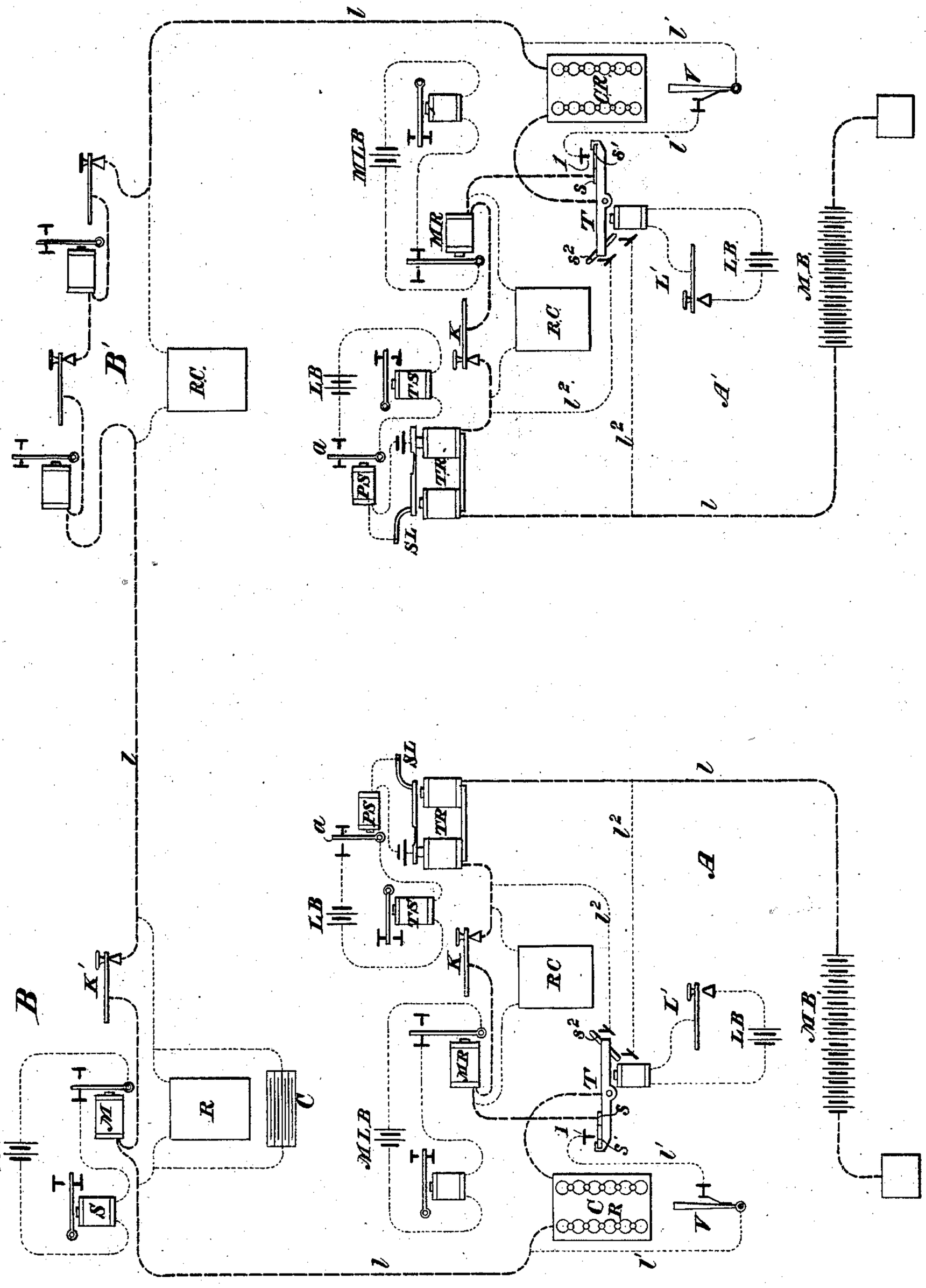
E. GRAY.

Morse Telephonic Telegraphy.

No. 198,738. Patented Jan. 1, 1878.



WITNESSES

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ELISHA GRAY, OF CHICAGO, ILLINOIS.

IMPROVEMENT IN MORSE TELEPHONIC TELEGRAPHY.

Specification forming part of Letters Patent No. **198,738**, dated January 1, 1878; application filed October 29, 1877.

To all whom it may concern:

Be it known that I, ELISHA GRAY, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Multiple Telegraphy, of which the following is a specification:

My invention relates to that class of multiple telegraphs which combines the Morse and the telephonic or electro-harmonic systems in the same circuit, as exemplified in an application for Letters Patent filed by Charles H. Haskins, May 12, 1877, and in Letters Patent No. 198,378, granted to me December 18, 1877.

My patent above mentioned shows a compensating adjustment, to equalize the potential of the electric circuit when the telephonic system is working.

The objects of my present invention are to equalize the potentials of the electric circuit for both the Morse and the telephonic systems; to enable me to work from a battery common to other lines; to secure a better arrangement of the telephonic transmitters in the apparatus; and to improve the arrangement of the Morse apparatus to secure its more efficient working, as hereinafter set forth.

The subject-matter claimed will hereinafter specifically be designated.

The accompanying diagram shows the best way of carrying out my invention now known to me.

A A′ represent two terminal stations, and B B′ intermediate stations, any number of which may be employed.

The general construction of apparatus represented in this diagram is similar to that shown in the application and patent above mentioned, with the exceptions hereinafter named, and need not, therefore, be described in detail here.

As the arrangements of the terminal stations are identical, a description of one will be sufficient. The same remark applies to the intermediate stations.

M B represent a main battery; *l*, the line-wire; T R, the telephonic receiver; P S, the primary sounder; T S, the usual Morse sounder; L B, the local battery; K, a common Morse key; R C, the resistance and condenser; M R, the Morse relay; M L B, Morse local battery; T, the continuity-preserving key of the telephonic transmitter. L′ is an ordinary Morse key, in the same circuit with the local battery L B, which actuates the continuity-preserving key or transmitter T. V is the vibrating reed or telephonic transmitter. C R is a compensating-rheostat, which takes the place of the compensating-battery described in my former patent.

The arrangement upon circuit will readily be understood from the diagram.

One advantage of the arrangement shown is, that many lines may be worked from the same battery without interference, just as the ordinary single-wire Morse is now worked.

Another advantage is, that a compact arrangement of the wires is secured, so that they may be mounted upon a single table, instead of the employment of long wires running to the battery-room, as in the application and patent above mentioned.

In the Morse apparatus, K′ is the key; L B, the local battery; M, the relay, and S the sounder. C represents a condenser, and R a rheostat or resistance-coil.

It will be noted by reference to the diagram that the branch line runs around the relay and key and through the condenser and rheostat, instead of running around the key simply, as in my former patent.

The advantages of this arrangement will hereinafter be specified.

The arrangement of the Morse apparatus, both at the terminal and way stations, is the same as that above described, the condenser being shown as separated or set out from the rheostat at the way-station merely for convenience of illustration.

The following is a description of the preferred method of working my invention.

I will first describe the normal condition of the main circuit when the entire apparatus is at rest.

The line is worked with a closed circuit, as described in my Letters Patent No. 186,343, granted to me January 16, 1877. Starting from the main battery M B the circuit runs through the telephonic receiver T R; thence to the anvil of the Morse key K, which is closed. Before reaching this anvil the circuit divides, passing through the Morse relay, and through the resistance-coil R C, and the two branches

reunite beyond the relay, whence the circuit passes to the spring *s* of the continuity-preserving key, which is insulated from the lever T at the heel of the spring, its free end being in contact with the lever itself.

It is obvious, from the fact that the Morse relay has a resistance of, say, only about one hundred and fifty ohms, while the rheostat R contains a resistance of, say, six thousand ohms, that the amount of current passing through the relay will be much greater than that which passes through the rheostat R. The current will divide according to the well-known law of derived circuits.

From the lever T the current passes through a compensating-rheostat, C R, by which the degree of resistance may be regulated; thence to line, passing through the Morse apparatus at the way-stations, in the manner above described.

With the necessary changes telephonic apparatus may readily be substituted for the Morse apparatus, or put in with it.

The arrangement on circuit is the same at each terminal station.

To send telephonic signals, the telephonic vibrator V is kept constantly running by means of a local battery not shown, but fully described in patents heretofore granted to me, but particularly described in Letters Patent No. 165,728, granted to me July 20, 1875. Telephonic signals are transmitted by operating the key L′, which throws the local battery L B into circuit, and actuates the continuity-preserving key T, the spring *s′* of which comes in contact with the break-point 1, which, at the same time, causes the spring to break contact with the lever, and the current to flow to the line through the break-point, and the current which before flowed from the lever through the compensating-resistance C R to line now flows directly through the vibrating transmitter V to line, as indicated by the light dotted lines *l′*. The heavy dotted lines represent the circuit when the apparatus is at rest, while the light dotted lines represent them as affected by the depression of the key.

The vibratory signals thus transmitted pass from the line through the way-station to the receiver or terminal station, and actuate the telephonic receiver T R, which is turned in unison with the vibrating transmitter V.

When the reed of the receiver is thrown into vibration it works in contact with a pivoted lever, S L, vibrating more slowly than the reed, as explained in Letters Patent No. 165,728, granted to me July 20, 1875, the effect of which is to open the local circuit of the primary sounder P S and its local battery L B, and hold it open as long as the receiver is in vibration, the effect of which is to cause the armature *a* to fall back and throw the local battery L B and telephonic sounder T S into action, and cause it to close and remain closed as long as the vibration of the receiver continues.

When the key L′ of the transmitter is opened the vibration ceases, the lever S L comes to rest, and the circuit is re-established, and the armature *a* is attracted to the primary sounder, breaking connection on its back point with the sounder T S, which allows it to open.

From this it will be obvious that ordinary Morse signals made by the transmitter will be reproduced on the telephonic sounder T S.

In order to prevent the vibrating transmitter from affecting the receiver at its end of the line, a short circuit, l^2, is arranged between the battery and the continuity-preserving key, so as to cut out the receiver T R, an insulated spring, s^2, on the end of the lever T coming in contact with the break-points of this circuit at the proper time, so that the circuit passes around the receiver instead of through it. This arrangement also enables me to break the sender when a repetition is desired, which is done by the operator at the receiving end closing his key for a few moments, and throwing his telephonic transmitter into vibration, so that the first time the sender opens his circuit, and consequently takes off the shunt, the vibrations from the receiving-station pass through the receiver at the sending-station, actuating the sounder, as above described, which is a signal to the sender to pause for the communication desired by the receiver.

If, while messages are being sent by the telephonic apparatus, any station or any one of the Morse keys at any point in the line is opened, there will be an additional resistance thrown into the circuit of about six thousand ohms. Ordinarily this would reduce the vibratory effect, from the fact that the electric potential of the line is diminished thereby.

To obviate this difficulty, as it proves to be on every long line, and keep the vibratory potential up to its normal strength before the Morse key was opened, I connect the two poles of a moderate-sized condenser around the rheostat R.

A diagram of the connection of the condenser with rheostat is shown at the way-station B, which will be readily understood.

The condenser is inclosed in the same box with the rheostat, but is here set out therefrom for convenience of illustration. The effect of the condenser upon the vibrations is as follows: When any Morse key is opened the relay branch is out of circuit, and the only channel left is that through the resistance-coil. The first effect of the resistance is to force the electric current into the condenser, which, of course, induces a corresponding charge on the opposite side or in the opposite half of the condenser, thus causing a static charge analogous to that of the Leyden jar.

Each time the vibrator at the sending-station takes the battery from line the condenser discharges, and each time it puts the battery to line it charges, thus making a series of charges and discharges coinciding in rate per second with that of the motion of the transmitting-vibrator.

By this means the vibratory effect, which would otherwise be lost by the introduction of the resistance, is compensated for in a great measure, so that the operation of any Morse key practically does not effect the vibrations produced by the telephonic signals.

Another advantage of this arrangement of the condenser and rheostat with reference to the key and relay arises from the fact, first, that the relay, when its key is open, is taken wholly out of the circuit, so that the extra current created by the discharge of the magnet is not felt upon the line; and, on the other hand, when the key closes, the combination of relay, resistance, and condenser is such that the sudden jarring effect on the telephonic receivers (produced more or less under the old system described in my former patent of December 18, 1877, No. 198,378,) is practically obviated.

Another advantage arising from this arrangement is as follows: In the old method of working, where the relay was not shunted by the resistance and condenser, there was a tendency, when the telephonic signal was sent, to cause the armature of the Morse relay to jar upon its local contact, especially when working on a high adjustment and a small margin.

This difficulty is entirely obviated by my present arrangement, which is as follows: It will be observed that when the Morse key is closed the condenser is connected around both relay and resistance-coil, so that the condenser is charged (each time the vibrator at the sending-station puts the battery to line) with a power proportionate to the amount of resistance offered by the two branch circuits, one composed of the relay and key, the other of the resistance-coil. Each time the vibrator takes the battery from line the condenser discharges, not throughout the line, but in the short circuit at the way-station.

It will be obvious to any electrician that this discharge will take place through the relay in the same direction that the impulses from the battery previously passed, and that it takes place at a time when the battery is taken from line by the vibrator, thus filling up the gap between the vibrations which would otherwise follow, and causing a smooth solid current to be constantly passing through the Morse relay when its key is closed.

The operation of the Morse relay is substantially the same as that described in my former patent, hereinbefore referred to.

To preserve an even potential on the line when the telephonic system is working, I use the following arrangement: When the telephonic key is closed and the vibrations are passing to line through the vibrator V there is a resistance caused at the break-point 1, which measures, when properly adjusted, about one thousand ohms. To compensate for this, when the key is opened and the vibrations cease, the current passes to line through the compensating-resistance C R.

It will be obvious that if a resistance in C R is unplugged equal to the amount offered by the break-point X of the vibrator the potential of the current on the line will be kept uniform during the working of the telephonic part of the system.

It is obvious that in some cases the condenser and rheostat might be used to shunt several relays and keys on a loop running out from the main line, as shown in the diagram.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, substantially as hereinbefore set forth, with a telephonic transmitting apparatus and a Morse apparatus, of a rheostat which shunts the key and relay of the ordinary Morse apparatus.

2. The combination, substantially as hereinbefore set forth, of two branch circuits in a main line, one embracing a rheostat, the other one or more Morse relays and keys.

3. The combination, substantially as hereinbefore set forth, in one circuit, of telephonic apparatus, Morse apparatus, a rheostat shunting the Morse key and relay, and a condenser which, when the Morse key is closed, shunts both relay and rheostat, and, when opened, shunts the resistance only, whereby an even vibratory current is maintained upon the line.

4. The combination, substantially as hereinbefore set forth, of branch circuits, a key, a relay, a resistance, and a condenser which shunts the key and relay when the key is closed, and the resistance when the key is opened.

5. The combination, substantially as hereinbefore set forth, in a branch circuit, of a relay, a key, and a condenser shunting them.

In testimony whereof I have hereunto subscribed my name.

ELISHA GRAY.

Witnesses:
WM. J. PEYTON,
WM. D. BALDWIN.