spots were put on the wire. The two methods have equal sensitivity, but since the first involves radio frequency erasure with continuous oscillations and the second involves only storage batteries and resistance, the second method is preferable.

In the first method, the polarity of the polarizing battery current is immaterial, since if it is in one direction the positive half of each signal is recorded and if it is in the other direction, the negative half will be recorded. In the second method it is necessary that the battery 16 be so connected with reference to the direction of winding of the magnets 15 and the polarity of the battery 18 and direction of winding of the magnets 13, that the polarity of the magnets 15 due to the battery 16 is the reverse of the polarity of the magnets 13 due to battery 18.

I claim:

1. In a telegraphone having a magnetizable member and means for magnetically influencing successive portions of said member in accordance with the receipt of signals, so that a magnetic record, consisting of relatively intensely magnetized portions alternating with relatively weakly magnetized portions, is imparted to the member, the method of preparing the member for the record and of producing the record, which comprises reducing the magnetic state substantially to zero, subjecting successive spots on the body to the combined influence of a direct current field and a field corresponding to the signals, and adjusting the value of the direct current field so that it is alone sufficient to magnetize the member to an intensity corresponding to a point just below the knee of the saturation curve.

2. In a telegraphone having a magnetizable member and means for magnetically influencing successive portions of said member in accordance with the receipt of signals,

so that a magnetic record, consisting of relatively intensely magnetized portions alternating with relatively weakly magnetized portions, is imparted to the member, the method of preparing the member for the record and of producing the record, which comprises bringing the member under the influence of a magnetizing force so that the successive portions have substantially no magnetism, moving the member away from this field and to a field consisting of a direct current component and a component corresponding to the signal, and adjusting the value of the direct current component to a value sufficient to bring the magnetic intensity of the member just below the knee of the saturation curve.

3. The method of recording signals on a magnetizable body which consists in first bringing the body to its neutral state and then passing the body through a magnetic field produced by a direct current and a signaling current.

4. The method of sensitizing the telegraphone which consists in first subjecting the magnetizable body to a radio frequency magnetic field to bring the body to its natural state and then passing the body through a magnetic field produced by a direct current and an alternating message carrying current.

In testimony whereof, I have hereunto set my hand at Palo Alto, California, this 14th day of August, 1918.

LEONARD F. FULLER.