(No Model.) 11 Sheets—Sheet 1.

G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 1.

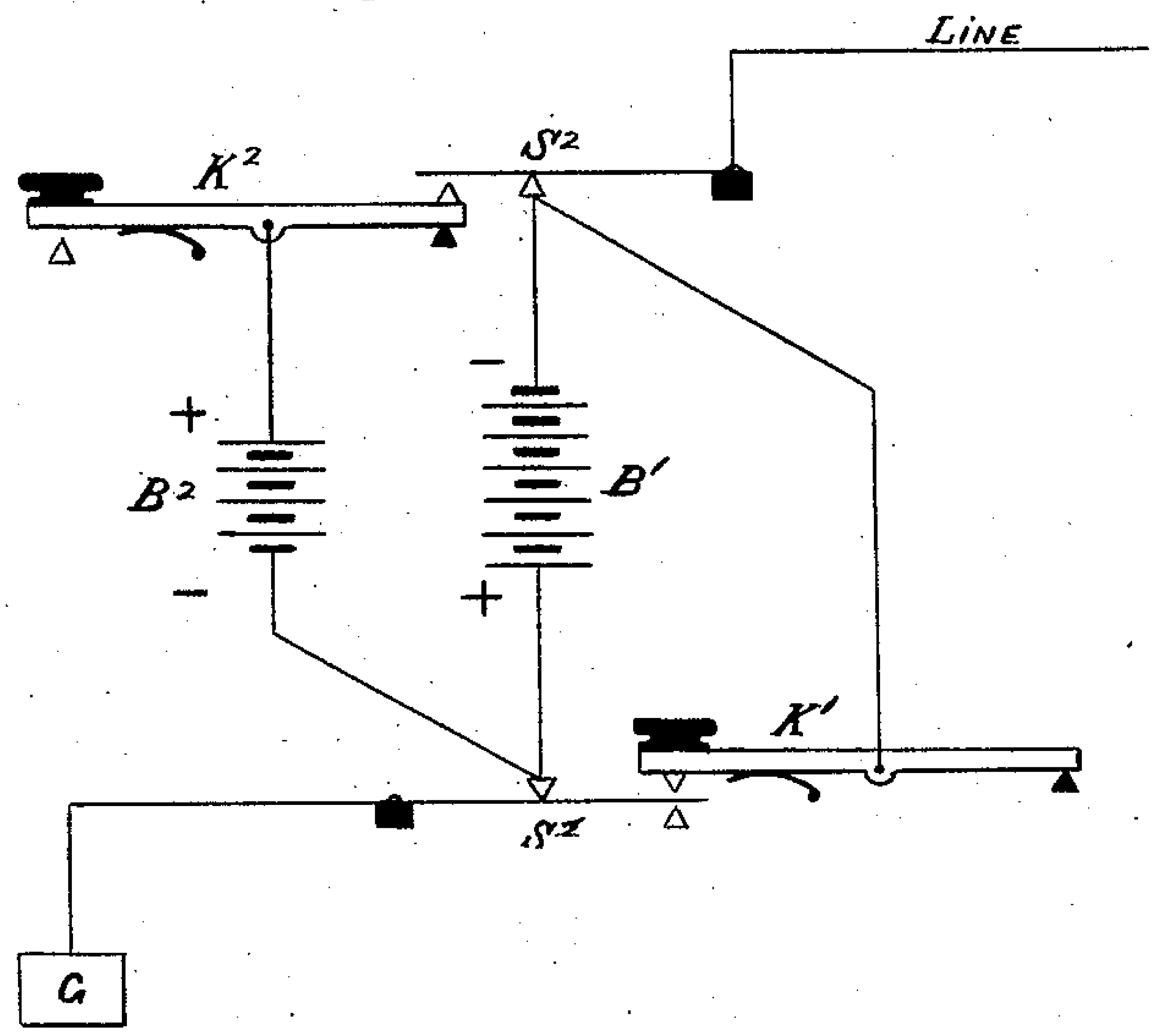
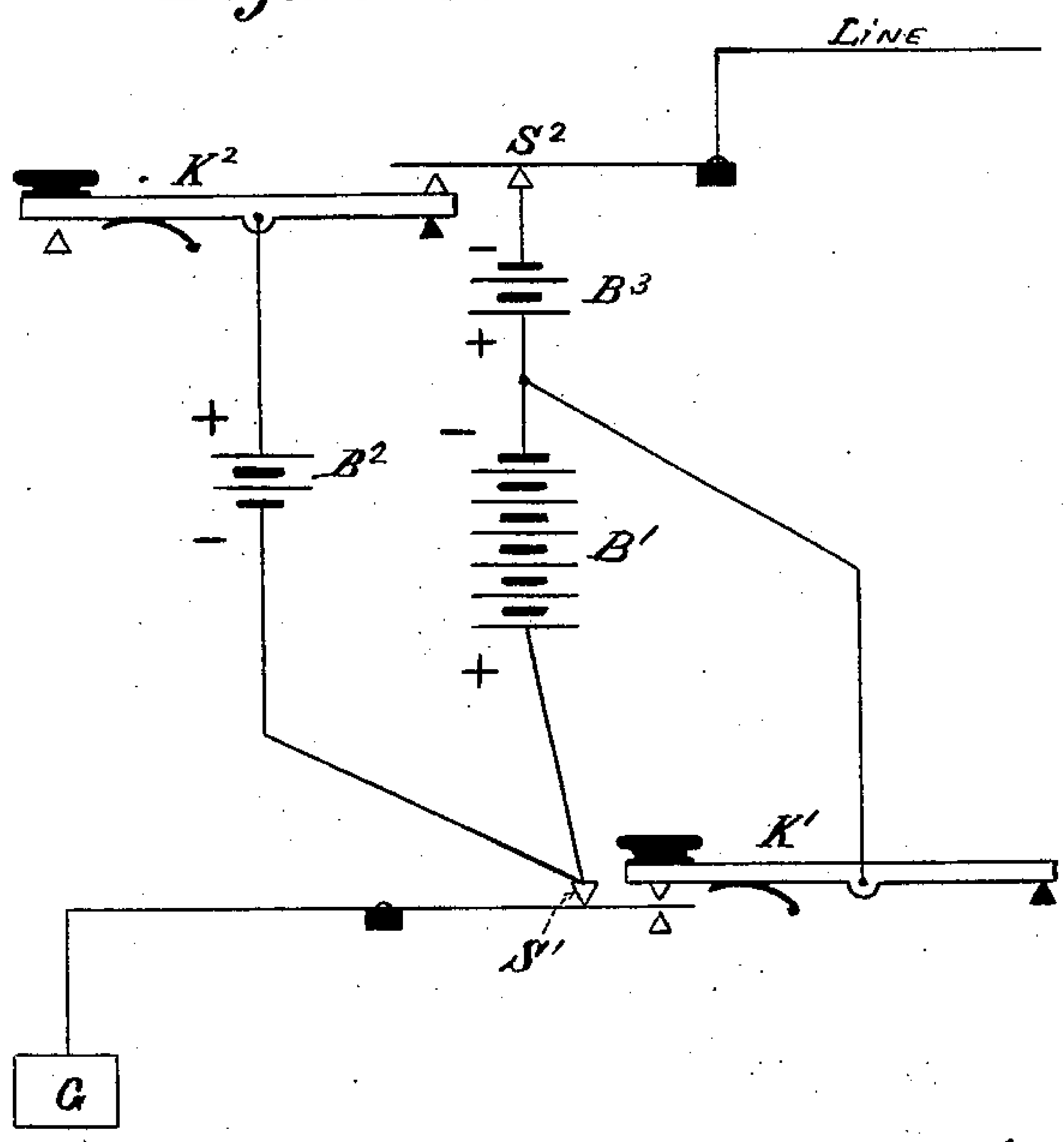


Figure 2.



Witnesses:

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Geo. W. Miatt

Inventor:

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By his attorney

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(No Model.) 11 Sheets—Sheet 2.

G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

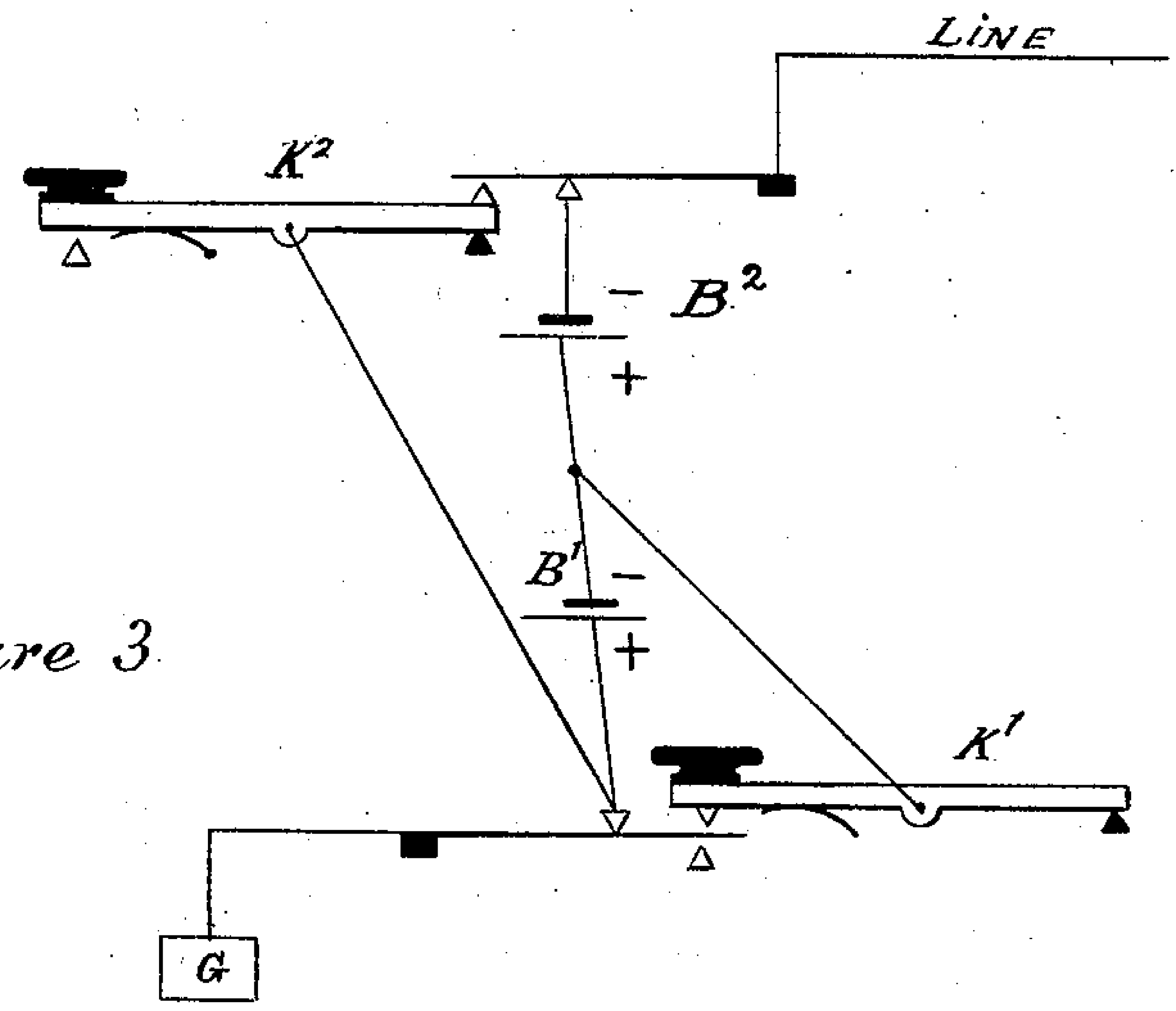

Figure 3

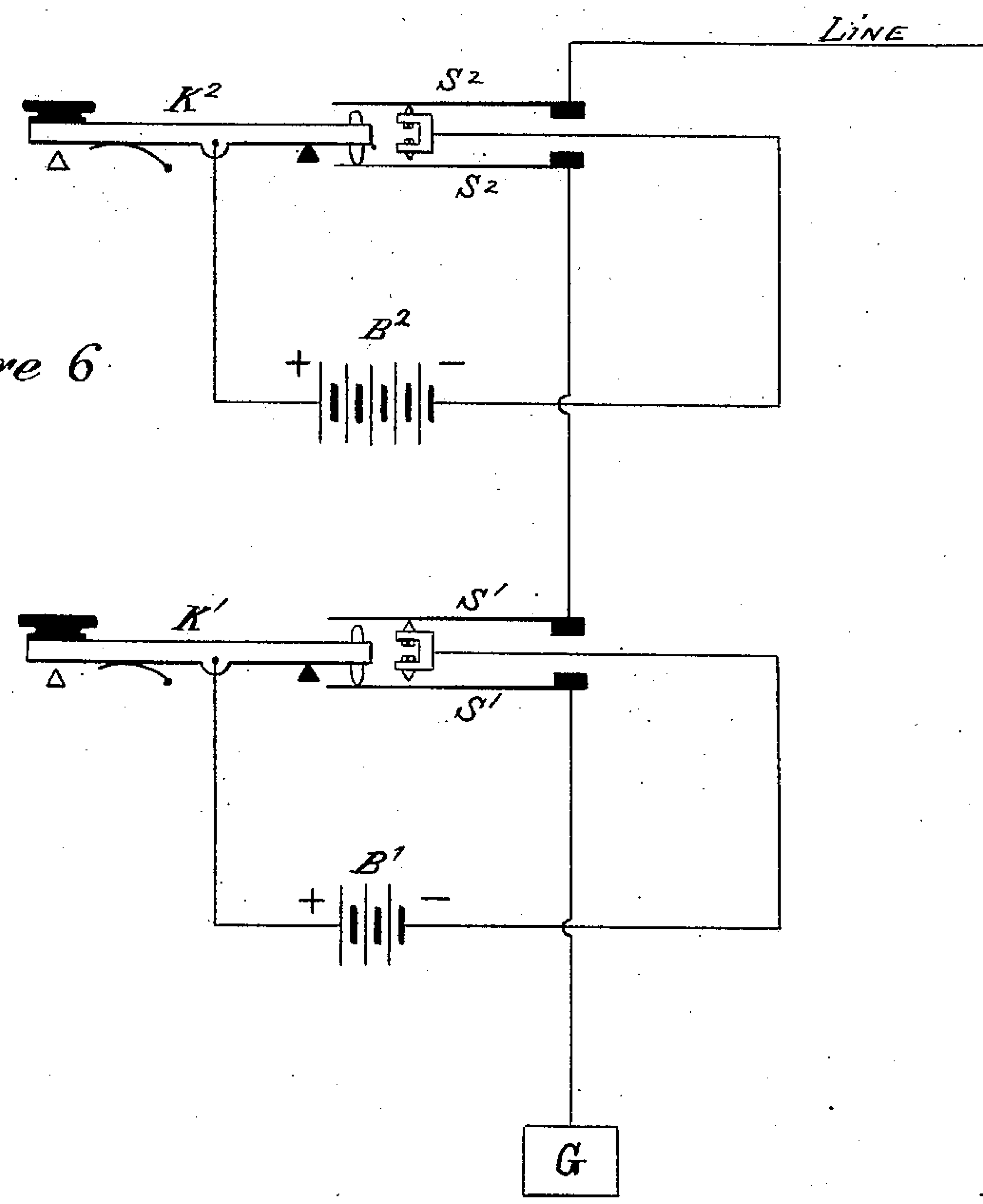

Figure 6

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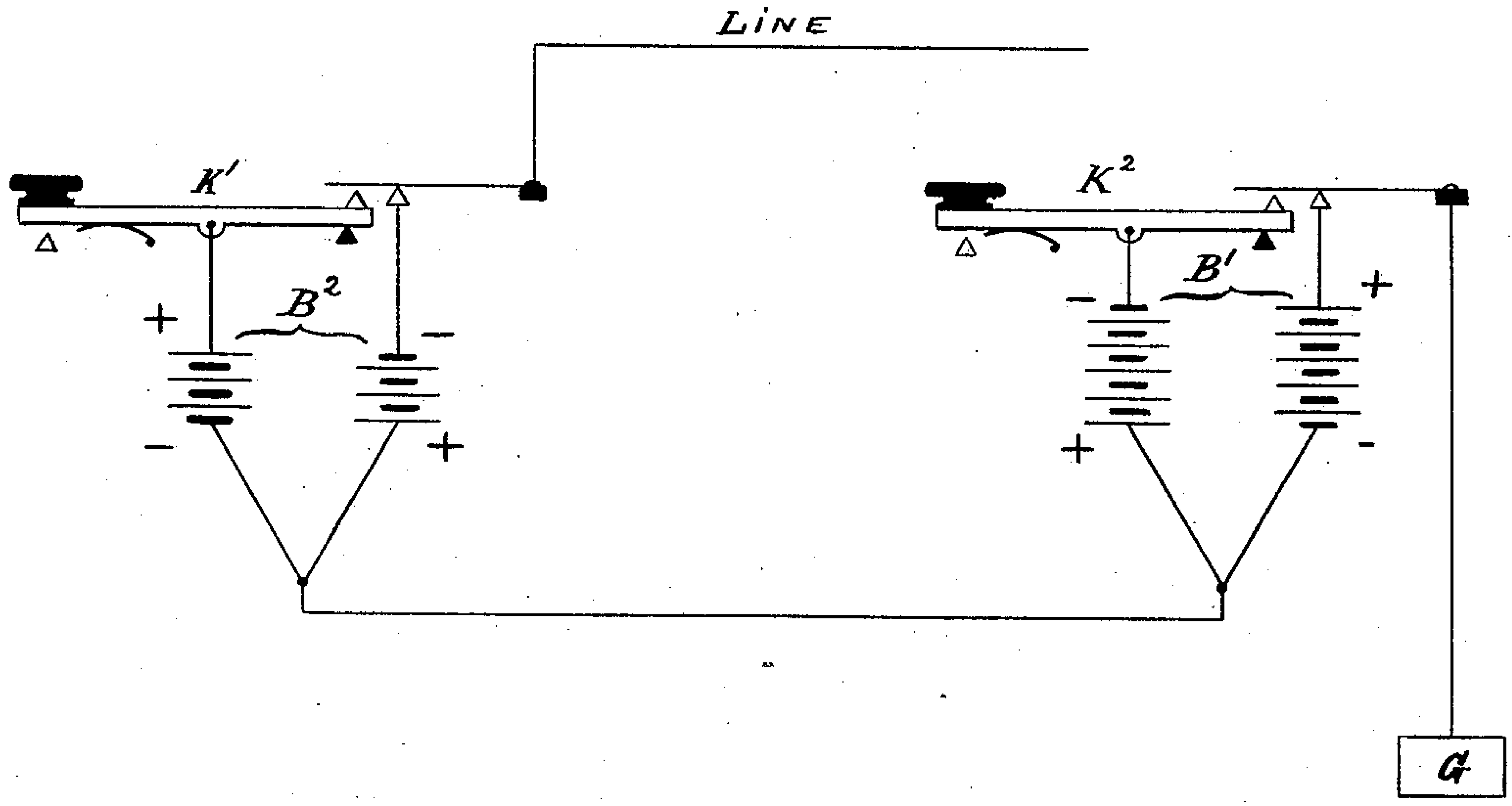
G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 4.



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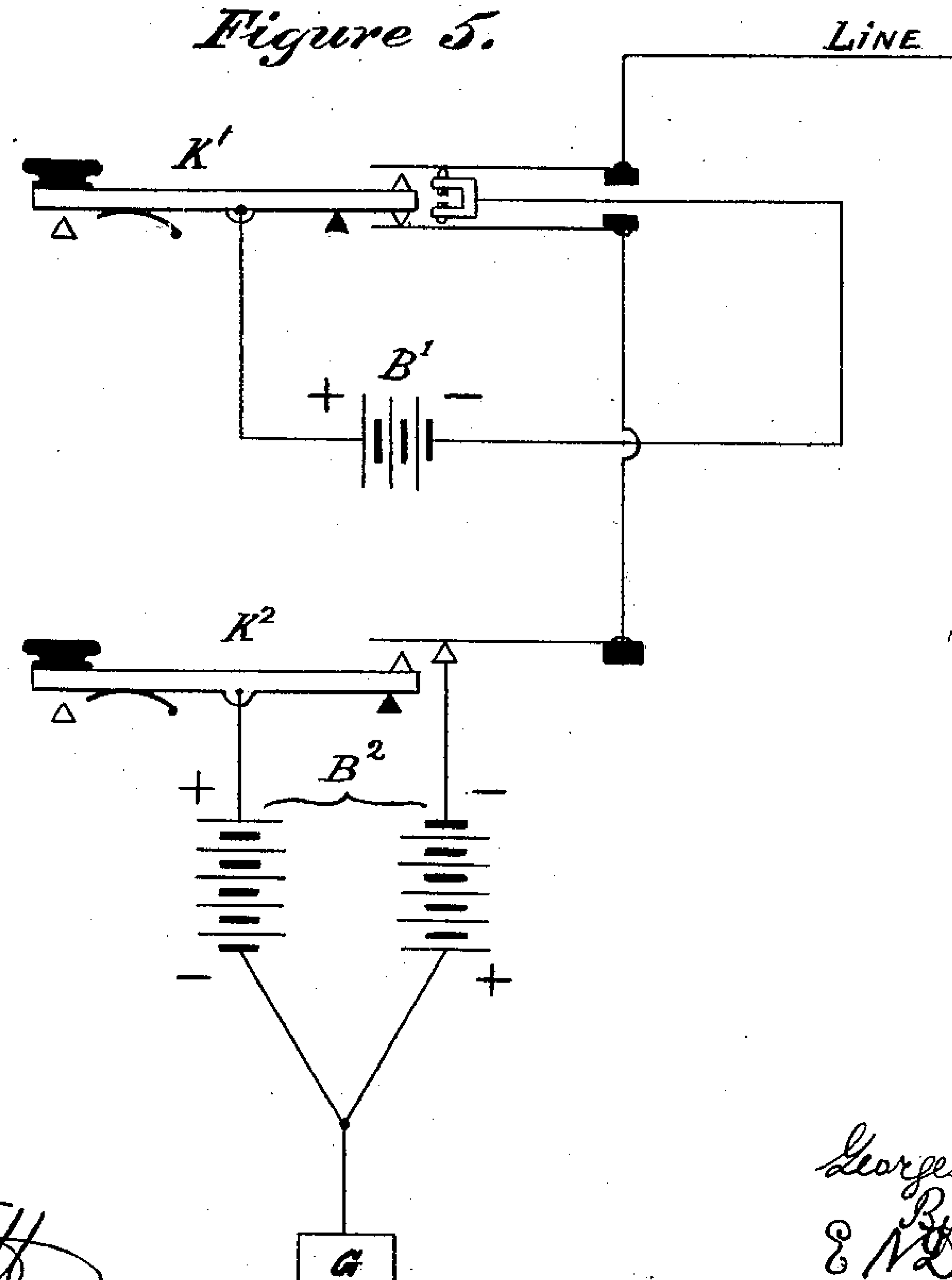

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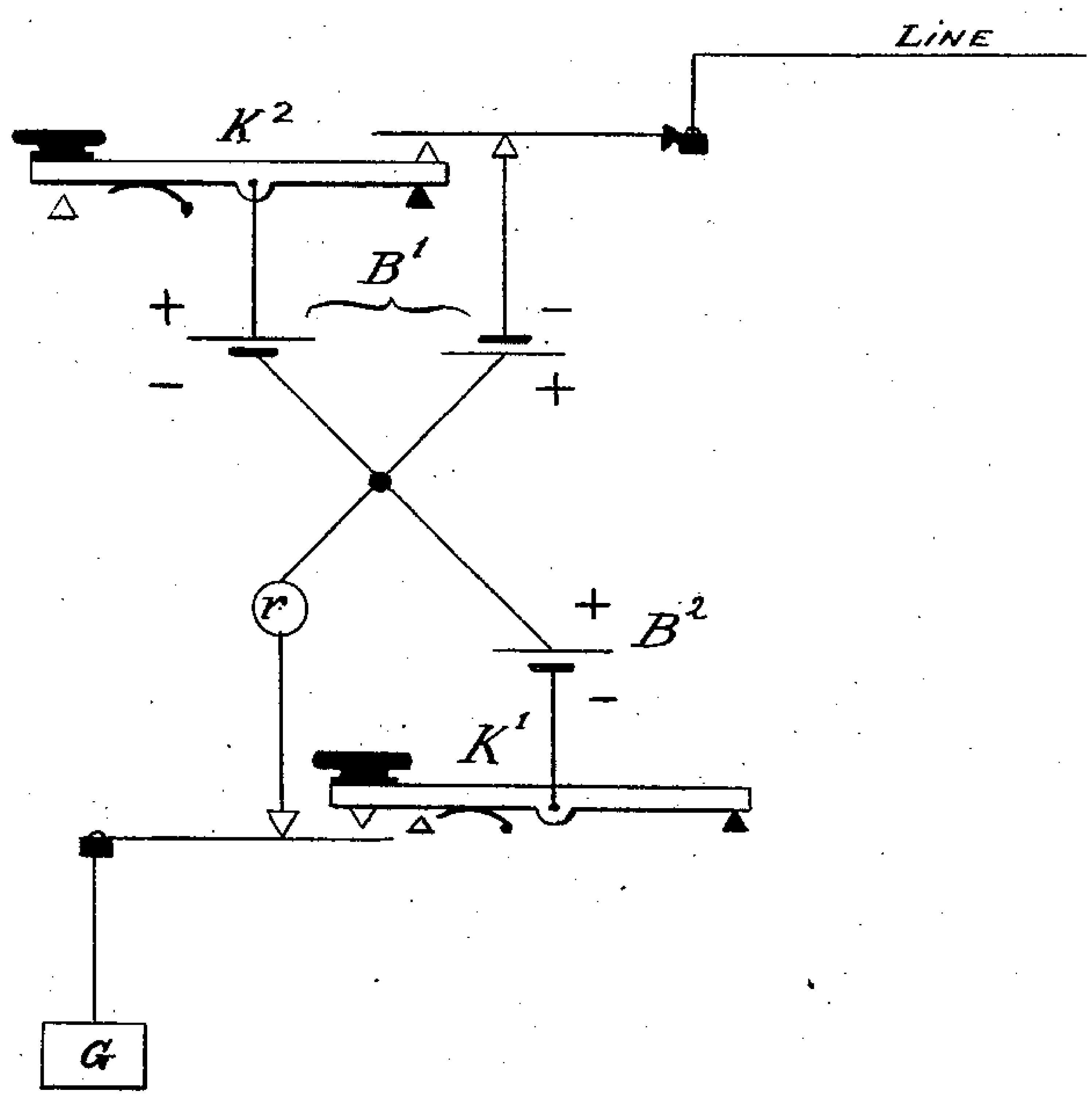
(No Model.) 11 Sheets—Sheet 4.

G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 7.



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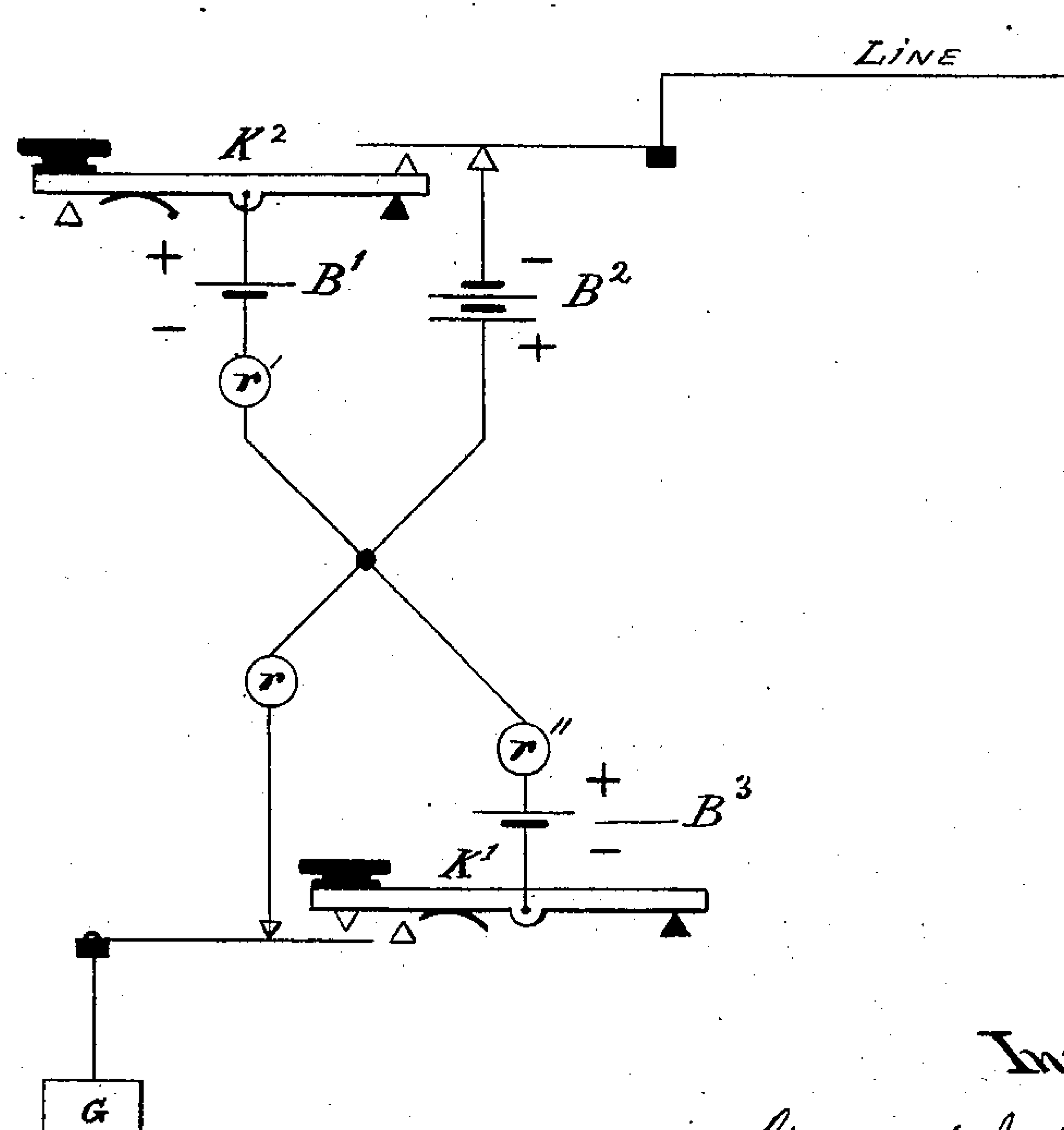

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G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 9.

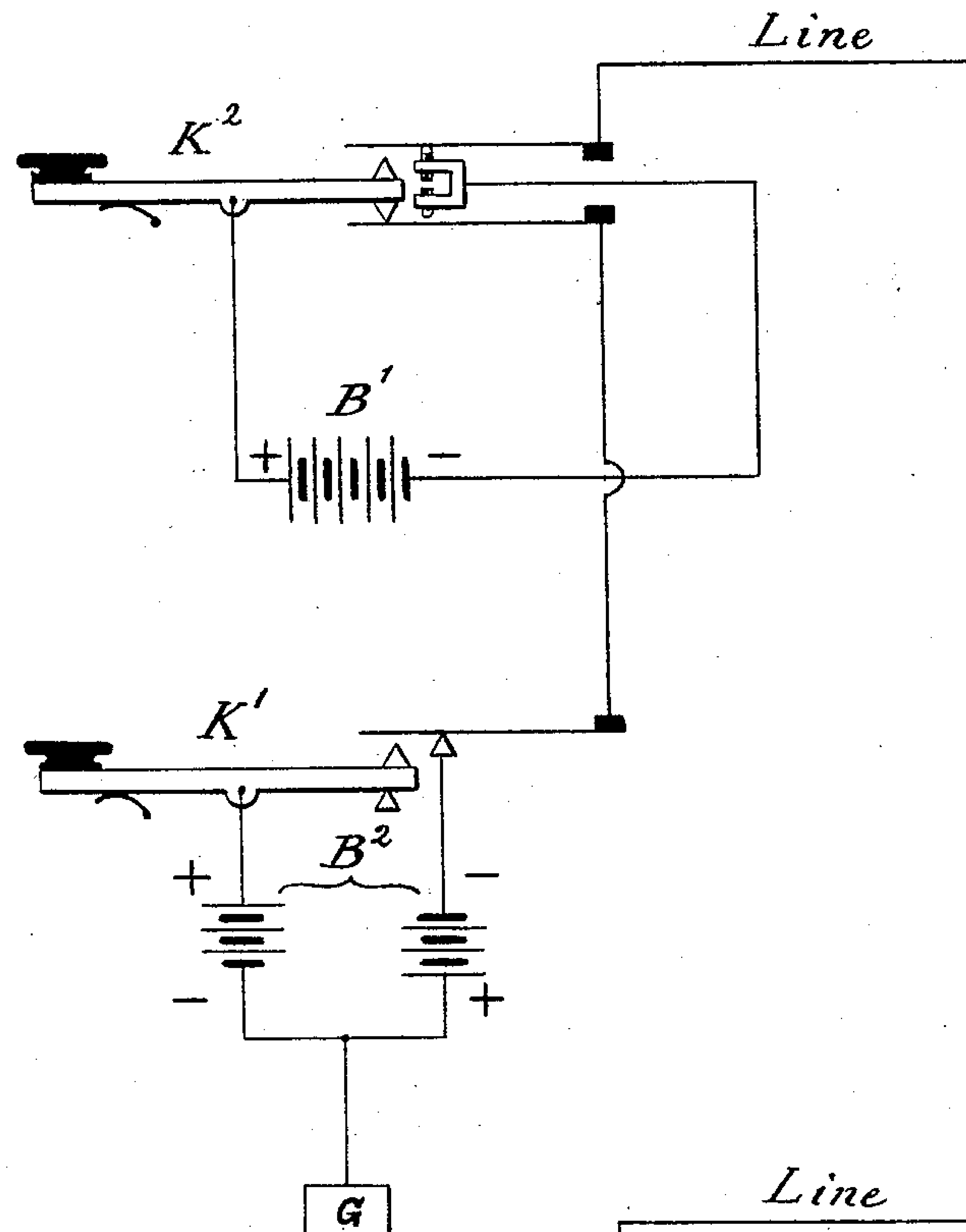
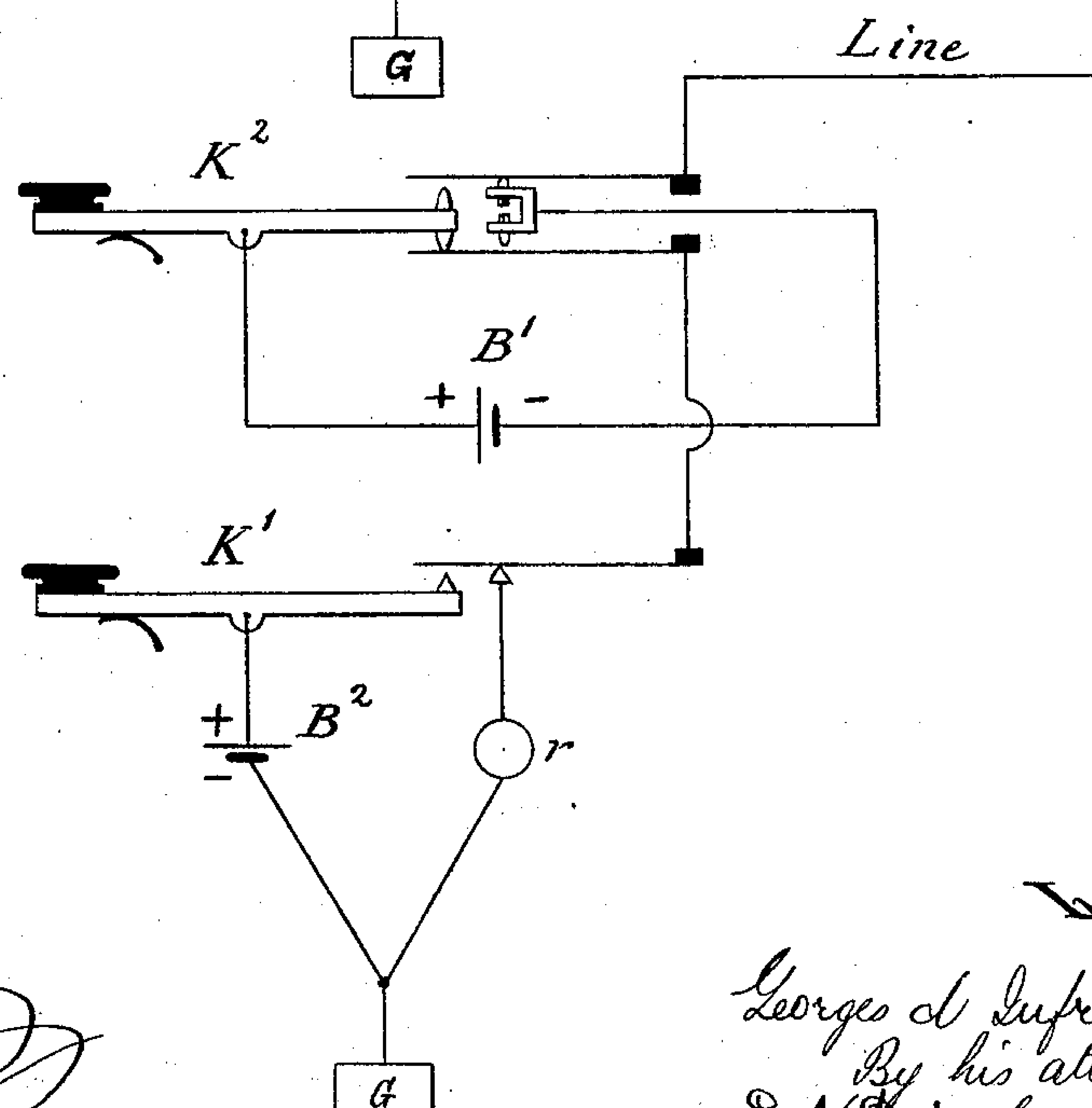


Figure 10.



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G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 11.

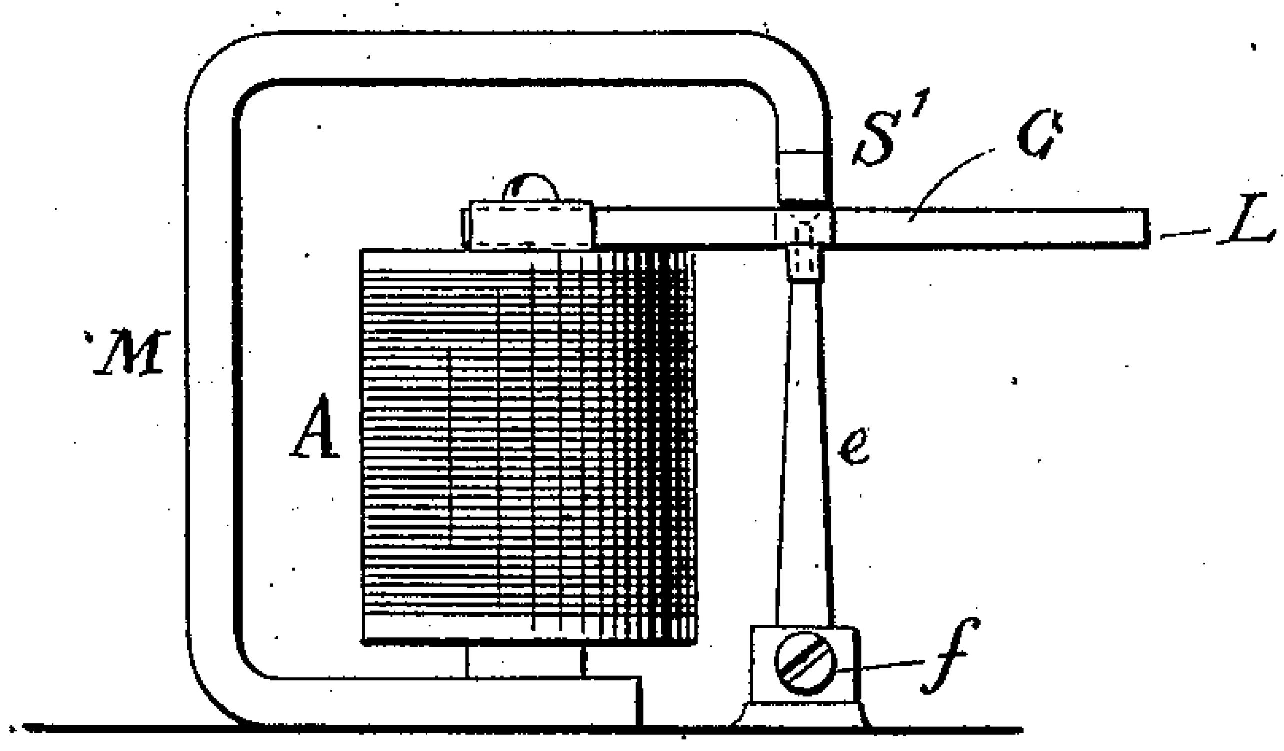
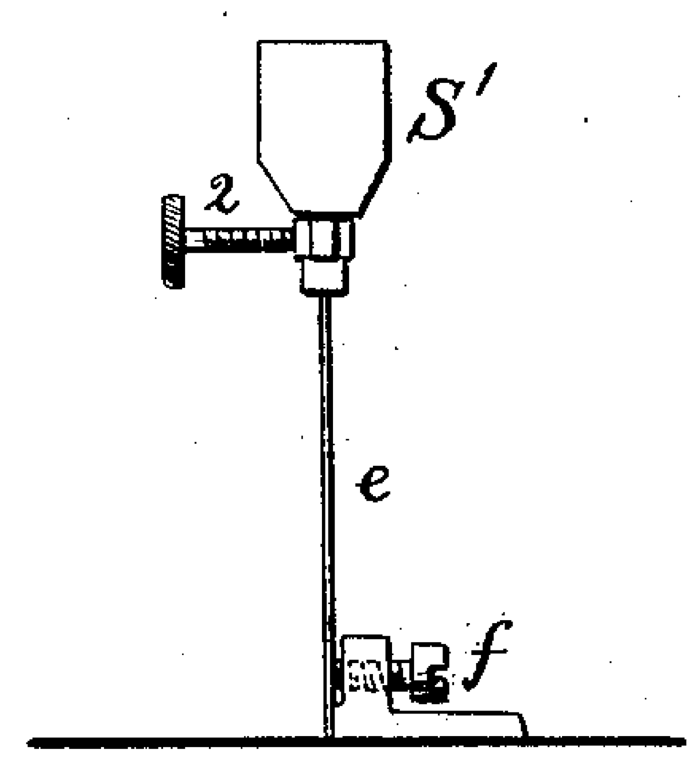


Figure 12.



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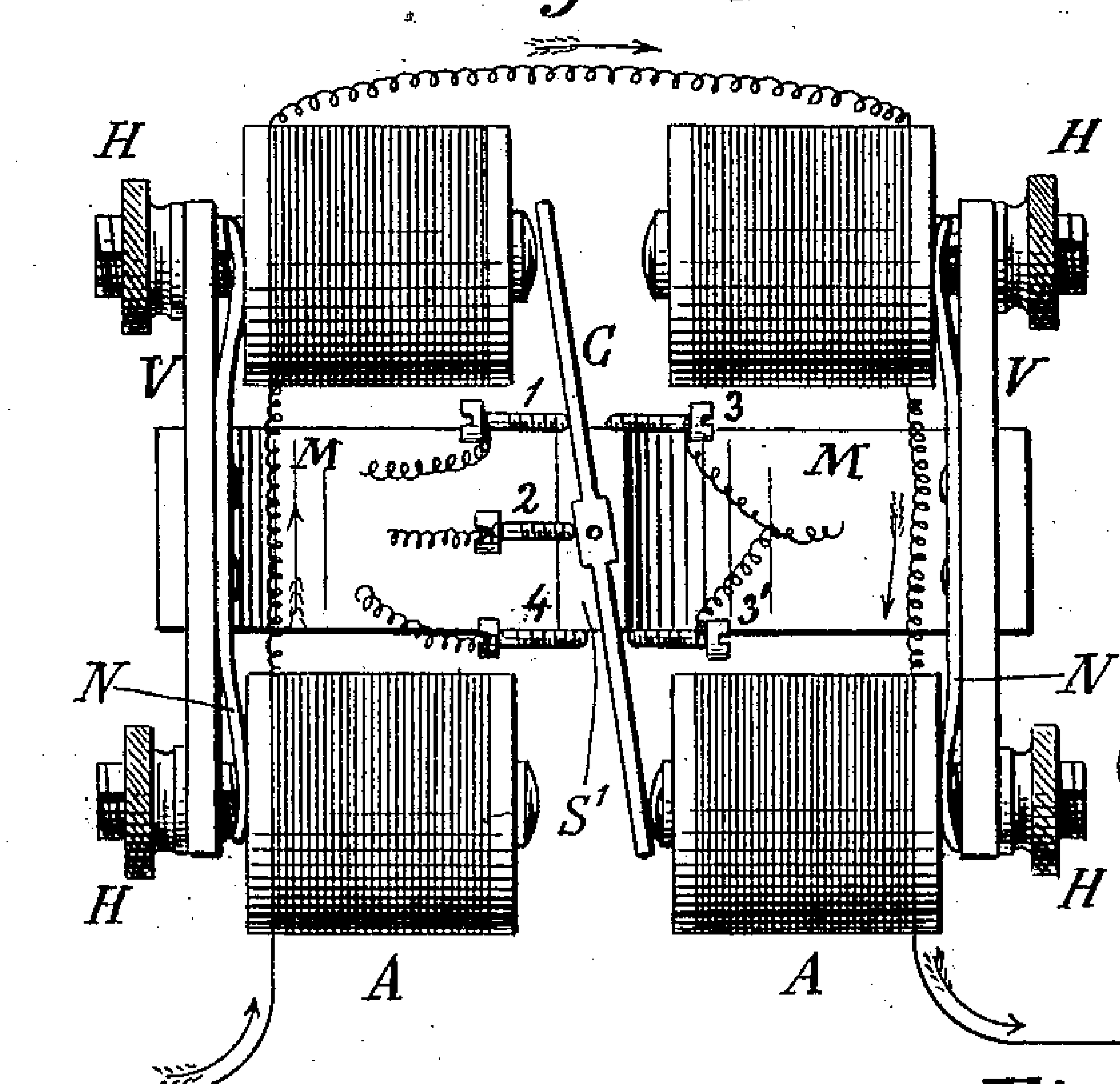

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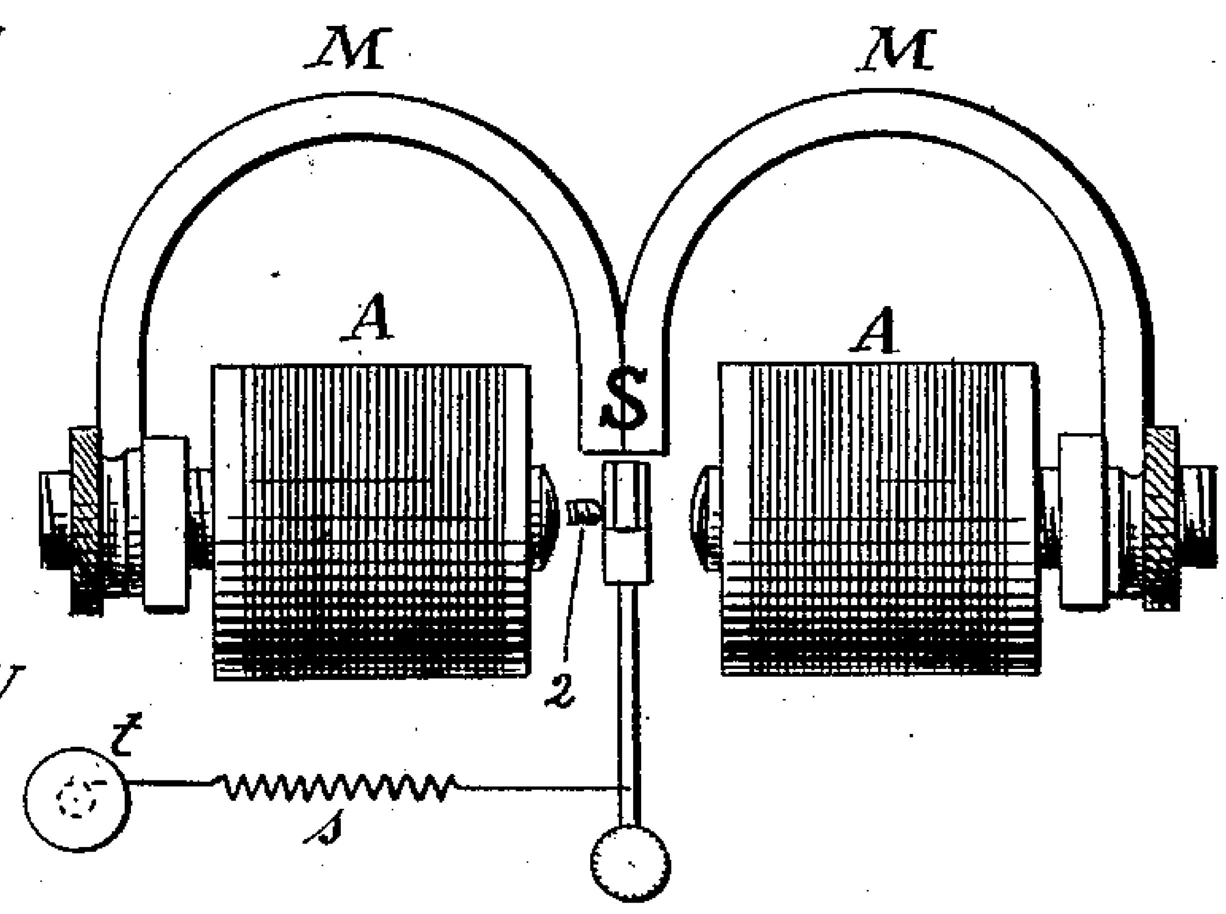

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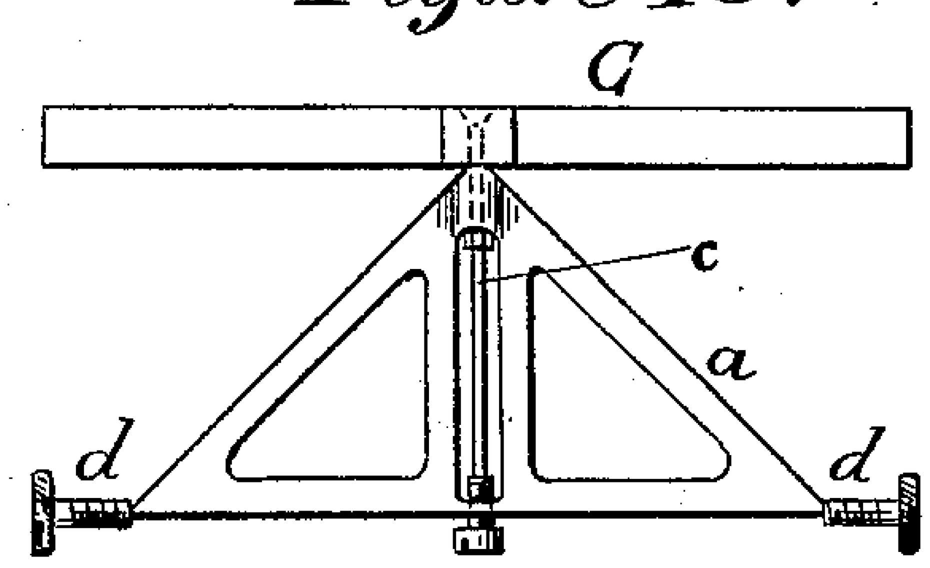

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(No Model.)

11 Sheets—Sheet 7.

G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 16

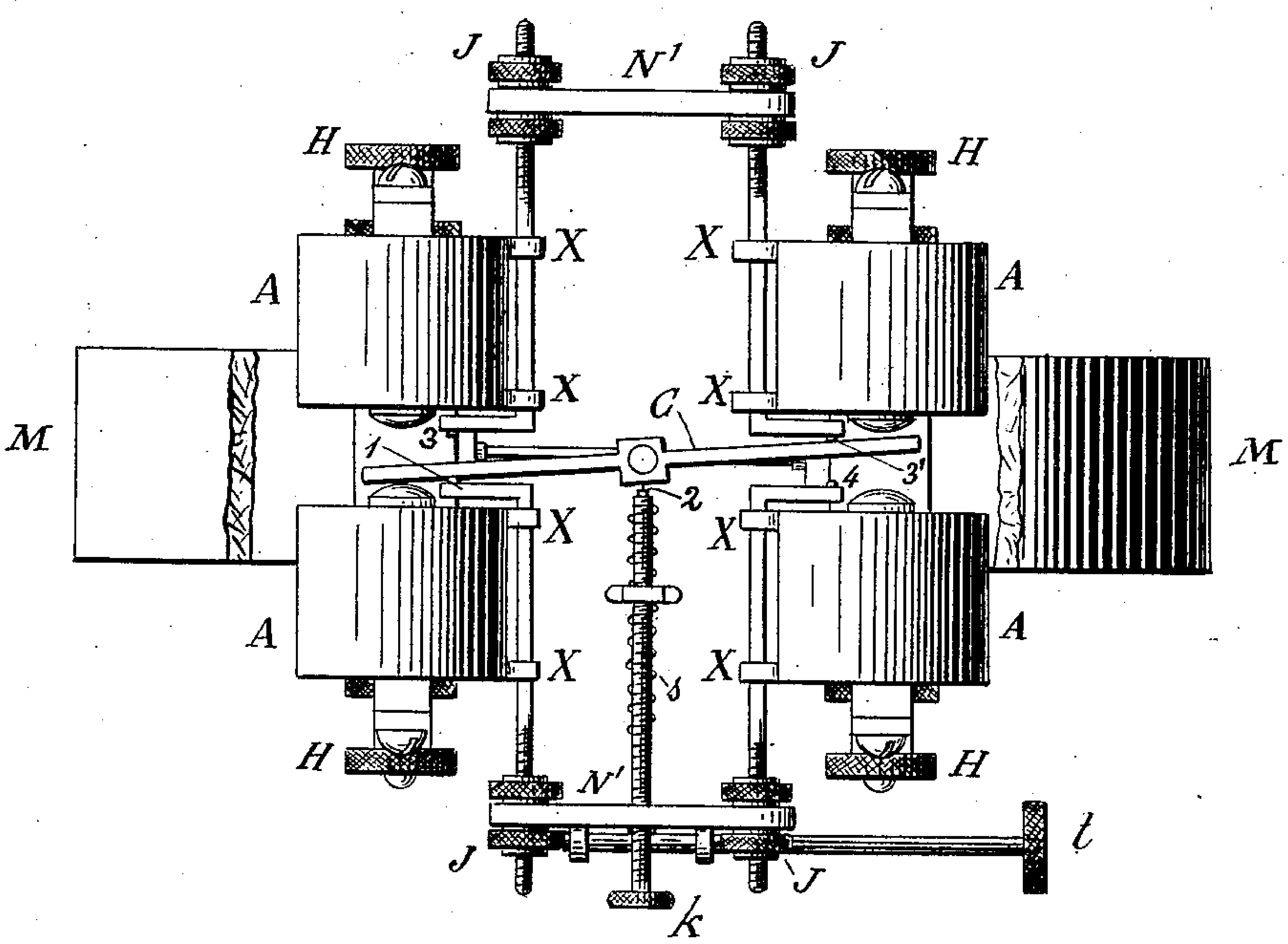
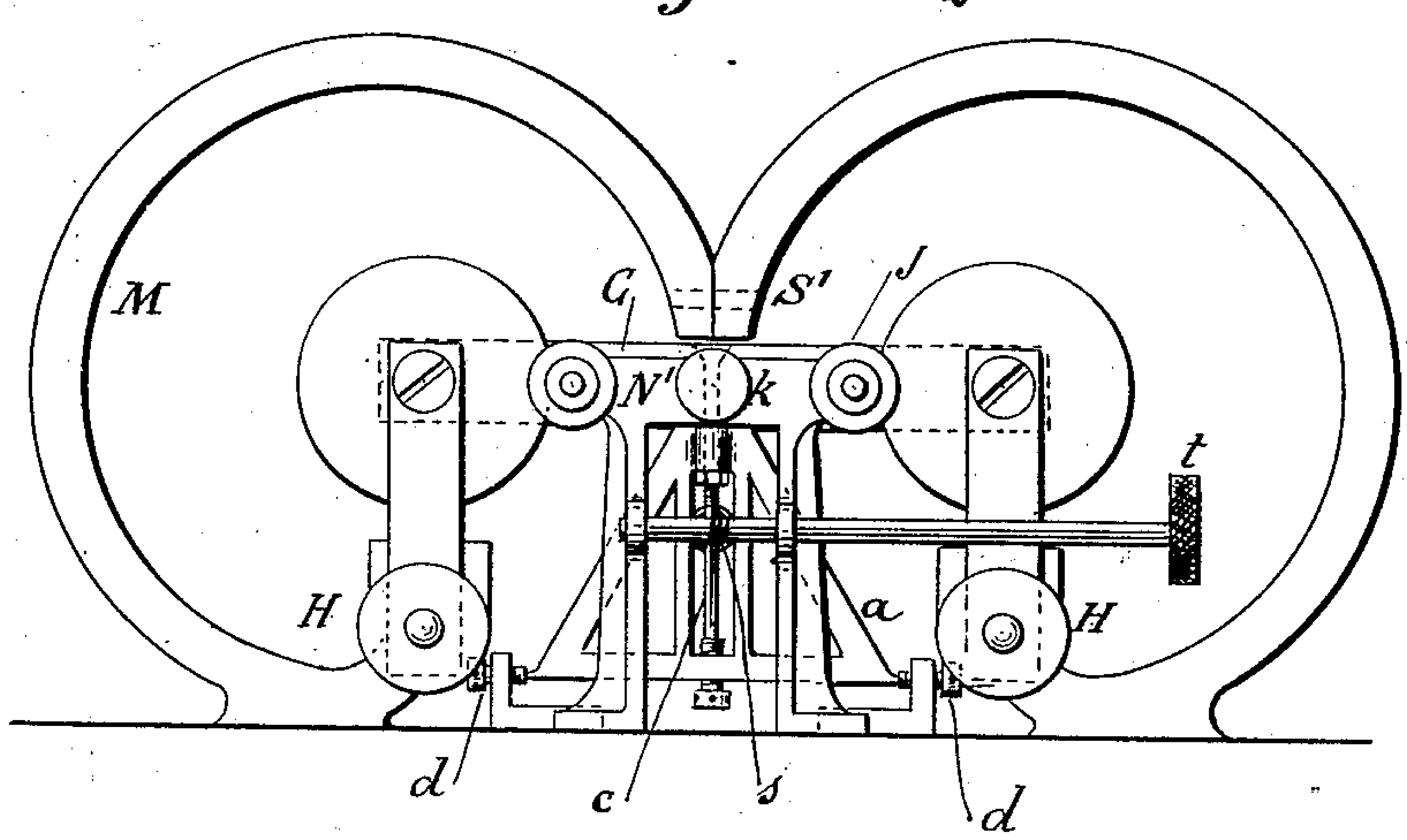


Figure 16½



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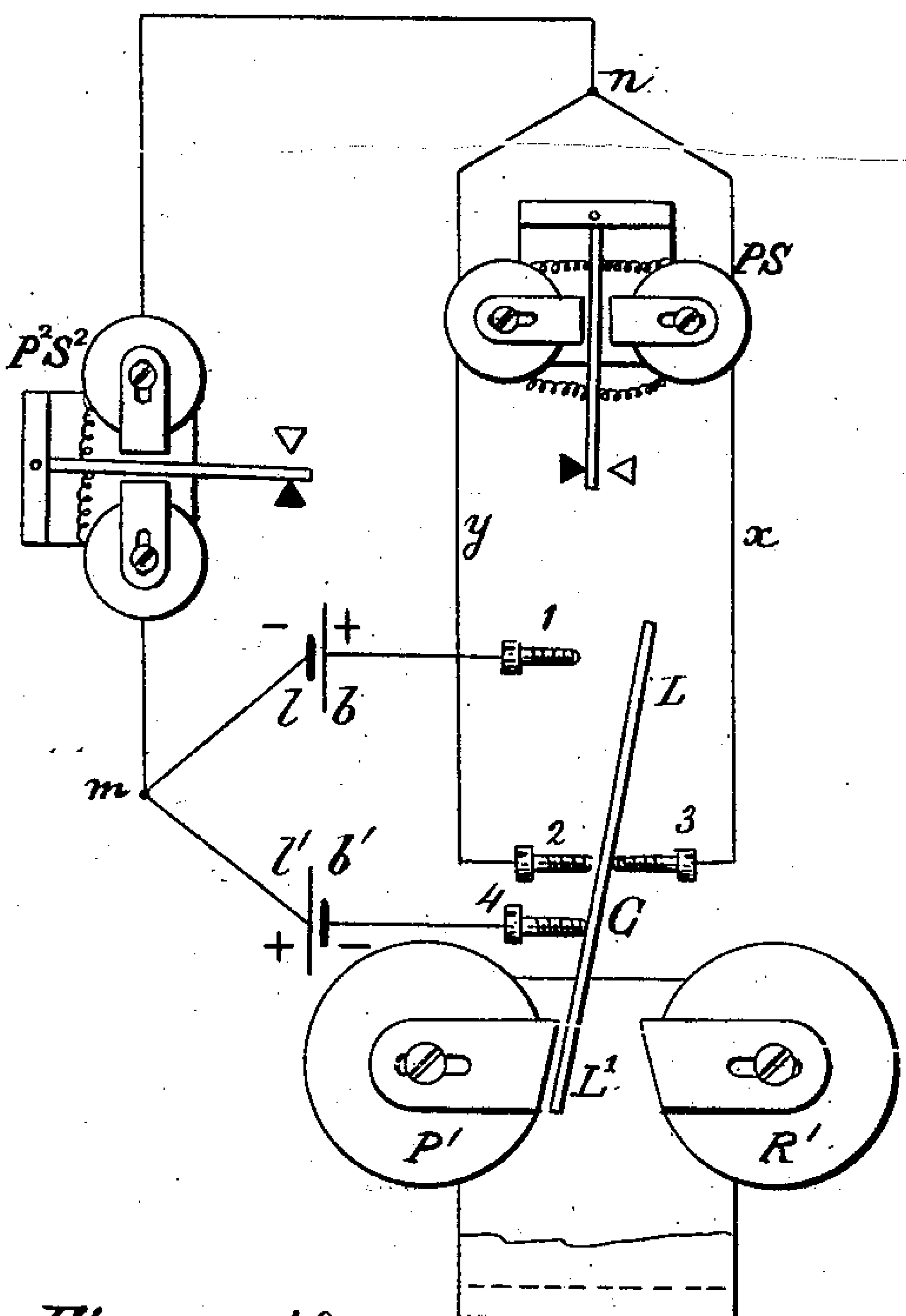
G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 17.



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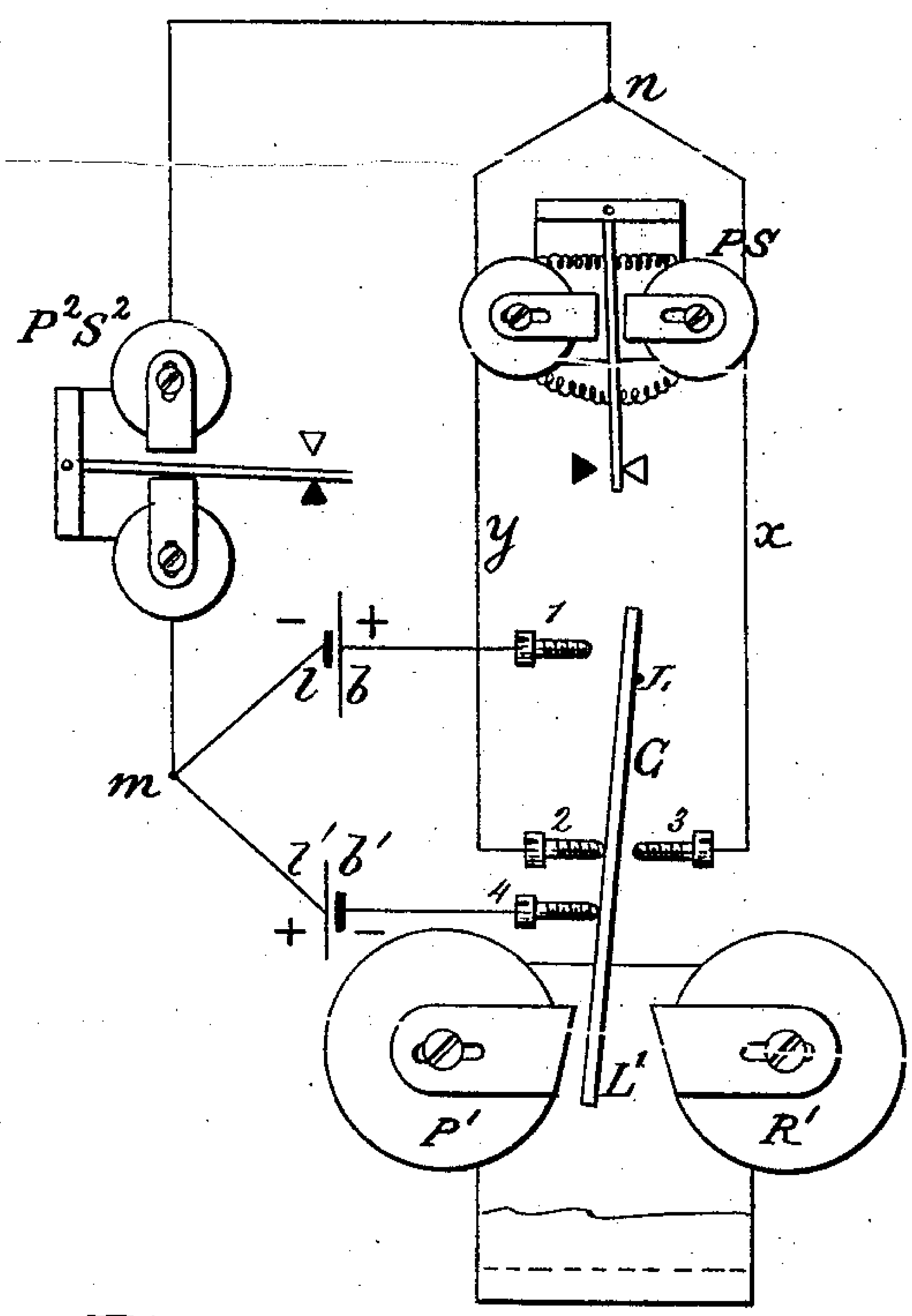

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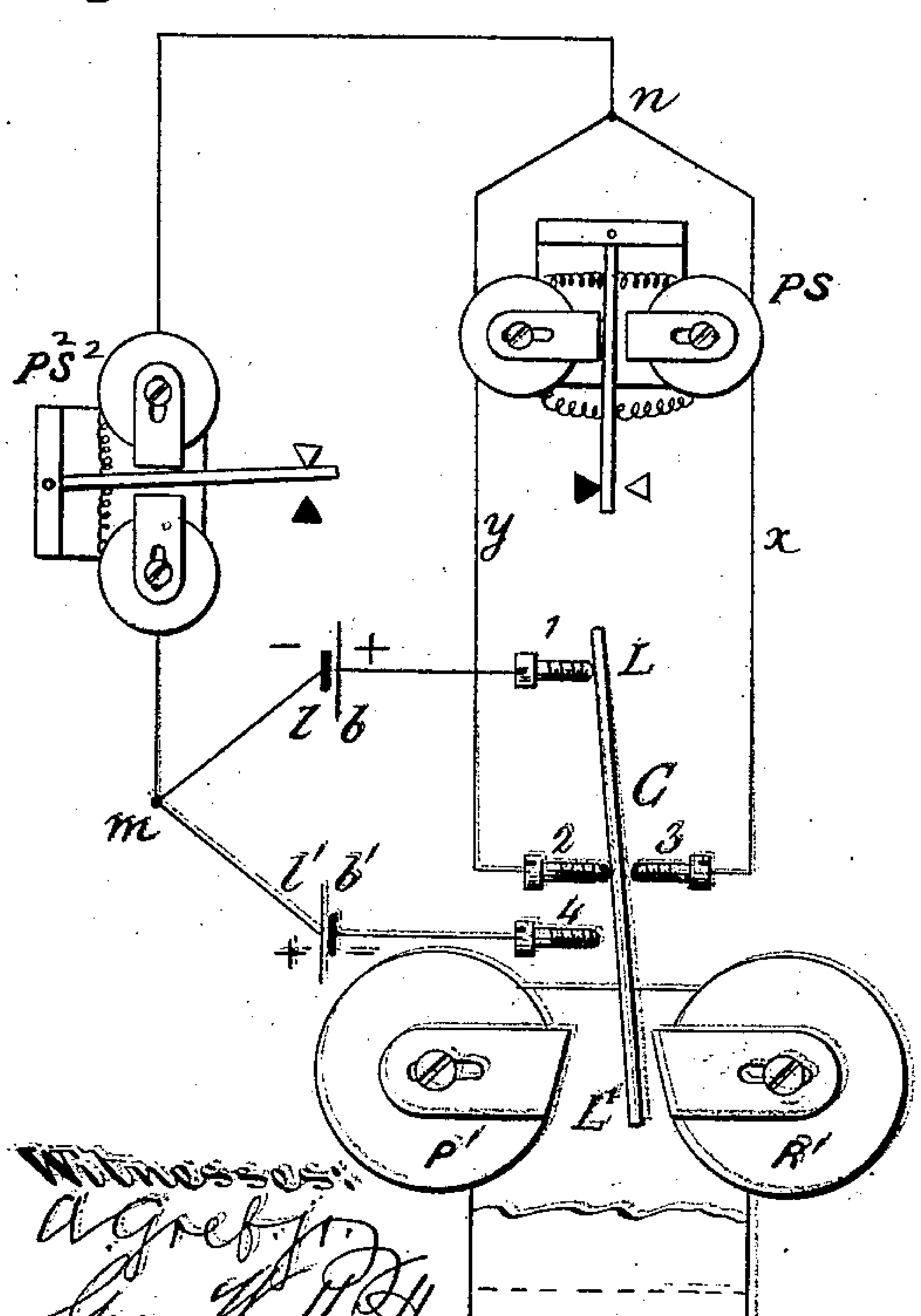

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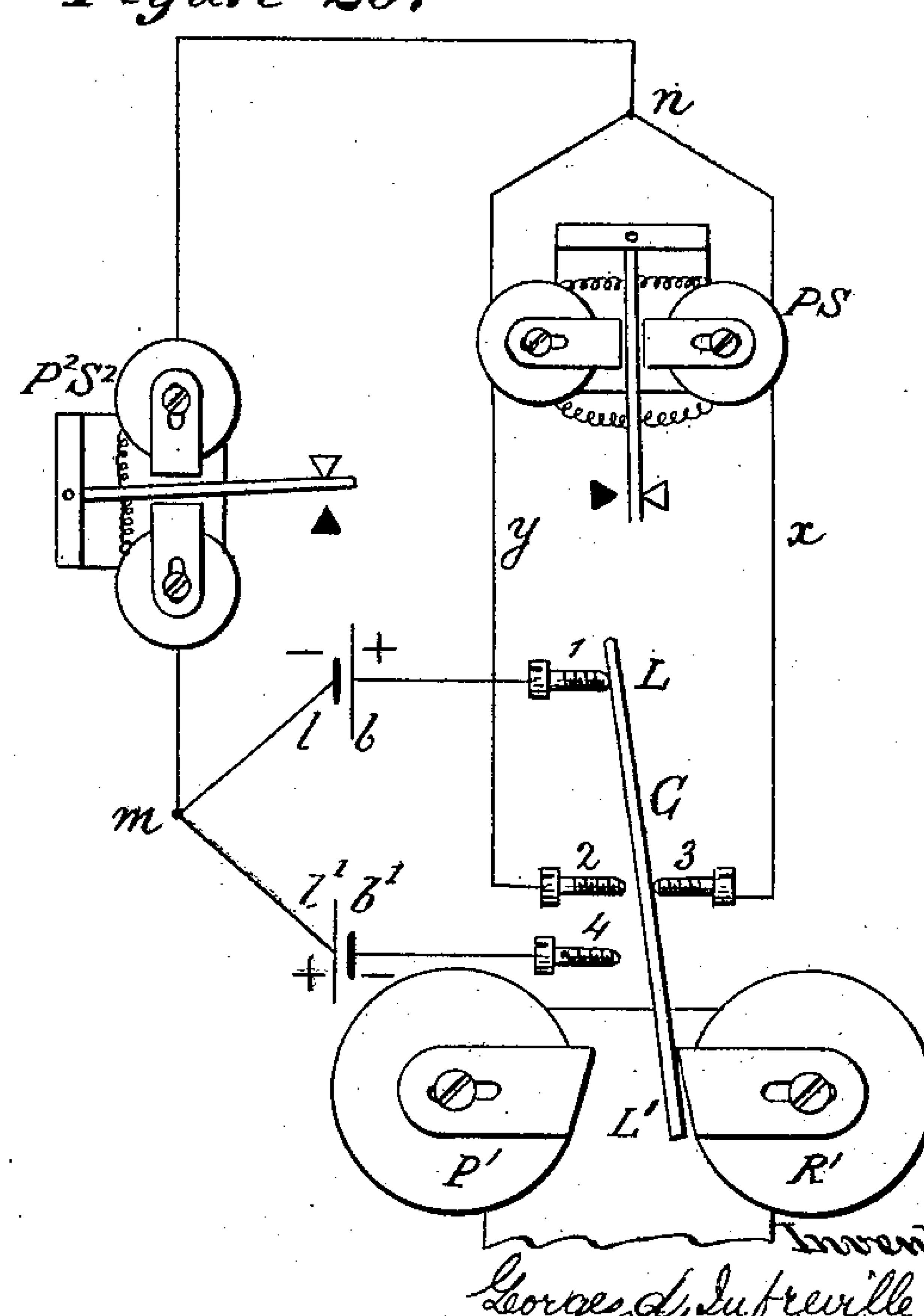

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G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 22.

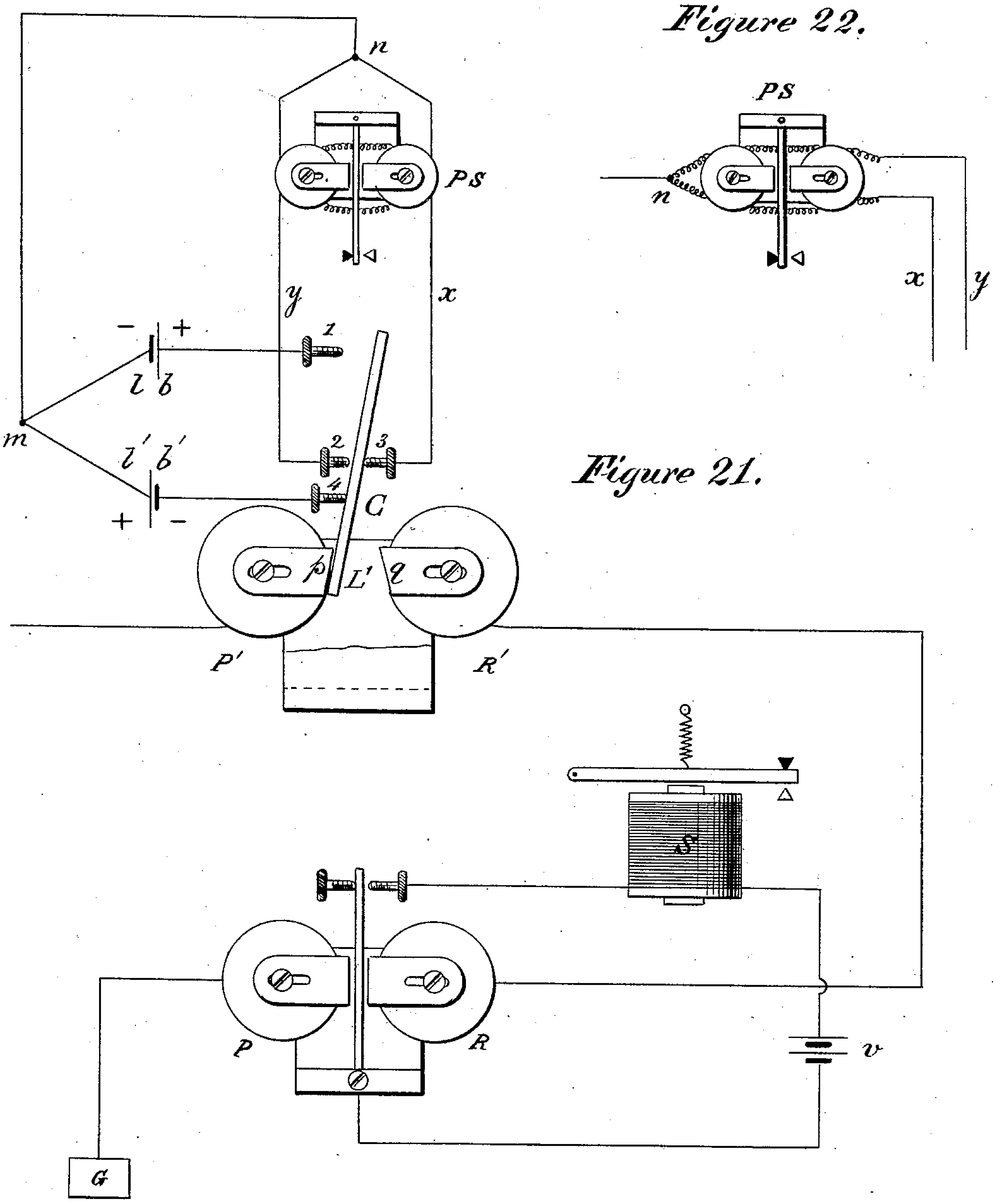

Figure 21.

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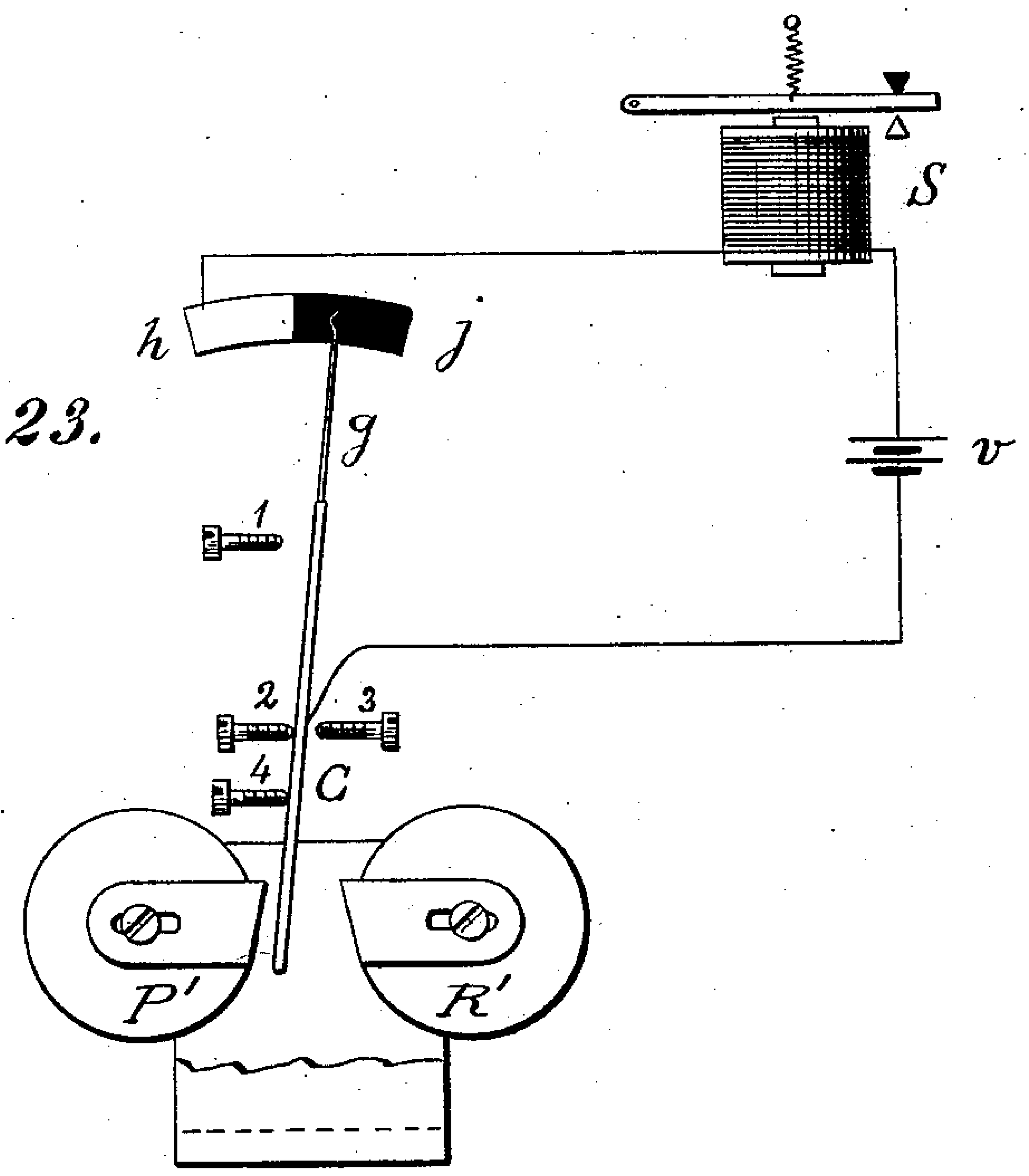
G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 23.



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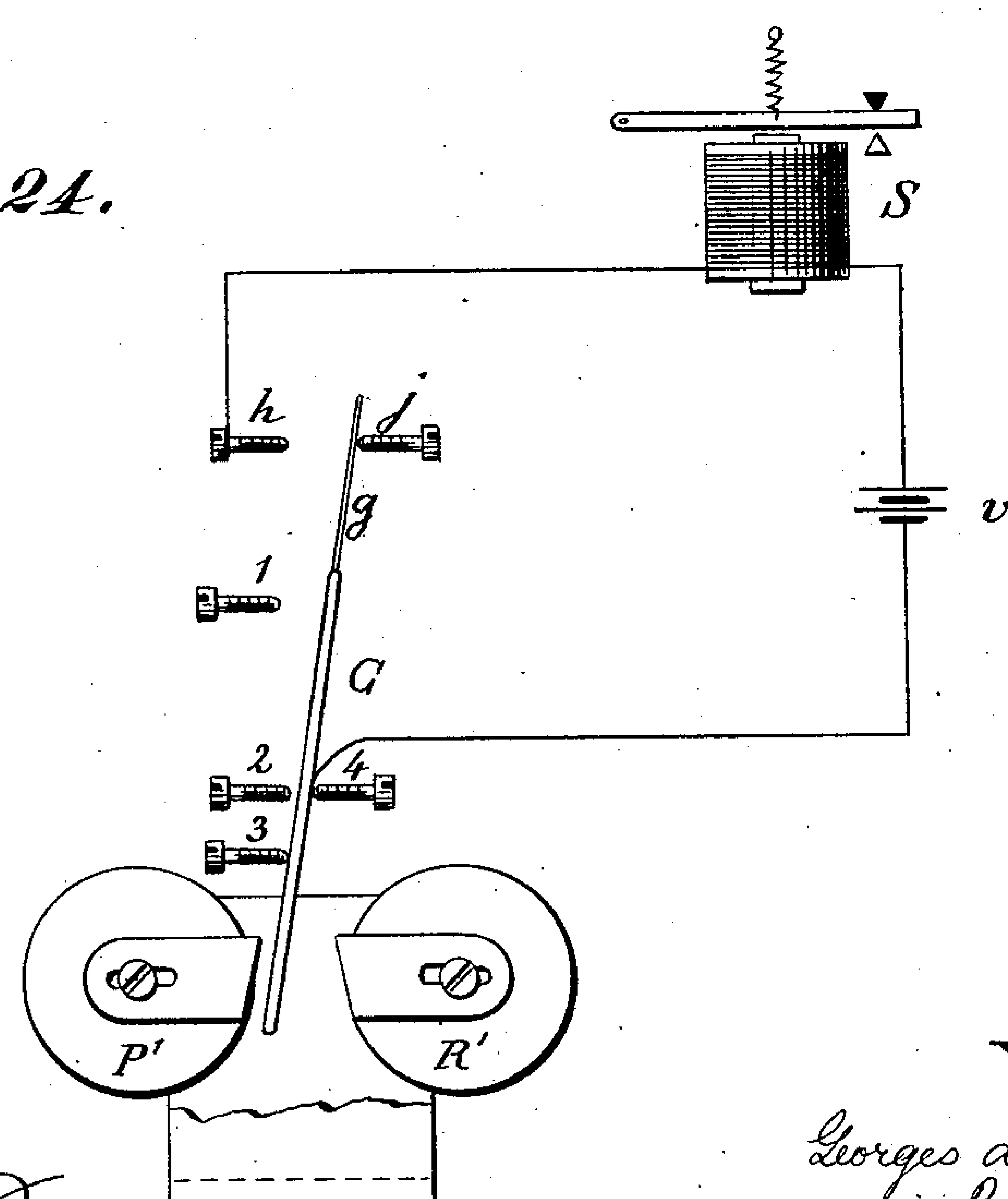

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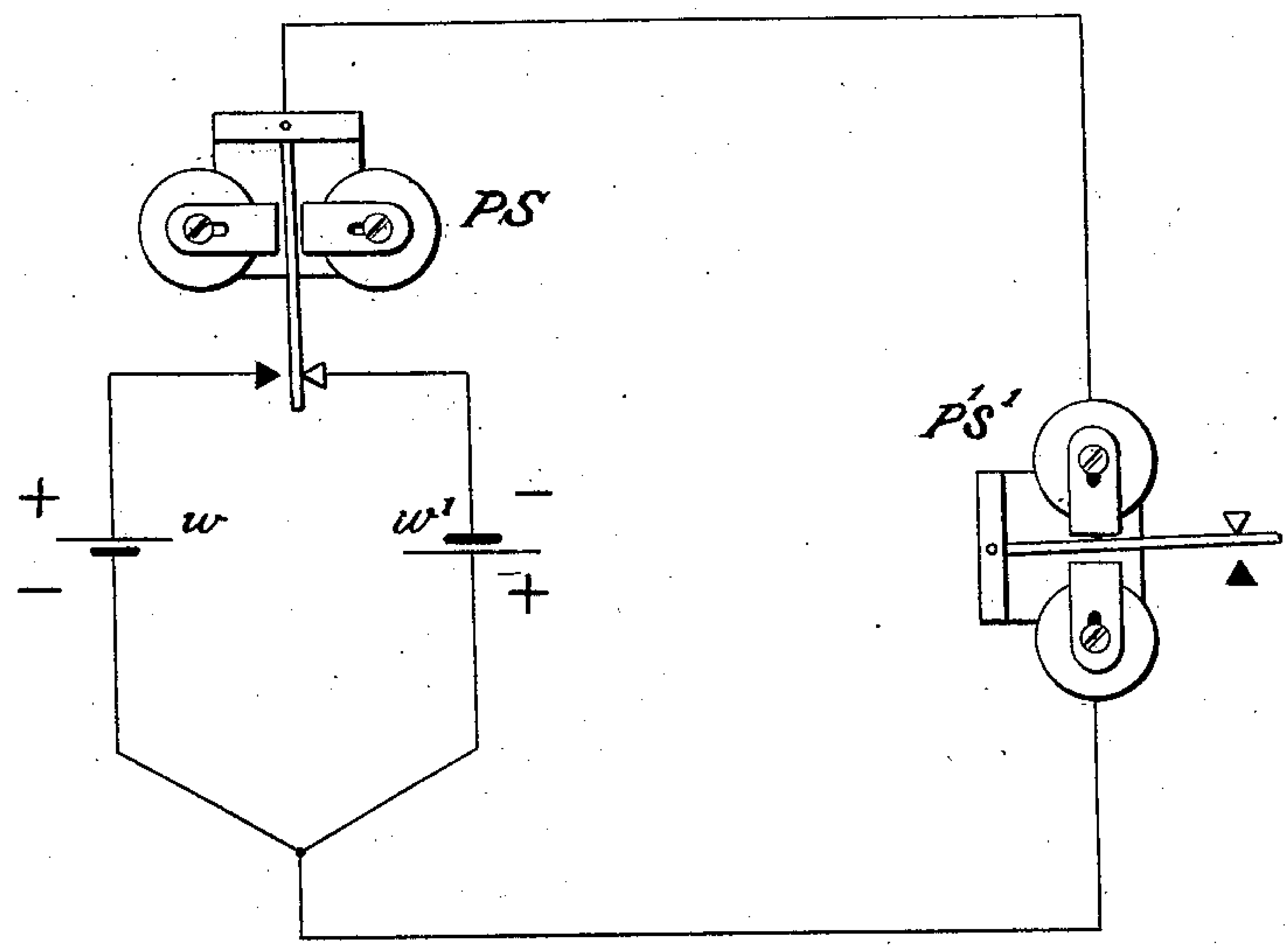
(No Model.) 11 Sheets—Sheet 11.

G. D'INFREVILLE.

QUADRUPLEX TELEGRAPH.

No. 281,249. Patented July 17, 1883.

Figure 25.



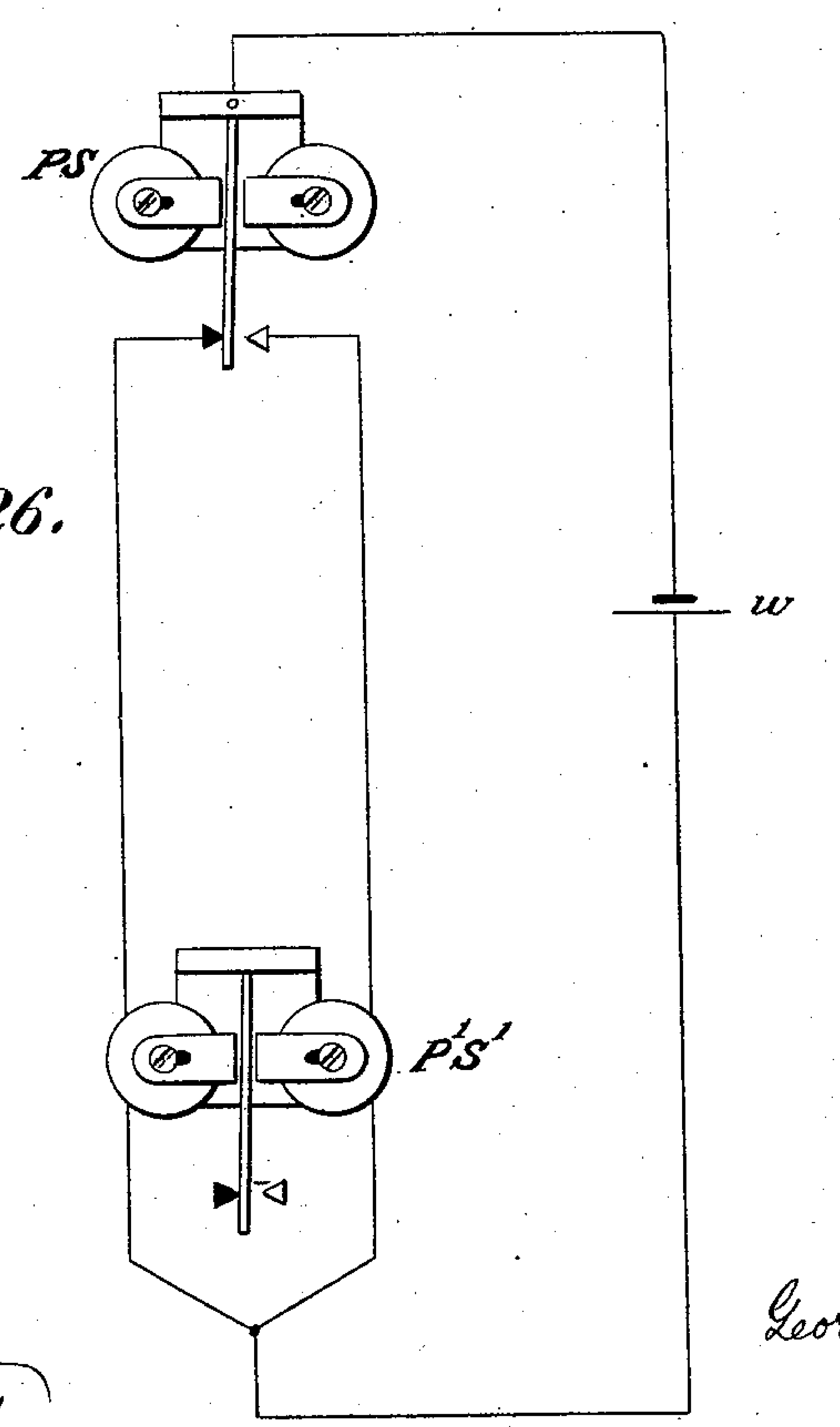


Figure 26.

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UNITED STATES PATENT OFFICE.

GEORGES D'INFREVILLE, OF NEW YORK, N. Y.

QUADRUPLEX TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 281,249, dated July 17, 1883.

Application filed July 1, 1882. (No model.)

To all whom it may concern:

Be it known that I, GEORGES D'INFREVILLE, of the city, county, and State of New York, have invented a new and useful Improvement in Quadruplex Telegraphs, of which the following is a full, true, and exact description, reference being had to the accompanying drawings.

The method of diplex transmission now in use in this country, which, when duplexed, becomes a quadruplex, consists generally in a method by which one set of signals is transmitted by an increase or decrease in the strength of the line-current, and the other set of signals is transmitted by reversing the polarity of the entire current which may be upon the line at the time of transmitting said signals. Various other methods of diplex transmission have been suggested, such as those of Stark and of Zetsche; but, so far as I know, they have never been put in practical operation in this country. By my improved quadruplex herein described I transmit signals by variation in the potential of the current without reversing the entire current upon the line in order to transmit any one set of signals. I am enabled to use in my invention the entire change of potential of which the battery is capable, or I need not use so much, depending upon which of my transmitting apparatuses is adopted; but in my method no key at any time causes a change from the maximum negative potential to the maximum positive potential, or vice versa; wherefore it follows that the tendency to sparks at one of the transmitters is greatly reduced, and also the extent of the sudden variations of potential on the main circuit, thereby reducing the evil effects of induction on neighboring wires. For my receiving apparatus I employ a new polarized relay having a rocking armature and several contact-points, which will be hereinafter more fully described. Although I prefer to use but one receiving-instrument, yet I may receive on two polarized relays, as I shall proceed to describe.

In my drawings similar letters refer to similar parts.

Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 represent arrangements of batteries and transmitting-keys. Fig. 11 represents a vertical view of part of my receiving polarized relay; Fig. 12, a view at right angles to Fig. 11, showing the spring-support of the armature; Fig. 13, a bottom view of another form of receiving-relay; Fig. 14, a vertical view of the same at right angles to Fig. 13; Fig. 15, a view of the method of supporting my rocking armature; Fig. 16, a view of a slightly-modified form of receiving-relay from that shown in Fig. 13; Fig. 16½, a vertical view at right angles to the view of Fig. 16; Figs. 17, 18, 19, and 20, plans of the general arrangement of my receiving apparatus, showing the different positions; Fig. 21, a view showing a method of receiving by two polarized relays; Fig. 22, a view of a different method of winding of the receiving polarized sounder; Fig. 23, a view of a modification of the armature of the receiving polarized relay by which an independent battery is used for one of the receiving-sounders; Fig. 24, another arrangement almost similar to Fig. 23; Figs. 25 and 26, methods of duplicating the receiving polarized sounders to make the sound of the receiving-instrument more uniform and certain.

Two transmitting-keys, K' K^2, are shown, and by the general scheme of my transmitter the lowest or most negative potential which can occur in any arrangement is to the line when both keys are up. When the first key is depressed, a move is made toward positive potential, and when the second key is depressed a still farther advance is made in the same direction, and when both keys are depressed the highest positive potential of which any arrangement is capable is attained. Of course the advance might be from positive to negative in the same way without altering the principle of my invention.

In Fig. 1 is shown a transmitter and batteries by which the desired effects may be produced. Two batteries, B' B^2, are shown. Of these, B' is the larger, and we will assume it to contain sixty cells, and B^2 the smaller, to contain forty cells. The keys K' K^2 are ordinary circuit-preserving keys, S' S^2 representing, generally, springs bearing upon the contacts shown. These drawings will not require detailed description to one skilled in the art. In all cases where contact-preserving keys are used, it is generally preferable to operate them by an independent local battery and magnet. When both keys are up, as will be readily seen, the negative pole of the battery B' is to line. When K' is down and K^2 up, no battery is to the line. When K^2 is down and K' is up, the positive pole of battery B^2 is to line, and when both keys are depressed the sum of the batteries B' B^2 is to line by their positive poles—that is, under the assumptions of batteries made, both keys up, minus sixty cells to line; K' down, K^2 up, nothing to line; K' up, K^2 down, plus forty to line; K' K^2 down, plus one hundred to line. By this arrangement it will be observed that there is a constant advance of potential by the depression of the keys in the order made from the lowest to the highest, there being, therefore, four possible conditions of current upon the line. In Fig. 2 the connections have been altered, the battery B^2 being divided into two equal portions, B^2 and B^3, as shown. In Fig. 3 two batteries are again used. In Fig. 4 duplicate batteries B' B^2 are shown. In Fig. 5 the battery B^2 is duplicated and the battery B' reversed by a circuit-preserving reversing-key. In Fig. 6 is shown the most advantageous method of varying the currents, provided continuity-preserving current-reversing keys are used. By this arrangement the currents are changed from the highest negative to the highest positive by the operation of my keys. In Fig. 7 the battery B' is duplicated, while but one battery, B^2, is used, a resistance, r, being interposed, so as to equalize in a well-known manner the resistance, whatever be the position of the keys. By making the batteries B' B' B^2 and the resistance r equal, the resistance to ground through the transmitter will always be the same. In Fig. 8 the batteries are divided into three, B' B^2 B^3, B' and B^3 being equal, and resistance r' and r^2 are used, so as to maintain equality of resistance through the transmitter. The amounts of these resistances will be readily calculated by any electrician for any given condition of battery. In Fig. 9 the battery B^2 is duplicated and the battery B' reversed. In Fig. 10 the battery B' is reversed, and the resistance r, equal to the battery B^2, is interposed, so as to equalize resistance to the ground G.

The following table will exhibit the different currents sent to the line, the batteries B', B^2, and B^3 being assumed to contain the number of cells set opposite them. Of these it may be said that Figs. 1 and 3 illustrate in the most simple manner the theory of my transmitter, and Fig. 6 gives the most beneficial results for the amount of battery used:

Number of the figure.	Relative numbers of cells in the batteries.			Relative positions of keys.			
				K' up. K^2 up.	K' down. K^2 up.	K' up. K^2 down.	K' down. K^2 down.
1.	B' = 60	B^2 = 40		− 60	0	+40	+100
2.	B' = 60	B^2 = 20	B^3 = 20	− 80	−20	+20	+ 80
3.	B' = 50	B^2 = 50	“	−100	−50	0	+ 50
4.	B' = { 50 / 50	B^2 = { 30 / 30	“	− 80	−20	+20	+ 80
5.	B' = 30	B^2 = { 50 / 50	“	− 80	−20	+20	+ 80
6.	B' = 30	B^2 = 50	“	− 80	−20	+20	+ 80
7.	B' = { 50 / 50	B^2 = 50	“	− 50	0	+50	+100
8.	B' = 20	B^2 = 40	“	− 40	−20	+20	+ 40
9.	B' = 50	B^2 = { 30 / 30	“	− 80	−20	+20	+ 80
10.	B' = 50	B^2 = 50	“	− 50	0	+50	+100

The proportions between the main batteries in the arrangement shown in Fig. 6 can be determined by the following formula: Supposing it to be desired with this combination to have the potential of either polarity represented by the larger figure amount to n times the potential of the same polarity represented by the smaller figure, then the following equation: $(B^2+B')=n\ (B^2\,B',)$ which reduces to $\frac{B'}{B^2}=\frac{n-1}{n+1}$, which gives the proportion between the batteries. Should it be desired to make n equal to 4, for instance, we have the proportion $\frac{B^1}{B^2}=\frac{3}{5}$, which has been assumed to be the value of the batteries in respect to this figure. I do not limit myself of course to the particular value just assigned to n in the preceding equation; but I have obtained good results from the use of batteries relatively arranged in the proportion just obtained from said value being assigned to n.

In describing my receiving apparatus I shall call the current on the line, when K' and K^2 are up, "Current 1;" when K' is down and K^2 up, "Current 2;" when K' is up and K^2 down, "Current 3;" when K' and K^2 are down, "Current 4." The general theory of my receiving apparatus is best shown in Figs. 17, 18, 19, and 20, the detail of the polarized relay being given in Figs. 11, 12, 13, 14, 15, 16, and 16½.

Referring now to Figs. 17, 18, 19, and 20, these apparatuses represent in order the condition of my receiving apparatus when currents 1, 2, 3, and 4 are upon the line. P' R' represent, generally, a polarized relay, the details of which will be hereinafter explained. This relay is provided with the armature C, which may be considered to be supported at the end of a flexible spring about its middle—that is, between the contact-points 2 and 3 shown. This armature is also supposed to have a tendency to move at its center toward the contact-screw 2, but to have no tendency to revolve about its axis by reason of any spring, the pressure toward 2 being adjustable by some convenient means. The polarized relay is provided with four contact-points, 1, 2, 3, and 4, as shown, and the end of the armature between the poles of the magnet is constantly polarized by a suitable arrangement. The distance between the ends of the armature and the point 2 should be equal, while the distance between 2 and the end of the armature should be three times greater than the distance between 2 and 4. Two receiving-instruments or polarized sounders, P S and P^2 S^2, are shown. Of these, P S is a differentially-wound sounder. This sounder may either have a single coil upon each leg differentially connected, as shown, or may be arranged as shown in Fig. 22, having two wires wound side by side around each pole and differentially connected, as shown. Two local batteries are provided, l b and l' b', having their poles reversed, as shown. Wires from the positive and negative poles of these batteries respectively join at m, whence they pass through P^2 S^2, thence to the point n, where the circuit divides, one part going through each of the coils of P S; whence the branch x leads to the contact-point 3 and the branch y to the contact-point 2. The polarized relay P′ R′ is so wound and so connected with the main line as that a negative current tends to draw the lower end toward the pole P′, and as the potential rises the tendency of the said lower end is to move toward the pole R′. Therefore, when current 1 is upon the line, the armature G is in the position shown in Fig. 17. In this position the lower end, L′, is strongly drawn toward the pole P′. The armature C therefore rests, as shown, against the contact-point 4, and the attraction of the pole P′ being sufficient, it rests also, as shown, against the screw 3, overcoming, therefore, the tendency of the spring to move it toward the point 2. In this condition of affairs battery l b has no circuit. There being no contact at screw L, the current of battery l' b' passes through P^2 S^2, and tends to hold the armature of the same against its back contact. Thence the circuit passes by point n to the right coil of P S, which sounder is so wound as to cause its armature to rest against its back contact when a current passes through the branch n x. Thence the current of l' b' passes by wire x to point 3, through armature to point 4, and so back to battery. In this condition, therefore, when current I is to line, both P S and P^2 S^2 are on their rest-contact. Let us now suppose current 2 to be caused to flow upon the line. The attraction of pole P′ to the end of the armature L′ is now lessened, and the spring therefore takes effect upon the armature C and moves its center away from contact 3 against contact 2, the armature pivoting against contact 4, and said armature will remain against contacts 4 and 2 until some other variation in the current occurs. In this condition battery l b is still cut off; but the circuit of battery l' b' has now been shifted from branch x of sounder P S to branch y of the same, and the current of l' b' therefore passes through point 4, point 2, branch y, to point n and m, as before. The direction of the current through P^2 S^2 being unaltered, that sounder remains as before; but the current being caused to flow through the other branch of P S, that sounder has its polarity reversed, and its armature is shown pressing against its working-contact. The sounder P S, therefore, has responded to the closure of the key K′. Suppose, now, a further increase of potential to occur, and current 3 to flow upon the line. In this case the movement of the end L′ of the armature C continues to the right, or toward the pole R′, and the end L′ therefore leaves the screw 4, while the end L comes in contact with the screw I. The circuit of L′ B′ is thereby opened, and l b is thrown into action. Therefore a negative current flows by junction m through sounder P^2 S^2, and closes said sounder; but the direction of flow from point n through P S and branch y having now been reversed, the armature of P S falls back into the position shown. Therefore, in this case, sounder P^2 S^2 responds to the closure of the key K^2, while the key K′ being open or at rest, the sounder P S is also at rest. Let us now suppose current 4 being sent over the line. In this case the polarized relay P′ R′ causes the lower end, L′, of the armature to move still farther toward the pole R′, the middle part of said armature, leaving its contact with point 2, and making its contact with point 3 by pivoting at its end L against screw-contact I. After this operation, the current flows through P^2 S^2 in the same direction as before; but the current through P S has been shifted from the branch y to the branch x, thereby, as before explained, reversing the polarity in said sounder, and moving the armature of P S against its working-contact. In this condition, therefore, when both keys K′ K^2 are closed, polarized sounders P S and P^2 S^2 are also closed, or in the position of work. The armatures of the sounders P S and P^2 S^2 have no tendency to leave the stops against which they rest, except as they may be moved by reversals of local current.

It will be of course understood that where I have spoken of the "attraction of pole P′ upon the armature C," I have referred to the mutual action of the poles P′ R′ upon the lower end of said polarized armature L′.

In Fig. 21 is shown a variation in which the sounder P^2 S^2 is removed and an additional polarized relay, P R, is inserted in the circuit. The ordinary sounder, S, operated by the local battery v, is connected to this polarized relay. This relay is so adjusted that its armature closes only when currents 3 or 4 is upon the line. When currents 1 or 2 is upon the line, its armature rests against its back contact. In certain circumstances both the arrangements of Fig. 17 and of Fig. 21 may be combined, and the sounder S may be used as a repeater, &c. In this case the sounder P^2 S^2 (shown in Fig. 17) would occupy a position in the line between the points m n, Fig. 21.

In Fig. 23 is shown another modification, in which the sounder to be operated by currents 3 and 4 is effected by an independent local battery, v, the circuit of which is made and broken by a sliding spring-contact. In this arrangement the armature C is provided with the spring g, bearing upon the plate h j, one half of which, h, is formed of a conducting-body, and the other half of an insulating-body. The circuits of the local sounder S and battery v are plainly shown. Whenever the spring g is swung upon the plate h, the sounder S will close. Substantially the same arrangement is shown in Fig. 24. The spring g is again used to close against the point h whenever currents 3 or 4 are upon the line. On long lines, in order to prevent any shattering or false signals, I prefer to couple the receiving-sounder P S with a secondary receiving-sounder, P′ S′. Arrangements for doing this are shown in Figs.

25 and 26. By this arrangement the armature of sounder P′ S′, which is the one used to receive by, never leaves the position where it happens to be until the sounder P S has completed its movement to the other point and closed the circuit there. The batteries *w w′* in Fig. 25 are relatively reversed, and the connections are plainly shown. It will be obvious that the armature of the sounder P S might vibrate upon any of its two contact-points without disturbing the position of the armature of the sounder P′ S′ until it had completed its stroke to the other contact-point. In Fig. 26 is shown another arrangement for accomplishing the same result in substantially the same way, the only difference being that here the sounder P′ S′ is differentially wound, instead of using two batteries, as in the arrangement shown in Fig. 25. These arrangements, however, I do not claim in my present application, having made them the subject of an independent application heretofore filed.

I will now describe the mechanical arrangement of the receiving apparatus which I prefer, although other forms might be used. Drawings of two slightly-modified forms of such receiving apparatus are shown in Figs. 13, 14, 15, 16, and 16½, and, according to the simplest form, (which, however, is not the one I prefer to use,) the armature is supported on the upper end of a spring. This is shown in Figs. 11 and 12. A represents a vertical electro-magnet, between the upper poles of which the armature C vibrates. This armature is supported by a spring, *e*, which should connect with it opposite the points 2 and 3. (Shown in Fig. 17.) The tendency of the spring *e* to move the armature toward the point 2 is determinable by the adjusting-screw *f*. The armature is pivoted on the upper end of the spring, as shown. The armature is itself magnetized, as are also the cores of the magnet A, by the permanent magnet M, the pole-piece or termination of which is shown at S′, immediately over the pivot of the armature. This pole-piece should extend sufficiently on both sides across the width and over the pivot of said armature, so as to exert on it a practically-uniform influence in whatever position it may be while working. The end L of said armature may be made of non-magnetic material, so as to not unnecessarily dissipate the magnetic force derived by induction from the pole-piece S′

In Figs. 13 and 14 is shown a form of the practical construction of the said receiving-magnet. In this case four coils, A A A A, are shown. The armature C vibrates between the cores thereof, as shown. The method of supporting this armature is shown in Fig. 15. A light frame, *a*, is provided, which pivots in in the screws *d d*. The armature C is supported upon the pivot *c*, which rotates within the frame *a*, as shown. Thereby the armature is allowed to rock, and also to be moved in either direction. Contact-points are provided, as before, the only difference being that two points, 3 3′ are provided, which are connected together, and in the same way as point 3 in Fig. 17. The frame *a*, with its armature C, is drawn toward the point 2 by the springs, adjustable by the thumb-piece *t*. The permanent magnets for magnetizing the cores and the armature are shown plainly in Fig. 14, and are generally two horseshoe-magnets, uniting at the point S. In Fig. 13 the view is taken from below, except that the frame *a* and the spring *s* have been omitted for clearness. The cores and coils supported upon it are made adjustable by the screws H. These screws are mounted on yokes V, which connect the back ends to the cores of the magnets A A A A. These cores are longitudinally slotted, and are prevented from rotating by guides in the yokes V. Springs N are provided for forcing the cores forward, and can be withdrawn by the screws H. In this manner an exact adjustment of the contact-points 1 2 3 4 relatively to the poles of the magnets may be obtained.

In Figs. 16 and 16½ is shown a slight modification of the receiving-instrument shown in Figs. 13, 14, and 15. The armature is mounted as before. The contact-points 1, 2, 3, and 4 are mounted upon angle-supports sliding in the frames by the sides of the coils. They are thus carried in immediate proximity to the ends of the magnet-cores, so as to necessitate the least possible movement of the armature in making and breaking the circuit. These contact-points are supported in frames N′ and in the ears X. They are made longitudinally adjustable by screws J in frames N′. The contact-point 2 is mounted on the end of the screw *k*, also suppported in said frame. It will of course be understood that the points 1, 2, and 4 are insulated from each other and connected as shown in Fig. 17. The magnet-cores are made adjustable by screws 4, as before, and the armature and magnet-cores are magnetized by the double-circuit magnets M M, which are in this case placed at right angles to the magnets M M, (shown in Figs. 13 and 14,) thereby improving the general appearance and efficiency of the apparatus and making the adjustments more accessible. It will of course be understood, that in this case as well, the contact-point 3 (shown in Fig. 17) has merely been divided into two points, 3 3′, for the purpose of regulating the play of the armature, and that these points are connected together, making, in fact, but one connection.

It is plain that though my apparatus is described as a diplex telegraph it can be quadruplexed in the well-known ways for duplexing diplex telegraphs. It is plain, likewise, that when I have indicated in my specification or claims the use of a battery-current of one name a battery-current of the opposite name might be used, provided the poles of the batteries of the entire system are reversed. I have used the words "positive" and "negative" as explanatory words; but in all cases the opposite poles could be used, subject to the conditions I have just explained.

I do not limit myself to the exact forms of transmitting or receiving apparatus shown, provided my new system of diplex transmission be carried into effect by such modified apparatus.

I do not abandon or dedicate to the public any patentable features set forth herein and not hereinafter claimed, but reserve the right to claim the same either in a reissue or any patent that may be granted upon this application, or in other applications for Letters Patent that I may make.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The method herein described of transmitting two series of signals in the same direction, which consists in directing three different currents of different potentials, two of one polarity and one of the opposite polarity, to the line by two independent transmitters, the operation of either transmitter singly causing a movement of potential from the potential of the current normally on the line in the same direction, one greater than the other, and both transmitters together causing a still greater movement of potential always in the same direction, substantially as described.

2. The method herein described of transmitting two series of signals in the same direction, which consists in causing three different potentials to exist upon the line by two independent transmitters, either transmitter causing a movement of potential from the potential of the current normally on the line in the same direction, one greater than the other, and both transmitters together causing a still greater movement of potential always in the same direction, the said potential varying by the action of the transmitters from negative to positive, substantially as described.

3. The method herein described of transmitting two series of signals in the same direction, which consists in causing three different potentials to exist upon the line by two independent transmitters, either transmitter causing a movement of potential from the potential of the current normally on the line in the same direction, one greater than the other, and both transmitters together causing a still greater movement of potential always in the same direction, the said potential varying by the action of the transmitters from negative to positive, said total variation being the total variation of potential which the battery used is capable of affording, substantially as described.

4. In a diplex telegraph, the method shown of receiving two independent series of signals which are transmitted by currents varying in potential from some negative to some positive degree, or vice versa, which consists in causing the reception of one series of signals by an apparatus which responds to the lowest movement and to the greatest movement of potential in the same direction to receive one set of signals, and which responds to an intermediate and to the greatest movement of potential to receive the other set of signals, which intermediate condition of potential does not cause the apparatus to respond to the first set of signals.

5. The method herein shown of sending and receiving two series of signals sent in the same direction at the same time, which consists in directing currents of three different potentials, two of one polarity and one of another, upon the line by two independent transmitters, either transmitter causing a movement of potential from the potential of the current normally on the line in the same direction, one greater than the other, both transmitters together causing the greatest movement of potential in the same direction, and in receiving said independent series of signals by an apparatus which responds to the lowest movement and to the greatest movement of potential from the normal current to receive one set of signals, which responds to an intermediate and to the greatest movement of potential to receive the other set of signals, substantially as described.

6. A telegraph-transmitter which consists of two independent circuit-preserving pole-changing transmitters connected together by a single connection between the keys, over which all the currents flowing on the line pass, each transmitter controlling an independent main battery, one of which batteries is greater than the other, substantially as described.

7. A receiving telegraphic apparatus provided with an armature which is pivoted or supported so as to move toward and away from the attracting-magnet, and also to rotate or oscillate around its axis of support, and two or more electrical contact-points against which the armature is carried, according to the potential and polarity of the current, substantially as described.

8. A receiving telegraph-instrument provided with an armature centrally pivoted or supported, so as to oscillate or rotate around its axis of support, and with two or more electrical contact-points at one side, with which said armature makes electrical connection at different points of its movement, substantially as described.

9. The combination of a receiving-relay provided with a rocking armature and the local-circuit arrangement shown, which is provided with two local batteries and a differentially-wound polarized sounder, substantially as described.

10. The combination, in a diplex telegraph with the same receiving-instrument, of a singly-wound sounder and a differentially-wound sounder, with the batteries and connections shown, whereby either one coil or the other of the differentially-wound sounder is alternately put in connection with and made a part of the

circuit running through the singly-wound sounder, substantially as and for the purposes described.

11. In a diplex or quadruplex telegraph, the combination of a single relay and its armature having three or more contact-points and circuits, substantially as described, with two polarized receiving-instruments, each of which receives an independent series of signals, substantially as described.

12. The combination, in a telegraph receiving-relay, of a suspended polarized armature, capable of lateral movement, three or more electrical points with which the armature makes contact, and circuits, substantially as described, and a permanent magnet-pole placed over the armature, so as to aid in maintaining or supporting the same normally in a central position, substantially as described.

13. The combination of a polarized armature pivoted or supported so as to move laterally, and also to oscillate around a support, electrical contact-points, and an overhanging magnet adapted to normally aid in maintaining said armature in a central position, substantially as described.

14. The combination, in a receiving telegraphic instrument, of an electro-magnet, an armature centrally suspended, a single permanent magnet connected with the core of the electro-magnet, so as to magnetize the same, and also projecting with its poles over the armature for the purpose of determining the position of the same, and contacts, substantially as described, for the purpose specified.

15. The receiving telegraphic instrument herein described, which consists of four electro-magnetic poles, two of them arranged on each side of a rocking and vibrating armature, substantially as and for the purposes described.

16. The receiving telegraphic instrument herein shown, which consists of two oppositely-arranged electro-magnets, the cores of which are polarized by two permanent magnets, the poles of said permanent magnets uniting to form a directing-magnet in immediate proximity to the armature, substantially as described.

17. An armature for electro-magnetic instruments, which consists of a pivoted frame allowing the motion of the armature to and from the electro-magnet, and an armature pivoted in said frame at right angles to the pivoted support of the said frame, thereby allowing the armature to oscillate, substantially as described.

18. The receiving telegraphic instrument shown, which consists of two pairs of opposite magnets and a central armature, pivoted so as to vibrate and to oscillate, the said armature making contact with five electric connections, three being located on one side of said armature and two on the other, the said independent connections being electrically connected, substantially as described.

19. The receiving telegraphic apparatus shown, which consists of four electro-magnetic coils and cores, an intermediate vibrating and oscillating armature, the said cores being all magnetized with the same magnetism by a double permanent magnet arranged in line with the armature and projecting over said armature, so as to determine the position of the same, substantially as described.

20. The combination of a receiving polarized telegraphic relay provided with an armature which both rocks and vibrates with an independent polarized sounder for receiving the messages transmitted, substantially as described.

GEORGES D'INFREVILLE.

Witnesses:
ANTHONY GREF, Jr.,
GEO. H. EVANS.