3 Sheets—Sheet 1.

J. OLMSTED.

QUADRUPLEX TELEGRAPH.

No. 170,963. Patented Dec. 14, 1875.

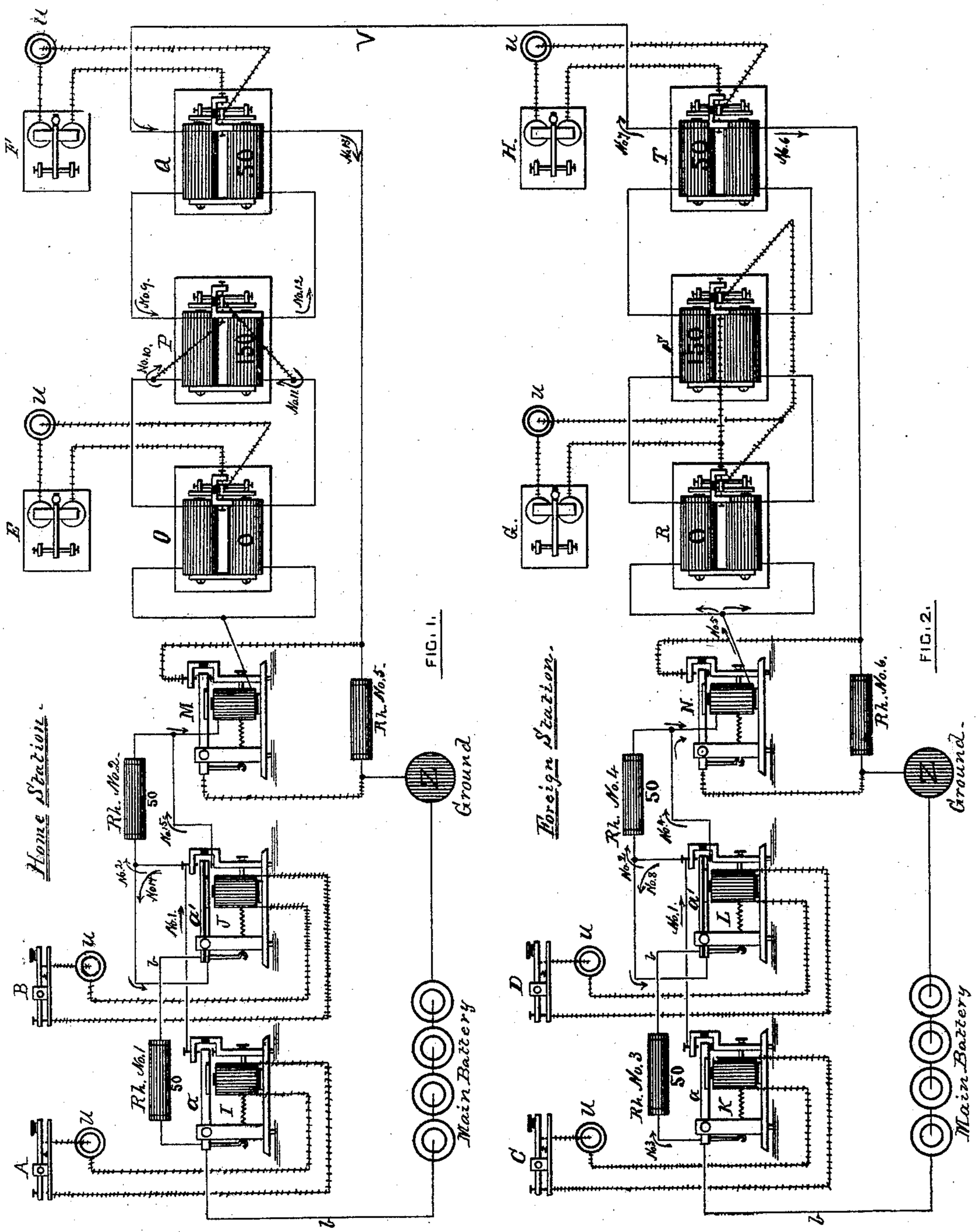

FIG. 1.

FIG. 2.

WITNESSES.

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3 Sheets—Sheet 2.

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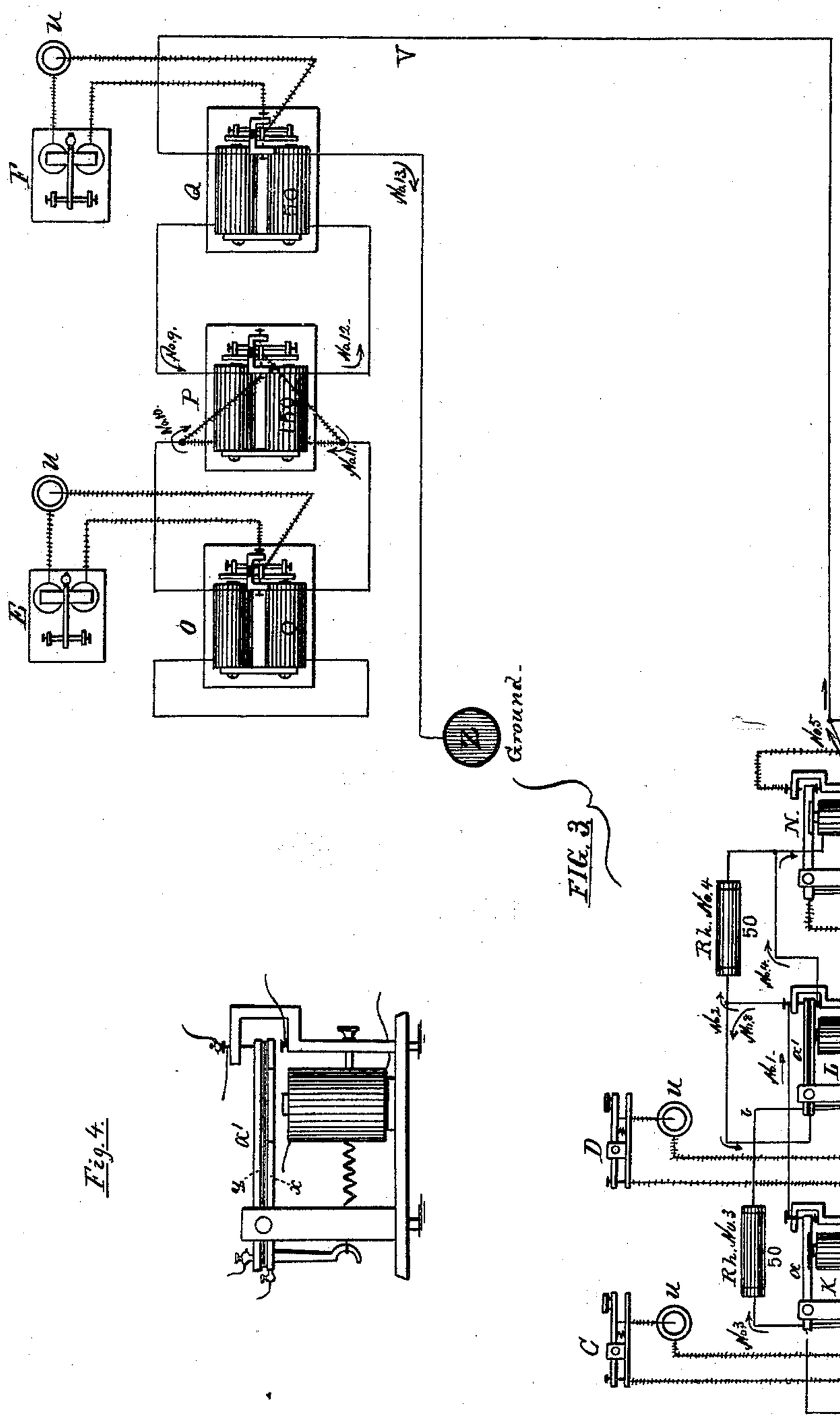

FIG. 3

Fig. 4.

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3 Sheets—Sheet 3.

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QUADRUPLEX TELEGRAPH.

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Fig. 5.

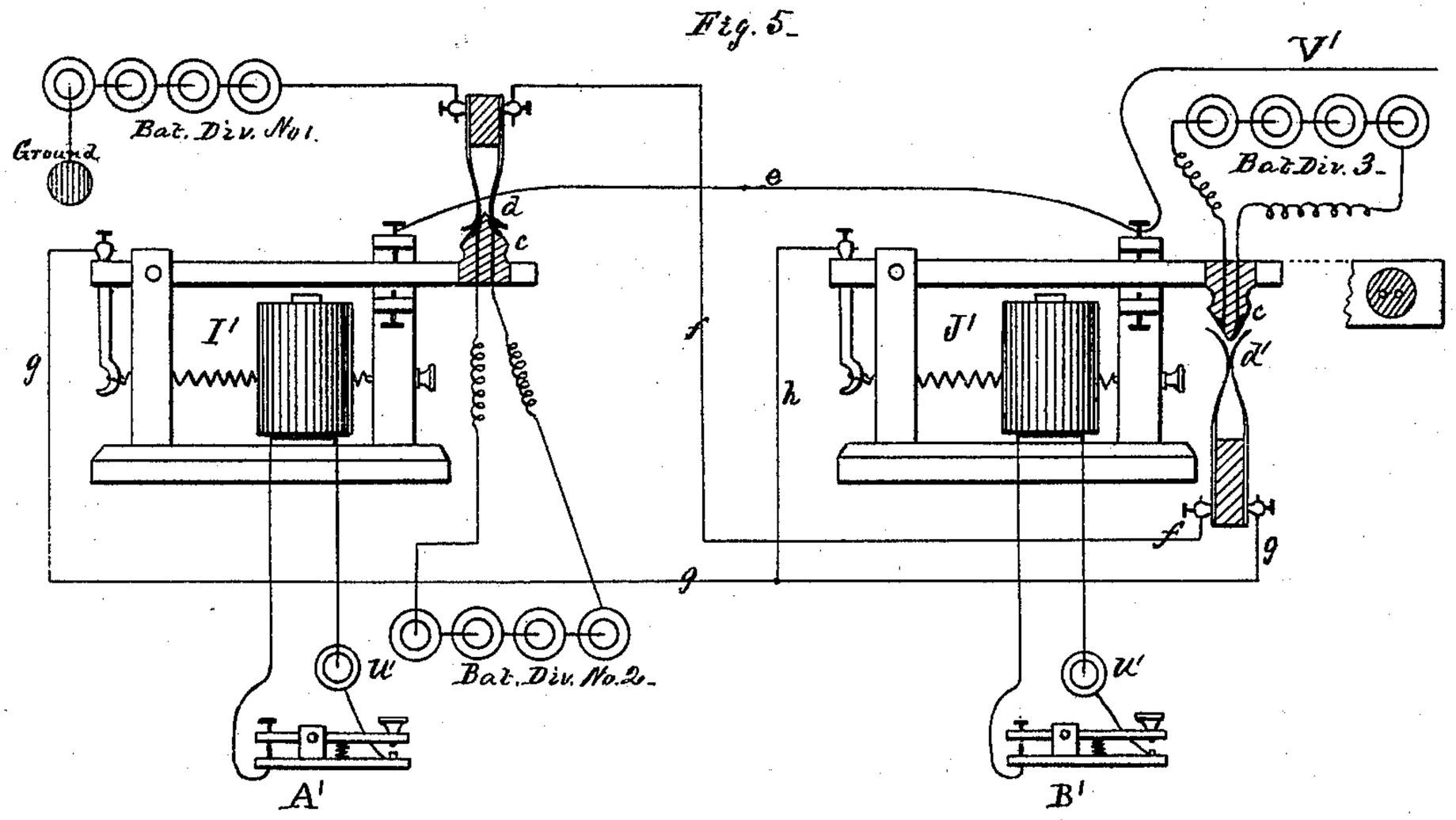
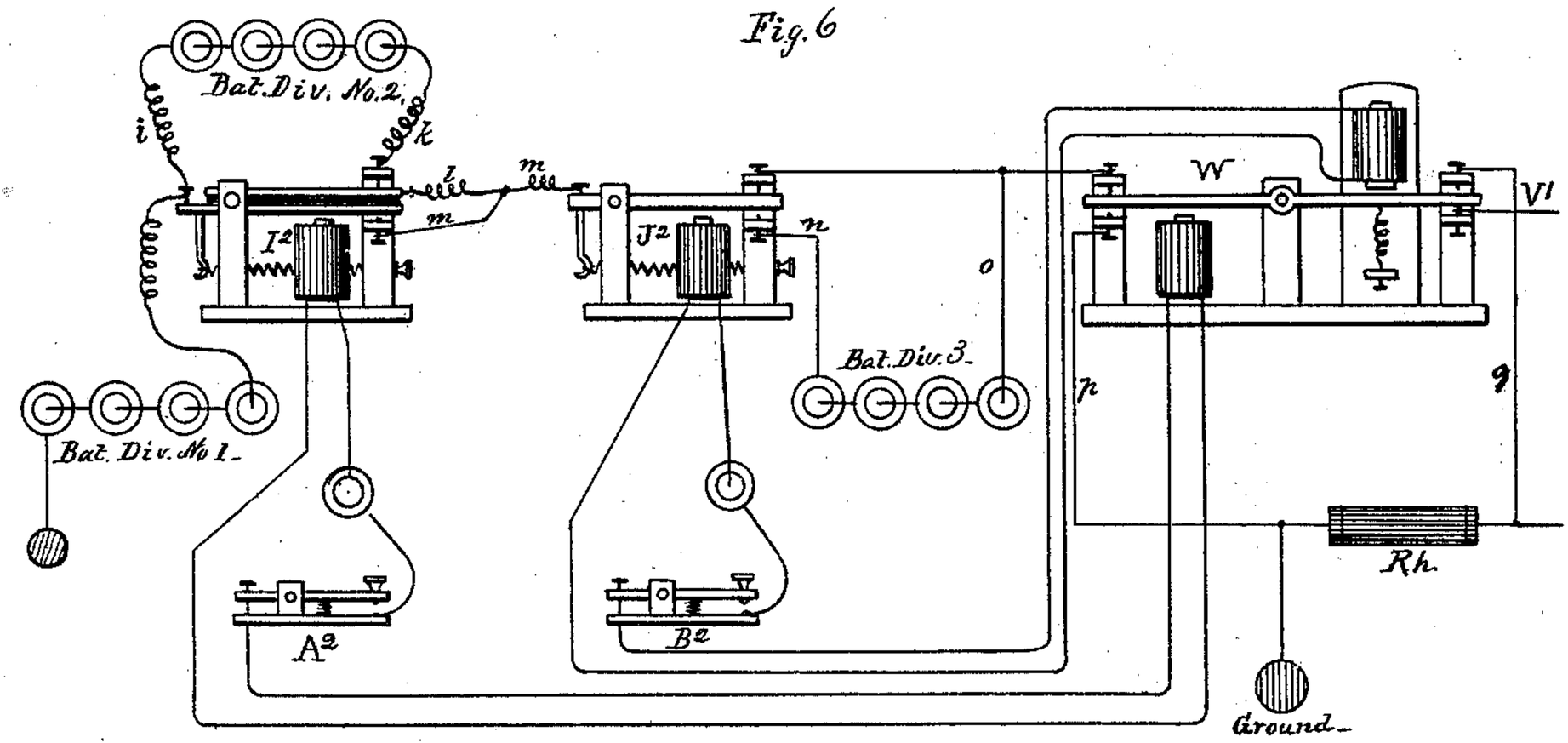


Fig. 6



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UNITED STATES PATENT OFFICE.

JOSEPH OLMSTED, OF PROVIDENCE, RHODE ISLAND.

IMPROVEMENT IN QUADRUPLEX TELEGRAPHS.

Specification forming part of Letters Patent No. **170,963**, dated December 14, 1875; application filed November 2, 1875.

To all whom it may concern:

Be it known that I, JOSEPH OLMSTED, of the city and county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Telegraphic Apparatus; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part thereof, is a clear, true, and complete description of my invention and an apparatus embodying the same.

I seek by my invention the simultaneous transmission, on a single wire, of four signals, two in each direction. This requirement, as met by me, necessarily involves a capacity for transmitting two signals at the same time on the same wire, whether one signal be transmitted from each end, or both be transmitted from the same end of the wire.

It has heretofore been proposed, by means of so-called quadruplex telegraphic apparatus, to simultaneously transmit two signals or messages over the same wire, in the same direction, by employing the positive and negative currents alternately; also, it has been heretofore proposed to send two signals or messages simultaneously from opposite ends of a line by employing both the positive and negative currents alternately.

By means of my invention I am enabled to accomplish these results by employing a battery-current which is applied to the line in the usual manner, and without alternation of current as heretofore proposed.

For accomplishing my purpose I employ the following well-known means: the line-wire, two main batteries, two ground-connections, four finger-keys, four sounders, several resistance-coils or rheostats, two transmitters of ordinary construction performing their proper function, two "cut-outs" or "shunts"—which resemble transmitters of ordinary construction, for performing an automatic controlling influence over the electric current—six relay-magnets, and several local batteries.

In addition to the above I employ two transmitters, each having an armature-lever of novel construction, in that it is composed of two plates or bars, insulated from each other, and so arranged that each bar may communicate with one of the two usual contact points or stops. These transmitters perform usual functions, and also serve as intermediate circuits for avoiding a resistance-coil when occasion requires full force of the current.

With the means described, by reason of their novel combination and arrangement with relation to each other, and a novel system of electric connections, I am enabled to practically attain the object sought, as previously indicated.

The line-wire, main batteries, and ground-connections are arranged as heretofore. The finger-keys have local batteries, which are connected thereto and with the transmitters; and the sounders have also local batteries connected with them in the usual manner; but the sounders are connected with their relays in a novel manner. Adjacent to each ground-connection is a resistance-coil, as heretofore employed, for balancing the resistance of the line. I employ, in connection with each of the transmitters, at each end of the line, a resistance-coil, so arranged that either or both of the coils may be automatically brought into service when required. The relay-magnets are located, as is usual in duplex telegraphic systems, with relation to the main line, the sounders and transmitters, and, as heretofore, the outgoing current passes through both coils of each relay-magnet at the transmitting end of the line. Each end of the line is provided with three relay-magnets. Their armatures are variably weighted. Two of the magnets—one at each end—have their armatures so set that, with a small portion of the electric current applied to them, their armature-levers will be held to the front stops, and when this current is lessened the armature-levers move to the back stops and make connection with their respective sounders. At each end of the line is one of two other relay-magnets, each of which communicates with a sounder. The normal or usual position of their armature-levers is against the front stops, and they are so weighted that they will remain against said stops until the holding-force of the magnets is reduced to about one-half of their normal power, at which time their armature-levers fall to the back stops and make connection with their respective sounders.

Between these two relay-magnets, at each end of the line, I employ still another relay-magnet, which is electrically connected by conductors to each of its neighboring relays. It may have no sounder of its own, but can be arranged to affect or control the sounder of the relay-magnet first described, by co-operating with or through said relay under circumstances hereafter recited; or it may be arranged to communicate directly with that sounder without co-operating with or through the relay last referred to.

My invention involves a novel method of transmitting two signals at the same time over the same line from each end, and in each direction, which consists in placing the battery-current under the control of four finger-keys without changing the relations between the poles of the batteries and the line-wire, so that it may be wholly cut off from the line under one condition, or reduced to, say, two-thirds of its power under another condition, and to, say, one-third of its power under another condition, or employed in its full force under still other conditions.

My invention consists mainly in the combination, with four keys, four sounders, a line-wire, suitable main and local batteries, and suitable intermediate conductors, of means for directing the battery force or power to the main line in three unequal powers; means for wholly neutralizing said power; and of means for placing each sounder into communication with its key, whereby, with unchanged relations between the poles of the main batteries and the line-wire, messages or signals may be transmitted from two of the keys at the same time over the same wire and in the same direction, while signals are being received from both of the other keys, as set forth.

My invention also consists partially in the combination, with the line-wire and its batteries, of two keys and their local batteries, two transmitters, controlled by the keys and their batteries, two rheostats, or equivalent means, for graduating the power of the battery-current to line, controlled by the transmitters, a cut-out or shunt all at one end of the line, and at the other end of the line three relay-magnets with armatures variously weighted, and two sounders with local batteries controlled by said relay-magnets.

It further consists in the combination of two keys and their local batteries with a transmitter capable of performing usual service, a transmitter having an armature-lever composed of insulated bars or plates, two rheostats, and a system of connecting-conductors, whereby a desired portion of the battery-current may be withheld, or the current cut off entirely.

It further consists in the combination, with a ground-wire and its rheostat, of an automatic shunt or cut-out, composed of an electro-magnet, an armature, and the usual back and front stops, a battery-wire, which charges the magnet, a conductor, which connects the front stop and armature with the ground-wire on each side of its rheostat, and a means for cutting off the current from the battery to the magnet of the cut-out.

It further consists in the combination, with a sounder and its local battery, of two relay-magnets, having their armatures set at different resistances, and arranged to separately operate the sounder when call is made thereon from its proper transmitting-key.

It further consists in the combination of a sounder having a local battery and a relay-magnet, which normally holds its armature lever to the front stop with but little electro-magnetic force, and permits the sounder to operate when its armature-lever is on its back stop with a second relay-magnet, which is connected to the first, holds its own armature-lever to its front stop by a greater force, is located between the first relay and the line-wire which charges the magnets of both relays, and is arranged to shunt the current received by it to a ground-wire, and so protect the weaker magnet, in the performance of its duty, from a current which would prevent it from causing its sounder to respond to its proper key.

And still further my invention consists, in a transmitter, of the combination, with an electro-magnet, of an armature-lever, composed of two separate bars or plates, insulated from each other, and arranged so that a surface of one plate will communicate with the front stop, and a surface of the other plate or bar will communicate with the back stop, whereby each bar or plate may serve as a conductor independently of the other.

In order to fully describe my invention, I will refer to the accompanying three sheets of drawings, in which—

Figure 1, Sheet 1, illustrates a complete apparatus at the home station; and Fig. 2, Sheet 1, a similar apparatus at the foreign station. Fig. 3, Sheet 2, illustrates a single apparatus, whereby two signals may be sent simultaneously over the same line in the same direction.

It will be seen that Fig. 3 is a counterpart of one-half of each apparatus shown at each end of the wire in Figs. 1 and 2, and the several parts of the apparatus are lettered as in those figures.

Figs. 5 and 6, Sheet 3, illustrate different modes of battery arrangement.

The main-line wire between the two stations is indicated at V.

A and B denote the finger-keys at the home station, Fig. 1, and C and D the keys at the foreign station, Figs. 2 and 3. The sounders of the home station are shown at E and F, and at G and H at the foreign station. Each finger-key and sounder is provided with a local battery, as at *u*. The finger-keys are in each instance connected with the magnets of their respective transmitters, which are shown at I and J in the home station, and K and L in the foreign station. Their connecting-conductors are shown in dotted lines in each in-

stance, and they are arranged in the usual manner. The sounders are also connected with their respective relay-magnets by conductors, indicated by dotted lines, as follows: Home sounder E to relay O, sounder F to relay Q, and at the foreign station sounder G may be connected in like manner, as shown in Fig. 1, to relay R, or by a different mode of connection, hereafter fully described. Sounder H is, however, connected with its relay T in the same manner as shown at the home station. The relay-magnets at the home station have their counterparts at the foreign station. The main batteries are plainly designated in the drawings, and the ground-connections are shown at Z.

For the purpose of illustration it will be assumed that 150 represents the full power of the main battery; and it is to be understood that the three relay-magnets at each end of the line have armatures, which are variably weighted, but that they correspond in this respect with the relays at the other station, as follows: relay O with R, P with S, and Q with T. The armatures of relays marked 150 are attracted by that power. Those of relays marked 50 are released at that or a lesser power. Those of relays marked zero (0) are released when their magnets are powerless.

I will first describe the normal condition of the line when at rest. Although the full force of the battery is represented by 150 the normal condition of the entire apparatus is 100, at which time the armature-levers of the transmitters I J and K L are, of course, on their back stops, their magnets not being then affected by the finger-key local batteries. The armature-levers of the cut-outs or shunts M and N, and the relays O, Q, R, and T are all against their front stops. The armatures of relays O and R are so set that when the power of the battery is reduced to zero they will be released from their front stops, while the armatures of relays Q and T are so set that they will be released from their front stops when the battery-force is not greater than 50. The armatures of the relays P and S are so weighted that they remain on their back stops, unless the power of their magnets is augmented to a force nearly or quite equal to 150, or the full force of the battery, which is, when the line is at rest, modified to 100, as stated. This modification of the power of the battery is effected as follows, in connection with Fig. 1: the current from the main battery, at the home station, for instance, by way of the wire indicated in solid lines at *b*, on reaching the transmitter at I finds a fork or branch in its conductor. One of these branches is obstructed by the resistance-coil shown at No. 1, and therefore the current passes along the armature *a* of transmitter I through its back stop; thence, by another wire, (indicated in solid lines and by arrows Nos. 1 and 2,) to and through the resistance-coil No. 2, which partially neutralizes the power of the current to the extent of one-third of its full capacity, leaving a force, which, as before stated, may be represented by 100. At the foreign station the same arrangement of conductors and resistance-coils is shown. The main-battery current reaches the main line V by passing through the magnet of the cut-out or shunt M at the home station, and through each core of each magnet of the relays O, P, and Q, and at the foreign station by passing through magnets of cut-out N and relays R S T, as is clearly shown in each case by conductors indicated in solid lines.

For explaining the working of the apparatus I will first describe how a single message may be sent over the line from the foreign to the home station. As before stated, Fig. 3, Sheet 2, illustrates a single apparatus, and its parts are designated by the same letters employed in Figs. 1 and 2. In said Fig. 3 the transmitting devices are as in Fig. 2, and the receiving devices as in Fig. 1, and therefore either of the two sheets of drawings may be referred to in connection with the descriptive matter relating to the transmission of signals from the foreign to the home station.

The finger-key at C is depressed, which permits its local battery *u* to charge the magnet of transmitter K, which attracts the armature *a* to the front stop. The current from the main battery, having now no conductor except the wire shown in solid line, passes, in direction of arrow No. 3, to resistance-coil or rheostat No. 3, whereby the force of the current is reduced from 100 to 50; beyond this point it continues on the wire *b* to transmitter L, as next described. This transmitter L has an armature-lever, *a'*, of novel construction. (Illustrated more fully in Fig. 4, Sheet 2.) It is composed of two bars or plates, which are insulated from each other. One bar, as at *x*, constitutes the front surface of the armature-lever, for contact with the front stop. The other bar, as at *y*, constitutes the rear surface, for contact with the rear stop. The current from the rheostat No. 3, thereby reduced to 50, passes to the upper portion of the armature-lever *a'*; thence to the back stop; thence by wire, as per arrow No. 2, to the rheostat No. 4; thence to and through the magnet of shunt or cut-out N, as indicated by arrow 5, to a point where the conductor is divided into two parts, each part connecting with one of the coils of the magnet of relay R, passing through said coils, and thence through the coils of magnets in relays S and T in like manner. One portion of the current, after passing relay T, passes to the ground-wire, as per arrow 6, and the other portion to the line-wire V, as per arrow No. 7. As is well known, the divided current, in thus passing through each coil, fails to affect these magnets in any manner.

It will be remembered that the armature-lever of relay Q is against its front stop, and it is here to be noted that the release of this armature and its contact with its back stop permits the sounder F to be operated by its local battery. The armature-lever of relay Q

is held to the front stop by a force greater than 50; and as the power of the current from key C is but 50, the armature is therefore released and the sounder F operated.

Leaving the key C down, and the sounder F executing its signal, I will next describe how, at the same time, signals may be transmitted from the key D to the sounder E at the home station: The key D being depressed, the magnet of transmitter L is charged, and its armature-lever *a'* carried to its front stop. The battery-current, being already reduced to 50, is still further reduced to zero by cutting off the current entirely from its battery at the back stop of transmitter L, and therefore the armature of relay O is released from its front stop, and, by contact with its back stop, permits the sounder E to be operated by its local battery.

Having described how keys C and D may simultaneously operate their respective sounders, I will now show how key D may continue to control its sounder after key C has ceased control of sounder F: Pressure being removed from key C, the magnet of transmitter K releases its armature, which returns to its back stop. The battery-current then, instead of passing through rheostat 3, passes along armature-lever *a* of transmitter K, through its back stop, along the conductor to the back stop of transmitter L, thence toward the rheostat 4; but finding resistance there, it takes the easier conductor, as indicated by arrow No. 8, backward and downward to the under plate of the armature-lever *a'* of transmitter L; thence, as before, to the main wire, with the full force of the battery—*i. e.*, 150. On reaching the relay P at the home station, the entire current is shunted thereby to the ground-wire, leaving the relay O still under control of the key D. The full battery-current approaches the relay P, as indicated by arrow No. 9, and is shunted by passing through the adjacent coil of the magnet, and from thence, as per arrow No. 10, by wire (in dotted lines) back to the front stop of the relay; thence along its armature-lever to its base; thence by the wire (in dotted lines) to opposite end of the other coil, as per arrow No. 11, back through the coil to its front end; thence to the ground-wire, as per arrows 12 and 13.

It will be seen that the outgoing current from the home station in no manner affects the home relays and sounders, because the current is equally divided, and passes through each coil of each magnet in the same direction, one division of the current ultimately reaching the line-wire, and the other portion the ground-wire.

Signals from keys A and B, at the home station, will be transmitted to the sounders at the foreign station, in the same manner as has been described in connection with signals from the opposite direction. The local-battery connections between relay O and its sounder E, at the home station, are shown to be somewhat unlike the connections between the relay R and its sounder G at the foreign station, and it will be seen that the relay S is also connected with the sounder G. In order to explain this latter mode of connection, it will be assumed that a signal is being transmitted from key B of home station to sounder G of the foreign station. On depressing the key B, the magnet of transmitter J places its armature-lever *a* on its front stop, the battery-current along wire, as at arrow No. 1, reaches the back stop of relay J, thence proceeds upward, and, finding resistance at rheostat No. 2, goes in the opposite direction therefrom, as indicated by arrow 14, to the lower surface or bar of armature-lever *a'*, thence to the front stop, and beyond, as indicated by arrow No. 15, and so on, as before described, one portion of the current going to the main wire, and the other to ground. On reaching the foreign station, the force of the current being 150, (rheostats Nos. 1 and 2 being both cut out,) it passes through relay T, and, acting on relay S, places its armature on the front stop. The sounder G and its local battery are connected, as by wire shown in dotted lines, to the front stop of relay S, and also to its armature-lever, and when the armature is thus brought forward it permits the sounder G to operate. If, while key B was closed, key A should also be closed, the current being thereby cut off entirely, the relay S will, of course, release its armature, but simultaneously the relay R will also release its armature to the back stop, and thus the control of sounder G is transferred from relay S to relay R. The cut-outs or shunts M and N are of service only when it is desirable that the ground-rheostats Nos. 5 and 6 be wholly cut out. When relays O and R are operated, as has before been stated, the battery-force has been reduced to zero, at which time the magnets of the cut-outs or shunts M and N release their armatures, which pass to their back stops, and, through their levers, communication is opened, by wire shown in dotted lines, from ground-wire to ground-wire, on opposite sides of the ground-rheostats 5 and 6. When operating two keys and transmitting two messages over the line in the same direction, the messages may both be dropped at any number of intermediate stations, if these latter are provided with sounders and relays of the general character of those herein described.

It will be seen that the rheostats 1, 2, 3, and 4 serve only as means for dividing the power of the battery into requisite divisions or parts. It will also be seen that for service, under one condition, I reduce the power of the battery with reference to the main line to zero. Under another condition I reduce it to 50, under another condition to 100, and under still another I employ the full force of the battery, *i. e.*, 150. Now, I am well aware that if a battery of twelve cups has a power of 150, that eight cups will have a power of 100, and four cups a power of 50, and therefore I well know that by the employment of a battery of, say,

that number of cups, and an arrangement of shunts or switches, which will be readily suggested to persons skilled in the art, they may be connected with transmitters in such a manner, that the battery-force to line-wire may be varied to the same extent, and in substantially like manner, as herein shown to be accomplished by rheostats Nos. 1, 2, 3, and 4.

For the purpose of showing that the rheostats which, in connection with the transmitters, serve as means for reducing the power of the battery to line, may be dispened with, by employing, say, a battery divided into three divisions, each having a power of 50, which, when properly connected, will transmit 150, 100, or 50 to line, or be capable of being wholly cut off when a zero of power is required, I will now describe the form and arrangement of apparatus shown on Sheet 3, Figs. 5 and 6. I will first refer to the transmitting apparatus shown in Fig. 5.

The keys are shown at A^1 and B^1, each with local battery *w'*. Key A^1 is connected to transmitter I^1, and key B^1 to transmitter J^1, as before described. The battery is in three divisions, which are plainly designated in the drawings, and are respectively numbered 1, 2, and 3. These divisions are so connected with each other that, when two or three of them are employed, they act as one battery in every respect. The transmitters I^1 and J^1 have armature-levers, which are provided in each instance with a plug, as at *c*, composed of good insulating material. Each plug has a wedge-shaped face, and a small metal plate therein, which is connected to a wire which extends through the plug longitudinally. Opposite each plug is a pair of union springs, as at *d* and *d'*, which serve as electric connections for the wires attached thereto. When the plugs *c* enter between these springs they are forced apart, breaking their direct connection, and each communicates with a metal plate and one of the wires. The back stops of transmitters I^1 and J^1 are connected by wire *e*.

When the apparatus is in the condition as shown in the drawings, two of the divisions of the battery, Nos. 1 and 2, are in connection with the main line, which, when the apparatus is at rest, may be represented as 100. The battery-divisions connect as follows: Division No. 1, by way of wire clearly shown, to one side of union spring *d;* thence through plug in armature-lever of transmitter I^1 to division No. 2, with which it properly connects; and from the other end of this battery No. 2 continues by wire back through the plug and the opposite side of union spring *d* along wire *f* to union spring *d';* thence back by wire *g* to rear end of the armature-lever of I^1, thence to its back stop, to the back stop of armature of J^1 by wire *e*, and thence to line with power of 100, received through the proper connection of two batteries, each having power of 50. Now, it is to be remembered, in connection with the form of apparatus previously described, that we require at the transmitting end of the line the following conditions: Normally, battery-power to line, 100; when key A^1 is operating separately we require power to line of 50; when key B^1 is operating separately we require power 150, and that, when both keys are operated simultaneously, we require zero. Now, it is to be understood that one of the cut-outs or shunts M or N of the previous figures is to be also employed with the transmitters I^1 and J^1 of this figure, and in precisely the same connection, and that, at the other end of the line *v'*, either set of the relays previously shown may be connected thereto.

I will first show how a signal may be transmitted from key A^1 to a sounder like F through a relay like Q of the previously-described apparatus. To do this the power on the line must be reduced to 50. Key A^1 being depressed the armature-lever of I^1 is carried to its front stop. The withdrawal of the plug *c* from union spring *d* takes division No. 2 of the battery from the line. The two sides of spring *d* being in contact maintain connection of division No. 1 of the battery with main line, and therefore the proper relay at the other end of the line will release its armature, and so operate the sounder. The current, under these circumstances, passes from division No. 1 of the battery to union spring *d*, crosses to wire *f*, thence to wire *g*. Having no outlet at armature-lever of transmitter I^1, (it being on front stop,) the current passes from wire *g* by way of wire *h*, to rear end of armature-lever of transmitter J^1, thence through its back stop to line wire.

I will next show how a signal may be sent from key B^1 to a sounder like E, through relays like O and P of previous figures. It has already been explained that either zero or 150 will operate that sounder. Key B^1 being depressed causes armature-lever of transmitter J^1 to move to its front stop, and in doing so its wedge-block *c* separates union spring *d'*, and brings division No. 3 of the battery into connection with wires *f* and *g*, so that the full current from the two divisions Nos. 1 and 2 of the battery joins with that of division No. 3, and, thus augmented, passes backward on wire *g* to rear end of armature-lever of transmitter I^1, thence through its back stop by wire *e* to back stop of transmitter J^1, thence to line-wire V' with a power of 150.

I will next explain how signals may be transmitted simultaneously from both keys to their respective sounders. It has already been described, in connection with previous figures, that sounders E and F may both be operated simultaneously, because sounder E is operated through an armature in a relay, which releases it when at zero, and sounder F is operated by a relay which releases its armature at 50, and this latter relay will, therefore, of course perform in the same manner at zero.

It will be seen that, when the armature-lever of transmitter I^1 is on its front stop, the division No. 2 of the battery is cut out entire-

ly. The current from division 1 proceeds through union spring *d* to union spring *d'* per wire *f*. The armature-lever of transmitter J^1 being down, the current passes on the wire through the plug to division 3 of the battery, and, joining with its current, passes through the opposite side of the plug to opposite side of spring *d'*; thence by wire *g* to rear end of armature-lever of transmitter I^1, which, being down, has no connection with its back stop, wire *e*, and line-wire, and, therefore, it completely cuts off the divisions Nos. 1 and 3 of the battery, No. 2 being already cut off, and the condition of the line-wire is reduced to zero, and the two sounders respond. While both keys are being thus simultaneously operated, if key A^1 be alone released, the armature-lever of I^1 falls to its back stop, which puts division 2 of the battery into connection with the current from divisions 1 and 3 by wires *f* and *g* to rear end of armature-lever of transmitter I^1, thence through its back stop, and via wire *e* to back stop of transmitter J^1, thence to line at 150.

If, on the other hand, key B^1 be alone released, armature-lever of J^1 falls to its back stop, cutting out division 3 of the battery. The armature-lever of I^1 being on its front stop, division No. 2 is also cut out, leaving division No. 1 in connection with the line at a power of 50.

There are numerous other modes of affecting the direction of the force of the battery to line in three unequal powers, which may be employed with still other means for wholly cutting them off from the line, one of which is shown in Fig. 6, Sheet 3.

As in Fig. 5, the battery is divided into three divisions, Nos. 1, 2, and 3. Neither of these divisions is short-circuited. When at rest division 1 sends its current to rear end of lower insulated portion of armature-lever of transmitter I^2, thence by wire *i* through division 2 of battery; thence by wire *k* to back stop through end of the upper insulated portion of armature-lever of transmitter I^2; thence by coil-wire *l* to wire *m*; thence to rear end of armature-lever of transmitter J^2, along it and through its back stop to line with power of both divisions of battery—*i. e.*, 100.

When, through key A^2 armature of I^2 is depressed, it cuts out division 2 of battery, and power of division 1 passes through front stop to wire *m*; thence, as before, with a power of 50.

When, through key B^2 armature of J^2 is depressed, its lever is brought into contact with its front stop, carrying power from divisions 1 and 2 through division 3 of battery by way of wires *n* and *o* to line with power of 150.

When both keys actuate simultaneously the armatures of both transmitters to their front stops, division 2 is cut out, and divisions 1 and 3, with power of 100, proceeds to switch W, where it is cut off entirely, reducing the battery-power to line to zero. This switch W may be composed, as shown, of two magnets, which operate on one armature-lever. Neither magnet alone will actuate it, but both will do so, and so cut off the line entirely. These magnets are, respectively, connected with one of the keys and its usual local battery, and, therefore, when both keys are depressed, the switch is opened, but neither key separately can affect it.

If, following the depression of the armatures of both transmitters, that of I^2 be released by release of key A^2, there is an accompanying closure of switch W, and the full power of all the divisions of the battery goes to line at 150.

With the switch W, constructed as shown, it may be also arranged by means of wires *p* and *q*, to perform the function of a shunt or cut out, for avoiding a ground-resistance, as shown in Figs. 1, 2, and 3, at M and N.

It will be seen that when the three divisions of the battery are employed, as shown in Figs. 5 and 6, they are so connected as to operate as one battery, and therefore yield the requisite intensity or working force; also whether I use an undivided battery with a power of 150, with rheostats for reducing that power to 100 and to 50, as previously shown, or a divided battery of three divisions, as shown in Figs. 5 and 6, it will be seen that I employ for transmitting my simultaneous signals from one end of the line-wire in the same direction the same combination of elements, to wit: the keys, sounders, line-wire, main and local batteries, and suitable intermediate conductors; means for directing the battery force or power to the main line in three unequal powers; means for wholly neutralizing said force with relation to the main line, and means for placing each sounder into communication with its proper key; and it will also be seen that the relations of the poles of the batteries to the main line in both modes of working always remain unchanged.

Although I have thus shown three modes of arrangement for transmitting the power of the battery to line in three unequal powers, and am aware that still other similar arrangements may be employed, I prefer the mode illustrated in Figs. 1, 2, and 3, involving the use of the undivided battery and the rheostats.

It is also to be distinctly understood that I do not limit the main features of my invention to keys, rheostats, transmitters, cut-outs, relays, and sounders of any precise construction, as I am well aware that they may be considerably varied in that respect, and still perform the functions of those employed by me for the purpose of illustrating my invention.

Having thus described my invention, I claim as new to be secured by these Letters Patent—

1. The combination, substantially as described, with four keys, four sounders, a line-wire, suitable main and local batteries, and suitable intermediate conductors, of means for separately directing the battery-force to the line-wire in three separate and unequal powers; means, substantially as described, for

wholly neutralizing said force; and of means, substantially as described, for placing each sounder into communication with its key, whereby, with unchanged relations between the poles of the main batteries and the line-wire, messages or signals may be transmitted from two of the keys at the same time, over the same wire and in the same direction, while signals are being received from both of the other keys, as set forth.

2. The combination, with the line-wire, its batteries, suitable conductors, two keys and their batteries, two transmitters, two rheostats controlled by the transmitters, and a cut-out or shunt, of three relays with armatures variously weighted, and two sounders with local batteries, substantially as described.

3. The combination of two keys and their local batteries with a transmitter capable of performing the usual service, a transmitter having an armature-lever composed of insulated bars or plates, two rheostats, and a system of connecting conductors, substantially as described, whereby a desired portion of the battery-current may be withheld or sent beyond the transmitters, or the entire current cut off.

4. The combination, with a ground wire and its rheostat, of an automatic shunt or cut-out composed of an electro-magnet, an armature-lever, and the usual back and front stops, a battery-wire which charges the magnet, a conductor which connects the armature, and one of its stops to the ground-wire on opposite sides of its rheostat, and a means for cutting off the current from the battery to the magnet of the shunt, substantially as described.

5. The combination, with a sounder and its local battery, of two relay-magnets, with armatures variably weighted and arranged to separately operate the sounder when call is made thereon from its proper transmitting-key, substantially as described.

6. The combination, with a sounder having a local battery, and a relay which normally holds its armature-lever to its front stop with but little magnetic power and operates the sounder from its back stop, of a second relay which is electrically connected to the first, holds its armature to its front stop with a greater force, is located between the first relay and the line-wire, which charges the magnets of both relays, and is arranged to shunt the current received by it to the ground-wire, substantially as described, whereby the weaker relay may be protected in the performance of its duty when its sounder is called to respond to its proper key.

7. In a transmitter, the combination, with an electro-magnet and the usual front and back stops, of an armature-lever composed of two separate bars or plates insulated from each other, and constituting two distinct surfaces for engaging with the stops, substantially as described, whereby each bar or plate of the armature may serve as an independent conductor, as set forth.

JOSEPH OLMSTED.

Witnesses:
WM. C. WOOD,
PHILIP F. LARNER.