2 Sheets—Sheet 1.

G. SMITH.

Duplex-Telegraphs.

No. 199,869. Patented Jan. 29, 1878.

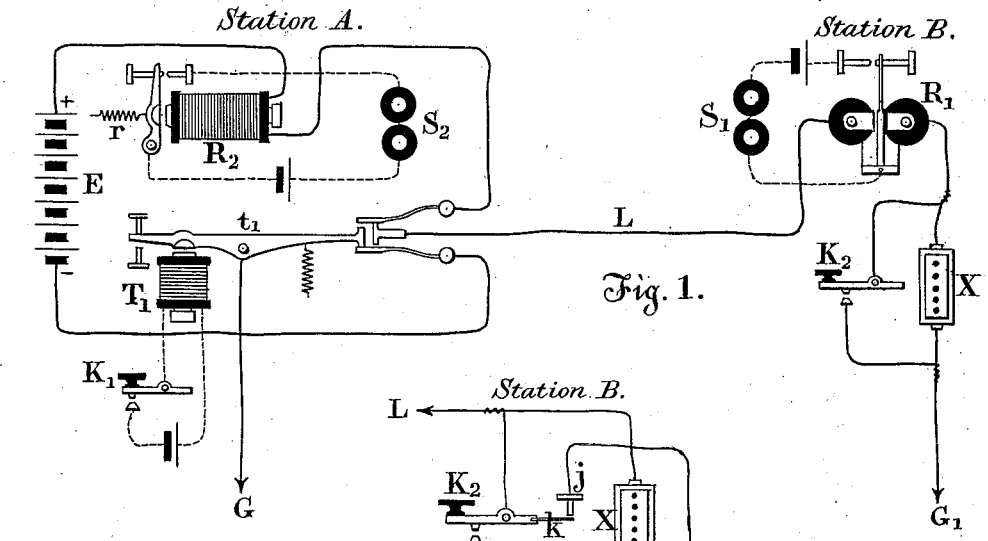

Fig. 1.

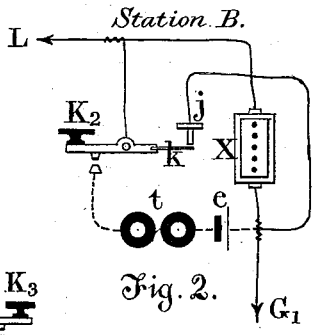

Fig. 2.

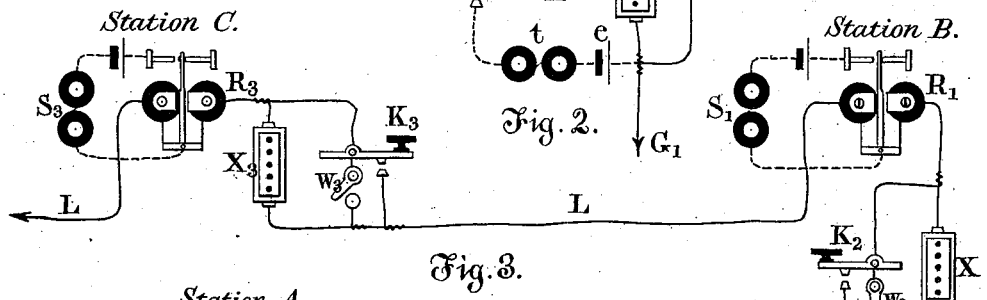

Fig. 3.

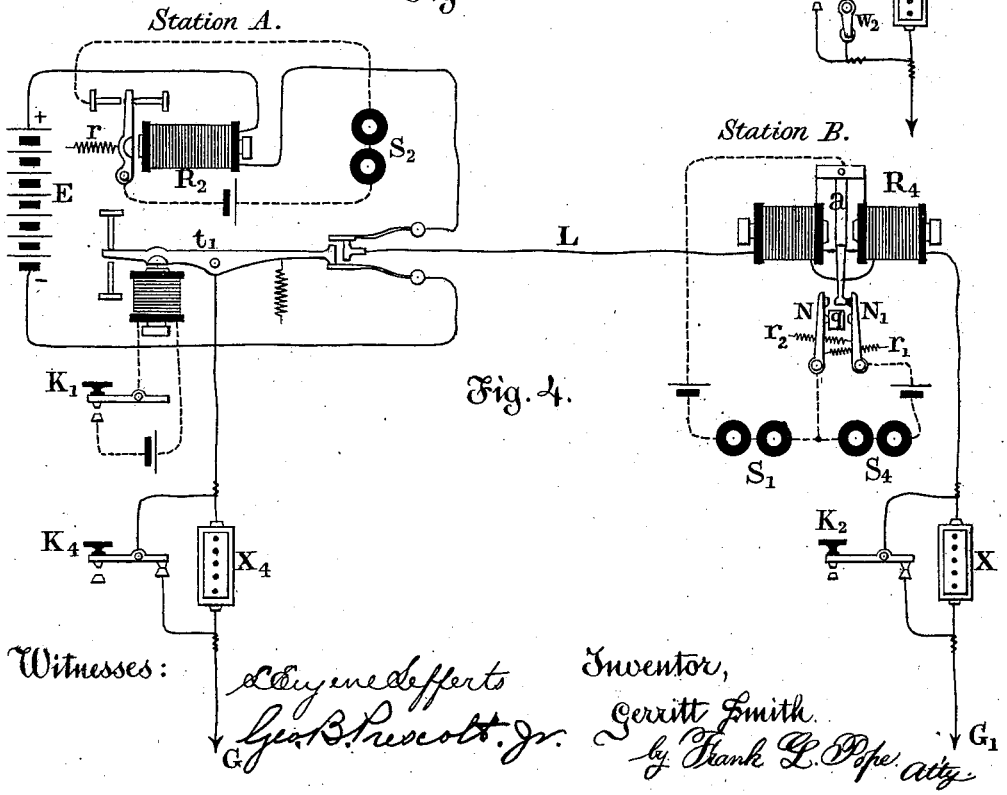

Fig. 4.

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by Frank L. Pope. atty.

2 Sheets—Sheet 2.

G. SMITH.

Duplex-Telegraphs.

No. 199,869. Patented Jan. 29, 1878.

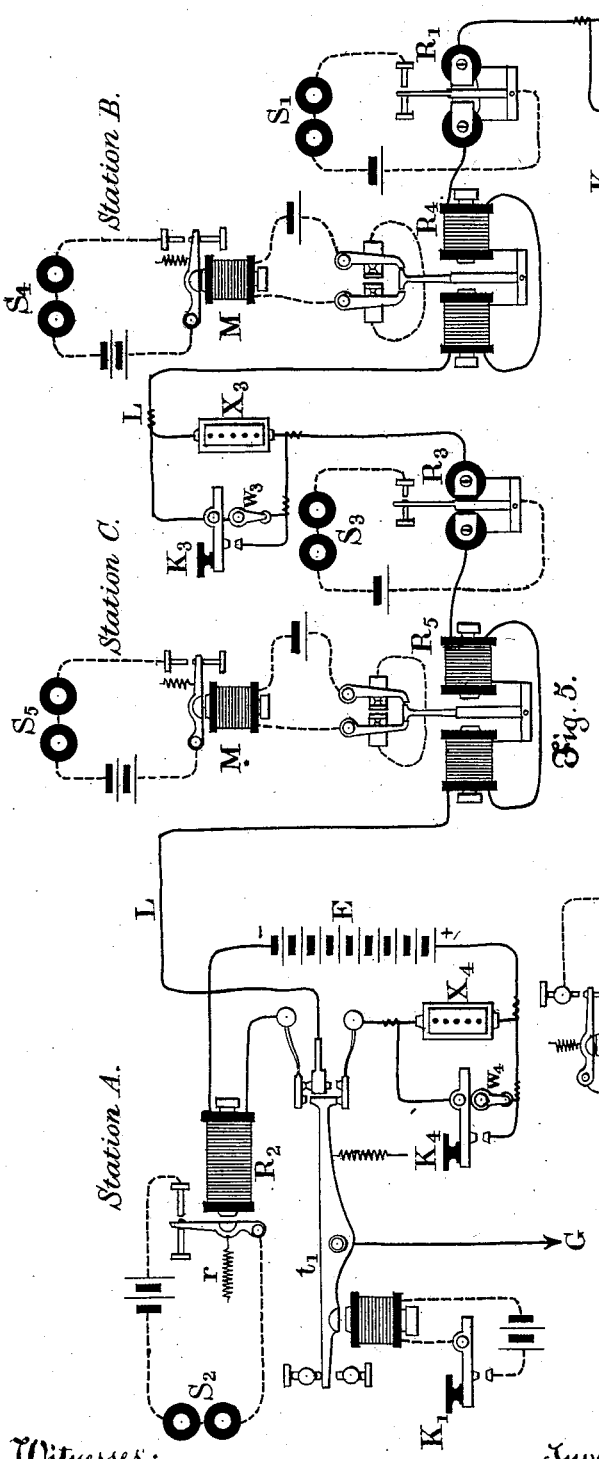

Fig. 5.

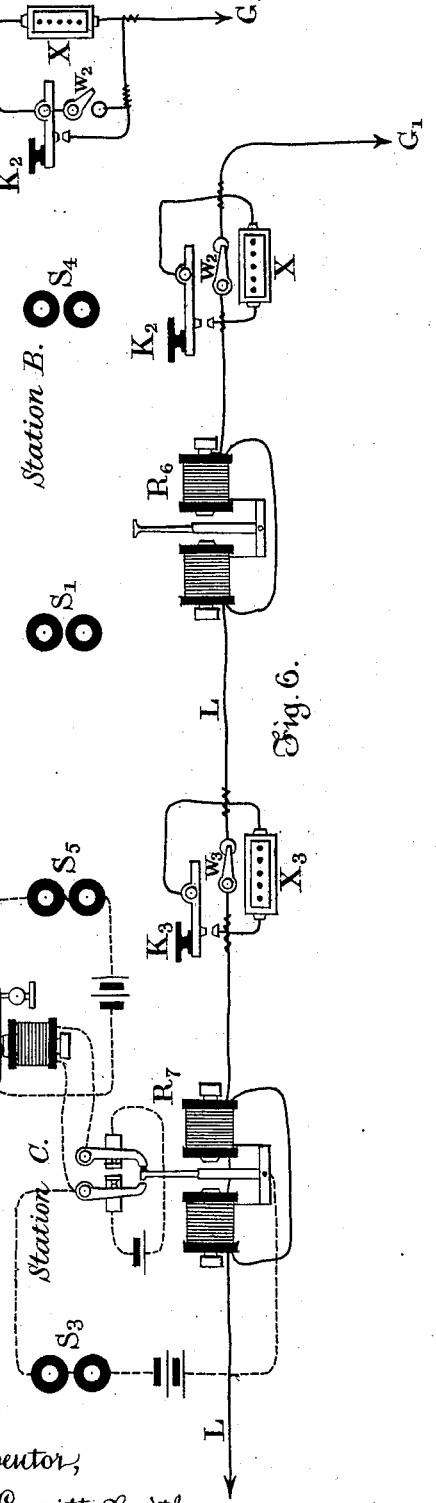

Fig. 6.

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UNITED STATES PATENT OFFICE.

GERRITT SMITH, OF ASTORIA, NEW YORK, ASSIGNOR TO GEORGE B. PRESCOTT, OF NEW YORK, N. Y., AND THE WESTERN UNION TELEGRAPH COMPANY.

IMPROVEMENT IN DUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **199,869**, dated January 29, 1878; application filed April 14, 1877.

To all whom it may concern:

Be it known that I, GERRITT SMITH, of Astoria, in the county of Queens and State of New York, have invented certain new and useful Improvements in Duplex Telegraphs, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

My invention relates to that class of duplex telegraphs by means of which two separate communications are made to traverse the same wire at the same time, one series of signals being transmitted by changing the polarity of a continuous current, and the other series of signals by changing the strength of the same current; and my improvements consist in the combination, in a duplex telegraph, of a pole-changing transmitter, a battery, and a receiving-instrument which responds to changes in the strength of the current, and is placed between the transmitter and the battery, with one or more transmitters which act by increasing and decreasing the strength of the current without interrupting the main circuit, and one or more receiving-instruments which respond to changes in the polarity of the current without reference to its strength, and in attaching a local circuit and a sounding or recording instrument to the key which transmits signals by opening and closing a shunt which passes around a rheostat included in the main circuit.

In the accompanying drawings, Figure 1 is a diagram showing the application of my invention to the simultaneous transmission of two communications in opposite directions over the same wire. Fig. 2 shows the method of connecting a local circuit and sounder to the key or transmitter at one end of the line. Fig. 3 shows one mode of arranging an intermediate station for simultaneous correspondence with the terminal stations. Fig. 4 shows a modification of my invention, by which two communications may be transmitted simultaneously, either in the same direction or in opposite directions; and Figs. 5 and 6 show the same arrangement in connection with intermediate stations.

Referring to Fig. 1, t, is the lever of a double-current or pole-changing transmitter, which is operated by an electro-magnet, T, local battery, and key K_1. The office of this transmitter is to reverse the poles of the main battery E with respect to the line L and the ground G each time that the key K_1 is depressed by the operator at station A.

The construction and operation of this transmitter are fully described in my former patent, No. 189,276, dated April 3, 1877, to which reference is had.

At station B a receiving-instrument, R_1, having a polarized armature, is placed in the circuit of the line, and, in consequence of the polarity of its armature, will respond to each reversal of the current upon the line produced by the movements of the double-current transmitter t, and will open and close the local circuit of the sounder S_1, giving signals corresponding to the movements of the key K_1.

The line at station B, after passing through the receiving-instrument R_1, is conducted to the earth at G. A rheostat, X, is inserted, preferably, between the receiving-instrument R_1 and the earth, the resistance of which may be, say, from twice to four times as great as that of the line. A key, K_2, is connected with the line in such a manner as to shunt the rheostat X by a circuit of practically no resistance each time it is depressed. At station A a receiving-instrument, R_2, which may be provided with a neutral armature and an adjustable spring, r, is placed in one of the wires leading from the battery E to the double-current transmitter.

The armature of the receiving-instrument R_2 opens and closes the local circuit of the sounding or recording instrument S_2 in the ordinary manner.

The retracting-spring r of the receiving-instrument R_2 should be strained up to a sufficient tension to withstand the attraction of the electro-magnet when the rheostat X is in circuit at the other station, while it will be easily overcome by the increased force of the line-current which results from the shunting of the rheostat X, and the consequent removal of its resistance from the circuit whenever the key K_2 is depressed.

By placing the receiving-instrument R_2 in one of the wires leading from the battery to

the pole-changing transmitter t_1, the direction or polarity of the current traversing its coils is never changed, and consequently its armature has no tendency to fall off when the current is reversed upon the line.

In order that the operator at station B may be able to hear his own signals, it is preferred to arrange the apparatus at that station in the manner shown in Fig. 2. The key K_2 is provided with a spring contact-arm, *k*, which, when the key is depressed, is brought in contact with the stop *j*, thus shunting the rheostat X and giving the signal at station A, in the manner hereinbefore described. The ordinary contact-point of the key at, or nearly at, the same time strikes upon its anvil, and closes the circuit of the local battery *e* through the sounder *t*, and thus duplicates the signal sent to the other station.

In Fig. 3, I have shown a simple method of arranging the apparatus at a way or intermediate station, (designated in the drawing as station C.) The apparatus at station A is not shown in this figure, but is precisely the same as in Fig. 1. The only change in the apparatus at station B is the addition of a switch or button, w_2, by which the rheostat X is cut out of circuit when the operator at that station is not using the line, precisely as in the case of the ordinary closed Morse circuit. Station C is arranged precisely like station B, with a switch, w_3.

In the diagram, the operator at station C is supposed to be transmitting to station A. Each time he depresses his key K_3 a signal is given by the relay R_2 and sounder S_2 at station A, while at the same time station A may transmit by means of key K_1, and the signals may be read from sounder S_1 at station B, and also from sounder S_3 at station C.

It is obvious that any required number of receiving-instruments similar to R_1 and R_3 may be placed in the circuit of the line L L, all of which will simultaneously respond to the signals given by the key K_1 and transmitter t_1.

Fig. 4 shows a modification of my invention, which is so arranged as to be capable of either transmitting two communications simultaneously from A to B, or one in each direction, at pleasure.

If the keys K_1 and K_4 are operated at the same time, the former will control the polarity and the latter the strength of the current going to line from the battery E.

At station B, I make use of a receiving-instrument the construction of which has been fully described in my former patent, No. 189,276, dated April 3, 1877, to which reference is had.

The polarized armature *a* plays between two contact-levers, N and N_1, which are held against the stop *q* by springs $r_1 r_2$, these springs being strained up to a tension sufficient to resist the electro-magnetic action of the weak current, which traverses the line when the rheostat X_4 is put in circuit by the depression of the key K_4, but which will readily be overcome by the stronger current, which passes when the said rheostat is cut out.

Under these circumstances it will be readily understood that the sounding or recording instrument S_1 will respond each time the key K_1 is depressed, while in like manner the sounding or recording instrument S_4 will respond each time the key K_4 is depressed.

In order to transmit communications in opposite directions at the same time, the operator at station A will use the key K, and the operator at station B the key K_2. In this case the latter operator will hear his own signals upon the sounder S_4, and those of the distant operator upon the sounder S_1.

Fig. 5 is a modification and extension of the system as shown in Figs. 3 and 4. The only change in the apparatus already described, beyond the mere duplication of devices, consists in the introduction of local relays M M between the receiving-instruments R_4 R_5 and their respective sounders S_4 and S_5 at stations B and C. The local relay, when arranged in this manner, is a well-known device for reversing the signals of the relay, in order that they may appear correctly upon the sounder.

When the apparatus is constructed and arranged as in Fig. 5, the operation may be briefly summed up as follows: When key K_1 is operated, sounders S_1 and S_3 will respond. When either K_2, K_3, or K_4 is operated, by first opening the switch attached, sounders S_2, S_4, and S_5 will respond. It will therefore be readily understood that the following results may be obtained: First, station A may send a message to C, and C at the same time send one to A, both of which may be read at B; second, A may send a message to B, and B at the same time send one to A, both of which may be read at C; third, A may send a message to C, and at the same time B may send one to A, which latter may also be read at C; fourth, A may send a message to B, and at the same time C may send one to A, which latter may also be read at B; fifth, A and C may simultaneously send messages to B, the latter of which may be read at A; also, sixth, A and B may simultaneously send messages to C, the latter of which may be read at A; seventh, A may send messages to B and C at the same time; eighth, A may send two messages simultaneously to B, both of which may be read at C; ninth, A may send two messages simultaneously to C, both of which may be read at B; tenth, B and C can work together singly, precisely as in the ordinary closed-circuit Morse system; and, eleventh, when it is not required to work duplex, A can signal B or C with either of his two keys. This arrangement may be modified by the insertion of main batteries at stations B and C, thereby still further adding to the practical utility of the system.

All the results which have been described are accomplished by means of a single main battery, E, placed at one terminal station, A.

Fig. 6 is a modification of the arrangement shown in Fig. 5. No change is made at station A; but at stations B and C the two sounders are both connected with one and the same receiving-instrument, instead of two separate receiving-instruments, as in Fig. 5. The manner in which the local connections are arranged to accomplish this result is fully set forth in my former patent, No. 189,276, dated April 3, 1877, to which reference is had. The local connections at station B are precisely the same as at station C, but are omitted to avoid confusion of lines in the drawing.

I claim as my invention—

1. In a duplex telegraph, a pole-changing key or transmitter, a battery, and a receiving-instrument so constructed as to respond to changes in the strength of the main-line current, (said receiving-instrument being placed between the transmitter and the battery,) in combination with one or more keys or transmitters so constructed as to transmit signals by increasing and decreasing the strength of current upon the line without interrupting the circuit, and one or more receiving-instruments so constructed as to respond to changes in the polarity of the current irrespective of its strength.

2. A rheostat in the main-line circuit and a key which transmits signals by breaking and closing a shunt passing around said rheostat, in combination with a sounding or recording instrument and a local battery, the circuit of which is opened and closed by the movements of the key when transmitting signals upon the main line.

In witness whereof I have hereunto set my hand this 19th day of March, A. D. 1877.

GERRITT SMITH.

Witnesses:

GEORGE A. HAMILTON,

WILLIAM ARNOUX.