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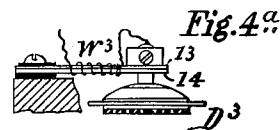
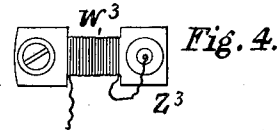
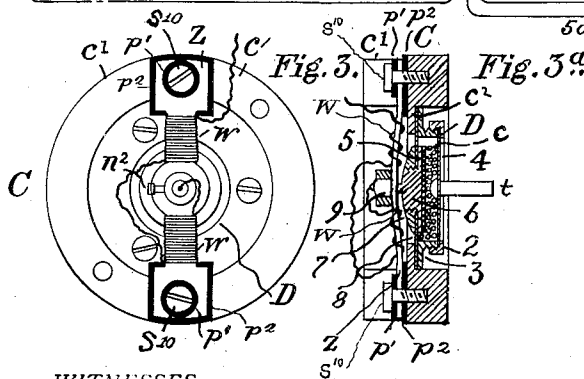
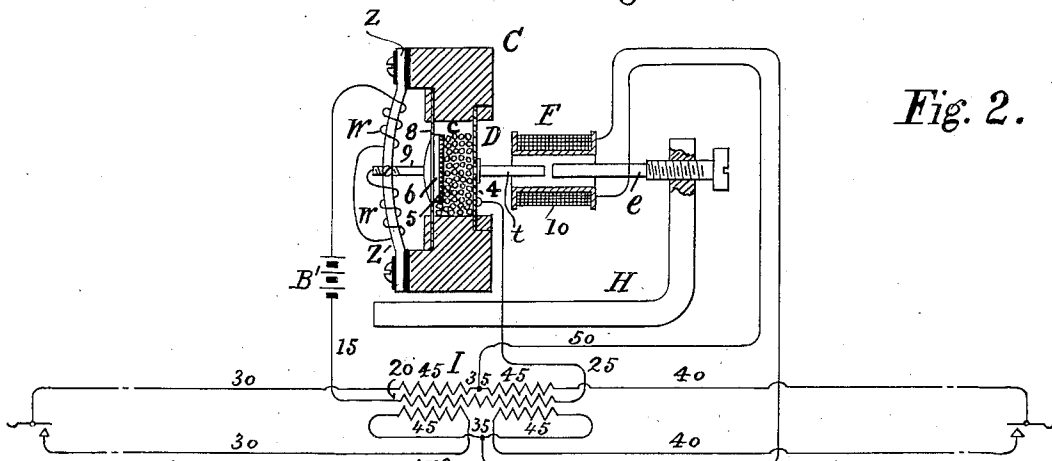
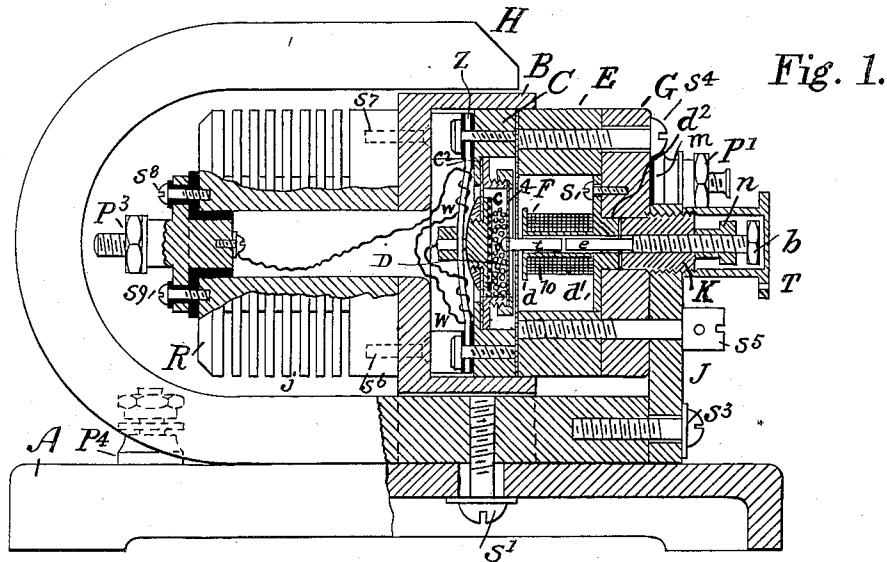
PATENTED NOV. 20, 1906.

H. E. SHREEVE.

REGULATING DEVICE FOR TELEPHONE RELAYS AND TRANSMITTERS.

APPLICATION FILED OCT. 26, 1905.

2 SHEETS—SHEET 1.



WITNESSES:

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Frank C. Lockwood.

INVENTOR.

BY Thomas Lockwood

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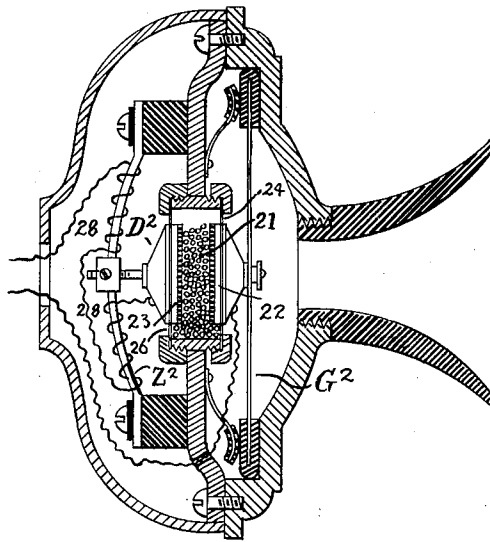
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2 SHEETS—SHEET 2

Fig. 5.



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UNITED STATES PATENT OFFICE.

HERBERT E. SHREEVE, OF NEWTON, MASSACHUSETTS, ASSIGNOR TO
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REGULATING DEVICE FOR TELEPHONE RELAYS AND TRANSMITTERS.

No. 836,811.

Specification of Letters Patent.

Patented Nov. 20, 1906.

Application filed October 26, 1905. Serial No. 284,449.

To all whom it may concern:

Be it known that I, HERBERT E. SHREEVE, residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Regulating Devices for Telephone Relays and Transmitters, of which the following is a specification.

This invention relates to improvements in telephonic instruments or apparatus (such as current reinforcers, relays, and transmitters) which embody as an element thereof a granular carbon "button" or microphone; but the invention is especially intended as an improvement upon the telephone-current reinforcers or relays of my Patents No. 791,655 and No. 791,656, dated June 6, 1905.

This invention is designed as a remedy against the packing of the carbon granules in the carbon-chamber or button of such apparatus; and, generally stated, consists in the combination with an expansible and contractible chamber in which the carbon granules are confined, of a thermostatic regulating device connected in circuit with the electrodes and carbon granules of the button and controlled by said circuit to effect such expansion and contraction of the chamber as to automatically rearrange and loosen the mass of carbon granules to restore its normal resistance and efficiency should it become abnormally compacted.

In relays such as described in my patents above enumerated and to a lesser extent in the granular carbon-transmitter used independently of relays there is a tendency of the granules in the carbon-chamber to pack, such packing impairing the resistance-varying properties of the mass in responding to relative vibrations of the electrodes, and consequently diminishing the transmitting efficiency of the apparatus. Such packing of the carbon granules, a defect inherent in instruments of this type is, it is believed, due in part to the natural tendency of the carbon granules to settle toward the bottom of the chamber, particularly under the influence of the slight relative vibrations of the electrodes in the normal operation of the instrument, in part to the constant and slight vibrations going on everywhere, and particularly in buildings where such apparatus is likely to be located, in part to the expansion effects of heat

generated in the button, including the granular carbon thereof, by the passage of current therethrough in the normal operation of the apparatus, and, possibly, to other causes which need not be mentioned.

In the preferred embodiment of this invention the thermostatic device is so mechanically connected to a movable wall of the carbon-chamber or button that when heated to abnormal temperature it will draw out the movable wall to increase the interior dimensions of the chamber, and hence lessen the pressure upon the granules. The thermostatic device is so constructed that with the carbon granules in their normal condition of looseness and resistance the current which said carbon permits to pass to the thermostatic device will not produce in the latter sufficient heat to cause it to move the wall of the chamber, the heat thus produced being balanced by dissipation thereof away from the thermostat, due to conduction and radiation; but this equilibrium is disturbed when any change takes place in the local circuit. Hence when the carbon granules become packed and the resistance to the current passing therethrough from one terminal to the other thus reduced the considerably-increased current thus permitted to circulate generates abnormal heat in the thermostatic device, which thereupon draws out the movable wall, loosening the mass of carbon particles and the contact thereof with the electrodes. This results in a sudden material increase of the resistance of the button and like diminution in the current flowing through the thermostatic device and the heat generated in the latter. The temperature drops and the thermostatic device contracts, forcing the movable wall inward, and thereby decreasing the capacity of the chamber, (for the instant to probably less than its normal size,) the velocity of motion in this direction being accentuated by the resiliency of the support of the wall. The more or less abrupt contact of the inwardly-moving wall with the carbon mass, previously permitted to relax by the outward movement, completes the rearrangement of the microphonic particles, which accordingly are again loosened within the chamber. This is believed to be the correct explanation of the manner

in which the expansion and contraction of the chamber effects the loosening of the packed carbon mass, although it has been found impossible to actually observe the changes which take place therein in operation owing to the inclosing of said mass, the almost imperceptible movements which effect the changes and the swiftly successive and recurrent character of the changes. It is of great importance, however, that the apparatus has in practice operated to overcome the packing.

The present invention, embracing further certain details of construction, will be more fully understood by reference to the accompanying drawings, wherein—

Figure 1 is a central elevation, partly in section, of an instrument embodying the principal features of my invention. Fig. 2 is a diagram illustrating the connections of said instrument with a local battery, an induction-coil, and the main line, by which the current may be relayed in either direction. Figs. 3 and 3^a are details of the instrument shown at Fig. 1. Figs. 4 and 4^a are a modification of the thermostat. Fig. 5 is a telephone-transmitter embodying the main invention.

A is a metallic base-plate upon which is mounted and held in position by screws (not shown) a centrally bored metal standard B, within which closely fits, as shown, a cylindrical metallic casing C, provided with flanges c' and c², for a purpose which will appear. This standard B is cut away or slotted at the bottom between said holding-screws, to make room for the heavy permanent magnet H.

The casing C supports and protects the carbon button D, mounted therein and constituting the delicate transmitting portion of the instrument. Button D comprises an annular wall or ring 3, closed at one side by the front electrode 4 in the form of a flexible diaphragm or disk held in place by screw-clamp ring 2 and at its other side closed by mica disk 8, held about its outer edge between the flange c² of casing C and the ring 3.

5 is the back electrode, mounted upon and supported by disk 8. A screw-threaded part of electrode 5 passes through a central opening in disk 8 and is engaged by a screw-threaded collar 7, which clamps the parts to the disk. A central projection 9 on the outer end of the electrode 5 is referred to hereinafter. As will be apparent from this explanation, both electrodes are movable. The movements of relatively small amplitude imparted to the front electrode 4 correspond to the rapidly-varying voice-currents which are to be relayed, and by slight variations of pressure upon the carbon mass correspondingly vary the resistance which the latter offers to the current flowing in the local circuit through the carbon. The back electrode 5 remains quiescent under normal conditions, but by

the action of the thermostatic device described hereinafter and induced by packing of the carbon receives movements of such relatively large amplitude as to first materially increase the size of the carbon-chamber to loosen the carbon mass by an outward movement and to then by a reverse movement react upon the loosened mass to scatter and distribute the carbon particles in their chamber in a condition of normal efficiency.

E is a solid metal ring the periphery of which in part fitting closely within the central bore of standard B serves as a protection for the receiving part of the instrument now to be described, the same consisting in part of a boxwood spool F, centrally bored and having two flanges d and d', the latter of which fits closely the interior of the ring E and is secured by screws s to a centrally-bored metallic back G of the instrument, a hub-like projection d² from flange d' closely fitting the bore of said back G entering therein about half-way. The spool F is wound with fine insulated wire 10, designed to be connected with the secondaries of a triple-wound induction-coil I, in turn connected with the main wires of the main circuit, as shown at Fig. 2. In Fig. 1 these connections are by wires (not shown) to binding-post P', and a similar binding-post (not shown) on the other half of the instrument. These binding-posts are insulated from the back G by mica plates m. H is a large permanent magnet bent, as shown, to embrace the greater part of the instrument of which it is itself a working part. It is centrally located upon the base-plate A, to which it is secured by screw s', as shown. This magnet has for its object to permanently magnetize a fixed but adjustable pole-piece e, that projects within the bore of the spool F to within a short distance of a variable magnetic pole-piece t, which latter projects within the same spool in the opposite direction from the front electrode 4, as described in my Patent No. 791,655, mentioned above.

Between the permanent magnet H and the magnetized pole-piece e is an iron block J, held against one end of magnet H by iron screw s³, as shown, the said block J having near its upper end a threaded opening, into which screws the base of a sleeve K, the forward part of which closely fits the bore of back G opposite the projection d' and is prevented from turning in block J by a pin (not shown.) The pole-piece e is an elongation of an iron thumb-screw b, working through the sleeve K. It is furnished with an iron check-nut n, the head of said thumb-screw b and said check-nut n being protected by a hollow cap T, covering the whole and screwing upon the rearwardly-projecting end of said sleeve K. By removing the cap T and turning the thumb-screw b the gap between the fixed pole-piece e and the variable pole-piece t may be adjusted to the requisite distance, as ex-

plained in my said Patent No. 791,655. Screws s^4 and s^5 secure the several parts together, as shown.

R is a heavy radiating-block secured to the standard B by screws s^6 , s^7 and scored at j to increase its surface. To its outer end is secured by screws s^8 , s^9 an insulated binding-post P^3 .

P^4 is a corresponding binding-post on the base-plate A.

The thermostat and its connections will now be described: Z is a flat strip of zinc broadened somewhat at the middle (see Fig. 3) to permit the passage through it of the projection 9 from back electrode 5 and at the ends to permit the passage of screws s^{10} , by which said ends are rigidly secured to the flanged casing C. The said strip is insulated from said screws and said casing by mica plates p' , p'' , p''' , p^4 . It is secured at the middle to projection 9 by a set-screw n^2 . W is an insulated resistance or heat-concentrating coil wound about said strip Z, one end of which coil is electrically connected with the back electrode 5 of chamber D through projection 9 and metal back 6, while the other end is (in Fig. 1) connected to the binding-post P^3 . If the resistance-coil is given a resistance of twenty ohms and the zinc strip is one-fourth of an inch wide and one thirty-second of an inch thick, the heat developed in the coil and communicated to the strip by a normal current flowing through the carbon button when made of the ordinary dimensions and with the carbon granules in their normal unpacked condition of efficiency will be balanced by dissipation due to conduction and radiation; but when the carbon granules become detrimentally packed, thereby decreasing the resistance which they offer in the local circuit, the increased current thus permitted to circulate through coil W imparts through said coil to the zinc strip Z sufficient heat to expand the latter. As the strip is rigidly secured at its ends, this expansion manifests itself at the middle, which is still farther bowed out, drawing out the back wall and electrode of the button D, and hence expanding the carbon-chamber and releasing pressure upon and loosening the mass of carbon granules. It is not believed that this retreat of the back wall of the chamber results at once in the utter collapse of the packed carbon mass; although it is possible that some incipient disintegration occurs and the mass is loosened. Whatever else happens, this retreating movement of the rear wall causes the resistance through the button to suddenly and strongly increase. The current through coil W as suddenly falls. The abnormal heat produced by the coil W quickly disappears, and the resulting sudden contraction of strip Z forces the back wall and electrode 5 forward again, the vigor of this movement being

assisted by the tendency of the resilient mica disk 8 to return to its initial position, from which it had been deflected by the expansion of the strip Z. The carbon-containing chamber is thus contracted (for the instant to perhaps less than its normal size) and the impact exercised upon the already relaxed carbon mass distributes its component particles loosely throughout the chamber.

The manner in which the instrument is connected for use is shown at Fig. 2, although the binding-posts are there omitted. B' at Fig. 2 is the local battery, a continuation of the winding W of the thermostat connecting with one pole thereof, while the other pole is connected by wire 15 with one end of the primary 20 of induction-coil I, the other end of said primary being connected by wire 25 with the front electrode 4 of the transmitting-chamber or button D. The incoming line of the circuit which it is desired to reinforce is marked 30 30, and the corresponding outgoing line is marked 40 40, or, as will be made more clear, 40 40 may be regarded as the incoming line and 30 30 as the outgoing line. These incoming and outgoing lines or wires are connected, as shown, with the ends of two secondary windings 45 45 of the induction-coil I, which windings have at their middle points the terminals 35 35 of a bridge composed of wires 50 50. This bridge is connected, as shown, with the two ends of wire 10, designed to set up end-to-end vibrations of the variable pole t , corresponding to voice vibrations coming over the line. It is obvious that the currents coming over the main line in passing through the secondaries 45 45 will have an inductive effect upon the primary 20 of the induction-coil I; but it is found in practice that this effect may be ignored. The powerful vibrations, however, in the current set up in the primary 20 by the action of the relay and its reinforcing battery are essential, and that the effect of these vibrations may be exerted to the best advantage the windings are all in the same direction as respects one another and relatively to the primary, as shown—that is the currents in the secondaries are all in the same direction, reinforcing each the other in the main circuit.

In Figs. 4 and 4^a is shown a modification of the thermostat, the arm Z³ being supported at one end and being made of two metals 13 and 14 of unequal coefficients of expansion. An increase of current in the resistance-coil W³, wound around the two metals, causes the end secured to the button D³ to move outward, thus increasing the separation between the electrodes of the chamber or, more particularly, between the back electrode and the granular carbon in the chamber with which the arm Z³ and resistance-coil W³ are designed to operate.

In Fig. 5 I have illustrated the present in-

vention as applied to an ordinary granular-carbon transmitter. It is unnecessary to give a minute description thereof. It is sufficient to say that the carbon-chamber and its walls as a whole are marked D². The granular carbon is marked 21, the front electrode 22, the back electrode 23, while 24 and 26 are mica plates. The front electrode 22 partakes of the movements of mica plate 24, which in turn is rigidly connected with the diaphragm G² of the transmitter, as shown, and follows its vibrations. The back electrode 23 partakes of the movements of mica plate 26, or, rather, by means of the present invention causes the movement of said mica plate. Z² is a zinc strip made and operating like the zinc strip Z, heretofore described, being a resistance-coil such as has already been described.

I claim—

1. The combination with a variable-resistance telephone transmitting device, of a thermal resistance and current-regulator therefor in circuit therewith, substantially as set forth.

2. The combination, in a telephone-current reinforcer or relay apparatus, of the variable-resistance telephone-transmitting device thereof, with a thermal resistance and current-regulator for said transmitting device and in circuit therewith.

3. In a telephone-current reinforcing apparatus, the combination of the current-varying-transmitting medium or system, comprising the electrodes and carbon granules, of a thermal-regulating device in circuit therewith, responsive to an abnormal fall in the resistance of said transmitting system, and adapted to rearrange said granules, and restore the normal relations of said electrodes and granules; substantially as set forth.

4. In a telephone or telephone current relay employing granular carbon in a local circuit as the transmitting portion of the instrument, one wall of the chamber containing said granulated carbon being made movable, the combination with said movable wall and the battery or source of electromotive force in said local circuit of a thermostat adapted to

be energized by heat developed therein by increase of current in said local circuit due to packing of the granulated carbon and to impart movement to the movable wall.

5. In a telephone or telephone current relay employing granular carbon as the transmitting portion of the instrument, a movable electrode forming one wall of the chamber containing said granular carbon, in combination with a thermostat, the said thermostat being in circuit with said electrode and granular carbon and being adapted to be energized by heat developed therein by increase of current in said circuit due to packing of said granular carbon and to impart movement to said movable electrode.

6. In a telephone-current reinforcer or relay employing granular carbon as the transmitting portion of the instrument, a movable back electrode forming one wall of the chamber containing said granular carbon, in combination with a thermostat, the said thermostat being in a local circuit with said back electrode and said granular carbon and being adapted to be energized by heat developed therein by increase of current in said local circuit and to impart movement to said movable wall.

7. In a telephone-current reinforcer or relay employing granular carbon as the transmitting portion of the instrument, a movable back electrode in the chamber containing said granular carbon, in combination with a metallic strip provided with insulated supports at its ends, the said strip being in mechanical connection with said back electrode and having wound about it an insulated resistance and heating-coil in a local circuit including said back electrode and said granular carbon.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 23d day of October, 1905.

HERBERT E. SHREEVE.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.