J. F. D. HOGE.

ALTERNATING CURRENT RELAY.

APPLICATION FILED APR. 11, 1910.

1,006,089. Patented Oct. 17, 1911.

Fig: 1.

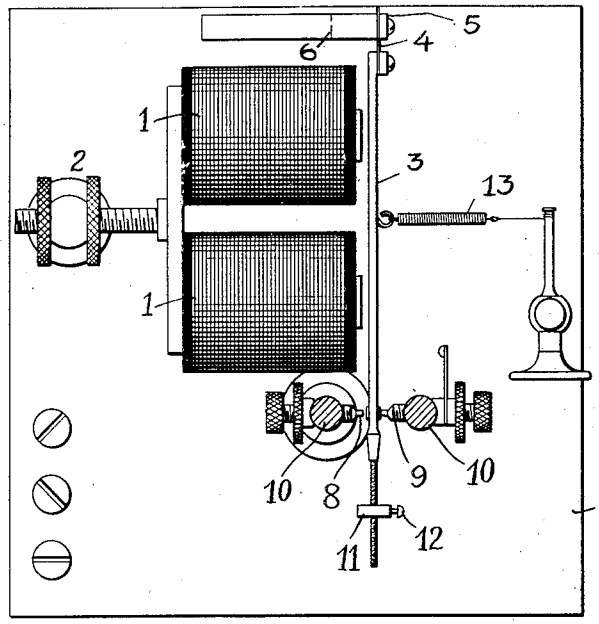


Fig: 3.

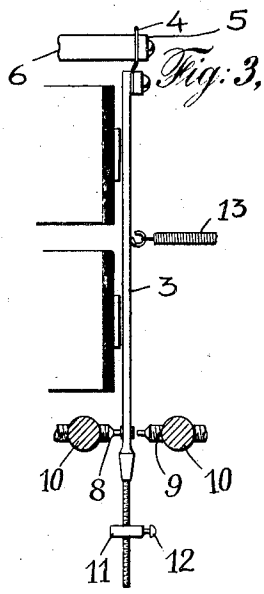


Fig: 2.

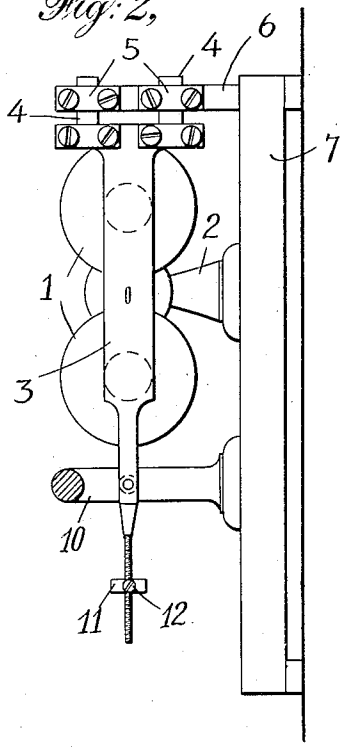
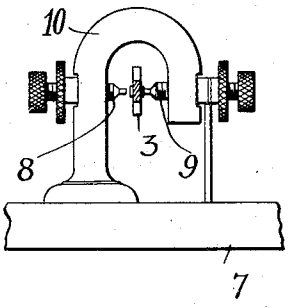


Fig: 4.



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UNITED STATES PATENT OFFICE.

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ALTERNATING-CURRENT RELAY.

1,006,089. Specification of Letters Patent. Patented Oct. 17, 1911.

Application filed April 11, 1910. Serial No. 554,667.

To all whom it may concern:

Be it known that I, JOSEPH F. D. HOGE, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Alternating-Current Relay, of which the following is a specification.

My invention relates to improvements in relays adapted to be operated by alternating or pulsating currents of definite frequency, and comprises an improved type of vibrating armature, an improved armature mounting, and various other features, all as hereinafter described and particularly pointed out in the appended claims.

The objects of my invention are to make the relay respond to alternating or pulsatory currents with substantially the same positiveness with which an ordinary telegraph relay responds to the breaking and closing of a direct current; to make the relay respond effectively to currents of predetermined frequency only, and to fail to respond effectively to other currents of materially different frequency; to make the relay sensitive and quick acting; to cause the relay to break and close circuit with substantially the same promptness and positiveness as is characteristic of the ordinary telegraph relays; and generally to make the relay simple, compact and easy to construct and adjust.

I will now proceed to describe my invention with reference to the accompanying drawings, and will then point out the novel features in claims.

In the drawings: Figure 1 shows a side elevation of one form of my improved relay; Fig. 2 shows a front elevation thereof; Fig. 3 is a detail side elevation of a part of the relay illustrating the action of the suspension of the vibratory armature; and Fig. 4 is a detail elevation of the yoke carrying the contact stops which coact with the vibratory armature.

In the drawings 1 designates the relay magnet, which in the construction shown is an ordinary horse shoe electro-magnet, provided with the usual adjusting device 2 for moving the magnet toward and from this armature. 3 designates the said armature, which in the construction shown is a soft iron rod supported at one end by thin flexible strips 4 adjustably secured in clamps 5 of a rigid support 6.

7 designates a base plate for the armature, which preferably is a rigid inexpansible member, such for example as a slate base.

The relay is provided with front and back stops 8 and 9 respectively, mounted as is customary in relays, in a yoke 10 carried by the said base 7. Either or both of these stops may be contact stops. Beyond these stops the armature is provided with a weight 11 for regulating the position of the node of vibration of the armature; such weight being, preferably, adjustable longitudinally upon the armature; for which purpose the end portion of the armature is screw threaded, and the weight is arranged to screw back and forth on this portion of the armature, and is provided with a set screw 12 to hold it in any position in which it may be adjusted. The purpose of so adjusting the weight is to vary the normal rate of vibration of the armature, when necessary, to correspond with the rate of vibration imposed on the armature by the alternating or pulsatory current energizing the relay magnet. I have found that an armature such as shown, vibrates in synchronism with the alternate magnetization and demagnetization of the magnet 1, caused by an alternating or pulsatory current of definite frequency, but that by proper adjustment of the weight 11 with respect to the frequency of such magnetization and demagnetization, the said armature may be caused to have a node or stationary point opposite the stops 8 and 9 so that the vibration of the armature at other points will not interfere with the formation of a good contact between such nodal point of the armature and the front stop 8. The armature is affected differently by currents of different frequencies passing through the magnet 1, and for any one adjustment of the weight 11, the nodal point of the armature will be different for different frequencies; or, possibly, the vibration of the armature may be so complex when exposed to the influence of current other than that of substantially the frequency corresponding to a particular adjustment of the weight, that there is no definite nodal point, the vibration of the armature being possibly very complex under such conditions. At any rate, it is found in practice, that for any particular current frequency within reasonable limits, with respect to the frequency for which the

relay is designed, an adjustment of the weight 11 may be found at which the armature has a node or stationary point opposite the stops 8. The armature is provided with the usual retractile spring 13. The action of the relay, with respect to currents of the frequency for which it is adjusted, is substantially the same as that of an ordinary neutral relay with respect to direct current; that is to say, when the circuit upon which the current of such frequency is imposed, is closed, the armature is attracted to its front stop 8, against the tension of the retractile spring 13, and closes contact with its stop 8, such contact remaining closed until the circuit is broken, when the armature is retracted; and the contact so formed between the front stop 8 and nodal point of the armature, is substantially as good as the contact formed between the armature of an ordinary neutral relay and its front stop, upon the closing of a direct current circuit through the magnet of such neutral relay. But while, in the relay herein illustrated and described, the nodal point remains stationary while the alternating or pulsatory current is passing through the magnet, at other points the armature is vibrating in synchronism with the current pulsations or alternations in the energizing circuit, and it is found that the point of maximum amplitude of vibration is at the upper end of the armature, where it is connected to the flexible supporting strips 4. This flexible support of the armature therefore plays a very important function in the operation of the relay, and a function very different from the ordinary pivotal armature support of an ordinary relay, for while such flexible supporting strips 4 permit the armature as a whole to swing toward the magnet poles and the front stop 8 when the circuit through the magnet 1 is closed, they also permit the armature as a whole to vibrate and in particular permit the upper end of the armature to vibrate back and forth, while the nodal point of the armature remains in contact with its front stop 8. The adjustment of the weight 11 for a particular current frequency may be effected easily with great accuracy, because so long as the adjustment is not practically perfect the armature vibrates rapidly opposite the stop 8, producing a buzzing or humming noise which decreases rapidly as the point of correct adjustment of the weight is approached, and finally ceases when the correct adjustment is reached. Also it is found that so long as the point of the armature opposite the front stop 8 is vibrating a very imperfect contact is formed with said front stop, which imposes a great resistance to the passage of current, but that as soon as a proper adjustment is reached the contact between the armature and stop is practically as good as in an ordinary relay. My improved relay therefore, comprises a vibratory armature tuned to vibrate at a definite rate or frequency, and, when vibrating at such frequency, having a nodal point opposite and adapted to contact with the front stop of the relay; this armature being free to move as a whole toward and from such front stop, so that the armature closes contact with its front stop upon closing of the energizing current, and breaks contact with its front stop upon the breaking of such energizing current.

I am aware that it has been proposed heretofore to employ vibratory armatures tuned to vibrate at a definite frequency; but so far as I am aware such armatures have not been supported in such manner as to be able to move as a whole toward and from a front stop located opposite a nodal point of the armature. In such former relays employing vibratory armatures, with which I am acquainted, it has been impracticable to make a good electric contact with a front stop, and instead of making contact with a front stop the armatures of such former relays have been arranged to coact with a sort of vibratory kicker contact lever coacting with the armature at a point where the vibration of the armature is relatively great, such kicker lever making a relatively poor contact with a corresponding contact stop when the armature is in vibration, but making a relatively better contact with its stop when the armature is at rest or nearly so. It has been found that in such former relays the armature continues to vibrate at its predetermined rate for a considerable time after the energizing current has ceased, so that such relays have been relatively slow to respond to breaking of the energizing current and so have not been well adapted for rapid operation. In the improved relay herein described, however, the armature as a whole breaks contact with its front stop as soon as the energizing current ceases, or decreases greatly, (according to the adjustment of the retractile spring), and therefore breaks contact with its front stop as quickly and as positively as does the armature of an ordinary neutral relay working on direct current; and even though the armature may continue to vibrate at its predetermined rate, after so leaving its front contact, it makes as good contact with its back stop as it does, upon closure of its energizing circuit, with its front stop, because the back stop, like the front stop, is located opposite a nodal point of the armature. If, however, the alternating or pulsatory current passing through the magnet coils of the relay, is of a frequency materially different from that frequency to which the armature is tuned, then although the armature may be attracted upon the closing of such alternating or pulsatory cur-

rent circuit, and may be retracted upon the breaking of such circuit, the contact between the armature and the front stop is not sufficiently good, during closed circuit intervals, to pass current through such contact at anything approximating the normal rate, the contact with such front stop in such cases imposing so high resistance to the passage of current that there is no difficulty in discriminating between attraction of the armature by a current of a frequency corresponding to that to which the armature is adjusted, and the attraction of such armature by a current of a materially different frequency; in other words, although the armature does in fact respond to a current of frequency other than that to which the armature is tuned, in effect the relay does not respond to currents of frequencies other than those to which the armature is tuned.

In adjusting the relay it is sometimes found necessary in adjusting it for a definite frequency of current, to adjust the length of the strips 4 by loosening the clamps 5. But in practice this is necessary if at all, only when first setting up the relay.

In another application Sr. No. 554,668, filed April 11, 1910, I have illustrated this relay in connection with certain multiplex telegraph systems, in which it is adapted to be used, and have also there illustrated an alternative form of my said relay, which forms the subject matter of a further patent application, Sr. No. 574,202, filed July 27, 1910. My said relay in its various forms, is obviously adapted for use in various telegraph systems, involving the use of alternating or pulsatory currents of definite frequencies, whether such current be the only current in the circuit or whether there be in the circuit other direct currents, or other alternating or pulsatory currents of different frequencies. One important application of my invention is a non-interference fire alarm telegraph system, wherein each fire alarm box is adapted to transmit through the alarm circuit a current of definite frequency, the current frequencies of the different boxes being different, and wherein there is, at the receiving station, for each such box, a receiving relay of corresponding frequency, controlling local alarm receiving or alarm-sounding or indicating apparatus. Such a system provides absolute non-interference between the different fire alarm boxes of the circuit, it being possible for all the boxes of the circuit to send in their signals simultaneously, the receiving relay of each box being operated only by a current of its corresponding frequency, and therefore being effected only by its own box. Such a system permits what, so far as I know, has never been possible before, namely, the simultaneous operation of a large number of fire alarm boxes in the same circuit, and the simultaneous transmission of signals by said boxes and simultaneous reception of signals from said boxes, without interference of signals and without delaying the signal of any box in the circuit.

What I claim is:—

1. In combination, a vibratory member, having a normal period of vibration and having a stationary node at an intermediate point when vibrating normally, one or more contact points arranged to contact therewith at said node, said member mounted to move bodily, as distinguished from such vibratory movement, toward and from said contact points, and means for vibrating said member and for moving it bodily toward and from such contact points.

2. In combination, a vibratory member, having a normal period of vibration and having a stationary node at an intermediate point when vibrating normally, one or more contact points arranged to contact therewith at said node, said member mounted to move bodily, as distinguished from such vibratory movement, toward and from said contact points, means for vibrating said member and for moving it bodily toward and from such contact points, and means for adjusting the position of said node.

3. In combination, a vibratory member, having a normal period of vibration and having a stationary node at an intermediate point when vibrating normally, one or more contact points arranged to contact therewith at said node, said member mounted to move bodily, as distinguished from such vibratory movement, toward and from said contact points, means for vibrating said member and for moving it bodily toward and from such contact points, and means for regulating the normal period of vibration of said member.

4. In combination, a vibratory member, having a normal period of vibration, and having a node at an intermediate point when vibrating normally, said member free at one end and mounted to move bodily toward and from said contact point, such bodily movement being distinct from its vibratory movement, and means for vibrating said member and for moving it bodily toward and from such contact points.

5. In combination, a vibratory member, having a normal period of vibration, and having a node at an intermediate point when vibrating normally, said member free at one end and mounted to move bodily toward and from said contact point, such bodily movement being distinct from its vibratory movement, means for vibrating said member and for moving it bodily toward and from such contact points, and means for adjusting the position of said node.

6. In combination, a vibratory member,

having a normal period of vibration, and having a node at an intermediate point when vibrating normally, said member free at one end and mounted to move bodily toward and from said contact point, such bodily movement being distinct from its vibratory movement, means for vibrating said member and for moving it bodily toward and from such contact points, and means for regulating the normal period of vibration of said member.

7. In combination, an electro-magnet, a vibrating armature therefor having a flexible support permitting both vibratory movement at the point of support and elsewhere and bodily movement of said armature toward and from the magnet, said armature having an intermediate nodal point when vibrating normally, and one or more contact points arranged to contact with said armature at said nodal point, one end of said armature being free to permit bodily movement of the armature toward and from said contact points.

8. In combination, an electro-magnet, a vibrating armature therefor having a flexible support permitting both vibratory movement at the point of support and elsewhere and bodily movement of said armature toward and from the magnet, said armature having an intermediate nodal point when vibrating normally, and one or more contact points arranged to contact with said armature at said nodal point, one end of said armature being free to permit bodily movement of the armature toward and from said contact points, and means for adjusting the position of said node.

9. In combination, an electro-magnet, a vibrating armature therefor having a flexible support permitting both vibratory movement at the point of support and elsewhere and bodily movement of said armature toward and from the magnet, said armature having an intermediate nodal point when vibrating normally, and one or more contact points arranged to contact with said armature at said nodal point, one end of said armature being free to permit bodily movement of the armature toward and from said contact points, and means for regulating the period of normal vibration of said member.

10. In combination, an electro-magnet, a vibrating armature therefor, flexible strips secured to a fixed point and to said armature and serving to support same while permitting motion thereof, said armature having a nodal point when in vibration, and one or more contact points arranged to contact with said armature at said nodal point.

11. In combination, an electro-magnet, a vibrating armature therefor, flexible strips secured to a fixed point and to said armature and serving to support same while permitting motion thereof, said armature having a nodal point when in vibration, and one or more contact points arranged to contact with said armature at said nodal point, and means for adjusting the position of said node.

12. In combination, an electro-magnet, a vibrating armature therefor, flexible strips secured to a fixed point and to said armature and serving to support same while permitting motion thereof, said armature having a nodal point when in vibration, and one or more contact points arranged to contact with said armature at said nodal point, and means for regulating the period of normal vibration of said member.

13. In combination, an electro-magnet, a vibrating armature therefor, flexible strips secured to a fixed point and to said armature and serving to support same while permitting motion thereof, said armature having a nodal point when in vibration, and one or more contact points arranged to contact with said armature at said nodal point, and a weight adjustable longitudinally of said armature for adjusting the vibration thereof.

14. In combination, a vibratory member, having a normal period of vibration and having a node at an intermediate point when vibrating normally, and one or more contact points arranged to contact therewith at said node, said member arranged to have a bodily movement toward and from said contact points in addition to its vibratory movement, and means for vibrating said member and for moving it toward and from such contact points, and a weight adjustable longitudinally on said armature for adjusting the vibration thereof.

15. In combination, an electro-magnet, and a vibratory armature therefor having a normal period of vibration and having a node at an intermediate point when vibrating normally, and one or more contact points arranged to contact with said armature at said node, said armature arranged to have a bodily movement toward and from said magnet and contact points in addition to its vibratory movement, and a weight adjustable longitudinally on said armature for adjusting the vibration thereof.

16. In combination, an electro-magnet, a vibrating armature therefor having a flexible support permitting both vibratory movement at the point of support and elsewhere and bodily movement of said armature toward and from the magnet, said armature having an intermediate nodal point when vibrating normally, and one or more contact points arranged to contact with said armature at said nodal point, and a weight adjustable longitudinally on said armature for adjusting the vibration thereof.

17. In combination, an electro-magnet, a vibratory member exposed to the influence of said magnet, and arranged to be vibrated

by the passage of an alternating current through the coils of said magnet, and a support for said member, said member having a point, distant from such support, which is stationary during said vibration, and a contact member arranged to contact with such stationary point during vibration of said member, said armature arranged also to move bodily toward and from said contact point.

18. In combination, an electro-magnet, a vibratory member arranged to be vibrated by the passage of an alternating current through the coils of said magnet, and also to have a bodily movement toward and from said magnet, a support for said member, a front contact point arranged to contact with said armature during vibration, and means for retracting the armature.

19. In combination, an electro-magnet, a vibratory member arranged to be vibrated by the passage of an intermittent current through the coils of said magnet, and a support for said member on which said member is arranged to swing bodily, as distinguished from its vibratory movement, and one or more contact points arranged to contact with such armature as a result of the motion thereof, said armature having a nodal point at such point of contact, which nodal point is stationary during normal vibration.

In testimony whereof I affix my signature, in the presence of two witnesses.

JOSEPH F. D. HOGE.

Witnesses:
M. M. THORP,
CHARLES F. PATTERSON.