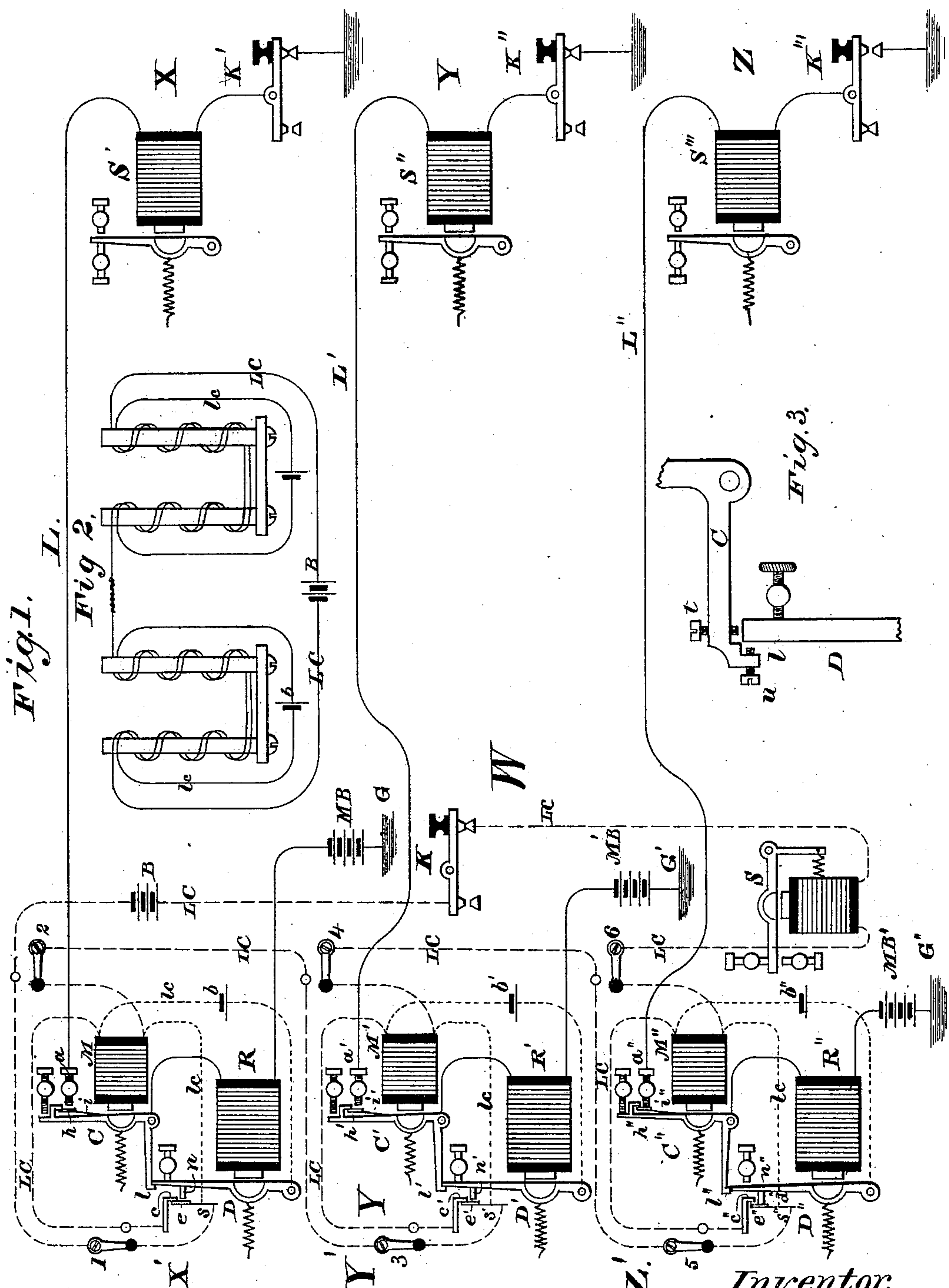


G. F. BALLOU.  
TELEGRAPHIC REPEATER.

Patented Dec. 13, 1881.



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# UNITED STATES PATENT OFFICE.

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## TELEGRAPHIC REPEATER.

SPECIFICATION forming part of Letters Patent No. 250,774, dated December 13, 1881.

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*To all whom it may concern:*

Be it known that I, GEORGE F. BALLOU, of Waltham, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Repeating-Telegraphs, of which the following is a specification.

The object of my invention is to repeat automatically over two or more lines radiating from a central office messages transmitted over any one of them and to work all the lines simultaneously from the central office.

To this end my invention consists in controlling the key or transmitter of each line by a magnet included in a local circuit at the central station, so that on breaking the local circuit the keys of all the lines radiating from the central office will be worked. I also adjust the relay or receiver of each line in such a manner that on receiving a message it makes and breaks the local circuit at the central station, and thus operates the transmitters of the other lines, causing them to repeat the message received.

A further object of my invention is so to organize the lines that any one or more of them can be isolated or cut out in such manner that it will repeat messages received over other lines or sent from the central station, while in receiving a message it will act independently without repeating it over the other lines, and so that any one of the lines can be entirely cut off from the others and be worked independently thereof.

In the accompanying drawings, Figure 1 is a diagram showing three similar lines and their instruments, with their respective electrical connections as arranged at a central station. Fig. 2 shows a method of winding and connecting up the magnets in circuit; and Fig. 3 is a detailed view, showing the relation of the circuit-breaking levers in each line.

W is a central station, from which radiate the main lines L L' L'', provided with repeating-instruments X' Y' Z'. X Y Z are terminal stations. These lines being similar, a description of one will suffice for all.

Referring to the circuit at instrument X', M B is a main battery on line L, grounded at G; R, a relay or receiving-magnet; D, its lever, provided with a stud, *n*, and a retractile spring.

C is a transmitting-lever, having a latch, *l*, at one end, a retractile spring to throw the

latch into engagement with the lever D, and the spring *i*, with point *h*, to make contact with the adjusting-screw *a* on line L.

At terminal station X, S' is a sounder; K', a key. The circuit being closed, the current flows from M B through relay R, armature-lever C, contacts *i* and *a*, line L, sounder S', key K', to the ground, and thence back to the battery.

L C is a local circuit, in which are included local auxiliary magnets M M' M'', operating the armature-levers C C' C'', the battery B, key K, sounder S, switches 1 2 3 4 5 6, and the contacts at each instrument consisting of the springs *s s' s''*, the points *e e' e''*, and the rests *c c' c''*. The studs *n n' n''* of the relay-levers D D' D'' serve to make and break these contacts. Key K being closed, the circuit, (indicated in long broken lines in the drawings) flows from battery B through key K, sounder S, switch 6, auxiliary magnet M'', line L C, contacts *c'' e''*, switches 5 and 4, auxiliary magnet M', and so on through each repeating-instrument back to battery B. The auxiliary magnet M has in addition an independent local circuit, (indicated in short broken lines in the drawings,) the current flowing from the battery *b* around the magnet in the same direction as the local circuit, and is completed through spring *s*, contact *e*, stud *n*, relay-lever D, back to battery *b*. This method of winding and connecting up the auxiliary magnets is shown in detail in Fig. 2, in which L C is the local circuit of the central station, and *l c* the independent local circuit of each instrument. The wires L C and *l c* are wound parallel to each other upon the core of the magnet, and the current in each wire flows around the core in the same direction. The core is thus maintained in an energized condition when either of the circuits is closed.

The operation of my invention is as follows: Key K being closed, the local circuit is completed through auxiliary magnets M M' M'', and armature-levers C C' C'' are drawn down, making contact with points *a a' a''* of lines L L' L'', and complete the main circuits of each instrument. This in turn causes relay-magnets R R' R'' to attract their armatures D D' D''. The circuits are now all completed except the independent local circuits *l c*. The sending of a message is shown at Z', Fig. 1. By breaking key K''' of station Z the relay-armature D''



is released and retracted by its spring past the latch  $l'$  of armature-lever  $C''$  until its stud  $n''$ , separating contacts  $e''$  and  $c''$ , breaks the local circuit  $L C$ , common to all the instruments, causing auxiliary magnets  $M M'$  to release their armature-levers  $C C'$ , thus interrupting the line-circuits on lines  $L L'$ , but simultaneously with this breaking of the local circuit the stud  $n''$  completes the independent local circuit  $l c$  of the auxiliary magnet  $M''$ , which is thus kept energized and prevented from releasing its armature-lever  $C''$ . There is, therefore, no break in the main line at the instrument receiving the message, and on closing the key  $K'''$  the relay  $R''$  attracts its armature  $D''$ , breaks the independent local circuit  $l c$ , and re-establishes the local circuit  $L C$ . The breaking of the local circuit also operates sounder  $S$ . When the breaking of the local circuit releases armature-levers  $C$  and  $C'$  they are drawn back by the retractile springs, as shown at  $X' Y'$ , Fig. 1, locking by their latches  $l l'$  the armature-levers  $D D'$ . This they are enabled to do by the agency of the springs  $h h'$ , which do not permit the points  $i i'$  to break contact with  $a a'$  at once, and the relays  $R R'$  thus hold down relay-levers  $D D'$  until armature-levers  $C C'$  are drawn back far enough to lock them. Relay-levers  $D D'$  are thus prevented from completing through their studs  $n n'$  the independent local circuits of magnets  $M M'$ , and from breaking the local circuit, which circuit is therefore only broken at one point.

The operation above described is of course the same whichever line the message may be transmitted over.

It is thus seen that if a signal is received over one line it will be repeated over all the others included with it in the local circuit of the central station and by the sounder of the local circuit.

Should it be desired to transmit over all the lines at once from the central station, this can be done by the operator working key  $K$  of local circuit  $L C$ . This operates all the instruments by making and breaking the local circuit, the operation being precisely the same as in the previous case, with the exception that all of the relay-levers  $D D' D''$  are locked and not allowed to close their independent local circuits or break the local circuit  $L C$ .

The switches 1, 3, and 5 are used to cut out the receivers of any of the instruments—say  $X'$ —by shunting the contact-points  $c e$ , so that in receiving over line  $L$  relay-lever  $D$  of relay  $R$  no longer breaks the local circuit, and in consequence the other instruments are unaffected, while messages sent or received over lines  $L' L''$  will be transmitted over  $L$  as its auxiliary magnet  $M$  is in and operated by the local circuit  $L C$ . Switches 2, 4, and 6 cut the instruments out of the local circuit, in which case they can be used as independent lines.

Fig. 3 shows the normal position of the relay and auxiliary armature-levers  $D$  and  $C$  when the local circuit of the central station

and the circuit of the main line are closed. They are in such relation to each other that the latch  $l$  of armature-lever  $C$  will lock relay-lever  $D$ , or relay-lever  $D$  pass under latch  $l$  and prevent armature-lever  $C$  from being retracted, as shown at  $Z'$ , Fig. 1. The screws  $t$  and  $u$  on armature-lever  $C$  serve to adjust the locking of relay-lever  $D$ , and as independent adjustable back-stops both for levers  $D$  and  $C$ . It is obvious more than three repeating-instruments may be employed.

I claim as my invention—

1. The combination, substantially as herein set forth, of the main lines, their independent relay-armatures, the local circuit, the contact-points in the local circuit, operated by each of the main-line armatures, and a sounder and battery in the local circuit, whereby messages sent over any one of the main lines are repeated on the sounder of the local circuit.

2. The combination, substantially as herein set forth, of the main lines, their relays and armatures, the auxiliary magnets and their armatures, the independent local circuit, and the local circuit with the sounder, key, and battery included therein.

3. The combination, substantially as herein set forth, of the main lines, repeating-instruments, a local circuit, auxiliary magnets included in the local circuit, and an independent local circuit for each auxiliary magnet.

4. The combination, substantially as herein set forth, of the local circuit of the central station, auxiliary magnets, and their independent local circuits.

5. The combination, substantially as herein set forth, of a main line, a local circuit, auxiliary magnets included in such local circuit, their armature-levers, and switches serving to cut the auxiliary magnets out of the local circuit.

6. The combination, substantially as herein set forth, of a main line, a local circuit, auxiliary magnets included in such local circuit, their armature-levers, their independent local circuits, and switches serving to cut the auxiliary magnets out of the local circuit.

7. The combination, substantially as herein set forth, of a local circuit, contact-points, auxiliary magnets included in the local circuit, their independent local circuits, a main line, a relay forming part thereof, and its armature, which serves to make and break both the local circuit and the independent local circuit.

8. The combination, substantially as herein set forth, of the main lines, their relays, their armatures, auxiliary magnets, their independent local circuits, a general local circuit, its contact-points, and switches 1, 3, and 5, whereby the contact-points controlled by the relay-armature of any one line may be shunted out of the general local circuit, so that messages received over that line are not repeated over the others.

9. The combination, substantially as herein set forth, of the local circuit, its contact-points,



the independent local circuit, its contact-points, and the relay-armature, whereby when the relay-armature is free to act one circuit is closed and the other is open, and vice versa.

5 10. The combination, substantially as herein set forth, of the relay-lever, the armature-lever of the auxiliary magnet, and the adjusting-screws *t* and *u*.

10 11. The combination, substantially as herein set forth, of the main line, its contact-point, the armature-lever of the auxiliary magnet, its spring, and contact-point, whereby when the armature-lever is released by the auxiliary magnet the circuit of the main line is not im-

15 mediately broken.

12. The combination, substantially as herein set forth, of the main line, its contact-point, the auxiliary magnet, its armature-lever, spring

and contact-point, the relay and its armature-lever, whereby when the auxiliary magnet re- 20 leases its armature-lever the main-line circuit is not immediately broken nor the relay-armature retracted.

13. The combination, substantially as herein set forth, of the main lines, the repeating-in- 25 struments, the general local circuit, including all the repeating-instruments, and a key in the local circuit, whereby messages may be transmitted over all the lines from the central sta- 30 tion by operating the key in the local circuit.

In testimony whereof I have hereunto subscribed my name.

GEO. F. BALLOU.

Witnesses:

M. S. G. WILDE,

CHAS. A. BERRY.