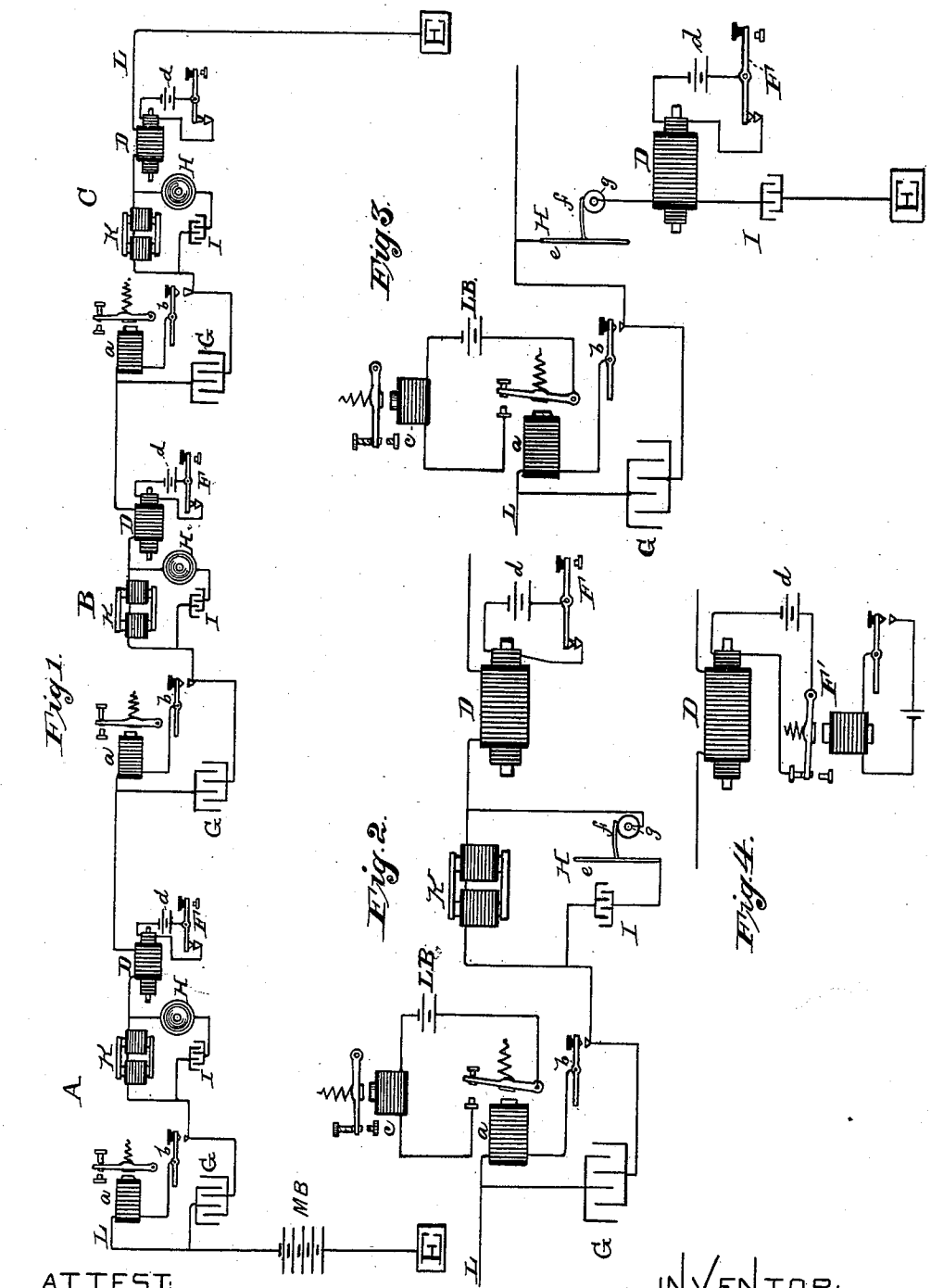
(No Model.)

T. A. EDISON.

TELEGRAPHY.

No. 333,289. Patented Dec. 29, 1885.



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TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 333,289, dated December 29, 1885.

Application filed May 8, 1885. Serial No. 164,856. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Telegraphy, (Case No. 648,) of which the following is a specification.

The object I have in view is to increase the capacity of telegraph-lines in a simple and practical manner by the production of instruments and connections permitting the transmission of two sets of Morse signals back and forth over the line at the same time without interfering one with the other, and not only between terminal offices, but between a terminal office and any intermediate office, or between intermediate offices alone.

The invention is especially applicable to local lines or to lines having several offices upon them, to which it can be applied at small expense, each office upon the line being provided with instruments for transmitting and receiving a second set of signals, and with devices for making the two sets of signals independent, and for insuring against their interference. Not only is the capacity of the telegraph-lines doubled, but the delays occasioned on lines with several offices by the interfering of two or more operators in their attempts to gain possession of the line are diminished.

In the accompanying drawings, forming a part hereof, Figure 1 is a view in diagram of a line with three offices embodying my invention; Fig. 2, a view on a larger scale of the apparatus for one office; Fig. 3, a view of the apparatus for one office, with a modified arrangement of parts; and Fig. 4, a view of a further modification.

Like letters denote corresponding parts in all the figures.

The line L L is grounded at its ends, and has the usual main battery, M B. The three offices A B C have each the ordinary set of Morse instruments, of which are shown in Fig. 1 the relay *a* and key *b*. In Figs. 2 and 3 the Morse sounders *c* and local batteries L B are shown. With these ordinary Morse instruments telegraphing is carried on by Morse signals in the usual way.

At each office is a device working independent of the main battery and acting to induce in the line impulses of high tension. This device is composed of an induction-coil, D, the secondary circuit of which may be located directly in line, as shown in Figs. 1 and 2. The primary circuit of this coil includes a battery, *d*, and a back-point key, F; or, in place of key F, a back-point sounder, F′, worked by a key and local battery, may be used, as shown in Fig. 4.

The ordinary Morse key, *b*, is shunted by a condenser, G, so that the line will be always closed for the induced currents. This condenser, also, preferably shunts the relay, for a purpose that will be presently set forth. To receive these induced currents there is provided at each office a diaphragm-sounder, H′, which is preferably, as shown in Figs. 2 and 3, constructed upon the principle of the electro-motograph, a diaphragm, *e*, being kept under tension by a spring, *f*, held by friction upon a revolving chalk cylinder, *g*. The chalk cylinder is rotated continually by a motor, electric or mechanical, and the circuit is closed through the spring and cylinder. This construction of instrument is a well-known telephone receiver of my invention, and hence does not require further description here.

For my diaphragm-sounder a magneto-electric telephone or other form of telephone-receiver may be used. The diaphragm-sounder at each office is preferably located in circuit with a condenser, I, and this circuit is preferably a shunt around a resistance located in the line, as shown in Figs. 1 and 2, which resistance is preferably an electro-magnet, K. The circuit at each office, including diaphragm-sounder H and condenser I, instead of being a shunt around a magnet in line, may be a grounded earth-connection or "leak to earth," as shown in Fig. 3, and the secondary circuit of the induction-coil D, instead of being directly in line, may be in a condenser-circuit, whether that circuit is a shunt around a magnet in line or a leak to earth. By the manipulation of keys F (or the working of sounders F′) signals are thrown upon the line in the form of momentary and sharply-defined waves, which are responded to only by the diaphragm-sounders, the regular Morse relays not acting quick enough to respond to these waves. The regular Morse keys being shunted by condensers, the line is always closed to the

high-tension induced currents, and since such condensers have what is equivalent to a low resistance on the instant of closing circuit, it will be seen that a free path is always provided for the momentary impulses of induction. By extending these condenser-shunts to include the relays as well as the keys a desirable result is obtained, in that the counter electro motive force set up by the relay-magnet effectively stops the passage of the induced impulses by way of the key and relay, and makes the condenser-circuit practically the only one closed to these impulses. The effect of this action is to make the induction-circuit of practically the same resistance, whether the regular Morse keys are open or closed. An additional advantage flows from the fact that the induced impulses are not absorbed by the relays, and the induction-signals are made more distinct for that reason. The condenser-shunts are, however, practically open circuits for the quantity-currents used to operate the relays for the regular Morse signals, the condensers becoming fully charged and of very high resistance in less time than is required for the relays to act.

By locating the diaphragm-sounders in the circuit of condensers I such sounders are not affected to the extent of a disturbance of signals by the regular line quantity-currents. To obtain this result, however, even with the diaphragm-sounders in condenser-circuits, I have found that the capacity of the condensers must be definitely fixed. It has been ascertained by me that the loudness of sound in the diaphragm-sounder is within certain limits quite independent of the capacity of the condenser I, while the disturbing effect of the regular Morse signals in the diaphragm-sounder increases with the capacity of such condenser I; hence I reduce the capacity of that condenser below the point of disturbance by the regular Morse signals. On the other hand, I find that the disturbing effect of the regular Morse signals on the diaphragm-sounders is diminished as the capacity of the condenser G around the keys and relays is increased; hence I make these condensers G of large capacity—say several microfarads each—while condensers I have a small capacity—say a fractional part of a microfarad each.

When each diaphragm-sounder and its condenser are located in a shunt around a resistance in the form of a magnet, K, in line, the reverse action of the condenser and magnet will make the condenser-shunt the only path practically closed to the induced currents and the line the only path closed to the regular quantity-line currents, as before explained, with respect to the relation of condensers G and the Morse relays.

The induced impulses thrown by the induction coil D upon the line are produced by a source of energy (the batteay *d*) independent of the main batteries. These impulses are practically the same whether the regular Morse keys are open or closed. By arranging the key F so that the downstroke will open the primary circuit and the upstroke will close that circuit the signal for the downstroke of the key will be louder than for the upstroke, since when the primary circuit is closed it absorbs to a certain extent the induction, and the impulse in secondary is weaker than when the primary is opened. The back-point sounder, worked by key and local battery, operates the same way. This difference in the down and up strokes of key is an important one, since if the two signals required to mark the interval of time denoting a dot or dash were the same the receiving-operator might be frequently confused by mistaking the last signal of a dot or dash for the first signal of the next succeeding dot or dash, and get what is called in telegrapher's parlance the "back-stroke."

The instrument and devices described make a complete system of Morse telegraphy, whereby over one line may be transmitted back and forth two sets of Morse signals produced by different sources of energy independent of each other as to loudness, and also as to interference in the receiving-instruments.

What I claim is—

1. In telegraphs, the combination, with two or more sets of Morse telegraph-instruments, consisting each of an ordinary relay and a signaling-key, a source of electrical energy for operating the same, and shunt-circuits to keep the line constantly closed at the signaling-keys, of two or more other sets of telegraph-instruments, each composed of a Morse signal-transmitter having a separate source of electrical energy and throwing momentary and sharply-defined impulses upon the line, and a diaphragm-sounder responding to such momentary impulses, whereby two sets of Morse signals can be transmitted and received simultaneously without interference, substantially as set forth.

2. In telegraphs, the combination, with two or more sets of Morse telegraph-instruments, consisting each of an ordinary relay and a signaling-key, a source of electrical energy for operating the same, and shunt-circuits to keep the line constantly closed at the signaling-keys, of two or more other sets of telegraph-instruments, each composed of a Morse signal-transmitter having a separate source of electrical energy and throwing momentary and sharply-defined impulses upon the line, and a diaphragm-sounder responding to such momentary impulses and located in a shunt from the line, whereby two sets of Morse signals can be transmitted and received simultaneously without interference, substantially as set forth.

3. In telegraphs, the combination, with a telegraph-line, Morse telegraph-instruments, consisting of relays and signaling-keys, and a source of electrical energy for operating the same, of an induction-coil having its secondary circuit in connection with line, a separate source of electrical energy, and a Morse sig-

nal-transmitting device in the primary circuit of such coil, and a diaphragm-sounder responding to the induction impulses, substantially as set forth.

4. In a system of Morse telegraphy, the combination, with a telegraph-line and Morse instruments, of a diaphragm-sounder and a signal-transmitter transmitting momentary and sharply-defined waves producing alternately varying signals at the diaphragm-sounder, substantially as set forth,

5. In a system of Morse telegraphy, the combination, for the transmission and reception of Morse signals, of a telegraph-line, an induction-coil having secondary connected with the line, a Morse signal-transmitter in primary producing alternately-varying signals in secondary, and a diaphragm-sounder receiving the induced impulses, substantially as set forth.

6. The combination, with a telegraph-line, Morse telegraph-instruments, and a source of electrical energy for operating the same, of an induction-coil having secondary connected with the line, a Morse signal-transmitter in primary producing alternately-varying signals in secondary, and a diaphragm-sounder receiving the induced impulses, substantially as set forth.

7. The combination, with a telegraph-line, of a diaphragm-sounder responding to induced impulses, a transmitting induction-coil having secondary connected with line, a battery in primary circuit, and a key controlling said primary circuit, said key being arranged to open the primary circuit on the down-stroke, substantially as set forth.

8. In telegraphs, the combination, with two or more sets of Morse telegraph-instruments, consisting each of an ordinary relay and a signaling-key, a source of electrical energy for operating the same, and shunt-circuits to keep the line constantly closed at the signaling-keys, of two or more other sets of telegraph-instruments, each composed of a Morse signal-transmitter having a separate source of electrical energy, and throwing momentary and sharply-defined impulses upon the line, and a diaphragm-sounder responding to such momentary impulses, and located in a condenser-circuit connected with such line, whereby two sets of Morse signals can be transmitted and received simultaneously without interference, substantially as set forth.

9, The combination, with a telegraph-line and Morse telegraph-instruments, of condensers located in shunts around the Morse keys, and diaphragm-sounders connected in condenser-circuits with said line, the key-condensers being of greater capacity than the sounder-condensers, and the relative capacity of the condensers being such that the disturbance of the diaphragm-sounders by the regular Morse signals is prevented, substantially as set forth.

10. The combination, with a telegraph-line, of a diaphragm-sounder receiving Morse signals produced by momentary and sharply-defined waves, resistance in line around which said diaphragm-sounder is shunted, and a condenser in said shunt-circuit, substantially as set forth.

11. The combination, with a telegraph-line, of a diaphragm-sounder receiving Morse signals produced by momentary and sharply-defined waves, an electro-magnet resistance in line around which said diaphragm-sounder is shunted, and a condenser in said shunt-circuit, substantially as set forth.

12. The combination, with a telegraph-line, of a number of sets of instruments directly in the line-circuit, each set consisting of an ordinary relay and signaling-key, and a condenser shunting both the relay and key, and several sets of other and independent instruments connected with or in said line, consisting of a transmitting device for sending momentary and sharply-defined waves, a diaphragm-sounder shunted around a resistance or magnet in the line, and a condenser in said shunt-circuit, substantially as set forth.

This specification signed and witnessed this 27th day of April, 1885.

THOS. A. EDISON.

Witnesses:
A. W. KIDDLE,
E. C. ROWLAND.