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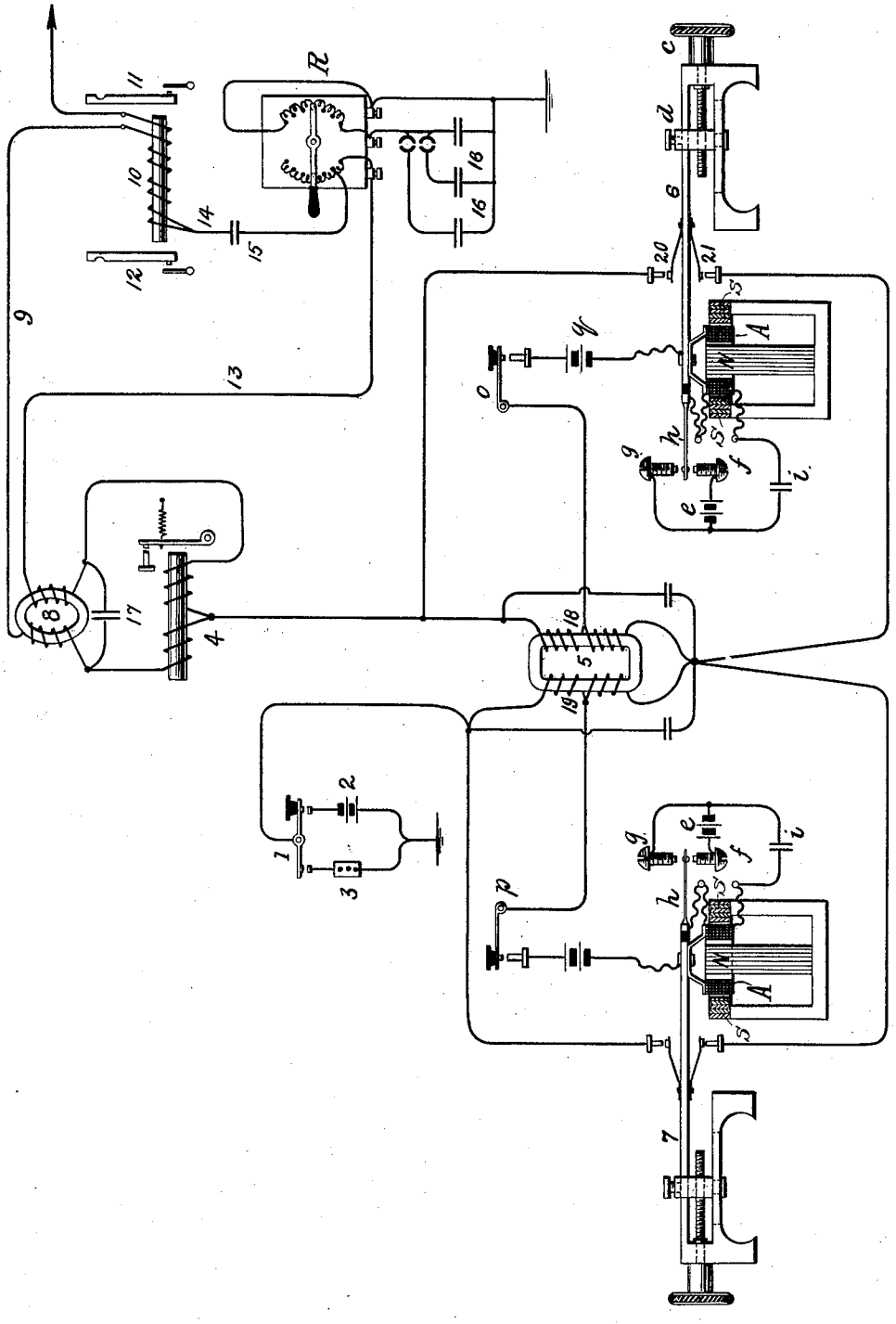
S. D. FIELD.

MULTIPLEX TELEGRAPHY.

APPLICATION FILED MAR. 24, 1903.

NO MODEL.



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UNITED STATES PATENT OFFICE.

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MULTIPLEX TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 755,647, dated March 29, 1904.

Application filed March 24, 1903. Serial No. 149,249. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN DUDLEY FIELD, a citizen of the United States, residing at Stockbridge, in the county of Berkshire and State of Massachusetts, have invented certain new and useful Improvements in Multiplex Telegraphy, of which the following is a full, clear, and exact description.

This invention relates to multiplex telegraphy, and has special reference to the system described in my application filed March 5, 1903, Serial No. 146,313.

The object is to provide a means for effecting a balance of the line, as also to further increase the efficiency of the tuned transmitters used in such systems.

The invention consists of a novel form of rheostat and connections thereto for "balancing;" also, of an association of an electromagnet, battery, condenser, and contacts with a tuned reed to obtain uniformity of the application of the force actuating the reed; also, in the combination of two reeds and a single iron core common to both and carrying windings traversed by the impulses created by the respective reeds in such manner that said impulses in no way conflict with each other, while currents emanating from other sources pass freely and without abnormal retardation.

The improvements will be described in detail with reference to the accompanying drawing, which illustrates the apparatus and circuits at one terminus of a line conventionally.

A key 1 is used to actuate a line-battery 2 and battery-resistance 3, first one and then the other being cut into line in a well-known manner to preserve the continuity of the line. The currents from this key pass the coils of an ordinary differentially-wound Morse relay 4 in the ordinary duplex manner. Between the relay and the key is interposed an inductive device 5, similar to those described in my application above referred to, differing, however, in this important point that in this case two independent windings are associated on the same core and the said windings are connected reversely to each other. Each of these windings is in connection with a vibratory reed 6 and 7, respectively, and its contacts while each reed is tuned to a different rate of vibration. After passing the Morse relay the line and equating circuits pass the windings of a differentially-wound retardation-coil 8, after which they divide, the line-circuit 9 passing the coils of a tone-receiver 10, equipped with two reeds 11 and 12. The coils 10 are in parallel and reversed to each other. The equating-circuit branch 13 goes to the rheostat R and earth in the usual manner. Midway on the windings of the tone-receiver is a leak or tap 14, which leads through a condenser 15 to a point distant from the line-terminal of the rheostat sufficient to compensate for the resistance of one of the coils 10 of the receiver. This makes the tapped point of the coil 10 neutral to outgoing currents, since the disturbance introduced by the first half of said coil is compensated for by that portion of the resistance of the rheostat cut off by the tap-circuit. The rheostat employed is of peculiar arrangement and is considered as novel. It consists of a series of coils of equal value bridged by a blade-spring switch in such a manner that a "balance" can be obtained by a single movement. The condenser 16 is of the divided type and is adjusted to the line at its maximum of static capacity, after which it requires little further attention. In order to arrive at a correct understanding of this arrangement, it must be borne in mind that the static of a line never varies. Changes in the rate of leakage by carrying off more or less of the static charge renders an adjustment for static capacity necessary. Hence my rheostat is constructed so that conditions due to leakage on the line can be reproduced with respect to the equating-condenser by permitting more or less leakage around the condenser. Consequently the apparent capacity of the condenser is altered in a manner very similar to that experienced on the line when leakage occurs. Lowering the resistance to compensate for line-leakage at the same time increases the leakage to which the condensers are subjected.

It will be seen that outgoing straight currents are balanced in practically the usual manner. Incoming Morse currents pass the coils as usual. The quick harmonic vibrations, however, are choked by the impedance-coil 8

and mostly pass through but one coil of the vibratory receiver-magnet and thence to earth via the condenser tap-circuit and rheostat. A condenser 17 is placed between both branches of the circuit at a point between the retardation-coil and relay. This condenser serves to equalize whatever vibratory impulses pass the retardation-coil 8 and equilibrate them through both branches of the relay.

Coming now to the tone-transmitters, N S is a strong magnet, between the laminated poles of which a coreless coil A vibrates freely. Said coil is attached to a tuned reed 6, the rate of which is governed by varying its point of suspension by means of the screw *c* acting on the clamp *d*. The coil gives motion to the reed 6 by virtue of the energy derived from the battery *e*. The reed may be set in motion by hand or mechanically. When the insulated blade-spring *h* collides with contact *f*, the condenser *i* receives a charge which, passing around the convolutions of coil A, impels the same, with the attached reed, in the the direction of contact *f*. In other words, the coil is sucked in. This condenser charge, however, is but of an instant's duration. It result, in a blow or snap to the reed, leaving the same free to start on its return excursion on the completion of its stroke. Upon the return stroke of the reed contact *g* collides with blade-spring *h*, thus giving a path for the discharge of the condenser. Said discharge passing coil A results in an outward impetus to the reed 6. Thus the reed is continuously operated by a series of minute impulses of fixed and determined value imparted at the instant when the fork is occupying its "zero displacement."

It is a law of automatically-vibrated pendulums or reeds that to secure absolute uniformity of movement the actuating force must be applied at the precise moment when the fork, pendulum, or string is passing through the point of zero displacement. To obtain this effect through the agency of electromagnets is extremely difficult. The various parasitic attributes—such as Foucault currents, self-induction and residual magnetism, &c.—due to such agents render them erratic in action. I have found that a coil of the character described, cutting the lines of force of a powerful magnet the poles of which are carefully laminated, possesses all the necessary qualifications for exact work and that such coils can, through the agency of the condenser-circuit, be made to deliver its torque to a vibrating agent at practically any desired point in the arc of its vibration.

Referring again to the core 5 and its association with both reeds, it will be seen that the closure of either finger-key *o p* will send induced currents to line. *o* being closed, for instance, will alternately energize the two halves of the divided coil 18 through battery *q* and contacts 20 and 21, the currents induced in the opposite half each time being relied upon to produce the signal at the distant station. Likewise coil 19 will operate under the control of key *p*.

Having described my invention, I claim—

1. A means for balancing a signaling-circuit, consisting of a rheostat in combination with a condenser, an equating-circuit, a portion of which forms a shunt to the condenser, and means whereby an alteration of the resistance in the equating-circuit will be accompanied by an alteration in the resistance of the shunt to the condenser, for the purpose set forth.

2. A means for balancing a signaling-circuit, consisting of a rheostat in combination with a condenser, an equating-circuit, a portion of which forms a shunt to the condenser, and a single switch-lever adapted to simultaneously alter the resistance in the equating-circuit and the shunt to the condenser, for the purpose set forth.

3. In a signaling system, the combination of a differentially-wound Morse relay, a duplex-wound receiver-magnet, a main line including the coils of the receiver-magnet and one of the coils of the relay, a balancing-rheostat, an equating-circuit including the other coil of the relay and connected to the rheostat and a tap-circuit from the middle of the winding of the duplex receiver to a point on the rheostat compensating for one-half the duplex winding, substantially as described.

4. In a signaling system, the combination of a differentially-wound Morse relay, a duplex-wound receiver-magnet, a main line including the coils of the receiver-magnet and one of the coils of the relay, a balancing-rheostat, an equating-circuit including the other coil of the relay and connected to the rheostat and a tap-circuit from the middle of the winding of the duplex receiver to a point on the rheostat compensating for one-half the duplex winding, and a condenser in said tap-circuit.

5. The combination of a main line, a duplex-tuned receiver having its coils therein and reversely wound, two tuned vibrators actuated by the receiver, a tap-circuit from between the two coils, a condenser in the tap-circuit and a rheostat to which the tap-circuit is connected.

6. In telegraphy, a vibratory element, two contacts with which said element is adapted to alternately engage, an electromagnet adapted to actuate the vibratory element, a battery, a condenser and two circuits one of which includes one contact, the battery, condenser and magnet, and the other the remaining contact, condenser and magnet.

7. In telegraphy, a main signaling-circuit, and a reed having contacts controlling said circuit, in combination with means independent of said main circuit for vibrating said reed consisting of a local source of current, a condenser, an electromagnet and an automatic

switch whereby the charging and discharging currents of the condenser are alternately directed through the magnet.

8. In multiplex telegraphy, the combination of two vibratory transmitting elements and a duplex induction-coil, the windings of said coil being in series in the main line but reversely wound and each winding being divided into two parts adapted to be alternately energized by its own vibratory element.

In witness whereof I subscribe my signature in presence of two witnesses.

STEPHEN DUDLEY FIELD.

Witnesses:

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