No. 835,772. PATENTED NOV. 13, 1906.

P. E. BLISS.

TELEGRAPH REPEATER.

APPLICATION FILED APR. 18, 1906.

2 SHEETS—SHEET 1.

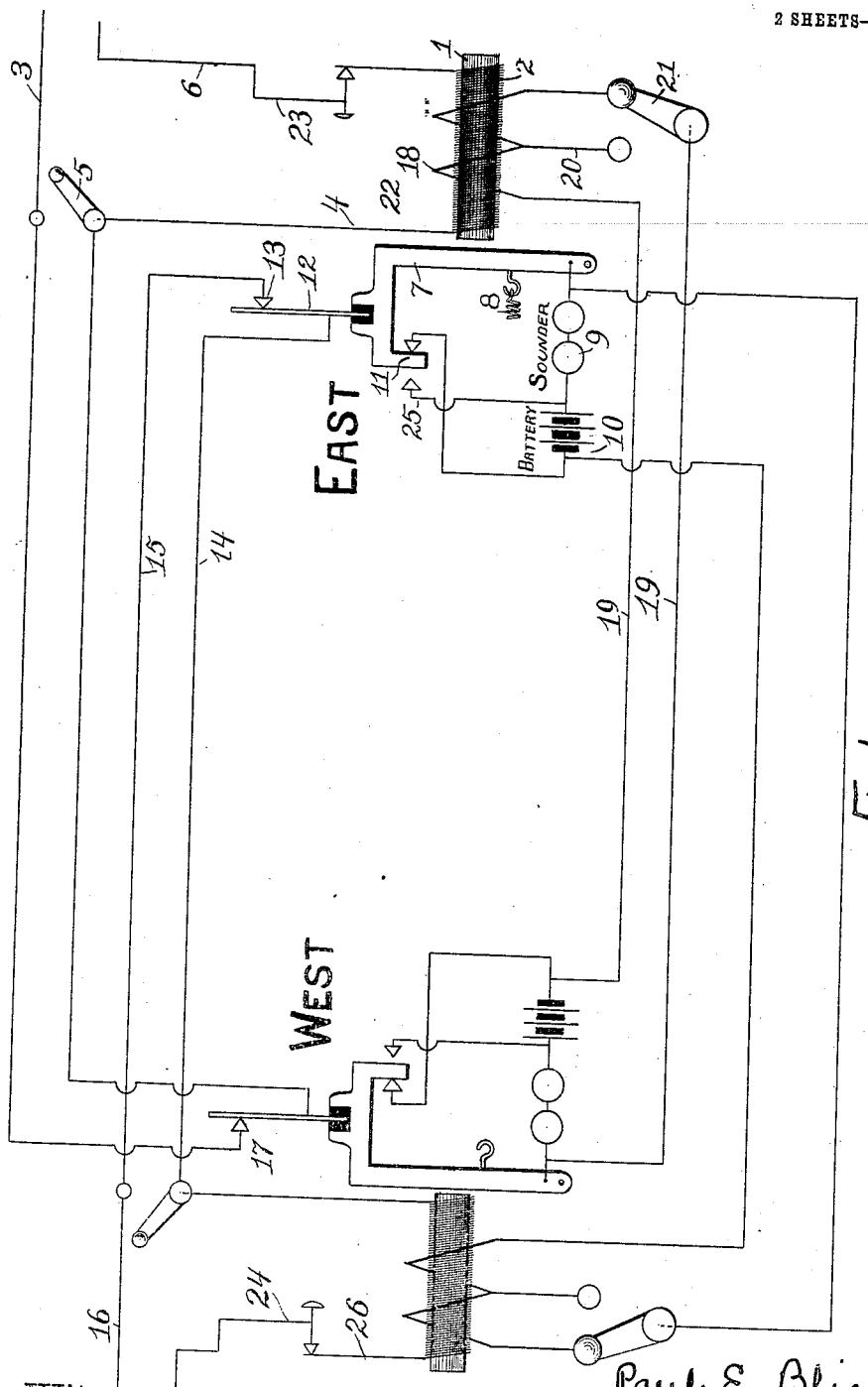

Fig. 1.

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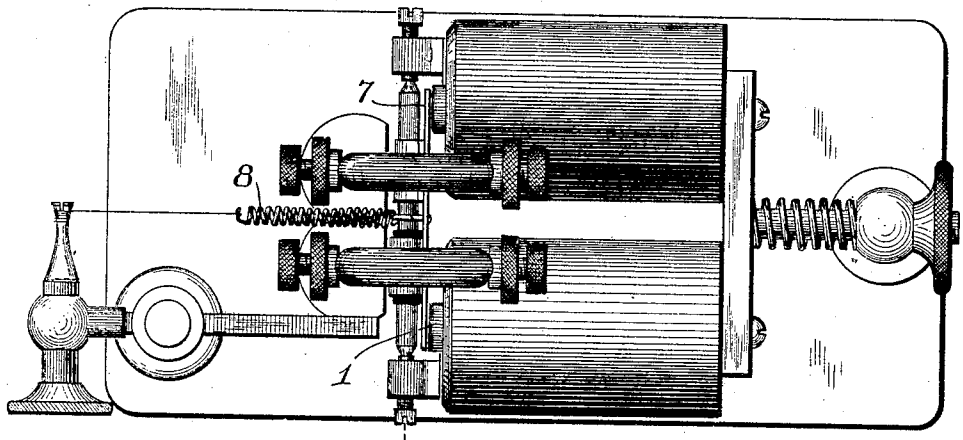

Fig. 2.

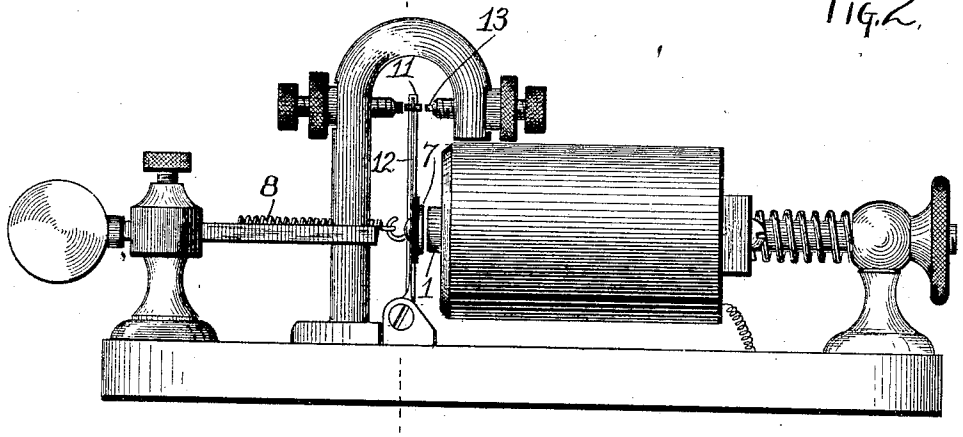

Fig. 3.

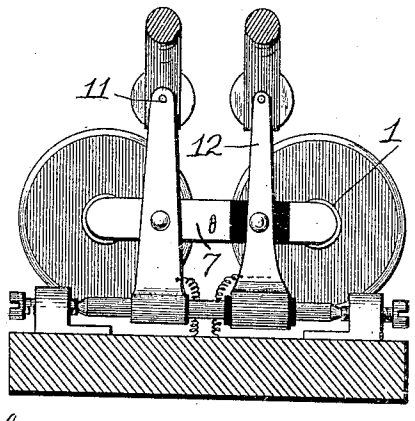

Fig. 4.

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UNITED STATES PATENT OFFICE.

PAUL E. BLISS, OF LEESBURG, FLORIDA.

TELEGRAPH-REPEATER.

No. 835,772. Specification of Letters Patent. Patented Nov. 13, 1906.

Application filed April 18, 1906. Serial No. 312,321.

To all whom it may concern:

Be it known that I, PAUL E. BLISS, a citizen of the United States, residing at Leesburg, Lake county, Florida, have invented certain new and useful Improvements in Telegraph-Repeaters, of which the following is a specification.

This invention, pertaining to telegraph-repeaters, will be readily understood from the following description, taken in connection with the accompanying drawings, in which—

Figure 1 is a diagram illustrating an exemplification of my invention; Fig. 2, a plan illustrating the preferred construction of relay; Fig. 3, a side view of the relay, and Fig. 4 a vertical transverse section of the relay.

In Fig. 1, which diagrams the repeating instruments and circuits of a station, the parts to the right may be considered as pertaining to the east line, while the parts to the left pertain to the west line, and as the two sets of parts are in duplicate the description will be mainly in the singular.

In the diagram, 1 indicates the east relay-core; 2, its usual winding—say one hundred and fifty ohms resistance; 3, the east incoming line; 4, connection therefrom to the relay-winding 2; 5, a switch to connect conductors 3 and 4; 6, a conductor from relay-winding 2 to continued line or to ground, as the case may be; 7, the relay-armature; 8, its retracting-spring; 9, the sounder; 10, the east local battery; 11, the local contact pertaining to the east relay.

Considering the parts as thus far described and assuming switch 5 to be closed, it will be observed that everything is as usual in ordinary non-repeating installations, the relay serving simply to respond to impulses from the eastern line and open and close the east local circuit and work the east sounder, and it is under these conditions that the apparatus would be used for non-repeating work on the east line. The description thus far given will apply precisely to the west line, and under the conditions mentioned—that is to say, with the switch 5 and its corresponding west switch closed—either of the lines may be used precisely as ordinary lines having no repeating equipment. The sounders may be precisely as usual—say with four ohms resistance. The local batteries may be as usual—say one cell of gravity-battery for each sounder. The relay-windings thus far referred to may be precisely as usual—say one hundred and fifty ohms resistance or whatever may be the adopted resistance for the relays of the given line.

Continuing with the diagram, 12 indicates a flexible contact-tongue carried by but insulated from the armature of the east relay; 13, a contact-point to coöperate with this tongue, the construction of this contact arrangement being such that as the relay-armature opens contact 11 will open first, contact 13 opening later, and when the relay closes contact 13 will close first, the spring-tongue then yielding somewhat and contact 11 closing later; 14, conductor from spring-tongue 12 to the main winding of the west relay; 15, conductor from contact-point 13 to west line; 16, the west line; 17, contact-point connected with the east line and coöperating with the spring-tongue of the west relay; 18, auxiliary winding on the east relay—say six layers of No. 26 wire or fifteen ohms resistance; 19, conductor from one terminal of this auxiliary winding to one side of the west local battery and from the other end of this auxiliary winding to the side of the west sounder opposite its battery—in other words, 19 constitutes a closed circuit containing the east auxiliary winding and the west sounder and its battery in series; 20, a branch from the auxiliary winding 18, taken off at about the mid-point of its resistance or, say, at the end of the third layer if there are six layers in the auxiliary winding; 21, a switch coöperating with circuit 19 and branch 20, permitting that circuit to include selectively either all or a part of the auxiliary winding; 22, the east relay considered as a whole; 23, the east key; 24, the west key; 25, a back contact for the relay-armature, connected with the local circuit between the battery and sounder; and 26 conductor from west relay-winding to continued line or to ground, as the case may be.

Detailed description has been given only of the apparatus pertaining to the east; but the west is the same. When employed in repeating, the switch 5 and its corresponding west switch are open, as shown.

Assume sending being done from a distant station on the east line. When the key at that station opens the east circuit, the armature of the east relay retreats, contact 11 opens, the armature of the east sounder rises, and spring-contact at 13 opens a trifle later. The west-line circuit therefore opens. The armature of the west relay does not retreat, being retained by the energizing of the west

relay through the medium of its auxiliary winding and the east local battery, plus residual magnetism in the west relay. Contact 17 remains closed, thus not opening the east line. The west sounder remains down.

When the key at the distant east station closes, then the armature of the east relay closes, contact 13 closes, thus closing the west-line circuit, contact 11 closes, thus closing the east local circuit, and the armature of the east sounder comes down. The auxiliary winding of the west relay loses its energy, or most of it, by reason of the closure of the east local circuit. In this way signals from the east are repeated to the west. The performance would be similar if the signals were coming from the west line.

If while signals are coming from the east line some operator on the west line should "break," the west relay would become deenergized and open when the east operator closes his key and causes contact 11 to close and bring about the deënergization of the auxiliary winding of the west relay, whereupon the west relay-armature retreats and breaks the east line.

Notwithstanding sounder 9 is always in closed circuit with its battery 10, it responds promptly to the opening and closing of contact 11 in accordance with well-established electrical laws, and it is found in practice that the entire apparatus is responsive to the most rapid sending. When the repeating capacity is not desired, the switch 5 and its corresponding west switch are closed and switches 21 are opened, the two sides of the apparatus then representing ordinary non-repeating stations. The relays are to be adjusted, as usual—that is to say, in correspondence with variations in main-line conditions. The auxiliary windings of the relays are to accomplish electromagnetic results when the main windings of the relays are open, and it follows that the auxiliary windings should have an effect fairly corresponding with that of the main windings. By manipulating switches 21 the auxiliary windings may have their electromagnetic effect varied in an obvious manner. No fine adjustments at this point are required. I have found in practice that varying from full to half strength of the auxiliary winding will take care of all of the usual variations in the main-line circuit and compensate for all the corresponding adjustments of the relay-spring. In many situations the strength-varying function of the switch 21 is called on only at very rare intervals. In the illustration the switch 21 provides for but two variations in the strength of the auxiliary winding; but it is obvious that an appropriate switch may effect any desired number of variations in the effect of these windings.

In the diagram the core of each relay is illustrated as being single; but it will of course be understood, as heretofore stated, that the relay construction follows usual plans, which universally involve magnets of horseshoe type, this of course calling for an appropriate modification in the switch 21 in order that it may effect symmetrical modifications in the effect of the windings.

Supplementing what has been heretofore stated regarding the action, or, rather the non-action, of the west relay when repeating is being done from the east, it may be explained that while the west circuit is closed the west relay is attracting its armature in virtue of the energy of the main winding of that relay. When the west circuit is opened by the east relay, then while the main winding of the west relay loses its energy the auxiliary winding of that relay becomes effective and takes the place of the main winding in retaining its armature. The west relay, therefore, when repeating is being done from the east has its armature held first by the energy of the main winding and then by the energy of the auxiliary winding, each energy overlapping the other as to time. It is to be observed that the auxiliary windings are not called upon to move the relay-armatures, the movement of attraction being effected by the main-line windings and the auxiliary windings requiring simply to retain the armatures after they have been moved. The auxiliary windings, while alternating in duty with the main windings as to holding the armatures, need, therefore, not be proportioned with any special accuracy. I have found in practice that auxiliary windings which have not sufficient energy to move the armatures are entirely satisfactory in holding the armatures after they have been moved by the main windings. This may be explained on the theory of lessened distance between armature and core in addition to residual magnetism.

The preferred construction of relay will be readily understood from a glance at Figs. 2, 3, and 4.

The relay-armature carries two contact-arms, one opposite each relay-spool, one of the arms being rigid to form the contact feature 11 of Fig. 1 and the other being flexible and insulated from the first one to form the contact feature 12 13 of Fig. 1. For each of these arms there is a pair of adjustable stop-screws, one screw of each pair forming a contact element. In the illustration these screws are carried by separate fixed gooseneck-standards.

It will be noted that when the east relay is open the east battery and sounder are then in circuit with the auxiliary winding of the west relay, the sounder thus constituting a resistance in the battery-circuit and to some extent lessening the energy of the auxiliary winding. In practice this is found to be without detriment; but still in order to pro-

vide for extraordinary conditions I have arranged for cutting the sounder out of the circuit when its relay shall have completed its opening stroke. It will be observed in the diagram that the effect of the back contact 25 is to short-circuit the sounder after completion of the back stroke of the relay-armature. It may be added that this feature for short-circuiting the sounder is of such little requirement that in general practice it may be ignored and omitted.

Attention is first called to the extreme simplicity of the apparatus and the circuits. The local circuit requires no change whatever either in sounder construction, battery-power, or relay-contact over ordinary non-repeating equipment. The relay requires simply the spring-contact and the auxiliary winding to be added. The cost of the apparatus is a mere trifle in addition to that of non-repeating apparatus, and the non-repeating functions of it are in no degree impaired.

The next point to which attention is called is the economy and convenience of local-battery conditions which are such that the battery is subjected to no more variations in strength than under ordinary non-repeating conditions, this resulting not only in economy and convenience as regards local battery, but also resulting in the non-necessity for anything more than the adjustments of relay usually incident to non-repeating conditions. Repeaters notoriously call for peculiar watchfulness in the matter of spring and contact adjustments, resulting in exasperating annoyance and in serious delays. In my apparatus the repeating function introduces no degree of increased necessity for adjustment as compared with non-repeating conditions, and the repeating capacity is up to the full standard of ordinary non-repeating relays.

While the contact devices perform functions in making and breaking circuits, I will for the sake of brevity in expression employ the term "circuit-breaker" in the claims, meaning thereby a contact device with the double function. It is manifest that any other suitable source of electrical energy may be substituted for the batteries set forth, and I therefore employ the term "battery" as comprehending any such substitute.

An analysis of the diagram will show that when the relay is closed then its local battery is in circuit with the sounder as a resistance. The electrical effect of the sounder-coils would be the same, quite regardless of whether or not the sounder were a sounder in fact and quite regardless of whether or not their resistance were in wire-coil form. I will therefore in the claims employ the term "first resistance" as meaning the comparatively low resistance in circuit with the battery when the local circuit is closed by the relay, which low resistance will of course preferably be constituted by the coils of a sounder, and I will employ the term "second resistance" as meaning the higher resistance as represented by the windings 18.

Those skilled in the art of telegraph-repeaters will recognize the fact that the improved system lends itself to various modifications without departure from the principle of my invention as pointed out in the claims. I have simply explained the principle of my invention and the best mode in which I have contemplated applying that principle, the claims particularly pointing out the combinations constituting my invention.

I claim—

1. A telegraph repeating apparatus comprising, in duplicate, a battery a first resistance and a second resistance higher than that of the first resistance, a circuit including all said members in series, a shunt-circuit including the first resistance and battery in series, a circuit-breaker in the shunt-circuit, an electromagnet having an armature mechanically connected with said circuit-breaker, and a main-line-circuit breaker also mechanically connected with the armature of said electromagnet, combined substantially as set forth.

2. A telegraph repeating apparatus comprising, in duplicate, a battery a first resistance and a second resistance higher than that of the first resistance, a circuit including all said members in series, a shunt-circuit including the first resistance and battery in series, a circuit-breaker in the shunt-circuit, an electromagnet having an armature mechanically connected with said circuit-breaker, and a main-line-circuit breaker also mechanically connected with the armature of said electromagnet, said main-line-circuit breaker being arranged to close prior to the closing of the first-mentioned circuit-breaker, combined substantially as set forth.

3. A telegraph repeating apparatus comprising, in duplicate, a battery a first resistance and a second resistance in coil form having a resistance higher than that of the first resistance, a circuit including all said members in series, a shunt-circuit including the first resistance and battery in series, a circuit-breaker in the shunt-circuit, an electromagnet having an armature mechanically connected with said circuit-breaker and having its core surrounded by the second resistance of the opposite set as an auxiliary winding, and a main-line-circuit breaker also mechanically connected with the armature of said electromagnet, combined substantially as set forth.

4. A telegraph repeating apparatus comprising, in duplicate, a battery a first resistance and a second resistance in coil form having a resistance higher than that of the first resistance, a circuit including all said members in series, a shunt-circuit including

the first resistance and battery in series, a circuit-breaker in the shunt-circuit, an electromagnet having an armature mechanically connected with said circuit-breaker and having its core surrounded by the second resistance of the opposite set as an auxiliary winding, a switch for cutting a portion of said second resistance out of circuit, and a main-line-circuit breaker also mechanically connected with the armature of said electromagnet, combined substantially as set forth.

5. A telegraph repeating apparatus comprising, in duplicate, a battery a first resistance and a second resistance higher than that of the first resistance, a circuit including all said members in series, a shunt-circuit including the first resistance and battery in series, a circuit-breaker in the shunt-circuit, an electromagnet having an armature mechanically connected with said circuit-breaker, a main-line-circuit breaker for the opposite line also mechanically connected with the armature of said electromagnet, a switch for opening the first-mentioned circuit, and a device for cutting said main-line-circuit breaker out of circuit, combined substantially as set forth.

6. A telegraph repeating apparatus comprising, in duplicate, a main circuit, a local circuit, a battery in the local circuit, a resistance in the local circuit, an electromagnet having windings in each of said circuits, a shunt-circuit across that one of said windings which is in the local circuit, a circuit-breaker in said shunt-circuit, and electrical connections, combined substantially as set forth, whereby when said circuit-breaker is closed said resistance will be in series with said battery.

7. A telegraph repeating apparatus comprising, in duplicate, a main-line circuit including an individual relay and including also a circuit-breaker controlled by the relay of the opposite line, a local circuit including a first resistance and battery and also a circuit-breaker controlled by the individual relay, and a shunt-circuit including said first resistance and battery and including also an auxiliary winding on the relay of the opposite line, combined substantially as set forth.

8. A telegraph repeating apparatus comprising, in duplicate, a battery a first resistance and a second resistance higher than that of the first resistance, a circuit including all said members in series, a shunt-circuit including the first resistance and battery in series, a circuit-breaker in the shunt-circuit, an electromagnet having an armature mechanically connected with said circuit-breaker, and a main-line-circuit breaker in the form of a spring-tongue also mechanically connected with the armature of said electromagnet, said main-line-circuit breaker being arranged to close prior to the closing of the first-mentioned circuit-breaker, combined substantially as set forth.

9. A telegraph repeating apparatus comprising, in duplicate, a battery a first resistance and a second resistance higher than that of the first resistance, a circuit including all said members in series, a shunt-circuit including the first resistance and battery in series, a circuit-breaker in the shunt-circuit, an electromagnet having an armature mechanically connected with said circuit-breaker, and a circuit-breaker and circuit connected with said circuit-breaker in the shunt-circuit and adapted to short-circuit the first resistance when the circuit-breaker in the shunt has completed its opening motion.

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