No. 777,290. PATENTED DEC. 13, 1904.

T. B. KINRAIDE.

VARIABLE INDUCTIVE RESISTANCE.

APPLICATION FILED MAY 25, 1904.

NO MODEL.

Fig. 1.

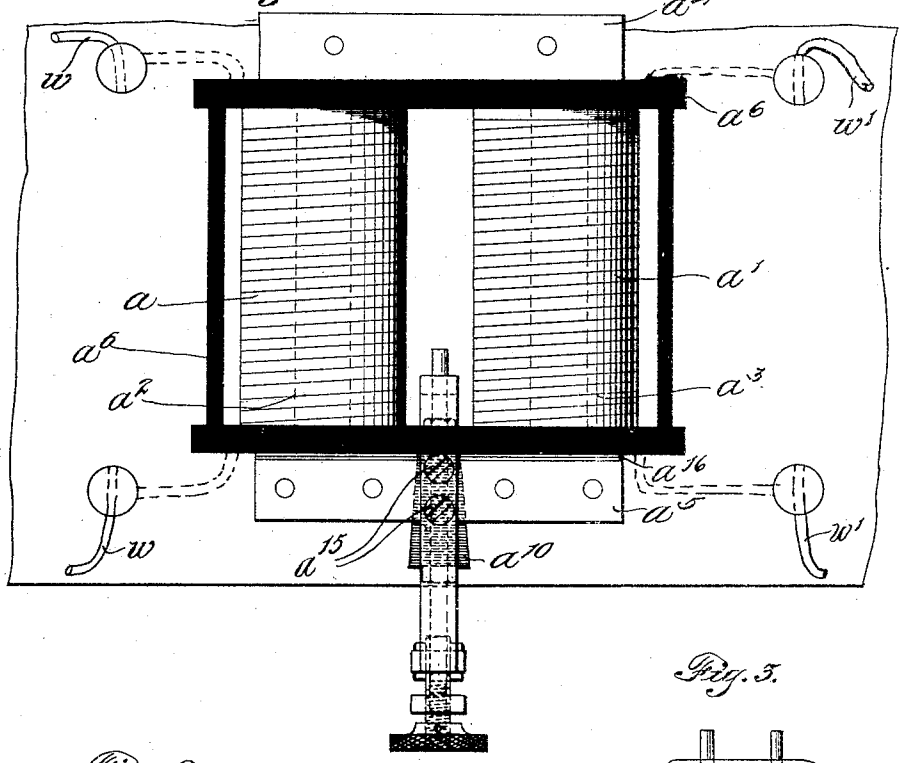


Fig. 3.

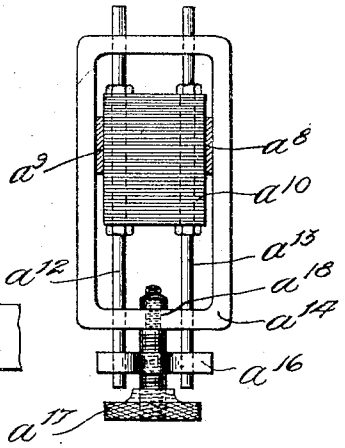


Fig. 2.

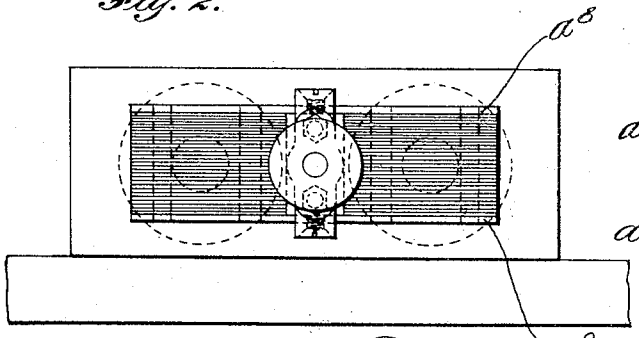
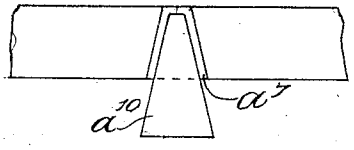


Fig 4



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No. 777,290. Patented December 13, 1904.

UNITED STATES PATENT OFFICE.

THOMAS B. KINRAIDE, OF BOSTON, MASSACHUSETTS.

VARIABLE INDUCTIVE RESISTANCE.

SPECIFICATION forming part of Letters Patent No. 777,290, dated December 13, 1904.

Application filed May 25, 1904. Serial No. 209,685. (No model.)

To all whom it may concern:

Be it known that I, THOMAS B. KINRAIDE, a citizen of the United States, and a resident of Boston, in the Commonwealth of Massachusetts, have invented an Improvement in Variable Inductive Resistances, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present apparatus has for its object the provision of an inductive resistance capable of accurate adjustment for regulating the current without, however, consuming the current so regulated.

The present apparatus is intended to take the place of the resistance-coils or rheostats commonly used in connection with alternating current, which, as is well known, consume all the unused current, acting to cut down the current simply by interposing such an amount of resistance as will use the extra current at that point, and thereby prevent its use farther along.

It is well known that an alternating electric circuit operating in conjunction with a closed magnetic circuit produces the greatest amount of inductive resistance, producing, in fact, resistance to such an extent as to be practically prohibitive of the passage of any current. Accordingly I base my invention upon this fact, my invention residing in providing special means for varying a magnetic circuit used in connection with the alternating current which it is desired to regulate.

In the drawings, in which I have shown a preferred embodiment of my invention, Figure 1 is a top plan view of one form of the apparatus. Fig. 2 is a front end elevation. Fig. 3 is a vertical cross-sectional view showing the adjustable wedge or air-gap adjuster in said elevation. Fig. 4 is a fragmentary view, largely diagrammatic, for illustrating the theory of operation of the device.

The general features of construction used in connection with my invention resemble a pair of solenoids whose cores are joined to form a closed magnetic circuit comprising opposite coils a a' (connected, respectively, in series with the wires w and w' of the main circuit) of coarse wires wound about cores a^2 a^3, magnetically connected in a closed circuit at their opposite ends by laminated armatures a^4 a^5, all supported in an ebonite or other suitable frame a^6.

The purpose of my invention is to provide means for varying the magnetic circuit from a closed magnetic circuit to a more or less open magnetic circuit, and while this may be accomplished in various ways I prefer to secure the desired result by interposing an air-gap. For this purpose I cut the laminæ at one end of the instrument, herein shown as the laminæ a^5, transversely, so as to effect a slightly wedge-shaped opening a^7, this opening being bridged on its upper and under sides by two non-magnetic pieces a^8 a^9 for giving the desired strength and permanence of position. In this opening a^7 I mount a wedge-shaped member a^{10}, also preferably laminated, the laminæ, however, extending vertically, as is clearly shown in Figs. 1 and 3, instead of extending horizontally, as the other laminæ, a^5 a^4, do. The opposite sides of this wedge are only slightly divergent, extending approximately at right angles to the path of the magnetic flux, thereby reducing the pull thereon, and hence there is no special strain or tendency thereof to move under the inductive influence of the alternating current. In order to still further render the same rigid, however, and also to insure precision of movement under all circumstances, as is necessary in order to maintain the air-gap even and uniform in its various adjustments, I mount the air-gap adjuster or wedge device a^{10} on guide-rods a^{12} a^{13}, slidingly mounted in a frame a^{14}, secured fast to the plates a^8 a^9, as indicated at a^{15}. On the outer ends of these rods a^{12} a^{13} is secured a cross bar or nut a^{16}, and in this nut a thumb-screw a^{17} works, being swiveled at a^{18} in the end of the frame a^{14}, so as to turn easily therein without moving longitudinally.

From the foregoing description it will be evident that simply by adjusting the thumb-screw a^{17} slightly one way or the other the most delicate adjustment of the wedge a^{10}

takes place, thereby regulating with extreme accuracy and nicety the air-gap a^3 for varying the magnetic field from a closed circuit, where the flow of current is practically stopped, to an open circuit in which merely the phenomena of the ordinary inductance-coil—*i. e.*, simply a coil around a core with an open magnetic field—takes place and the flow of current is only slightly checked.

As already stated, this device is to be used with an alternating current which operates in connection with a magnetic field as follows: Having produced the magnetic field by a wave of current flowing in one direction, the succeeding wave, flowing in the opposite direction, demagnetizes the same field, which produces a counter electromotive force in the winding, thus holding back the flow of the main current, and so on with each succeeding alternation, each wave first demagnetizing the previous polarity, thereby creating a counter electromotive force which suppresses further flow of current. The winding should have a sufficient number of turns to produce a counter electromotive force equal to that of the main current. When the magnetic field is entirely closed, the alternating current is not only checked, but practically stopped, and by reason of the delicate adjustment of the air-gap the magnetic field is rendered more or less closed, according to the effect which it is desired to produce upon the passage of the alternating current. The current is simply checked or stopped to a more or less degree, according to the adjustment of the air-gap, and is not consumed, and hence a great saving of power at the source of energy takes place.

In constructing my apparatus I prefer to interpose one or more sheets of mica or other insulation in the magnetic field, as indicated at a^{16}, for the purpose of originally regulating the instrument to the minimum amount of current to which it is desired to respond. For instance, it is convenient to have the apparatus originally built to permit the flow therethrough of a certain fixed minimum current when the air-gap is entirely closed, and this is accomplished by interposing in the field a certain fixed barrier to the magnetic flux.

From the foregoing description it will be evident that my invention is capable of a wide variety of embodiments, and accordingly I do not intend to limit myself to the form, arrangement, and specific combination of parts herein set forth, excepting as otherwise specified in the claims.

Having described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A variable inductive resistance for the purpose set forth, comprising opposite, independent coils formed respectively in the opposite sides of an alternating-current circuit, a magnetic field including opposite cores for said coils, and mechanical means for varying the magnetic influence of said field on the current of said coils.

2. A variable inductive resistance, comprising opposite, independent coils respectively in the opposite sides of an alternating-current circuit, cores therefor, magnetic connections at the opposite ends of said cores, a transverse wedge-shaped air-gap in one of said connections, and a wedge-shaped member for regulating the resistance of said air-gap.

3. A variable inductive resistance, comprising a magnetic field including opposite cores, independent windings on said respective cores adapted to be connected to the opposite sides of an alternating-current circuit, said magnetic field having interposed therein a fixed magnetic resistance determining the minimum amount of current transmissible through the apparatus.

4. A variable inductive resistance, comprising a magnetic field including opposite cores, independent windings on said respective cores adapted to be connected to the opposite sides of an alternating-current circuit, said magnetic field having interposed therein an insulating-barrier for determining the minimum amount of current transmissible through the apparatus.

5. A variable inductive resistance, comprising a magnetic field including opposite cores, independent windings on said respective cores adapted to be connected to the opposite sides of an alternating-current circuit, said magnetic field having a thin barrier of insulation extending transversely across one end of one of said cores for rendering it impossible entirely to close the magnetic field.

6. A variable inductive resistance, comprising a magnetic field including opposite cores, independent windings on said respective cores formed respectively in the opposite sides of an alternating-current circuit, said magnetic field having interposed therein a wedge-shaped air-gap, a frame mounted rigidly thereat, slides movable in said frame, a wedge-shaped magnetic member, carried by said slides, and adjusting means for moving said member toward and from said air-gap.

7. A variable inductive resistance, comprising an approximately closed magnetic field including opposite cores, independent windings on said respective cores, said magnetic field at one end of said respective cores having an air-gap formed therein, insulating-plates connecting said cores and bridging said air-gap, a magnetic closing member for regulating the extent of said air-gap, a frame carrying said member, and means for adjusting said member with relation to said air-gap.

8. A variable inductive resistance, having a magnetic field, provided with a transverse air-gap, and a magnetic closing device therefor, the adjacent side of said closing device extending approximately at right angles to the normal path of the magnetic flux.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THOMAS B. KINRAIDE.

Witnesses:
GEO. H. MAXWELL,
R. S. FORD.