H. GERDIEN.

RELAY.

APPLICATION FILED NOV. 25, 1914.

1,205,731.

Patented Nov. 21, 1916.

Fig. 1

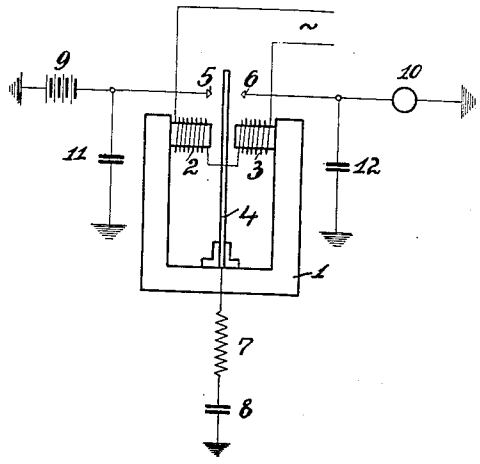


Fig. 2

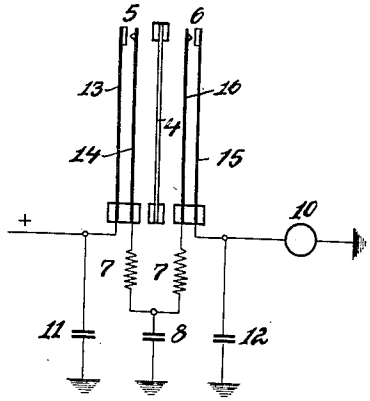


Fig. 3

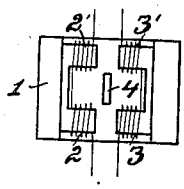


Fig. 5

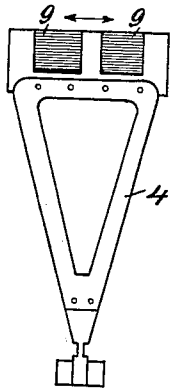


Fig. 4

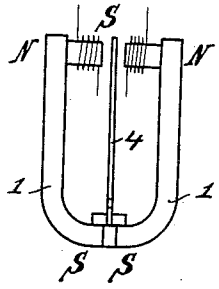


Fig. 7

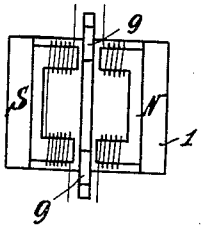
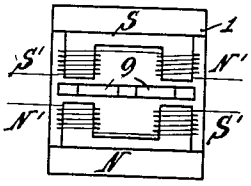


Fig. 6



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UNITED STATES PATENT OFFICE.

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RELAY.

1,205,731. Specification of Letters Patent. Patented Nov. 21, 1916.

Application filed November 25, 1914. Serial No. 874,067.

To all whom it may concern:

Be it known that I, HANS GERDIEN, a German citizen, and resident of Berlin-Schmargendorf, Germany, have invented certain new and useful Improvements in Relays, of which the following is a specification.

My invention relates to a relay which is designed to be actuated by alternating currents of a definite frequency and consists principally in an apparatus having an oscillating system working on the contact principle and including as a novel feature the employment of a capacity which is charged and discharged in alternation by the contacts made after each oscillation of said system. The advantage of this arrangement employing capacities coöperating with the contacts is found therein that in spite of the short operation of the contacts made by each oscillation far greater quantities of electrical energy may be transmitted whereby the operation of the relaying apparatus will be essentially improved regarding the safety of responding of the indicating or receiving device.

In an application for U. S. patent which is simultaneously filed herewith I have described and claimed a relaying apparatus which also employs an oscillating system, and which instead of the contacts makes use of an inductive action during the swinging period of the oscillating system. This system comprises in brief a secondary winding which is inductively coupled with the oscillating system, so that energy will be supplied thereto during the entire period of an oscillation. By this arrangement therefore a relatively large amount of energy is transmitted by the fact that the transmitting currents are being generated during the entire swinging period of the oscillating system. A similar effect is obtained in the apparatus according to my present invention by employing the contact principle together with a capacity charged and discharged thereby.

According to the present invention the electric relay is equipped with a body which is able to oscillate with a definite frequency or period of alternation and which is slightly damped for instance like the tongues in the well known "vibration" frequency meters or like a shaft which is strained by torsion. The oscillating system or tongue in this case is positioned in a magnetic field, which for instance may be generated by a horse-shoe magnet upon which an alternating current field is superposed. Instead of a permanent magnet also an alternating current magnet may be used for this purpose which magnet is excited by alternating currents of a frequency which is half that of the natural swinging period of the oscillating system or tongue. If the frequency of the superposed alternating magnetic field coincides with the frequency or natural swinging period of the oscillating system itself, the latter will be caused to oscillate, so that in a properly arranged induced or secondary circuit a receiving apparatus may be made to respond.

For charging or discharging the condensers in proper alternation by the contacts which are made by the oscillating system at the end of each oscillation, the arrangement is such that the oscillating system is mounted to swing between two contacts whereby one contact is made to close a circuit for a current source for charging a capacity, while the other contact when closed will discharge the capacity over the receiving apparatus. Thus by my present system which makes use of the contact principle together with the charging and discharging of a capacity, the relay will be rendered safer in operation and will even safely respond in case the contact pressure is very small.

Figure 1 shows one embodiment of my invention; Fig. 2 shows an arrangement of contacts used for the purpose of avoiding variation of the oscillation period of the tongue; Fig. 3 shows a modification in which the tongue is mounted so as to swing perpendicularly to the axis of the coils; Fig. 4 is a side elevation of Fig. 3; Fig. 5 shows a side elevation of one form of tongue; Fig. 6 is a plan view of a modification employing a tongue made in accordance with Fig. 5; Fig. 7 represents a slight modification of Fig. 6.

The horse-shoe magnet 1 in Fig. 1 is made at its poles from laminated iron and carries at this place two coils 2 and 3 which are excited by an alternating current of definite frequency. A tongue 4 is mounted upon said magnet in such a manner that it will be able to swing between the poles thereof and alternately make a contact at 5 and 6. At the supporting point of the

tongue a resistance 7 and a capacity 8 are included in circuit and connected to ground, as shown in the drawing. The contact 5 is connected to a current source 9 shown as a battery, which is connected to ground, and the receiving or indicating apparatus 10 is connected to the contact 6 and also grounded as shown in the drawing.

If through the coils 2 and 3 an alternating current is sent which is of a frequency corresponding to the natural period of oscillation of the tongue and if the coils are so connected with each other that the excitation in the one coil is strengthened and simultaneously weakened in the other coil, the tongue will oscillate to and fro between said contacts 5 and 6. When contacting with the contact 5 the capacity 8 will be charged and when contacting with the contact 6 the same will be discharged over the receiving apparatus 10. As self-inductions are generally inserted into the connecting lines the capacity 8 during the short contact will not have sufficient time to charge up and to discharge. For avoiding this according to my invention I employ further capacities 11 and 12 which are inserted in parallel to the charging and discharging circuit and as much as possible in proximity to the first capacity. The capacity 11 will therefore have time to charge up also during the contact 5 being opened and will be able to entirely give off a charge and transmit the same to the capacity 8 during closing of the contact 5. This capacity will then be able to transmit its charge upon the capacity 12 during the closing of the contact 6. The receiving apparatus 10 will thus not only obtain current from the capacity 8 during the short closing of the contact at 6 but in addition to this it will obtain current from the capacity 12 as long as the contact 6 is opened. The current for the excitation of the relay will thus flow from the current source over the capacities into the receiving apparatus and it is thus made impossible that during standstill of the tongue a current transmission takes place even if the tongue be contacting with one of the contacts.

A further feature of my invention consists therein that the capacities are so dimensioned that they will be in resonance with the oscillating period of the tongue and that the formation of sparks at the contact is prevented by the inserting damping resistances into the electrical oscillating circuit whereby the lifetime of the contact points will be essentially increased.

In order to avoid a variation of the oscillation period of the tongue which would possibly result in disturbing the resonance, the contacts are made to yield for instance in such a manner that fine wires, for instance of silver, are fixed between two points and used as contacts. These wires will then themselves be caused to oscillate, which oscillations are preferably limited for instance by stops in such a manner that the wires are able to swing freely toward the outside and that they are prevented from swinging toward the inside by means of said stops. By this arrangement I avoid a change of the mass of the oscillating torque and obtain therewith absolute constancy of its period of swinging. In Fig. 2 I have shown a construction embodying this latter feature. Here the tongue 4 serves only indirectly for closing the contacts 5 and 6. On either side of the tongue 4 there is mounted a pair of contact springs 13—14 and 15—16. By this arrangement in the first place the formation of sparks at the tongue and consequently wear of the same will be avoided by which possibly the frequency of the tongue could be changed. It is further preferable to give to the contact springs a somewhat higher period of oscillation than to the tongue in order that the contact springs after having made an oscillation at the following impact of the tongue will have essentially again arrived at their position of rest.

In the construction shown the tongue will always be swinging parallel to or in the axis of the coils 2 and 3, it may however also be mounted to swing perpendicularly to said axis which arrangement may have several advantages. In the first place the tongue will be prevented from hitting against one of the coils and it will be able to swing on edge, so that the air damping will be small. For this purpose on either side of the tongue two primary coils are provided which are so connected that the excitation of the two coils 2 and 3 in front is strengthened and that of the two coils 2′ and 3′ is weakened, as shown in Fig. 3. For this purpose the permanent magnet must be so constructed that poles of even sign are positioned at the end thereof and that the tongue will have opposite polarity. This is attained as shown in Fig. 4 by having two permanent magnets 1 which are facing each other at their poles for instance with their south poles while the free ends are north poles, so that the tongue 4 will then be a south pole. If the alternating current be switched in, the lines of force which are coming out of the north poles of the coils 2 and 3, positioned for instance in front, will seek a return path through the body of the tongue and consequently pull the same in this direction. Upon the subsequent alternation of the current the tongue will be attracted by the coils 2′ and 3′.

In Figs. 5 and 6 another arrangement is shown in which the tongue consists of soft iron armatures 9 made from laminated iron, said armatures being rigidly connected with

each other and embedded for instance in hard rubber. The exterior ends of these armatures reach about up to the middle of the coils. N and S are the poles due to the permanent magnetism of the magnet and N′ and S′ the poles caused by the alternating current. If the excitation of the two coils which are positioned on the left side is strengthened the poles as designated in the drawing will be generated and in consequence thereof the tongue will move toward the left side.

In Fig. 7 I have shown a construction which is somewhat different from that of Figs. 4 and 5 in that the interior ends of the armatures reach up to the middle of the coils. For charging the capacity instead of a continuous current source also the alternating current serving for the motion of the tongues may be used for this purpose.

My present invention may be used in many cases where an exact responding is required especially when it is desired to have firstly an exactly responding relay, and secondly a relay that will not respond unnecessarily. Thus, for instance, in electrical power stations with metering systems for double tariff the counting works of the meters may readily be switched over at the desired times from one system to the other. In continuous current systems it will be immediately possible to employ alternating currents of any frequency for operating the relays, while in alternating current systems the frequency for the operation of the relays must be chosen different from the line frequency. The relay of my present invention may further be advantageously employed with railroad signaling systems and with systems for transmitting signals to traveling trains especially if electric power is used for driving the same.

The peculiar manner of operation of the relay resides in the arrangement that the relay in case of resonance by a certain kind of current (alternating current) closes the secondary circuit which may practically be considered as a direct current circuit. The oscillating tongue, so to say, serves as a means for conveying the current from the battery 9 to the receiver 10. The intensity of this current indeed, varies owing to the condenser discharges, but not its direction, and therefore the receiver 10 in responding always makes the same motions. By providing the pole condensers 11 and 12, the direct current character of the discharges is still further emphasized because even after contact 6 is opened, and while the tongue 4 with its condenser is charged, the discharge of the pole capacity 12 can continue.

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

1. A resonance relay having an oscillating element tuned to a definite frequency, said element being provided with a condenser, contacts between which said element oscillates, a direct current source connected to one of said contacts, and a receiving circuit connected to the other of said contacts.

2. A resonance relay having spaced contacts, a receiving circuit connected to one of said contacts, a source of direct current connected to the other contact, and an oscillating element adapted to contact successively with said contacts, said element being adapted to receive a charge from said direct current source and to deliver said charge to said receiving circuit, said receiving circuit being provided with a condenser for receiving a portion of the charge from said oscillating element and subsequently delivering said portion to said receiving circuit.

3. A resonance relay having an oscillating element provided with a condenser, spaced contacts with which said element successively contacts, a direct current source connected to one of said contacts, a condenser connected to said direct current source and to that contact, and a receiving circuit connected to the other contact.

4. A resonance relay having an oscillating element provided with a condenser, spaced contacts with which said element successively contacts, a direct current source connected to one of said contacts, a condenser connected to said direct current source and to that contact, and a receiving circuit connected to the other contact, said receiving circuit having a condenser connected up therewith to receive a portion of the current charge when the oscillating element contacts with the receiving circuit contact and to deliver said portion to the receiving circuit after the oscillating element has broken such contact.

5. A resonance relay having an oscillating element tuned to a definite frequency, said element being provided with a condenser, contacts between which said element oscillates, a direct current source connected to one of said contacts, and a receiving circuit connected to the other of said contacts, said contacts being yieldable to avoid detrimental damping of the oscillating element.

In witness whereof I have hereunto set my signature in the presence of two subscribing witnesses.

HANS GERDIEN.

Witnesses:
HENRY HASPER,
ARTHUR SCHROEDER.