

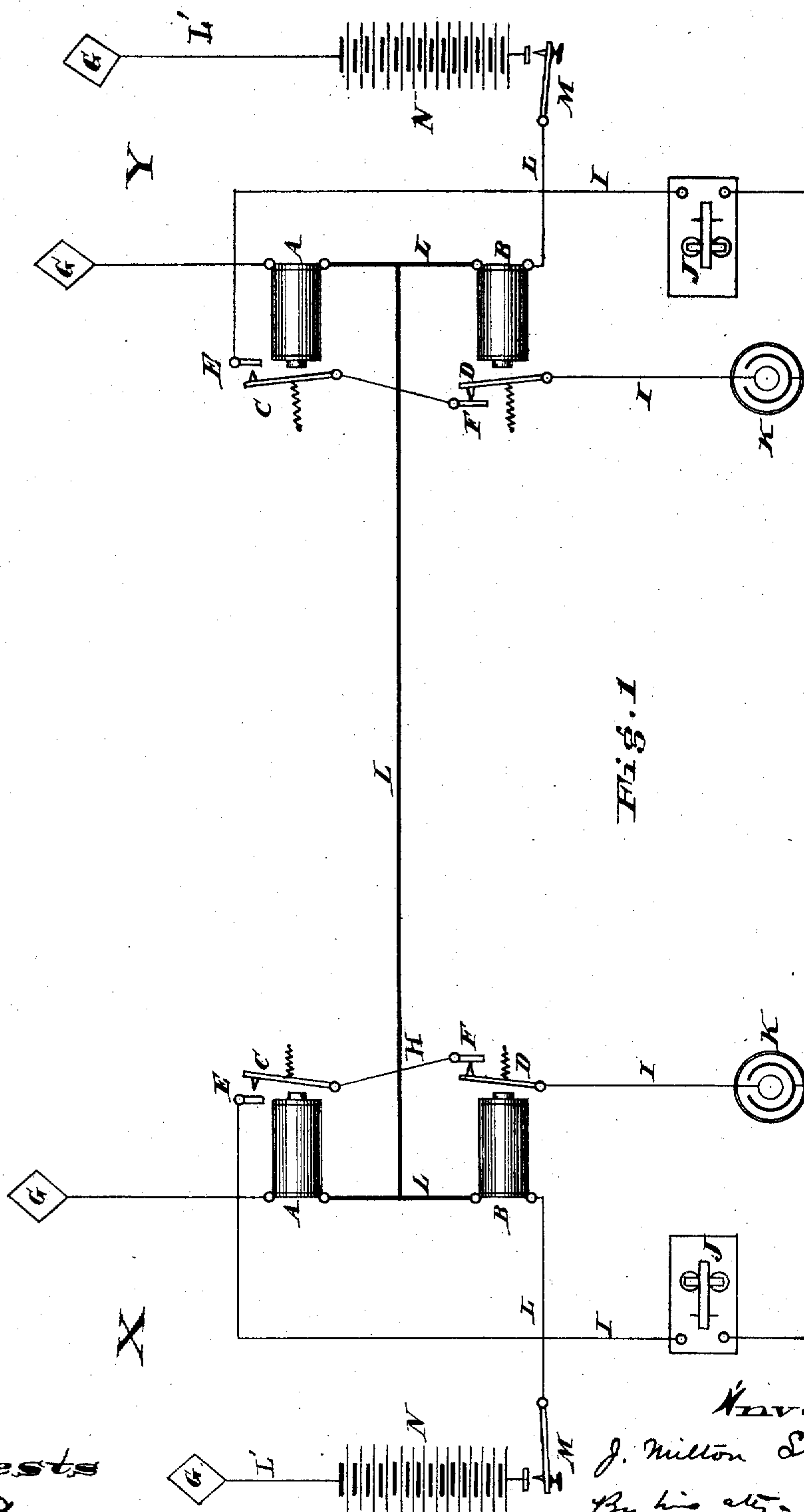
(No Model.)

2 Sheets—Sheet 1.

J. M. STEARNS, Jr.  
Duplex Telegraph.

No. 243,410.

Patented June 28, 1881.



Attests  
David  
S. L. Minter

Inventor  
J. Milton Stearns Jr.  
By his atty.  
*[Signature]*

(No Model.)

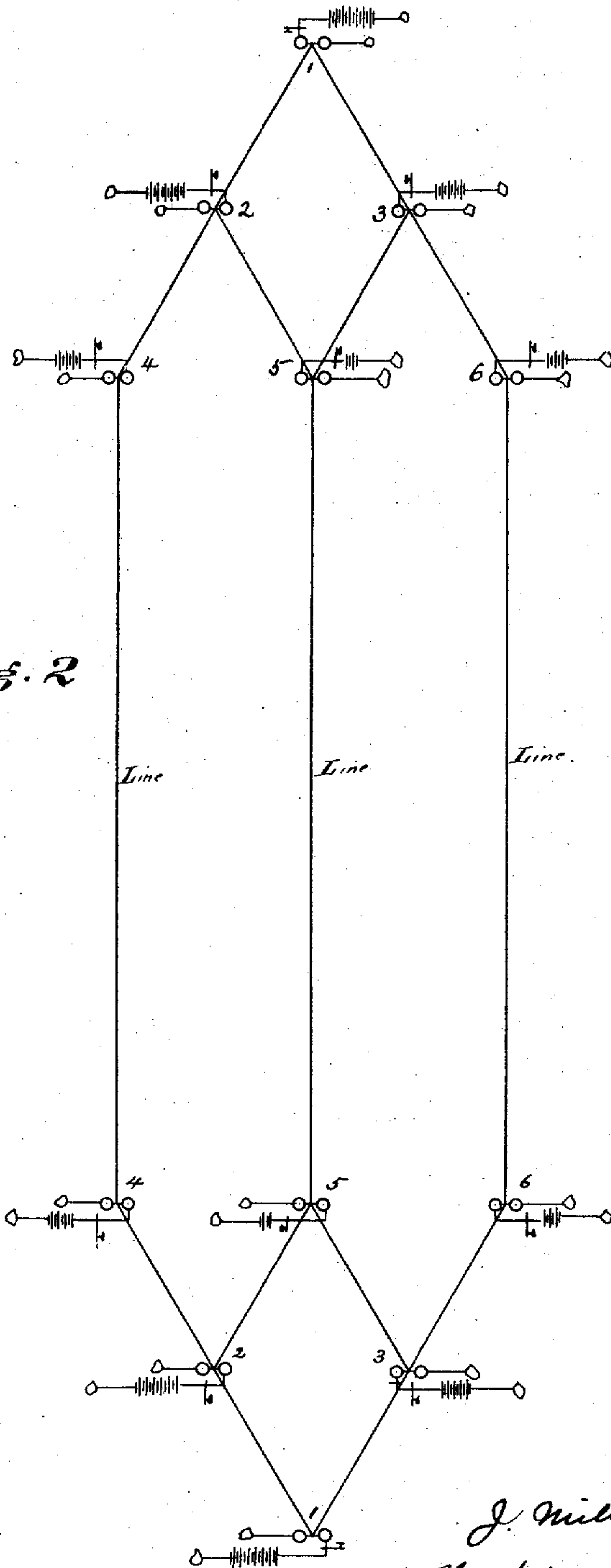
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*Fig. 2*



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*for J. M. Stearns Jr.*

*Inventor*  
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*By his atty-*  
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# UNITED STATES PATENT OFFICE.

J. MILTON STEARNS, JR., OF BROOKLYN, NEW YORK.

## DUPLEX TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 243,410, dated June 28, 1881.

Application filed December 30, 1880. (No model.)

*To all whom it may concern:*

Be it known that I, J. MILTON STEARNS, JR., of the city of Brooklyn, in the county of Kings and State of New York, have invented an Improvement in Telegraphy, of which the following is a specification.

My invention relates particularly to what is known as "duplex telegraphing" or transmitting messages both ways at the same time on one wire or single electric circuit; but it also has reference to multiplex telegraphing and optional transmission, or ability at one extremity of a single wire to signal and transmit to any one of many lines or circuits which may be connected to or at the other extremity of said single wire, or work on the same principle at the said point of junction or extremity of said single wire any particular electro-magnet.

The object of my invention is to utilize for the specific purposes specified the common instruments now in use, and to save time and expense; and the novelty consists in duplex telegraph and multiplex telegraph set up with common instruments in use, and a duplex perfectly adapted for local stations at will without interfering with the ordinary instruments, all of which tend to cheapen telegraph intercourse.

In the drawings, Figure 1 is a plan of my invention adapted to duplex telegraphing. Fig. 2 is a diagram of arrangement in which the system shown in Fig. 1 is adapted to the transmission of twelve messages over three wires.

Each of the pairs of relays in the multiplex system controls a local circuit and sounder, (not shown in Fig. 2,) as in the case of the duplex shown in Fig. 1, and operates in precisely the same way, one of said relays having a forward contact and the other a back contact.

Let there be two terminal stations, X Y, connected by a single wire or conductor, L, over which it is desired to establish a duplex system of telegraphy. At each of said stations is provided a line-battery, N, sufficient to work the line in the usual manner. Each of said stations is provided with two relays, A and B, key, M, local battery K, and sounder J. One of such relays, A, so provided is what is called a "forward-contact relay," making contact for a local circuit when its armature is attracted

toward its poles. The other of such relays, B, is what is known as a "back-contact relay," or making contact for a local circuit when its armature is from or not attracted toward its poles. The line-battery N of the station being properly set up and connected in series, either pole may be, but for convenience of description I will say its zinc pole is, connected to the earth by wire L', either direct or with the common connection for earth of other instruments. The copper pole of said battery is connected to the anvil of an ordinary telegraph-key, M, and the key is connected to one of the terminals or screw-cups of the back-contact relay B. The remaining screw-cup or terminal of said back-contact relay is connected to one terminal of screw-cup of the forward-contact relay A, and the other terminal or screw-cup of said forward-contact relay is connected to earth at G through such resistance as may be required, according to the length and character of the line. On short lines none is necessary. The line-wire L is connected to the conductor joining the two relays, or between said relays at any point. The sounder J on one screw-cup or terminal is connected to the local battery K by wire I on one side direct. The other connection from the other terminal or screw-cup of said sounder passes through both the forward and back contact-points of the said respective relays to the other side of said local battery.

The apparatus of the other station, Y, is arranged precisely like the one above described, and the line-wire connected in the same relative place—to wit, between the two relays of such station.

The operation is as follows: The apparatus being arranged as specified, each main battery N having zinc poles to ground, and both keys M being open, no currents of any kind traverse the line or apparatus. Now close the key M at X station. Both relays A B at X station draw up their armatures, and the current from battery N, passing through the key M, passes through both relays A B to the ground G beyond. It will now be seen that, as the local contact F D of the back-contact relay B is drawn apart or broken before the front contact E C of the same local current or circuit is made, the local circuit is never formed



through the sounder J, and consequently it remains silent, no matter how violently the key be worked; but a part of the current passes down the line L to station Y from the divide between the two relays A B. At Y key M is supposed to be open. Its only path is through the forward-contact relay A at Y station to earth G. This causes that relay to operate its contact-points E C, and as the back-contact relay B has no magnetism or current in it, the other contact, F D, of the local circuit at Y is already made, and the full local circuit being made on the forward-contact relay A, the armature of Y sounder J is drawn up and instantly responds to X key. Thus we see that operating X key keeps its own sounder still, while the other or Y sounder responds, and this with Y key open. Now shut Y key. This draws up both its relays A B, the forward and back contacts, and its own sounder or local circuit is not formed, for the reasons stated in relation to the arrangement before. The operation of the sending-key at X station opposes the battery-current in the back-contact relay B at Y station and demagnetizes it. It falls on and off with the operation of the sending-key M and works the sounder J, since the front contact on the other relay, A, remains drawn up. Hence it appears that working X key causes Y sounder to go whether Y key is open or shut. If keys at both stations were both shut at exactly the same instant of time, it is obvious that the opposed currents would cause the back-contact relays to remain demagnetized. The forward-contact relays would draw up and the sounders would both respond—that is, they would attract their armatures and produce a sound. Suppose we are sending to opposite station, its key being closed—that is, we are working its sounder with the back-contact relay-points thrown off. Now let the opposite or Y station suddenly open its key while the levers of the back-contact relay B are just beginning to move back to make signal. It is obvious that the only effect will be to hasten the back-contact relay on its journey, there now being no current at all in it. As the forward-contact relay A is not in action at all, opening the key will cause it to fall back, provided the key at the other Y station is open. If shut, no effect or motion is produced. If the other key is open, the resultant effect of the two is to break the sounder or local circuit, as it ought to be, when the opposite key is open, and the break is a point, not a line, as in the case of the make.

It is impossible to contrive any shifting of the keys that would cause the sounders to trip over each other, since in every position they seem to help each other out. Suppose key at Y station is being shut, and before that current has time to draw up the relays at home or complete the signal at the other station the other key at X station is suddenly closed, a false signal would not be made. The position is one that would not occur probably once

in a week; but still it is a possible position. The closing of one key draws up the relays at home and the forward-contact relay at the distant station. Now, while the relay-levers are in transition, in that infinitesimal period of time the other key is suddenly shut. The effect will be to throw the back-contact relay back and help draw up the front contact, and the signal is made by the responding of the sounder. In short, the sudden closing of the opposite key merely helps a signal in transition to completion in a shorter time, but with no change of form.

To adapt my invention to multiplex telegraphy I merely couple up the apparatus shown in Fig. 1 with one or more sets of the same kind as shown in Fig. 2, in which there are six sending-keys at each station and three main or line wires. The working of the whole simply depends on keeping the relay-springs adjusted, as the batteries of each key at one station are of different powers. The actual line-wire of keys 1 is really the three line-wires. The actual lines of keys 2 and 3 are really two of the line-wires, and of keys 4, 5, and 6 only one of the line-wires. Any number of keys may be arranged in such an apparatus, adding such additional main or line wires as become necessary; but it is evident that there are enormous facilities to be had by such an apparatus, for with twelve line-wires one hundred and fifty-six messages may be transmitted over the wires at the same instant.

I do not confine myself to any particular arrangement of wires, relays, sounders, &c., since my invention has reference, broadly, to duplex and multiplex telegraphy and repeaters when arranged for use with front and back contact relays, and without the use of any auxiliary complicated mechanism, as heretofore used.

I am aware of Thompson's patent, No. 195,055, for quadruplex telegraph, of 1877; but it works on an entirely different principle from that herein described, and I claim nothing therein shown or described.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. Telegraphic apparatus for transmitting two messages over a single wire, consisting of the usual line-wire, main batteries, keys, local circuits, sounders, and their batteries, combined with two relays capable of making or breaking the same local circuit, one of said relays being provided with a front-contact point and the other with a back-contact point, substantially as and for the purpose specified.

2. In a duplex or multiplex telegraph, the line wire or wires, main batteries, keys, sounders, local circuits, and local batteries, combined with two relays located at each of the ends of each line-wire, and at the connection or junction of wires connected with two or more said line-wires, one of said relays being provided with a front contact and the other with



a back contact, the armatures of each pair of said relays working in a local circuit, the back-contact relay always breaking the local circuit before the front contact relay makes it, unless  
5 said relays are rendered inactive by demagnetization, so that the sounders in said local circuits shall respond correctly to any action of the keys, in the manner and for the purpose specified.

10 3. In a duplex telegraph, the combination, with line-wire, its batteries, and key at either end of said line, of two relays located at each station in circuit with the line-wire, and provided respectively with front and back contact points, the actions of which are regulated  
15 by the currents in the line-wire and govern the local circuits and cause the sounders to respond correctly to the opposite key, substantially in the manner and for the purpose set  
20 forth.

4. In a system of duplex telegraphy, the line-wire, battery, and key, combined with a

front-contact relay and a back-contact relay, said relays being connected together by a conductor, which, in turn, is connected to the line-  
25 wire between the relays, the front and back contact points being in circuit with the sounder and local battery, substantially as shown and described.

5. In a system of telegraphy, the combination, with the regular line-wire, its batteries, and key, of a front-contact relay, and a back-contact relay, said relays operating on a single local circuit for the purpose of controlling  
30 the action of the sounder, and allowing messages to be sent over the wire in one or both  
35 directions at the same time, as and for the purpose specified.

In testimony of which invention I hereunto set my hand.

J. MILTON STEARNS, JR.

Witnesses:

GEO. H. SONNEBORN,  
JAMES F. DOYLE.