

1,287,982.

Patented Dec. 17, 1918.

Fig. 1.

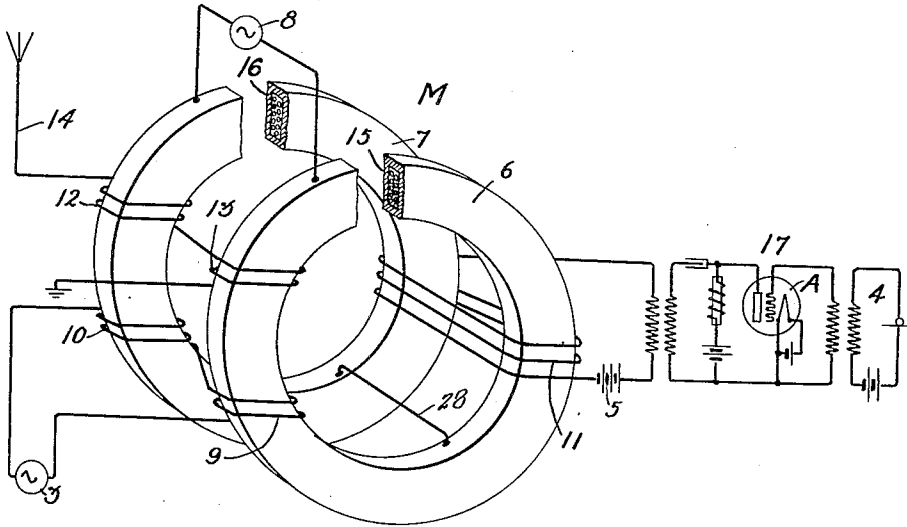


Fig. 2.

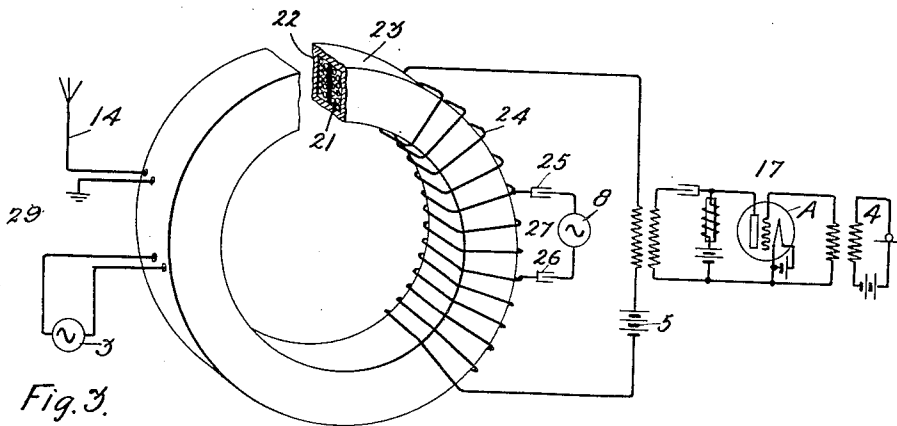
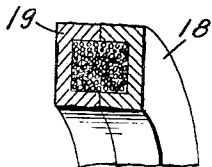


Fig. 3.



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UNITED STATES PATENT OFFICE.

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MODULATING SYSTEM.

1,287,982.

Specification of Letters Patent.

Patented Dec. 17, 1918.

Application filed February 16, 1917. Serial No. 148,978.

To all whom it may concern:

Be it known that I, RALPH V. L. HARTLEY, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Modulating Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to modulating systems in which high frequency carrier currents are modified or modulated in accordance with the signal to be transmitted. In a copending application, Serial No. 139,784, filed December 30, 1916, applicant has described and claimed a modulator of the magnetic type by means of which the carrier currents are modulated by varying the permeability of a carrier frequency transformer in accordance with a speech signal.

The quality of the speech transmitted by prior modulators of the magnetic type is relatively poor, as the modulated high frequency wave form is distorted by the hysteresis of the magnetic core forming a part of the modulator.

The present invention has to do with improving the quality of speech transmitted by modulators of the magnetic type.

This is accomplished by reducing the hysteresis of the magnetic core of the modulator. One way in which this may be done is to subject the magnetic core to a relatively weak and rapidly alternating cross-magnetization which keeps the molecules of the iron in a constant state of agitation, and renders them more susceptible to changes in the longitudinal magnetization produced by the modulating speech currents.

A further advantage in reducing the hysteresis is to improve the sensitiveness of the modulator. This sensitiveness may be defined as the ratio of the modulated high frequency power to the low frequency power affecting the modulation. By reducing the hysteresis loss a greater amount of modulated high frequency power can be produced by a given amount of low frequency modulating power, *i. e.*, the sensitiveness of the modulator is increased.

Two ways of carrying out the invention are shown in the drawing, in which—

Figure 1 illustrates diagrammatically the preferred form in which the hysteresis reducing winding is at right angles to the signaling and carrier current windings;

Fig. 2 illustrates a modification in which the carrier current windings are at right angles to the remaining windings; and

Fig. 3 shows details of the magnetic core construction.

In Fig. 1 of the drawing, the modulator M, which is of the magnetic type, is supplied with carrier currents from the source 3, which are to be modulated in accordance with signaling currents supplied by the signaling circuit 4. The battery 5 supplies a steady current which brings the magnetization of the toroidal cores 6 and 7 to the desired point about which the magnetization is varied by the signaling currents. The source 8 supplies currents of a frequency higher than the carrier frequency supplied by the source 3 for the purpose of reducing the hysteresis. The circuit of source 8 may be traced from the source through the turns of coil 16 in series to conductor 28, through the turns of coil 15 in series, back to source 8.

The carrier source 3 supplies currents to the primary windings 9 and 10, which are individual to each of the cores 6 and 7, and which produce high frequency fluxes in opposite directions in these cores so that the signaling winding 11, which is common to both cores, is substantially non-inductively related to the windings 9 and 10. The opposing high frequency fluxes induce a resultant zero carrier frequency electromotive force in the signaling winding 11. The secondary windings 12 and 13 are adapted to supply modulated carrier currents to the radiating antenna system 14. The windings 12 and 13 are wound in opposite directions and are individual to each of the cores 6 and 7. In order to reduce the hysteresis in the magnetic cores 6 and 7, means, such as the windings 15 and 16 disposed within the cores 6 and 7, are provided for producing a magnetic field which is at right angles to the magnetic field produced by signaling winding 11 and the windings 9, 10, 13 and 12. The windings 15 and 16 are supplied by the source 8 with comparatively weak and very rapidly alternating currents, which have a frequency which is higher than that supplied by the carrier source 3. The signaling current supplied by the circuit 4 may be amplified, if desired, by one or more amplifiers 17 of the audion type.

The cores 6 and 7 may be constructed as shown in Fig. 3, in which the halves of the

cores 18 and 19 which are suitably held in assembled position are preferably made of compressed iron dust, and are channeled to receive the winding.

5 In Fig. 2 the antenna circuit may be traced from antenna 14 through the turns of the secondary winding 22 in series to ground at 29. The carrier current source 3 is connected in series with primary winding 21. Windings 21 and 22 are both disposed within magnetic core 23. The low frequency winding 24 is wound around the core 23 so that the high frequency carrier current windings 21 and 22 produce magnetic fields which are at right angles to that produced by the signaling winding 24. The signaling winding 24 is non-inductively related to the carrier frequency windings 21 and 22 and the signaling winding 24 will accordingly not have any carrier frequency currents induced therein. This relative disposition of the carrier frequency winding and the signaling winding reduces the distortion as the molecules of the core are agitated by the magnetic field due to the carrier currents and are more readily susceptible to changes in the field due to the signaling current. To reduce the hysteresis loss due to the carrier frequency alternating field in the core 23, the source 8, supplying a frequency higher than the carrier frequency, in this case is connected through condensers 25 and 26 about a portion 27 of the signaling winding 24. The rapidly alternating magnetic field produced by the currents traversing the portion 27 of the winding 24 produces a field which is at right angles to the carrier frequency field so that the hysteresis is reduced, as in 40 Fig. 1, by high frequency cross-magnetizing field.

It will be apparent that the windings 15 and 16 or 21 and 22 within the magnetic cores may be of iron, in which case the magnetic cores may be dispensed with, as the windings themselves would, in this case, provide the magnetizable means.

What is claimed is:

1. A high frequency signaling system 50 comprising a modulator of the magnetic type having magnetizable means, means for supplying carrier currents for magnetizing said means, means for modulating said carrier currents, and means for reducing the hysteresis in said magnetizable means.

2. A high frequency signaling system comprising magnetizable means, carrier current windings, and signaling windings associated with said magnetizable means, 60 means acting upon the molecules of said magnetizing means for reducing its hysteresis.

3. A high frequency signaling system comprising a modulator of the magnetic type 65 having magnetizable means, signaling circuit windings associated therewith and means for producing a rapidly alternating cross-magnetization of said magnetizable means with respect to the magnetization produced by high frequency current in said signaling circuit windings.

4. A high frequency signaling system comprising a modulator of the magnetic type having magnetizable means, carrier current windings and signaling windings associated with said magnetizable means, and means for supplying said magnetizable means with a rapidly alternating cross-magnetic field relative to the field produced by currents flowing in said carrier current windings.

5. A modulating system comprising a modulator of the magnetic type, means for supplying said modulator with (1) signaling currents, (2) currents of the carrier frequency and (3) currents of a frequency higher than said carrier frequency, and a high frequency line adapted to be supplied with modulated currents by said modulator.

6. A modulating system comprising the combination of magnetizable means, carrier current windings and signaling windings associated with said magnetizable means, said carrier current windings being non-inductively related to said signaling windings, and means for reducing hysteresis in said magnetizable means.

7. A modulating system comprising magnetizable means and four windings associated therewith, means for supplying signaling current to one of said windings, means for supplying currents of a carrier frequency to another of said windings, means for supplying current of a frequency higher than said carrier frequency to a third winding, and a high frequency line adapted to be energized by said fourth winding.

8. A modulating system comprising magnetizable means, signaling windings and carrier current windings wound around said magnetizable means, and hysteresis reducing windings within said magnetizable means.

9. In a modulating system, the combination of two toroidal cores, a winding common to both of said cores, primary and secondary windings individual to each of said cores, and a winding within each of said cores.

10. A modulating system comprising the combination of two magnetic cores, a signaling winding common to both of said cores, carrier current primary and secondary windings individual to each of said cores, and hysteresis reducing windings within each of said cores.

11. In a modulating system, the combination of two magnetic cores, a signaling winding common to both of said cores, means for supplying signaling currents and a

steady current to said signaling winding, primary and secondary windings individual to each of said cores, means for supplying carrier currents to said primary windings, a high frequency line adapted to be energized by said secondary windings, other windings within each of said cores, and means for supplying currents of a frequency higher than that of said carrier currents to said other windings.

12. In a modulating system a circuit including a source of carrier frequency oscillations, a magnetic device associated with said circuit, and means for subjecting said magnetic device to the action of an alternating flux having a frequency higher than that of said oscillations.

13. The method of modulation which comprises subjecting a carrier frequency current to the action of a magnetic impedance element and subjecting the impedance element to the action of an alternating flux of frequency higher than that of said current.

14. A carrier frequency circuit, a signaling frequency circuit, magnetic means associated with both of said circuits, and means for subjecting said magnetic means to the action of an alternating flux of frequency higher than the carrier frequency.

In witness whereof, I hereunto subscribe my name this 15th day of February, A. D. 1917.

RALPH V. L. HARTLEY.