No. 707,829.

Patented Aug. 26, 1902.

A. C. CREHORE.

TELEGRAPHY.

(Application filed Oct. 21, 1901.)

(No Model.)

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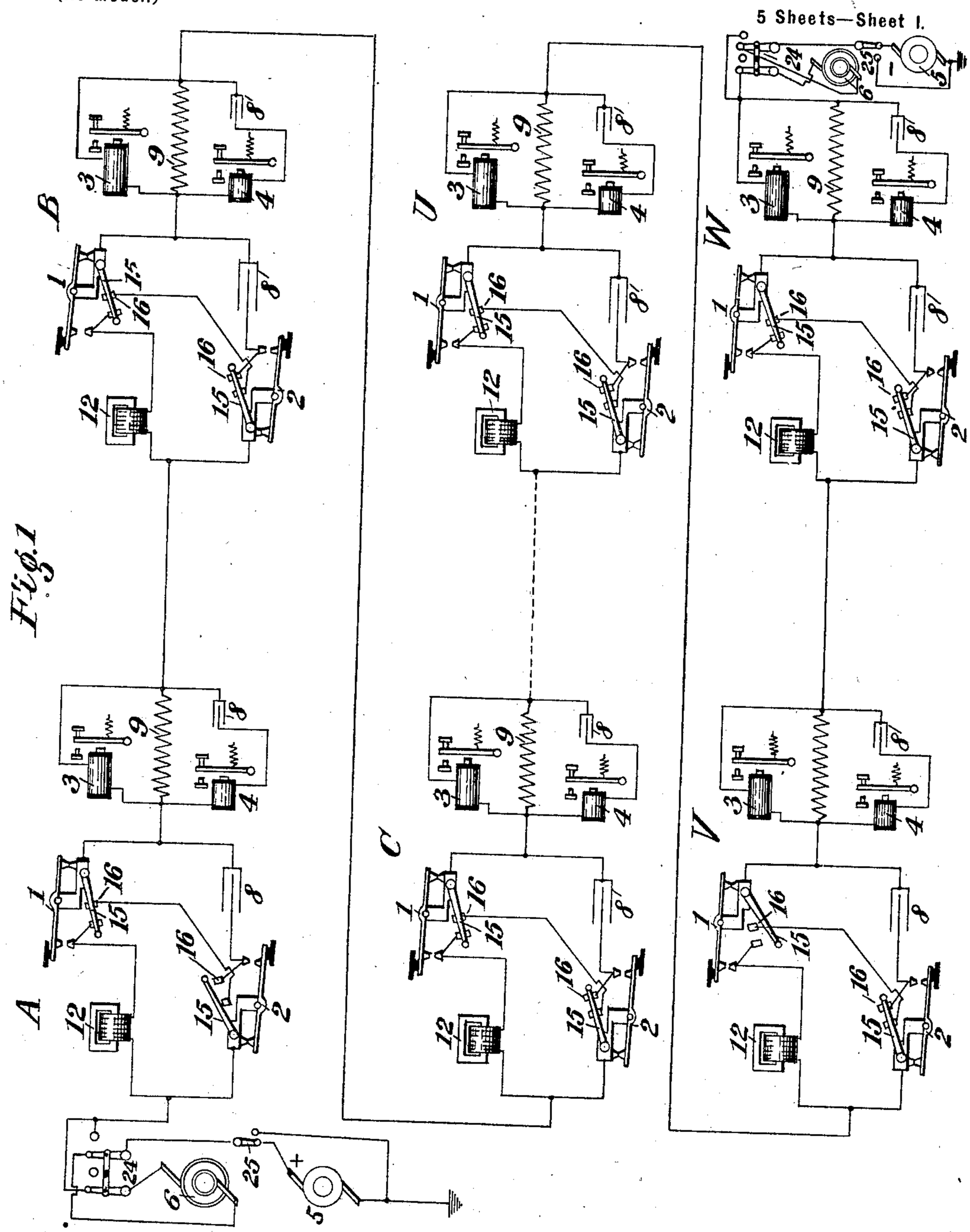

Fig. 1.

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5 Sheets—Sheet 2.

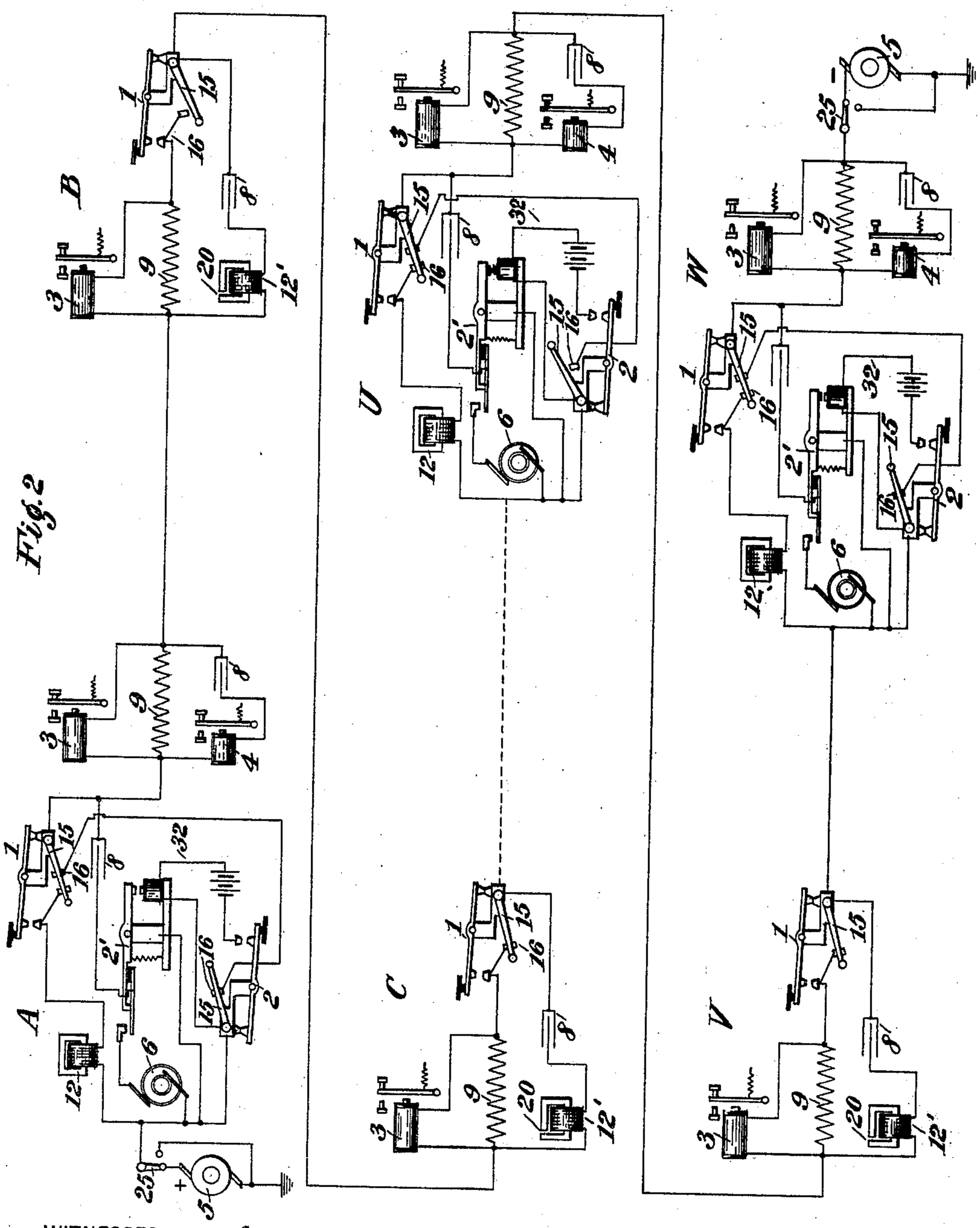

Fig. 2

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(No Model.)

5 Sheets—Sheet 3.

Fig. 3

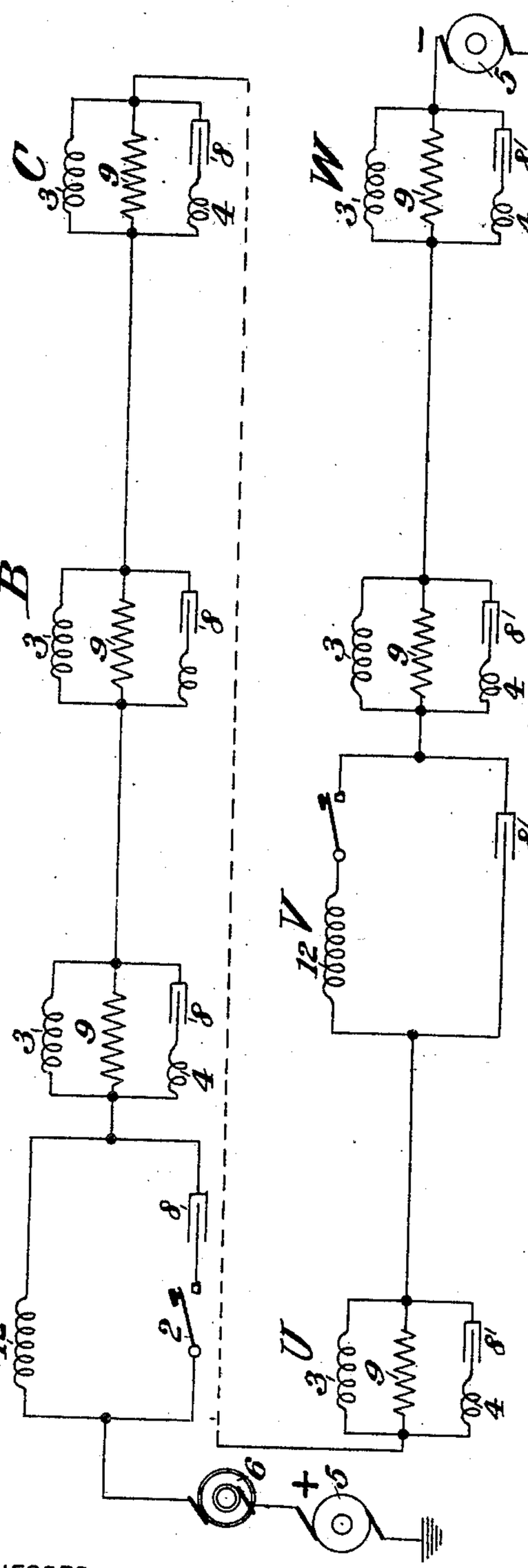

Fig. 4

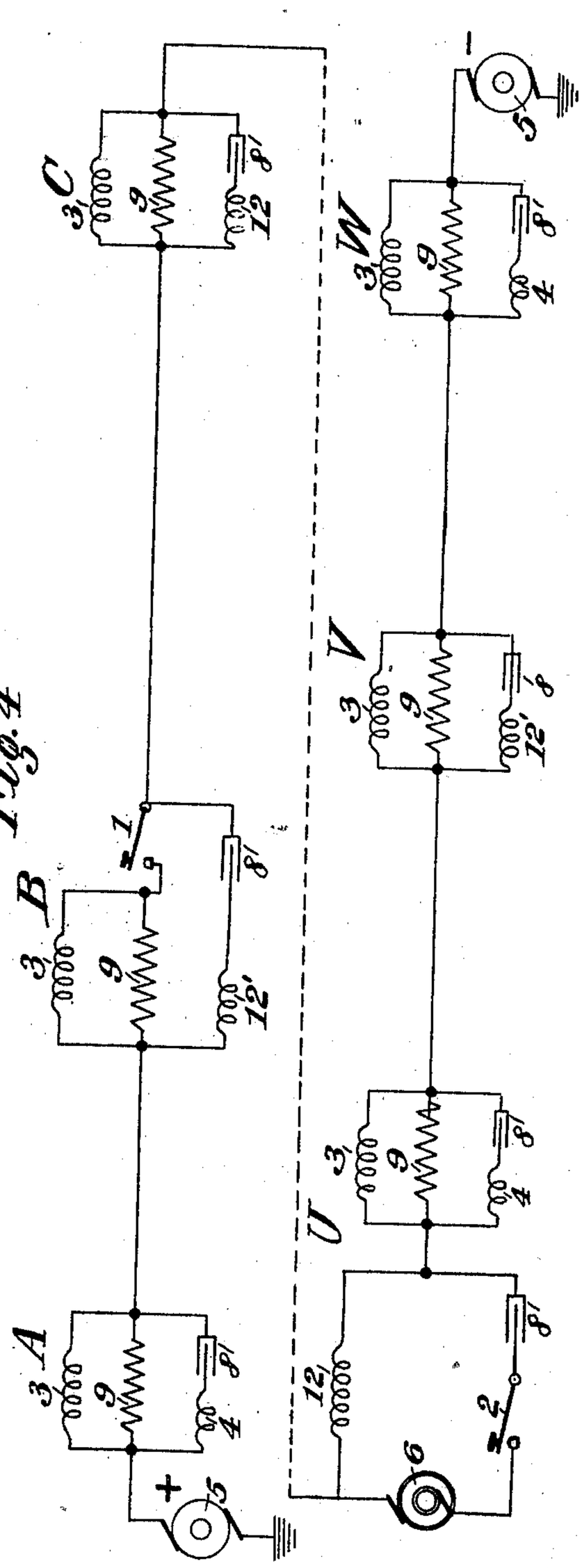

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Fig. 5

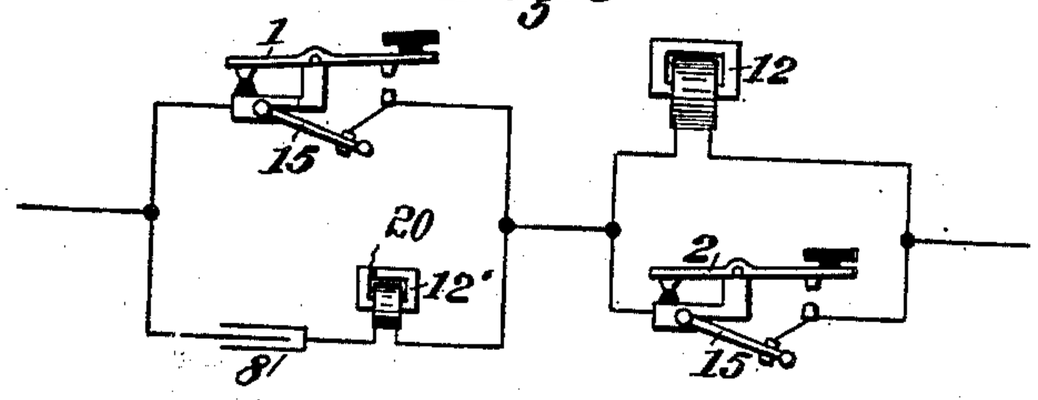


Fig. 6

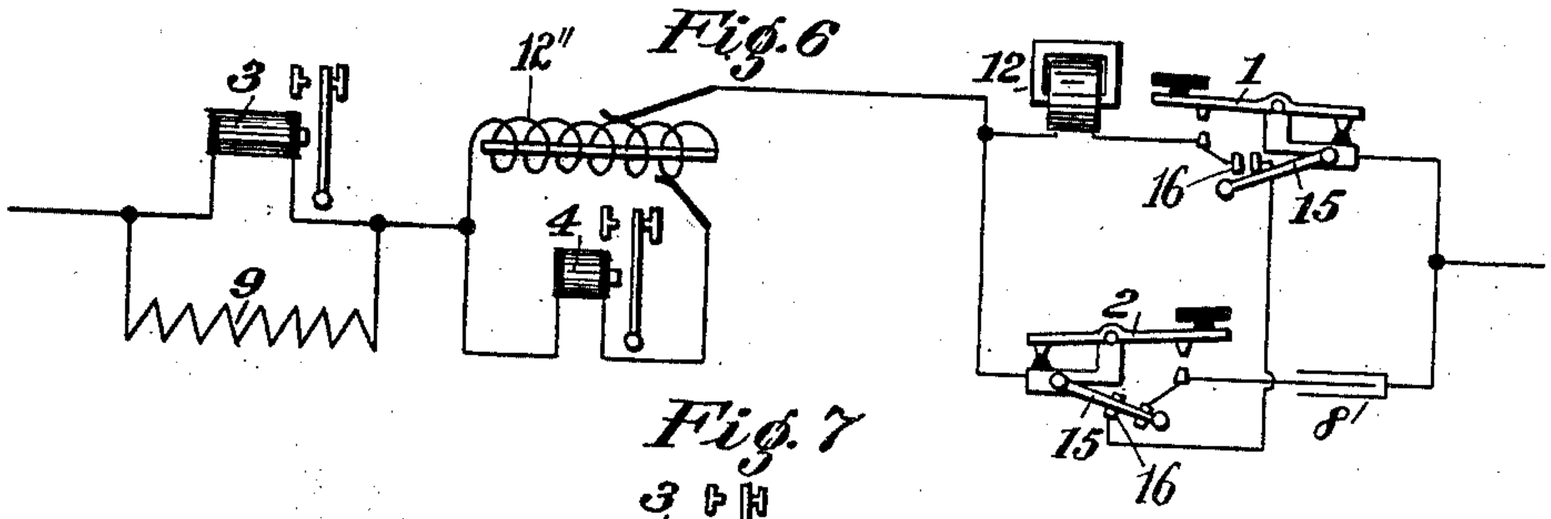


Fig. 7

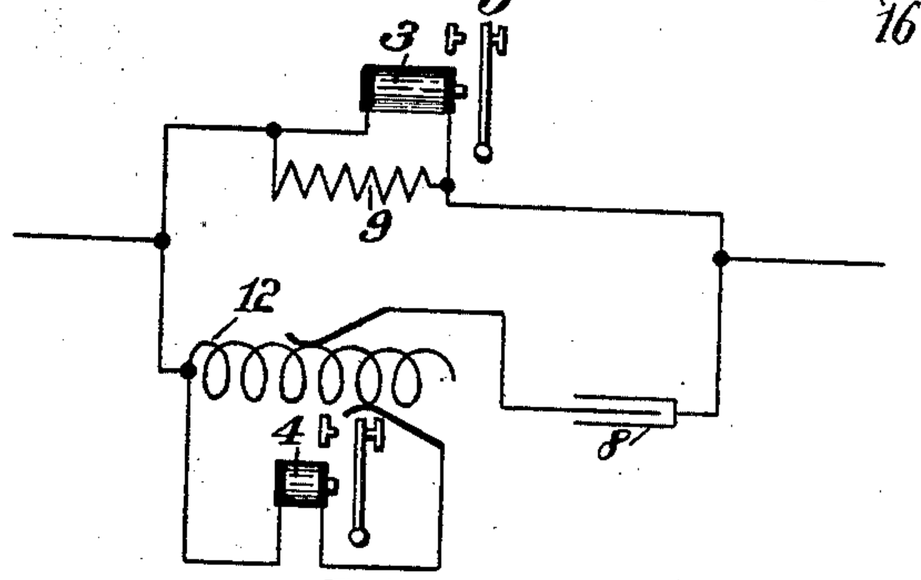
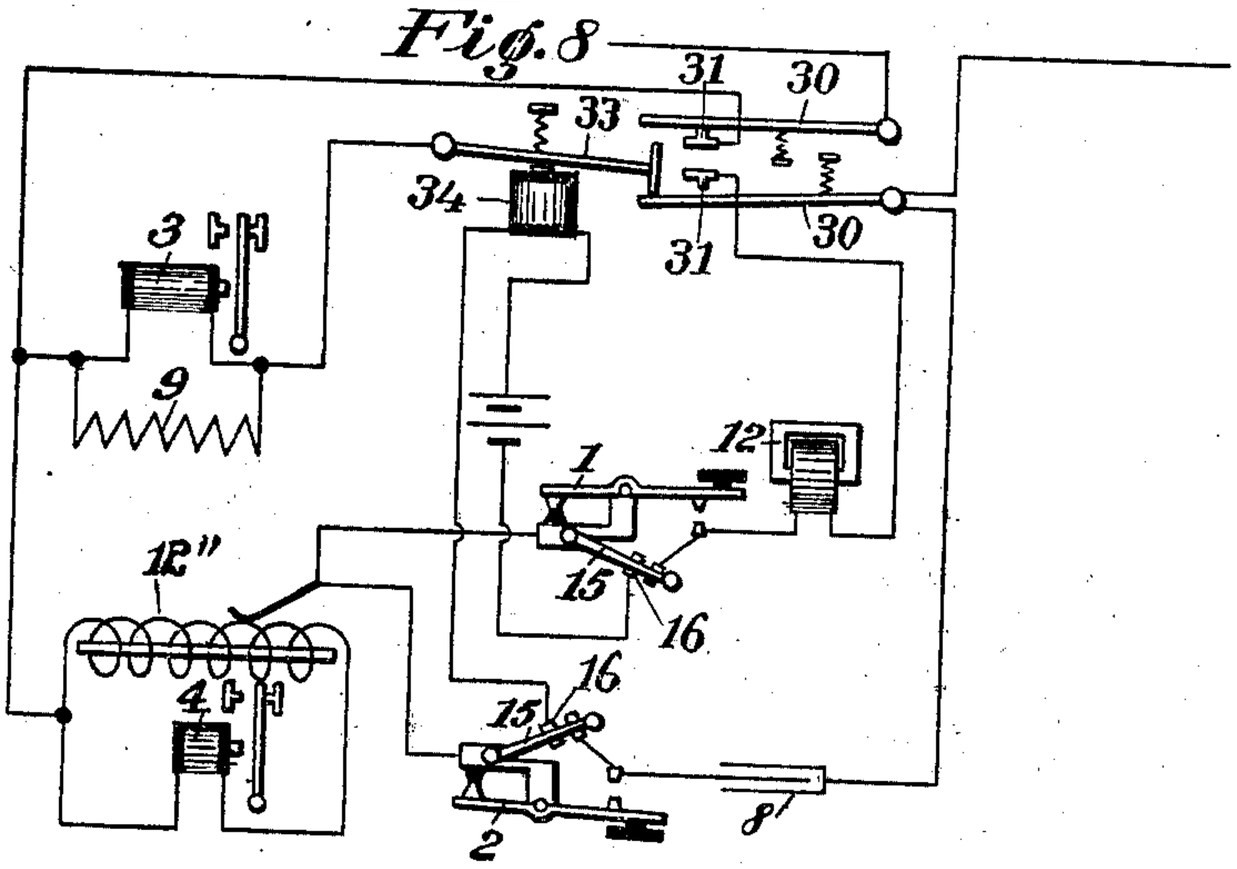


Fig. 8



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(Application filed Oct. 21, 1901.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 9

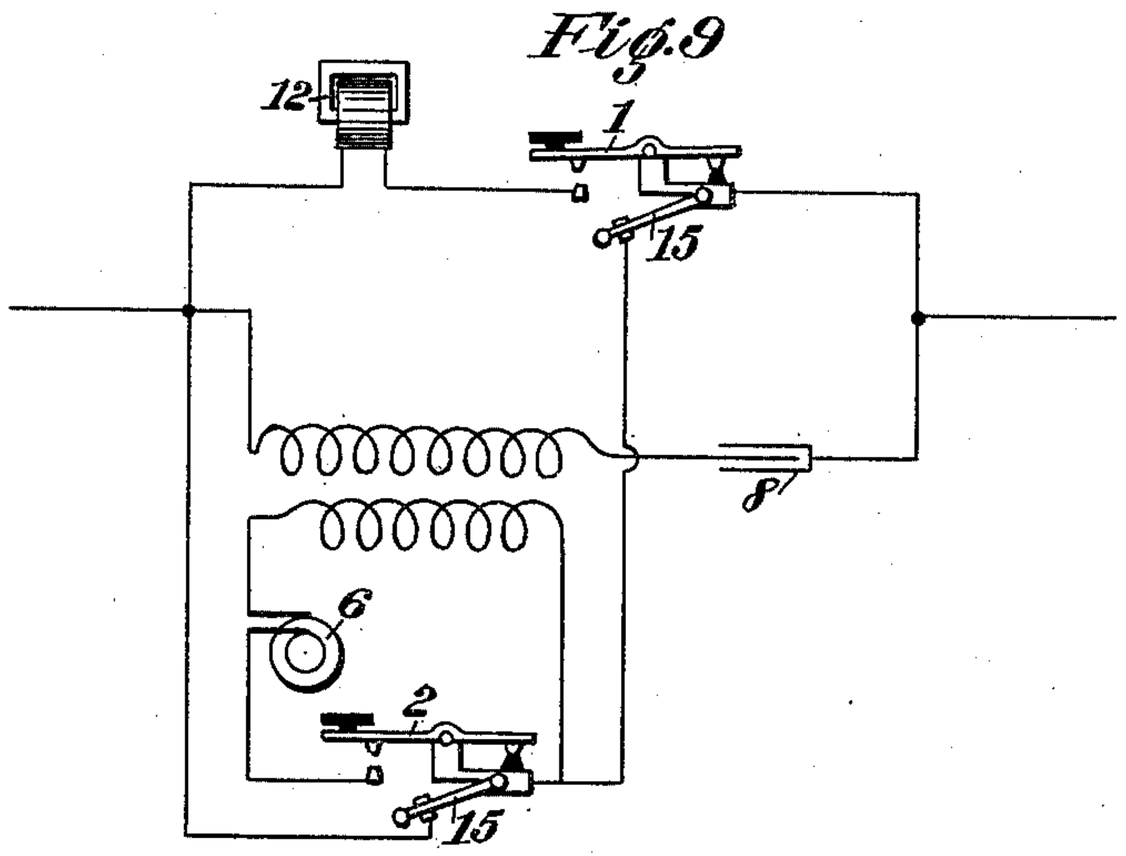


Fig. 10

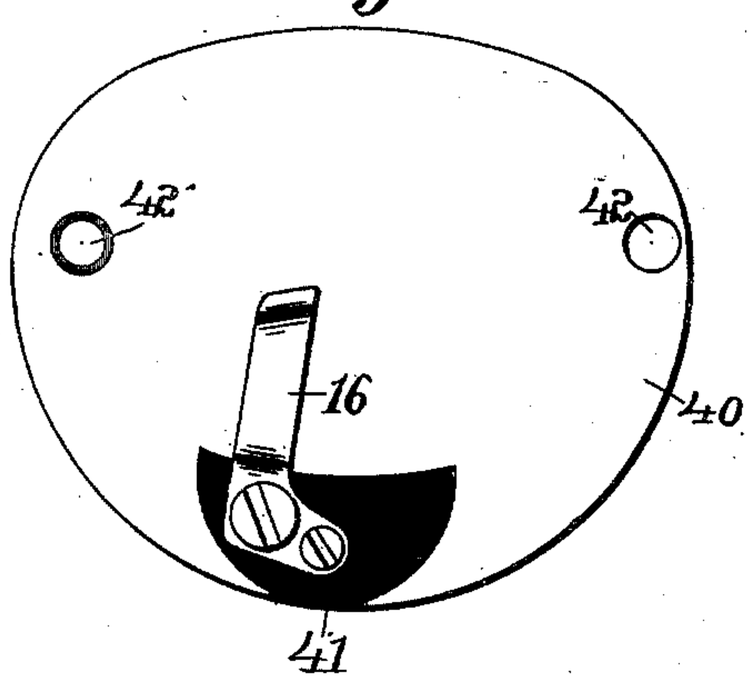
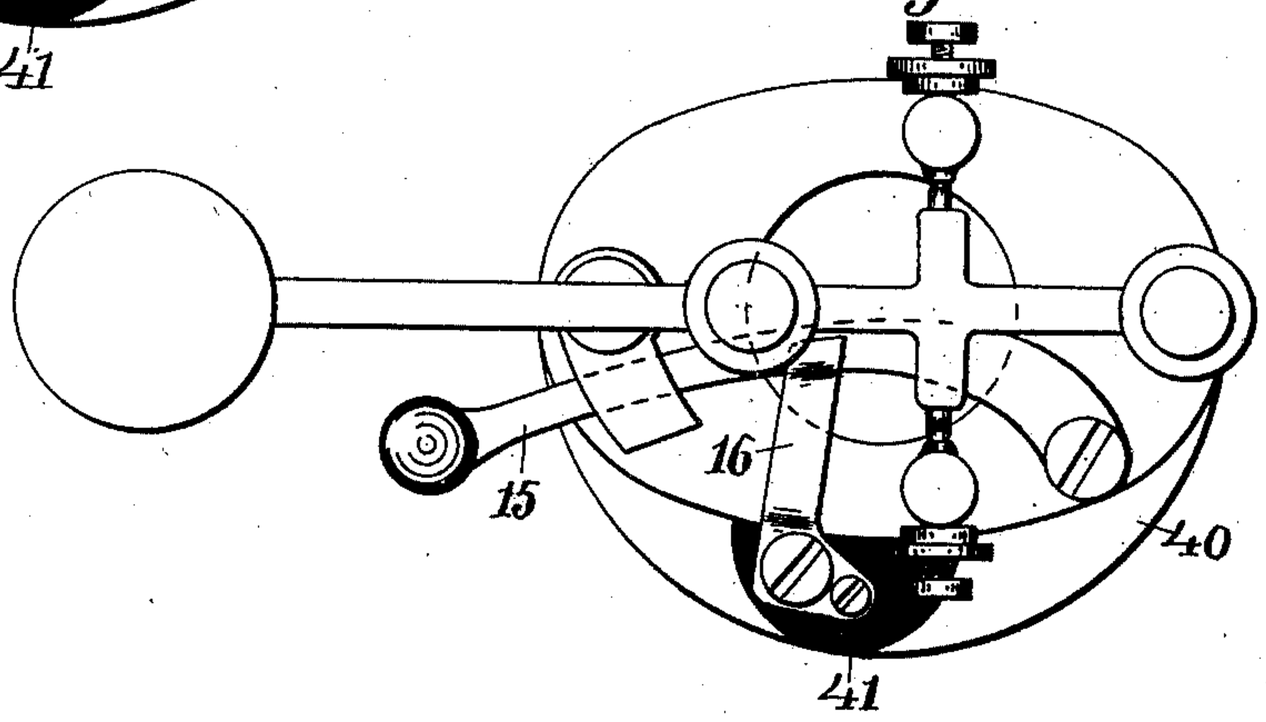


Fig. 11



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UNITED STATES PATENT OFFICE.

ALBERT C. CREHORE, OF TARRYTOWN, NEW YORK.

TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 707,829, dated August 26, 1902.

Application filed October 21, 1901. Serial No. 79,383. (No model.)

To all whom it may concern:

Be it known that I, ALBERT C. CREHORE, a citizen of the United States, and a resident of Tarrytown, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Telegraphy, of which the following is a specification.

My invention relates to that class of telegraphs known as "superposed-current" telegraphs, wherein two messages may be sent simultaneously over the same line or circuit, one by the use of momentary currents, or currents of short duration sharply defined or having a high rate of change of electromotive force, and the other by currents having a lower rate of change and, generally speaking, of longer duration and upon which the momentary currents are superposed.

In the following description the momentary currents will be referred to as "pulsatory currents," and the currents of longer duration will be referred to as "continuous currents."

As my invention is particularly useful when the continuous currents are used in the manner in which they are employed in the ordinary Morse telegraph, I will describe and show my invention as carried out in connection with a Morse telegraph-line.

While I describe my invention as carried out in connection with those superposed-current systems wherein the signals on the pulsatory-current side are transmitted by using for each signal a succession of pulsatory currents and determining the length of time during which pulsatory currents shall be permitted to flow uninterruptedly, it is also useful for those systems wherein two pulsations only are used for each signal, one marking the beginning and the other the end of the signal or character. It will also be obvious that on the pulsatory-current side of the system "spaces" might be made by permitting the pulsatory currents to flow and the signals be made by interruptions in the continuity of flow for greater or less periods of time.

My invention relates mainly to the transmitting portion of the system; and its object is to reduce the impedance to the flow of the pulsatory currents as well as of the continuous currents in a superposed-current system of telegraphy, thus permitting the system to be worked through a large number of way-stations, and also to secure other advantages more particularly hereinafter described.

The invention consists, broadly, of a novel system of superposed-current telegraphy for way-station work in which means are provided whereby the impedance of any inductance or condenser employed in transmitting over either side of the system may be removed from the circuit when the transmitting-key or other appliance is not in use, leaving only the impedance of any reactance or condenser at each station necessary for use in receiving on either side of the system. By this means the total normal impedance is greatly reduced, and the greatest increase at any time is that required for the two simultaneous transmissions, so that it is possible by my system to operate a way-station circuit with a very much larger number of stations than has heretofore been practicable.

My invention relates also, among other things, to the manner of arranging the transmitters for the continuous and pulsatory current sides of the system upon the circuit with relation to their receivers; and it consists, substantially, in placing said transmitters in branches around a condenser and an inductance, respectively, which branches are entirely independent of those branches or portions of the circuit in which the receivers for the continuous and pulsatory current sides of the system are located. The object of this part of my invention is to eliminate practically all disturbance of the receivers from the operation of the transmitters. This part of my invention may be used with any arrangement of receivers, although I prefer to employ that arrangement in which they are in shunt to one another and are provided with a third branch, which contains a non-inductive shunting-resistance, as hereinafter more particularly described.

My invention consists, further, in an approved arrangement of transmitters for the continuous and pulsatory current sides of the system with relation to one another; and it consists, substantially, in placing or locating them in shunt relation to one another, the shunt containing the continuous-current transmitter being provided with an inductance and

that containing the pulsatory-current transmitter being provided with a condenser.

While my invention has a large field of utility in a system wherein the signals sent on the pulsatory side of the system are sent without a pulsatory-current generator at said station, it is also useful in systems in which a generator is used in connection with the key or station from which signals are to be sent by the pulsatory-current side of the system.

As hereinafter described, the transmitter for the pulsatory-current side may be a device like a Morse key adapted to simply make and break the condenser-shunt, and the pulsatory-current generator may be then located at another station, or the transmitter may be a device adapted to introduce into or remove from the shunt a pulsatory electromotive force originating at its station, as would be accomplished by the use of a continuity-preserving key and pulsating generator or by including the secondary of a transformer in the shunt and using a key to make and break the circuit of a generator included in the primary circuit of said transformer.

In the subjoined description and claims, therefore, the term "transmitter" should be understood as including any of the arrangements above referred to or their equivalents.

Another feature of my invention relates to the means for short-circuiting the reactance and condenser when the two transmitters are in a special relation to one another—viz., a shunt relation; and it consists, substantially, of two interdependent switches so arranged and coöperating that neither can complete the short circuit around the apparatus unless the other is in position to close circuit.

My invention relates, further, to the relative arrangement of the two transmitters, each in its shunt or branch, as respects the condenser and reactance whereby the short-circuiting devices employed for short-circuiting the transmitting apparatus when not in use may be simplified; and it consists, substantially, in placing the transmitters at opposite ends, respectively, of the branches containing the condenser and inductance.

The invention consists also in the combinations of apparatus and details of construction hereinafter described and then specified in the claims.

In conjunction with the arrangement of transmitting devices herein described and claimed any desired arrangement of receiving apparatus upon the circuit may be employed. It is preferable to arrange said receiving apparatus, however, in branches or portions of the circuit independent of those containing the transmitters, and I also prefer to employ, in conjunction with the herein-claimed arrangement of transmitters, that arrangement of receivers which is more particularly described and claimed in another application for patent filed by me and which involves the placing of said receivers in shunt relation to one another and preferably with a non-inductive shunting resistance around the continuous-current receiver.

In the accompanying drawings, Figure 1 is a general diagram of circuits and apparatus for a way-station system equipped according to one way of carrying out my invention. Fig. 2 is a diagram of a system substantially the same as Fig. 1, excepting that some of the way-stations have continuous-current apparatus only and that the stations having pulsatory-current apparatus are provided with a pulsatory-current generator, whereas in Fig. 1 the pulsatory-current generator is at a terminal or another station and is continually furnishing pulsations to the circuit while transmission is going on. Fig. 3 shows the arrangement of Fig. 1 as it practically exists when two stations are transmitting simultaneously—one by the continuous-current side of the system and the other by the pulsating-current side—parts which are short-circuited and which do not, therefore, offer any impedance being omitted from the diagram. Fig. 4 shows, diagrammatically, the actual condition of the system, Fig. 2, as to impedance while transmission is going on over both sides of the system. Fig. 5 illustrates a modified arrangement of the transmitting apparatus that might be used with the same arrangement of receiving apparatus as is shown in Fig. 2 at stations A U W or with other arrangements, assuming that the transmission is to be effected by a pulsatory generator continually connected to the circuit during transmission on the pulsatory-current or No. 1 side. Fig. 6 shows another arrangement of the receiving apparatus that might be used with the arrangement of transmitting apparatus shown in Fig. 1, the receiving apparatus being in the relation to the circuit which it assumes when the switches of a way-station are thrown to position for transmitting. Fig. 7 shows the relation of said receiving apparatus to the circuit when the transmitting devices are not in use and the receiving apparatus is ready to receive a message. Fig. 8 shows a form of switching apparatus by which this rearrangement and removal of impedance used in transmitting may be effected. Fig. 9 shows another arrangement of transmitting apparatus for the pulsating-current side of the system. Fig. 10 shows in plan an attachment that may be made to an ordinary Morse key to adapt its circuit-closer to use in my system without reconstruction of the Morse key. Fig. 11 is a plan of the key with the attachment in place.

Referring to Fig. 1, 6 indicates the pulsatory-current generator employed in sending signals by the pulsatory-current side of the system. Said generator is preferably an alternating-current dynamo adapted to generate a sine-wave or approximately a sine-wave electromotive force, and the generator-coils of the machine may be connected directly to

the circuit, or, as well understood in the art, they may supply an electromotive force to the circuit inductively through the intervention of a transformer whose secondary is in the line-circuit, while the machine-circuit includes the primary of the transformer. The continuous-current generators, which might be dynamo-machines, are indicated by the numeral 5. One of these may be used at each end of the line or section of line to keep the line charged with continuous current, said generators being connected so that their polarities shall conspire. A pulsatory-current generator 6 is shown at each end of the line, which line, as indicated, has two terminal stations A W. In practice only one of the generators 6 would be used at one time. The generator at A is shown connected into the line in circuit with the continuous-current generator, while that at station W is shown disconnected. The switching appliances 24, whereby this may be done, may be of the typical form indicated. The generator 5 at the same station with the pulsating-current generator may be removed from the circuit by a switch 25. It will be understood, however, that the present invention is not confined to any particular location of the generators upon the circuit. The continuous-current transmitters, which may be ordinary Morse keys, are in each case marked 1, and the pulsatory-current transmitters, which may in each case also be Morse keys, are in each case marked 2. In Fig. 1 I show two terminal and four way stations; but a larger number of way-stations may be employed, and, in fact, with the arrangement shown I have operated successfully over a circuit having as many as twenty way-stations.

The line-circuit in the arrangement of transmitters shown in Fig. 1 is branched through said transmitters, so that they are in shunt relation to one another. In the shunt to the transmitter 2 which operates on the pulsatory-current side of the system is a suitable inductance 12, usually of considerable reactance and through which the continuous current may flow freely when the key 1 is closed in the operation of sending signals on the continuous-current side. The reactance or impedance of the coil 12, which is preferably of the closed-magnetic-circuit type, obstructs the flow of the pulsating currents, so that whenever the key 2 is opened in the process of sending a signal the coil 12 acts practically to open the circuit to the flow of the pulsatory current. The closure of the key 2 completes the shunt or branch around said coil 12, said shunt or branch being of such character as to permit the pulsatory current to flow freely. In the shunt or branch with the key 2 is a condenser 8, which operates in conjunction with the key 1 in the opposite shunt or branch during the process of sending signals on the continuous-current side of the system. While it opens the circuit or branch to the flow of the continuous currents, it does not prevent the pulsatory current from flowing. The key 1 operates on the continuous-current side of the system by simply making and breaking a shunt around said condenser, each opening of the shunt-circuit by the key 1 acting practically to open the circuit to the flow of the continuous currents, because when it is opened the only path for such currents is through the condenser. In cases where the circuit is short or the number of stations equipped with continuous-current apparatus is small the operation of the key 2, if the same were connected to a direct shunt across the terminals of the inductance 12, might by shunting the resistance 12 produce a false signal in the continuous-current receivers of the system. The condenser 8, while operating in connection with the transmitter 1 in the manner already described, has also the function of preventing such disturbance upon the continuous-current side of the system through variations of impedance introduced by the action of the key 2, since said condenser at all times keeps the shunt open to the flow of the continuous current, and the shunting of the reactance by key 2 will not, therefore, shunt the continuous current from the coil of 12. In a similar way if the key 1 were arranged to close its branch or shunt around the condenser directly without any reactance being included in the circuit of 1 it is obvious that the operation of the key 1 would under the conditions above supposed produce changes of impedance upon the pulsatory-current side of the system which might give rise to disturbance in the action of the pulsatory-current receivers. Such disturbance is, however, prevented by the presence of the inductance 12 at the time the key 1 is closed to send a signal by the continuous-current side. Inasmuch as the inductance 12 forms an obstacle to the flow of the pulsatory currents, pulsatory-current signals are not transmitted by the operation of the key 1. Hence it will be seen that by the arrangement of the keys in shunt to one another, one shunt containing the reactance and the other the condenser, each key may operate in the intended manner, one to form a shunt around a reactance, which shunt will permit the pulsatory currents to flow, and the other to close a shunt around a condenser, which will permit the continuous current to flow, while neither key will produce a disturbance upon that side of the system with which the opposite key is designed to work.

In the ordinary operation of the Morse keys it is usual to switch the key out of circuit when not in use by a supplemental switch-lever or circuit-closer upon the key-base, as well understood in the art. Such a circuit-closer is indicated by the numeral 15 and operates in each case to shunt the key 1 or 2 by completing the connection from the lever to the contact connected with the front post or anvil. The use of such a lever on each key without additional provision would

obviously, however, not short-circuit the reactance 12 or the condenser 8 when one or both keys are out of use, whether one or both switches be closed. It is also obvious that even if the key 1 be out of use the reactance 12 should maintain its relation to the circuit in order to permit the key 2 to send its signals, and, conversely, even if the key 2 be out of use the condenser should maintain its relation to the circuit if the key 1 be still in use. If both keys be out of use, however, it is desirable that the inductance and the condenser be both removed from the circuit in order to reduce the resistance of the line. To accomplish this result simply and without requiring any special construction of the telegraph-keys, I may arrange the said keys as shown at opposite end, respectively, of the branches in which they are included and provide the circuit-closer 15 with a supplemental contact 16. The supplemental contacts 16 being interconnected, as shown, it is possible for either operator to use his key and switch 15 in the ordinary way and to accomplish the following results: When both switches are open, the two keys 1 and 2 may be used simultaneously, and each operator may send his message over the circuit in a well-understood way—one by the pulsatory currents and the other by the continuous currents—without interfering with one another. When the operator using key 1 finishes sending, he throws his switch 15 just as he would on any ordinary Morse circuit, thereby short-circuiting his key and completing a connection from contact 16 to the contact 16 of the key 2. Inasmuch, however, as the switch 15 for key 2 is still open, no effect is produced by the closure of the switch 15 for key 1 beyond the mere short-circuiting of the contacts of the key, and the reactance-coil 12 still remains in the circuit as an obstruction to the flow of the pulsatory currents, so that key 2 will continue to act in its intended manner. As soon as, however, the operator using key 2 finishes transmitting the message he simply closes his switch 15 in the ordinary way to short-circuit his key, and thereby at the same time completes the connection on the contact 16, so that there is now formed a short-circuit from one side of the station directly to the other, avoiding both the reactance-coil and the condenser. Conversely it will be seen that if both keys be in use and the use of key 2 ceases first and its switch be then closed the operation of key 1 in shunting the condenser 8 will not be interfered with, but that as soon as the switch 15 of the key 1 is closed both the reactance-coil and the condenser will be short-circuited. It will also be seen that either key may be brought into use by simply opening its appropriate switch, which will have the effect of breaking the shunt for the key itself and also of breaking the short circuit for both the reactance-coil and the condenser, the connection of both of which in the circuit is necessary for the proper operation of either key.

The arrangement of the transmitters with the inductance and condenser in shunt relation to one another and also the arrangement of short-circuiting switches is useful with any arrangement of the receiving apparatus. I have shown it in Fig. 1 as employed upon a circuit on which the receivers are arranged in the manner described and claimed in another application for patent by me filed of even date herewith, Serial No. 79,385. In this arrangement the continuous-current receiver or relay 3 is in shunt to the pulsatory-current receiver 4 and condenser 8. The reactance or inductance of the relay 3 forces the pulsatory currents into the shunt or branch containing the pulsatory-current receiver, in which branch it may flow through said receiver and condenser. The condenser, on the other hand, forms a bar to the free flow of the continuous current and forces the same to take the path through the receiver 3 whenever said continuous current is permitted to flow over the circuit by the operation of a key 1, which, as already explained, closes the shunt around a condenser.

9 indicates a suitable non-inductive resistance placed in shunt to the receiver 3 to divert the discharge of the condenser 8 and prevent "kicks" in said receiver. It also operates to protect said receiver from the disturbing action of any other transitory or variable current coming from condensers, inductances, or other sources outside of the receiver branches by affording a shunt path or path of comparatively low resistance for them. It also has the function of diminishing the resistance of the station apparatus to the flow of pulsatory currents and permits the pulsatory current to flow down the line more freely to stations more distant from said generator, as set forth in my application for patent of even date herewith, Serial No. 79,385, in which this device is specifically claimed, together with the arrangement of receivers.

It will be noticed that the transmitters 1 are not in the shunt with the receivers 3, but are at points on the circuit outside said shunt, so that the instruments are less liable to disturbance upon the operation of the key and the discharge of the condenser in the shunt around it; also, the transmitter 2 for the pulsatory-current side of the system is in a shunt or branch independent of the branches containing the receiving instruments and for a similar purpose. This arrangement is of great practical importance, as it substantially eliminates the difficulties and disturbances in the action of the relays which would arise from the operation of the transmitters if the attempt be made to locate and operate them in the same branches with their receivers, respectively.

The diagram Fig. 1 shows a line having two terminal and four way stations. The terminal stations are marked A and W and the several intermediate stations are marked B,

C, U, and V. A larger number of intermediate stations might be employed. Upon examination of the diagram it will be seen that the switch 15 for the continuous-current side of the system at station V is opened and the switch 15 for the pulsatory-current side of the system at station A is also opened. At all other stations the switches 15 for both keys 1 2 are closed, and the impedance afforded by the inductance 12 and condenser used in connection with the transmitters is removed from the circuit at said stations. The receivers 3 and 4, however, maintain their relation to the circuit and each will respond to its own proper character of current. The pulsatory currents controlled by the transmitter 2 at station A flow over the whole circuit and operate all of the receivers 4 on the circuit, including that at station V, the action of the key being simply to open and close the shunt around the inductance 12 at station A and each closure allowing the pulsatory currents to flow freely over the circuit without encountering the impedance offered by the inductance 12. Said pulsatory currents flowing down the line operate upon all the receivers 4, even to the most distant. Similarly any key 2 at any station may be employed in transmitting the signals by the pulsatory-current side of the systems to stations farther down the line or toward station W. The operation of the key 1 at station V produces the usual effect of the Morse key on the continuous-current circuit, and all the instruments 3 on the circuit shown will respond in obvious manner. The actual condition of the circuit as to impedance, &c., under the condition assumed for the switches or circuit-closers can be more readily seen in the simplified diagram, Fig. 3. As will be seen, neither the inductance nor the condenser used in transmitting is in operative relation to the circuit at any station except at those engaged in transmitting, and the impedance offered by the same to the flow of the pulsating currents is therefore eliminated at stations B C U W and all others in the circuit excepting A and V. With a line having a large number of stations equipped as shown it may not be found expedient to transmit from station W toward station A through any large number of stations by the use of the pulsatory currents generated at A. Under such circumstances and if it is desired to reach as far as station A by the pulsatory-current side of the system the operator at W who wishes to use the pulsatory-current side may instruct station A on the continuous-current side of the system to remove the generator 6 from connection with the line at station A, and the operator at W may then switch in his generator 6 and by operating his key 2 will cause the pulsatory-current receivers at all the stations on the whole circuit to respond, inasmuch as the flow of currents from said generator is completely cut off by the action of said key. Also, as will be obvious, the operator at any intermediate station between W and A may transmit over the pulsatory-current side of the system effectually to all stations in the direction of station A in a similar way, the generator 6 having been connected at station W and that of A having been removed. If the station is near W, the operator may also transmit to W and intermediate stations between his own station and W by modifying the pulsatory current of generator 6 at station W through opening and closing the shunt around the inductance 12, as already explained.

I do not limit myself to placing the pulsatory-current generator at terminal stations on the circuit, as it may be placed at other points thereof and the flow of its current modified in the manner already described by the action of the key 2.

While I have shown all of the stations similarly equipped in the diagram Fig. 1, some intermediate stations might be provided with apparatus designed to work only on the continuous-current side of the system, as indicated at station C in Fig. 2 of the accompanying drawings.

In the diagram Fig. 2 I have shown two terminal stations A W and one intermediate station U, all provided with apparatus for telegraphing both by continuous and pulsating current. At the terminal-stations the transmitting apparatus for the pulsatory-current side of the system may be of any desired form, but is shown as comprising a key 2, controlling the local circuit of a magnet which operates upon a transmitter 2′ of the continuity-preserving type and having its contacts connected, as shown, to the condenser in the shunt around the key 1 and to the pulsating generator 6 in such manner that when the transmitter is opened the branch containing the condenser is closed directly to the continuation of the circuit leading to the generator 5 and earth. When the key is closed, the direct connection is broken and the generator 6 is included in the branch with the condenser, so that the pulsatory current generated thereby will be caused to flow upon the circuit and operate upon the receivers for the pulsatory-current side of the system. The transmitter 1 for the continuous side of the system is in the branch with the reactance 12, which latter operates to prevent the pulsating currents in the generator 6 from flowing in short circuit when said generator is connected into the condenser branch. The transmitting apparatus at station U is of similar character, so that when the transmitter 2′ is on its back stop the short circuit through the condenser will be closed directly, but when on its front stop the direct connection formed over the back contact will be broken and a substitute connection through the front contact including the pulsating-current generator 6 will be formed, so that pulsating currents from the latter will be supplied to the line and will affect all of the pul-

satory-current receivers 4 on the circuit. A similar arrangement of devices to that shown in Fig. 1 may be employed for cutting out the impedance of the condenser and inductance used in connection with the transmitting apparatus at the stations A U W or any stations similarly equipped. The circuit-closing switches 15, by which this is effected, are shown as used in connection with the transmitter 1 and with the key 2, which controls the transmitter 2′, and are connected in a similar way to those shown in the diagram Fig. 1. Upon the closure of both circuit-closers 15 a shunt which short-circuits both the reactance 12 and the condenser 8 is formed over the contacts 16 of the circuit-closers. Other way-stations upon the circuit, Fig. 2, may obviously be provided with continuous-current apparatus—as, for instance, stations B, C, and V. In each of these cases an artificial shunt containing a condenser 8 and an inductance 12′ is provided, said inductance taking the place of the inductance afforded by the receiver 4 at stations A U W and others similarly equipped. The inductance 12′ should be adjusted so as to balance by its reactance the opposing reactance of the condenser, and to thereby furnish at the stations B C V a ready path through said stations for the pulsatory currents at all times. This inductance 12′, as described in another application for patent filed by me of even date herewith, Serial No. 79,387, wherein I claim the balancing of the condenser capacity or reactance by the reactance, both arranged in the shunt to the continuous-current receiver 3, preferably consists of a coil wound upon a core which has a magnetic circuit of iron, completely closed excepting at one or more points, where a narrow or thin break is afforded by an air-gap or similar break in the magnetic continuity of the iron circuit. Said inductance might, however, be of other form. The transmitter 1 at each of the way-stations operates to break and close the circuit for the continuous currents, while the shunt containing the condenser 8 affords at all times a path for the pulsatory current. The non-inductive shunt 9 at said stations B C V has the function already described. Assuming that transmitter 1 at station B is in use and transmitter 2 at station U, the condition of the circuit at various stations as to the interposition of condensers and inductances used in transmitting would be as shown in skeleton in Fig. 4.

In the modified arrangement of the transmitter illustrated in Fig. 5 the transmitters 1 and 2 are arranged in shunt, respectively, to a condenser and to a reactance, but in series instead of shunt relation to one another. These shunts or branches, however, for said transmitters are, as in the previous figures, branches which are independent of those parts of the circuit in which the receivers are located. The receivers may be arranged in any desired relation to the circuit, but preferably in the relation already described. In circuit with the condenser 8′, to which the transmitter 1 forms a shunt, a coil may be placed for the purpose of preventing sparking at the contacts of the key. This coil is preferably an inductance-coil and is also preferably adjusted to balance by its reactance the reactance of the condenser 8, and thereby permit pulsatory current to flow more freely to said branch or shunt. For a reactance used in this relation I prefer to employ the form 12′, such as already described and which is claimed in another application for patent filed by me of even date herewith, Serial No. 79,387. Each key 1 and 2, Fig. 5, is provided with a circuit-closer 15 of any desired character. As will be seen in this arrangement, as in the other already described, both the inductance and the condenser used with the transmitting apparatus for both sides of the system may be shunted out of the circuit when the transmitters are not in use. In Fig. 6 the shunt arrangement of the transmitters is shown, together with a modified arrangement of the receivers. The receiver 3 for the continuous-current side of the system has the shunt 9 already described, and the receiver 4 is in shunt to an inductance or reactance 12″, operating after the manner of a transformer having a single coil to set up currents in the receiver branch. The arrangement of receivers as shown in Fig. 6 would not be permissible for a very large number of way-stations because of the high impedance that would be afforded to the currents flowing over the line, although under some circumstances it might be permissible when the apparatus at a station is in use for transmitting, provided that at all other stations where the transmitters are not in use provision be made for combining said receivers with one another and with a condenser in the manner already described, or, in other words, in substantially the relation indicated in Fig. 7. For the condenser used in this relation the condenser 8 used with the transmitters might be employed by making use of proper switching appliances—such, for instance, as indicated in Fig. 8—the action of which would be not only to rearrange the receivers with the condenser 8, but to shunt the inductance 12 in the transmitter branch with it entirely out of the circuit. As a switching appliance for this purpose an instrument like an ordinary pole-changing instrument might be used, but with two contacts insulated from one another instead of a common contact for the pair of contact-levers 30. The levers 30 of the pole-changer being connected, respectively, to the line the insulated contacts 31 would be connected, as shown, to one terminal of the receivers 3 and 4, while the contact-lever 33, which is placed between levers 30, would be connected to an opposite terminal of the receiver 3. Connection with the condenser 8 and the opposite terminal of receiver 4 would be made from one of the levers 30, as indicated. The circuit-closers 15

for the two transmitters 1 and 2 would control the local circuit of the operating-magnet 34, which acts on lever 33. When both circuit-closers 15 are in closed position, they complete, by the supplemental contact 16, already described, the local circuit of magnet 34, as may be traced in the diagram, thereby holding the parts in the relation shown, so that if circuit be traced from one bar or lever 30 to the other it will be found that the receivers and condenser are in the circuit relation indicated in Fig. 7. The opening of either circuit-closer 15 causes the lever 33 to reverse its position and to reverse the connections of levers 30 and contacts 31, so that the condenser 8 will be brought back to a shunt relation to the transmitter 1 and the reactance 12, which had previously been out of circuit, will be brought in shunt relation to the transmitter 2, while the receivers will be placed in circuit in series relation to one another, as shown in Fig. 6. This condition may be readily traced in the diagram Fig. 8 and will result from the operation of either circuit-closer 15 when either key 1 or 2 is to be employed for transmitting. By these devices, as by those already described, the reactance of any condenser and inductance employed in transmitting is removed from the circuit when the apparatus at a way-station is out of use. Other arrangements of devices might be used for accomplishing the same or substantially the same results as are effected by the particular arrangement illustrated in Fig. 8.

In Fig. 9 I show that modification of my invention which involves simply the use of a transmitter for the pulsatory-current side consisting of a transformer, a pulsating generator, and a controlling-key, the latter two devices being in the primary of the transformer, while the secondary holds the same relation to the circuit as the generator 6 at station U of Fig. 2. The circuit-closers 15 operate, like those already described, to shunt the transmitting apparatus out of the circuit when they are both in closed position, and the opening of either throws the apparatus into condition for transmitting.

In order to permit ordinary Morse keys as at present in use to be used for the purposes of my invention, I propose to mount the supplemental circuit-closing contact 16 upon a suitable base-plate 40, Fig. 10, which is preferably of metal, and in that case has the spring forming the contact 16 secured to a piece of insulation 41, that in turn is fastened to the base-plate 40. The plate 40 is provided with openings 42, through which the legs by which the ordinary Morse key is fastened to a table or base may pass. That one of the openings 42 through which the leg corresponding to the front contact of the key passes is provided with an insulating-bushing. To equip a key so that its circuit-closer 15, Fig. 11, as at present employed may operate in conjunction with a supplemental contact 16 in the manner already explained, it is simply necessary to place the attachment 40 beneath the base of the key, the key having been first removed from its support and the plate 40, with its attached contact 16, put in position upon said support.

It will be seen that in using the Morse keys the operators of the instrument and apparatus constructed and arranged in accordance with my invention will use the circuit-closers 15 in just the same manner as they employ them upon ordinary Morse circuits, and hence no difficulties will be encountered in equipping the circuit according to my invention because of the necessity of instructing the operators in any special use of the transmitting appliances. Moreover, the Morse keys at present employed may be utilized by simply attaching the device shown in Fig. 10.

What I claim as my invention is—

1. In a superposed-current telegraph, the combination substantially as described with continuous and pulsatory current receivers arranged in shunt relation to one another and having a condenser in the pulsatory-current branch, of transmitters for the two sides of the system arranged in shunt relation to one another, an inductance in the branch with the continuous-current transmitter, and a condenser in the branch with the pulsatory-current transmitter, said transmitter branches being independent of those containing the receivers.

2. In a superposed-current telegraph, the combination of transmitters for the pulsatory and continuous sides of the system respectively, arranged in shunt relation to one another, and an inductance in the shunt or branch containing the continuous-current transmitter whereby when the latter transmitter is closed the transmitter in the other branch opens and closes a shunt around the branch which offers an impedance to the flow of the pulsatory current.

3. In a superposed-current telegraph, a single main line having transmitting apparatus for the continuous and pulsatory sides of the system respectively, arranged in shunt relation to one another, in combination with an inductance in the shunt containing the continuous-current transmitter and a condenser in the shunt containing the pulsatory-current transmitter.

4. In a superposed-current system of telegraphy, the combination with the continuous-current and pulsatory-current transmitters at a station, of means for short-circuiting the transmitting apparatus for the pulsatory-current and continuous-current sides of the system respectively, said short-circuiting devices being connected in series as described so that neither shall be effective to short-circuit until both are thrown to short-circuiting position.

5. In a superposed-current telegraph, the combination substantially as described, of a continuous-current transmitter and a pulsa-

tory-current transmitter placed in shunt relation to one another upon the same circuit but both in series relation to the portion of circuit containing the receivers said transmitter branches or shunts containing respectively a condenser and an inductance as and for the purpose described.

6. In a superposed-current telegraph, two branches of the line-circuit in shunt relation to one another, one containing a Morse key and inductance, and the other a condenser and Morse key, said keys being arranged at opposite ends of the branches respectively, with their short-circuiting switches connected direct to line, and supplemental contacts for said switches connected together as and for the purpose described.

7. In a superposed-current telegraph, the combination substantially as described of a transmitter for the continuous-current side of the system and an inductance arranged in one shunt or branch of the circuit, a transmitter for the pulsatory-current side of the system and a condenser arranged in another branch which is in shunt relation to the first-named branch said transmitters being placed at opposite ends of their shunts or branches respectively, a switch for each transmitter whereby it may be short-circuited without short-circuiting the reactance or condenser as the case may be, and supplemental contacts for said switches connected as described so that only when both switches are closed both the inductance and condenser will be short-circuited.

8. In a superposed-current system of telegraphy, the combination substantially as described, with suitable continuous-current and pulsatory-current receivers, of continuous-current and pulsatory-current transmitters, a condenser in a shunt to a branch containing the continuous-current transmitter and an inductance in a shunt to the branch containing the pulsatory-current transmitter, said transmitter branches being independent of those branches or parts of the circuit in which the said receivers are located.

9. In a superposed-current telegraph, transmitters for the continuous-current and pulsatory-current sides of the system respectively, arranged in shunt relation to one another and each adapted to make and break the shunt in which it is placed, in combination with an inductance in the shunt containing the continuous-current transmitter and a condenser in the shunt containing the pulsatory-current transmitter.

10. In a superposed-current telegraph, the combination of a pulsatory-current generator, a continuous-current generator, transmitting-keys adapted to make and break circuit and normally short-circuited, a condenser, a reactance and means for introducing the keys into circuit, one in a condenser-shunt around the reactance and the other in a shunt around a condenser.

11. In a superposed-current system of telegraphy, the combination with way-station receiving apparatus comprising a continuous-current receiver in shunt to a condenser and the pulsatory-current receiving apparatus while the apparatus is in the condition for receiving, of transmitters for the two sides of the system both normally short-circuited, branches or shunts of the circuit, one a condenser shunt or branch around a reactance, and the other an inductance shunt or branch around a condenser, and means for including said transmitters respectively in the branches.

12. The combination with the continuous and pulsatory current transmitters in shunt relation to one another, of a reactance, a condenser, and two interdependent circuit-closing devices, one for each key, coöperating as described to short-circuit the condenser and reactance.

13. In a superposed-current system of telegraphy, the combination with two branches of the circuit one containing an inductance and transmitter, and the other containing a condenser and transmitter, of a short-circuiting device for each branch, one adapted to shunt the inductance and the other to shunt the condenser said short-circuiting devices being connected in series as described.

14. In a superposed-current system of telegraphy, two branches of line-circuit in shunt relation to one another, one containing an inductance and Morse key, the other a condenser and Morse key combined with key-switches having supplemental contacts, and a connection between said contacts forming a short circuit for both the inductance and the condenser, as and for the purpose described.

15. In a superposed-current telegraph, the combination of transmitting apparatus for the pulsatory-current side of the system, an inductance-shunt therefor, transmitting apparatus for the continuous-current side of the system, a condenser-shunt therefor and circuit-closing devices for said transmitting apparatus adapted to form a short circuit around both the inductance and the condenser when said transmitting apparatus is out of use.

16. In a superposed-current telegraph, the combination of a continuous-current receiver, a pulsatory-current receiver, a condenser, an inductance, continuous-current transmitting apparatus in a branch of the circuit independent of the continuous-current receiver and forming a shunt to the condenser, pulsatory-current-transmitting apparatus in a branch of the circuit independent of the pulsatory-current receiver and forming a shunt to the inductance, and circuit-closing devices adapted to short-circuit both said inductance and condenser when either transmitting apparatus is not in use.

17. In a superposed-current telegraph, the combination of an inductance, a pulsatory-current transmitter adapted to transmit signals by opening and closing a branch of the

main line around said inductance, a condenser in the branch with the pulsatory-current transmitter, a continuous-current transmitter adapted to open and close a branch of the main line around said condenser, and circuit-closing devices for shunting either the condenser or inductance out of the line-circuit when either transmitter is not in use.

18. In a superposed-current telegraph, the combination with a pulsatory-current generator and a Morse key controlling the connection of said generator with the line of a circuit-closer for said key, and a contact therefor connected to a branch leading from the key to the line around the coils of said generator.

19. In a superposed-current telegraph, the combination of an inductance in a main line and a pulsatory-current transmitter adapted to close and open a shunt around the same, a continuous-current receiver, and a condenser in said shunt for obviating disturbances in the continuous-current receiver through variations of line-resistance produced by the action of said transmitter.

Signed at New York city, in the county of New York and State of New York, this 16th day of October, A. D. 1901.

ALBERT C. CREHORE.

Witnesses:
J. GALLWITZ,
E. L. LAWLER.