Jan. 17, 1928. 1,656,250

E. O. THOMPSON ET AL

ALTERNATING CURRENT RELAY

Filed Dec. 29, 1921

Fig. 1

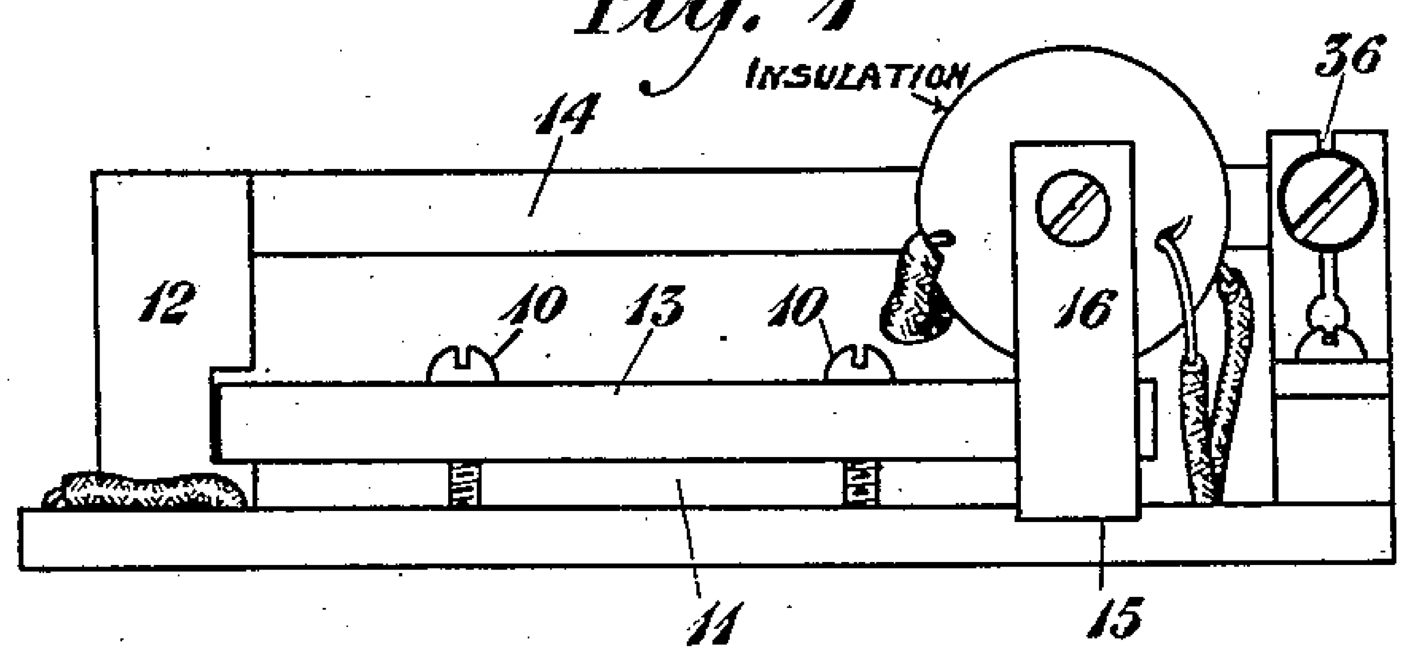
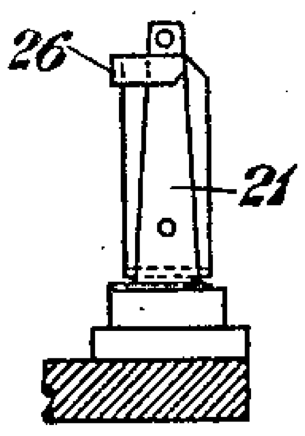


Fig. 2



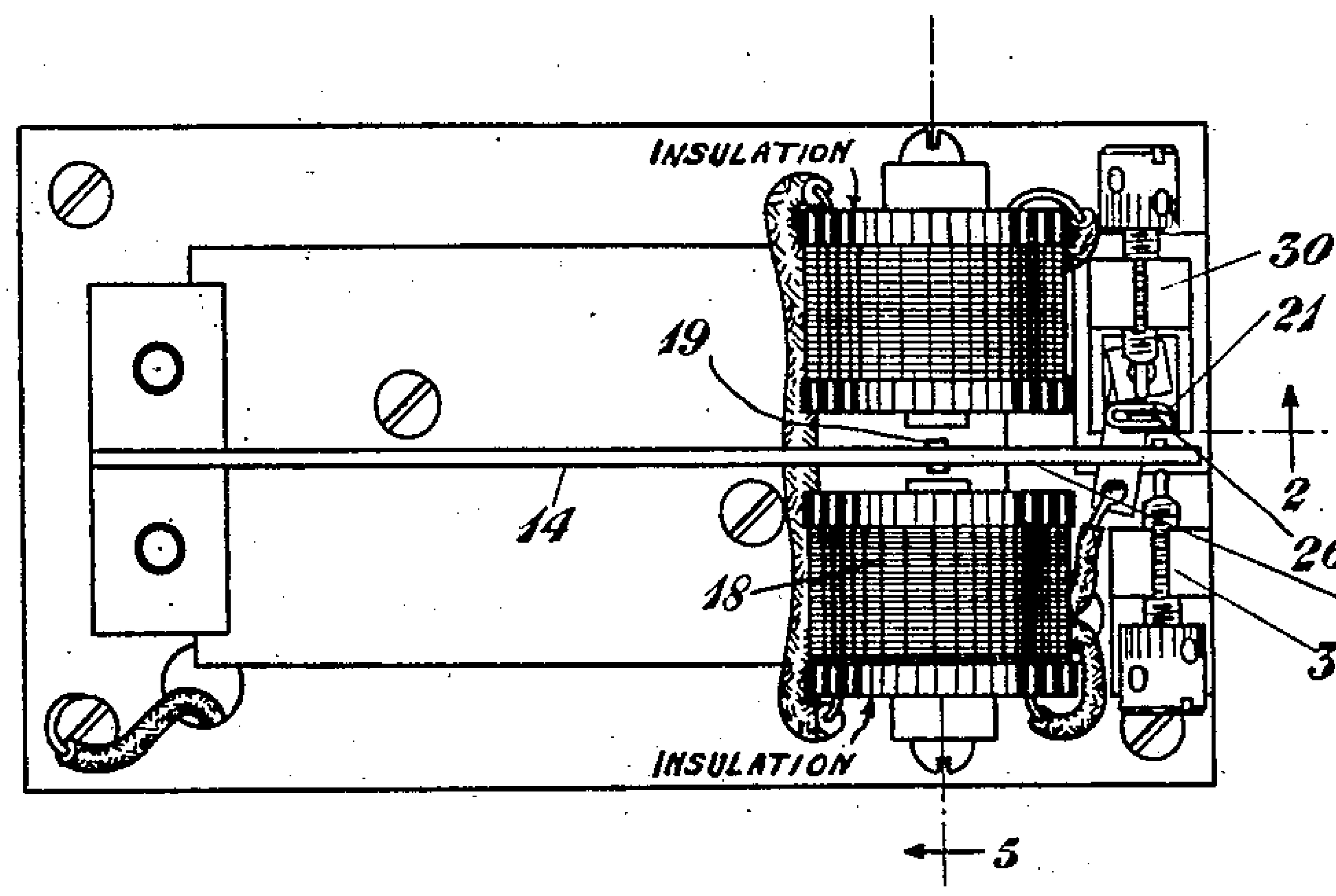


Fig. 3

Fig. 4

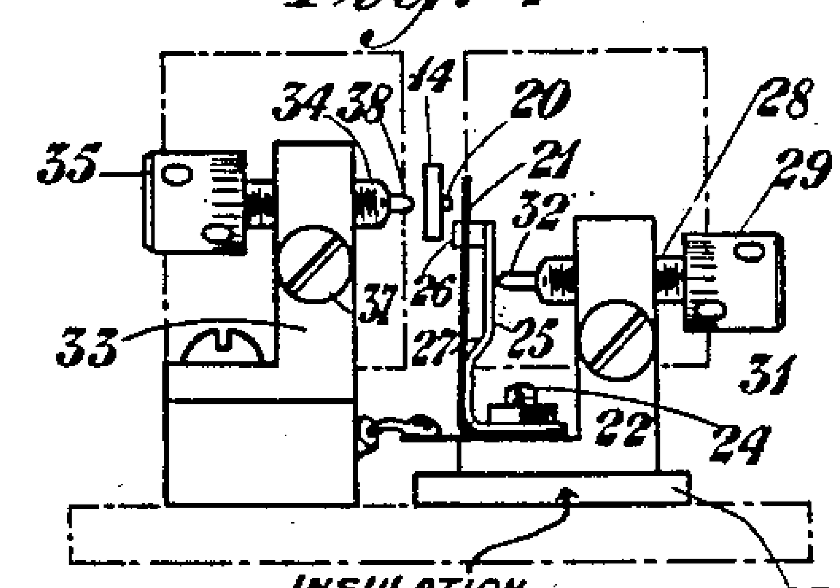


Fig. 6

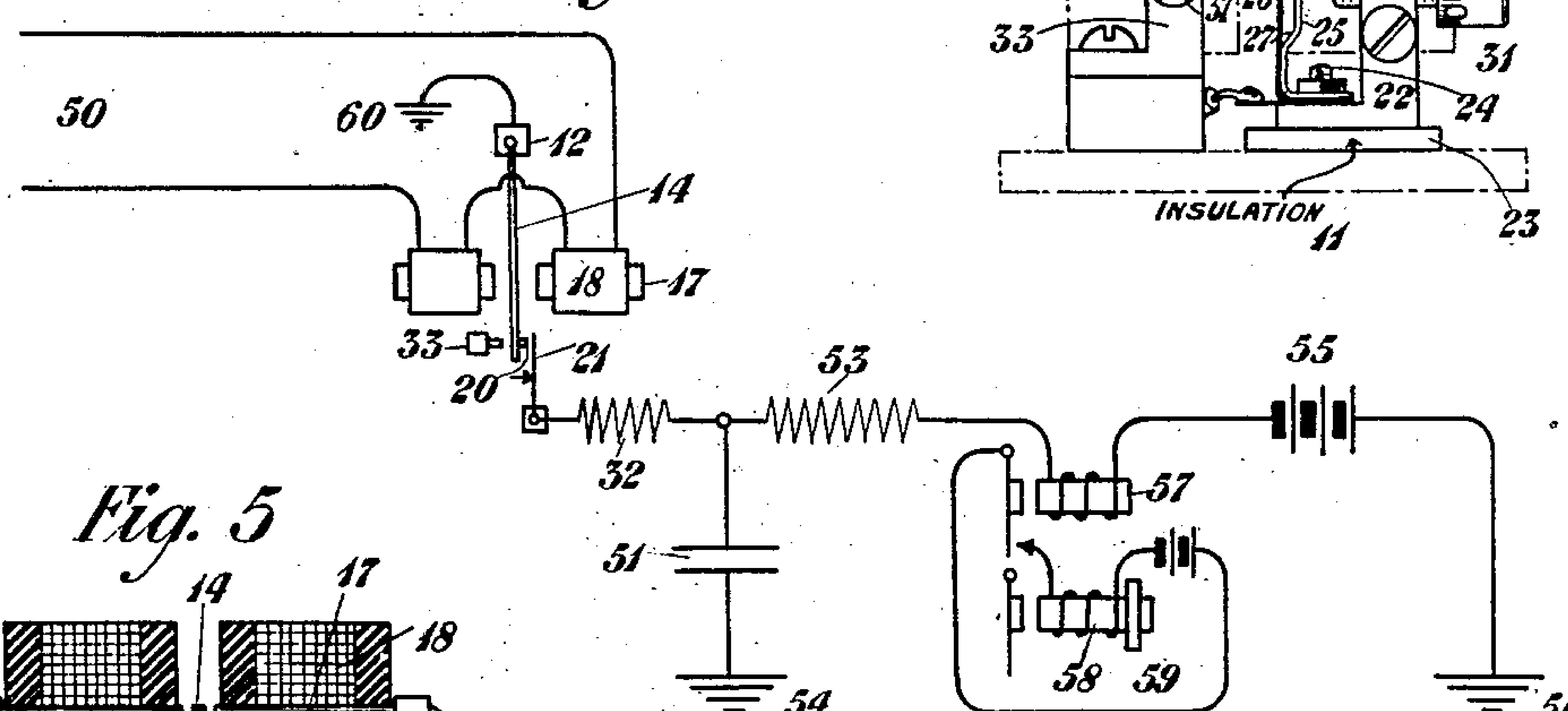
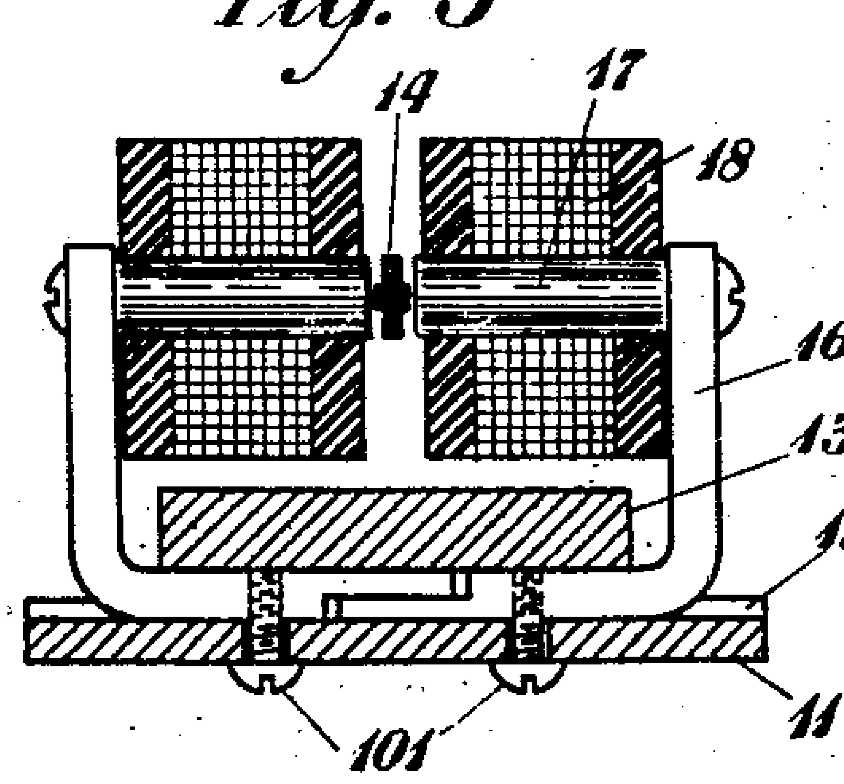


Fig. 5



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BY

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UNITED STATES PATENT OFFICE.

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ALTERNATING-CURRENT RELAY.

Application filed December 29, 1921. Serial No. 525,729.

The principal object of our invention is to provide an alternating current relay that shall be selectively responsive to currents of a particular frequency. Another object of our invention is to make such a relay so that it shall respond with certainty to currents of a desired frequency even though such currents be very feeble, but shall not respond to aperiodic currents nor to currents of other frequencies. Other objects of our invention relate to facilitating adjustment, making the operation as reliable as needed, etc. All these and other objects will become apparent upon consideration of the following disclosure of a specific example of our invention which we shall now proceed to describe in detail with the understanding that the invention is defined in the appended claims.

This example of the invention is illustrated in the accompanying drawings, in which Fig. 1 is a side elevation of our improved relay, Fig. 2 is a detail section taken on the line 2 of Fig. 3, looking in the direction of the arrow, Fig. 3 is a top plan view, Fig. 4 is an end elevation, Fig. 5 is a section on the line 5 of Fig. 3, looking in the direction of the arrow, and Fig. 6 is a diagram of circuits that may be employed with our relay. This relay, as shown in the drawings, is designed to respond selectively to alternating current of frequency 135 cycles per second. Such current is employed on long telephone lines for signaling and comes in much attenuated to a repeater or terminal station.

On the base 11 stands the iron block 12 in contact with the permanent bar magnet 13, which is secured to the base 11 by means of screws 10. The flexible iron reed 14 has one end firmly secured in a slot in the block 12, the opposite end being free so that the reed 14 is mechanically resonant; it is designed to vibrate naturally at 135 cycles per second.

There is a transverse groove 15 in the base 11 in which lie the two L-shaped iron members 16 secured by screws 101 and having the end of the magnet 13 clamped down on their toe parts by screws 10. The upper ends of the L-shaped members 16 carry pole pieces or cores 17, the faces of which are spaced slightly from the reed 14 on opposite sides thereof. On each pole piece 17 is a winding 18 to receive the alternating current from the line. A small brass pin 19 is riveted into a hole in the reed 14 between the faces of the pole pieces 17 and the ends of this pin project slightly so as to prevent contact between the iron of the reed 14 with the pole faces. The end of the reed 14 carries a contact pin 20 normally out of contact with the yielding contact member 21.

The L-shaped support 22 is fastened to the base 11 through the intermediate insulating member 23 by means of the bolt 24. The flexible contact member 21 has next to it a comparatively stiff spring 25, both being fastened together under the nut of the bolt 24 as shown in Fig. 4. The spring 25 has a tongue 26 bent around to serve as a stop for the contact 21 on the side toward the reed 14. The spring 25 also has a shoulder 27 engaging the contact 21 near its lower part. This contact 21 has considerable taper, being narrower above than below, so that its inertia is considerably reduced.

The support 22 carries an adjusting screw 28 with a graduated head 29. The support 22 is slotted at 30, and by means of a screw 31 it can be clamped tightly on the screw 28. The end of the screw 28 has a conical point 32 against which the spring 25 presses.

Mounted on the base 11 is another L-shaped support 33, carrying the screw threaded stop 34 with the graduated head 35. The support 33 is slotted at 36 and can be clamped on the screw 34 by means of the screw 37. The screw 34 has a spherically rounded end 38 against which the reed 14 strikes upon attaining a certain amplitude of vibration.

By loosening the screws 10 and 101, the L-shaped iron members 16 can be made to slide transversely in the slot 15, each member 16 carrying its respective pole piece 17. Thus the pole pieces can be adjusted any distance relatively to the reed 14, and then secured by means of the screws 101. The screws 101 pass through slots in the base 11, thereby permitting such adjustment.

The complete magnetic circuit of the permanent bar magnet 13 is through the iron block 12 and reed 14 on one side to the air-gaps between the reed 14 and the faces of the pole pieces 17, and on the other side from the bar magnet 13, this magnet circuit branches through the two L-shaped iron members 16 and the respective pole pieces 17 to the air-gaps already mentioned. It will be seen that the windings 18 on the pole pieces 17 serve to superpose the flux due to the alternating current in said windings upon the magnetic circuit just described and thereby cause a tendency to corresponding vibration of the reed 14, and if the alternating current is of the frequency to which the reed 14 is tuned; viz, 135 cycles per second, the reed 14 will vibrate resonantly and build up to a considerable amplitude.

The space between the reed contact 20 and the stationary contact 21 is adjusted by means of the screw 28. The flexible contact member 21 presses against the shoulder 27 on one side and against the tongue 26 on the other side. As the screw 28 is advanced, it advances the shoulder 27 and therefore keeps the flexible member 21 pressed against the tongue 26 with about the same force at all adjustments. The tongue 26 secures the result that the contact member 21 will not be set in vibration and will not follow the reed 14 in its vibration.

The adjustable stop 34 is set to be engaged when the amplitude of vibration of the reed 14 slightly exceeds that which is necessary to make contact with the member 21. This constitutes a means of protection against interference from transient currents on the line, which otherwise might set the reed in vibration for a long enough time to operate the secondary relays. The stop 34 also serves as a mechanical protection for the member 21, by preventing the reed 14 from swinging widely enough to harm it.

It is contemplated that rather fine adjustments may be made by the screws 28 and 34. The interval between the contacts 20 and 21 when at rest may properly be about .0015 of an inch, and the interval between the reed 14 and the stop 38 may be only about .0005 of an inch greater than that between 20 and 21. In attaining such fine adjustment with screw 28, it is an advantage to have the conical end 32. If it were attempted to have the end square instead of conically pointed, it would be difficult to make the end accurately enough square to the screw axis, and, if the angle were anything but a right angle, a slight unevenness of adjustment would follow upon rotating the screw. It is not practicable to make the end 38 of the screw 34 pointed, because the reed 14 strikes against the end 38 and might batter down a point and thus vary the effective adjustment. In this connection it will be seen that the spring 25 permanently engages the pointed end 32 of screw 28, so no such harm can occur there. Accordingly, we make the end 38 of screw 34 rounded so as to avoid the difficulty of a squared end and come as near as practicable to the advantage of a conical end.

With the narrow gaps between the reed 14 and the contact 21 on one side and the stop 38 on the other side, as just described, it is important that the changes of temperature shall not produce unequal expansion or contraction which might destroy the adjustment. Accordingly the flexible member 21 and its support 25 are made to go practically straight from their fixed ends and at a right angle to the axis of the gap. The member 21, being thin, will respond more quickly to a temperature change than the other parts of the relay, but its expansion or contraction, being almost entirely in a direction at a right angle to the axis of the gap, will not change the width of the gap.

The brass pin 19 not only prevents sticking by the contact of the reed 14 with a pole face, but it keeps the reed in more perfect isochronism. If the reed were allowed to get very close to a pole face the force would increase more than according to the law for isochronous harmonic motion and hence the periodicity would be varied. This is substantially prevented by the brass pin 19.

It has been common in the prior art to make alterating current relays with normally closed contacts. In this case a certain pressure must be given at the normally closed contact in order to make it close effectively. When the tuned reed is subjected to an alternating magnetic attraction, this must become great enough to overcome the pressure of the reed against the contact, before the reed can begin to vibrate. In our relay the tuned reed is normally on open contact, and is free to vibrate and will build up vibration on very feeble forces of the proper periodicity. When the contacts are made at 20—21, they are by impact and will be sufficient momentarily to enable a condenser discharge to take place through them.

Referring to Fig. 6, the attenuated incoming 135-cycle current is applied through conductors 50 to the winding 18. The circuit of battery 55 is normally closed on condenser 51, which is accordingly in a condition of static charge. Closure of the contacts at 20—21 discharges the condenser 51 to ground at 60. During the ensuing period of open contact at 20—21, the condenser 51 charges up again and then it is again discharged as before, and so on. Thus a pulsatory current flows through the windings of relay 57, which closes the circuit of relay 58 which holds closed by virtue of the slow band 59.

We claim:

1. In combination, a base, a bar magnet parallel to said base, said base having a groove transverse to the magnet under one end thereof, an L-shaped piece with its toe-part slidably engaging said groove, and a pole piece on said L-shaped piece.

2. In combination, a base, a bar magnet parallel to said base, said base having a

groove transverse to the magnet under one end thereof, two opposed L-shaped pieces having their respective toe-parts slidably engaging said groove, respective pole pieces on said L-shaped pieces and a reed with one end supported at the other end of said magnet, the free end of the reed being between said pole pieces.

3. In a vibratory tuned reed relay, magnet pole pieces of opposite polarity in the same magnetic circuit on opposite sides of the reed, respective windings on said pole pieces, and means to adjust said pole pieces carrying said windings therewith so as to vary the air gaps on both sides of the reed.

4. In a vibratory reed relay, a bar magnet, two opposed L-shaped pieces with their toe-parts engaging one end of the magnet, and respective opposed pole pieces carried by the upstanding parts of said L-shaped pieces, said pole pieces being positioned on opposite sides of said reed and said L-shaped pieces being adjustable transversely to vary the air gaps between the reed and the pole pieces.

5. In a vibratory reed relay, the reed 14, the normally open yielding contact member 21, the stop 26 for said member, and the stop 38 for said reed, said reed 14 in its normal position being spaced from the said stop 38 and the said yielding contact member 21 by respective gaps, the normal gap 14—38 being slightly greater than the normal gap 14—21.

6. In combination, a relay magnet, a vibratory reed, a contact member carried thereby, a fixed contact member normally spaced therefrom, and a stop on the opposite side of the reed from the said fixed contact at a normal distance from the reed slightly greater than the distance between said contacts.

7. A vibratory reed relay with a normally open, yielding, spring contact, and a stop on the opposite side from said contact and at a slightly greater distance from the reed than said contact.

8. In a vibratory reed relay, a bar magnet, two opposed L-shaped pieces with their toe-parts engaging one end of the magnet, and respective opposed pole pieces carried by the up-standing parts of said L-shaped pieces, said pole pieces being positioned on opposite sides of said reed and being adjustable transversely to vary the air gaps between the reed and the pole pieces.

In testimony whereof, we have signed our names to this specification this 28th day of December, 1921.

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