(No Model.)

3 Sheets—Sheet 1.

E. F. FROST.

INDIVIDUAL SIGNALING APPARATUS.

No. 320,923. Patented June 30, 1885.

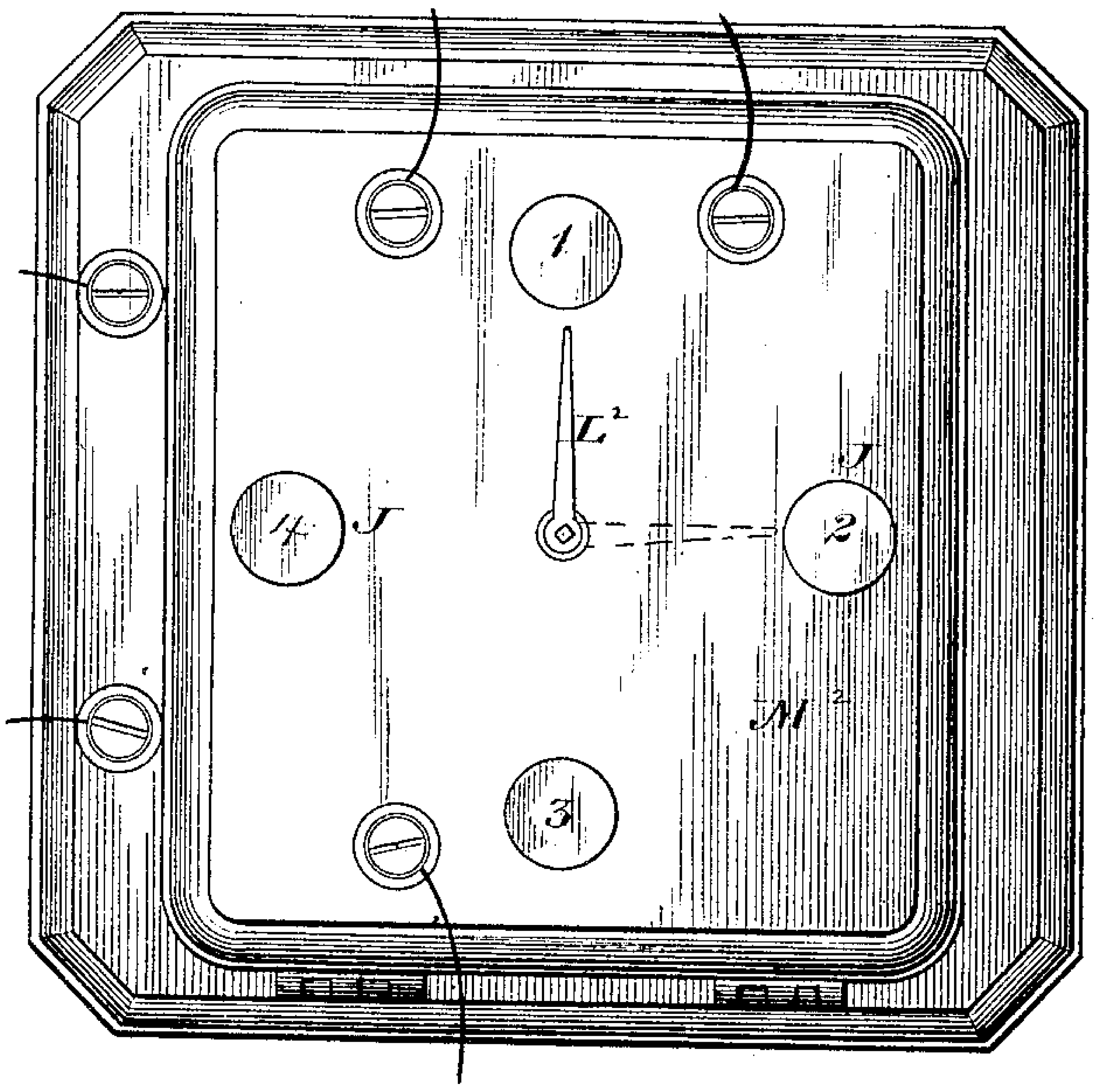


Fig. 1.

Fig. 10.

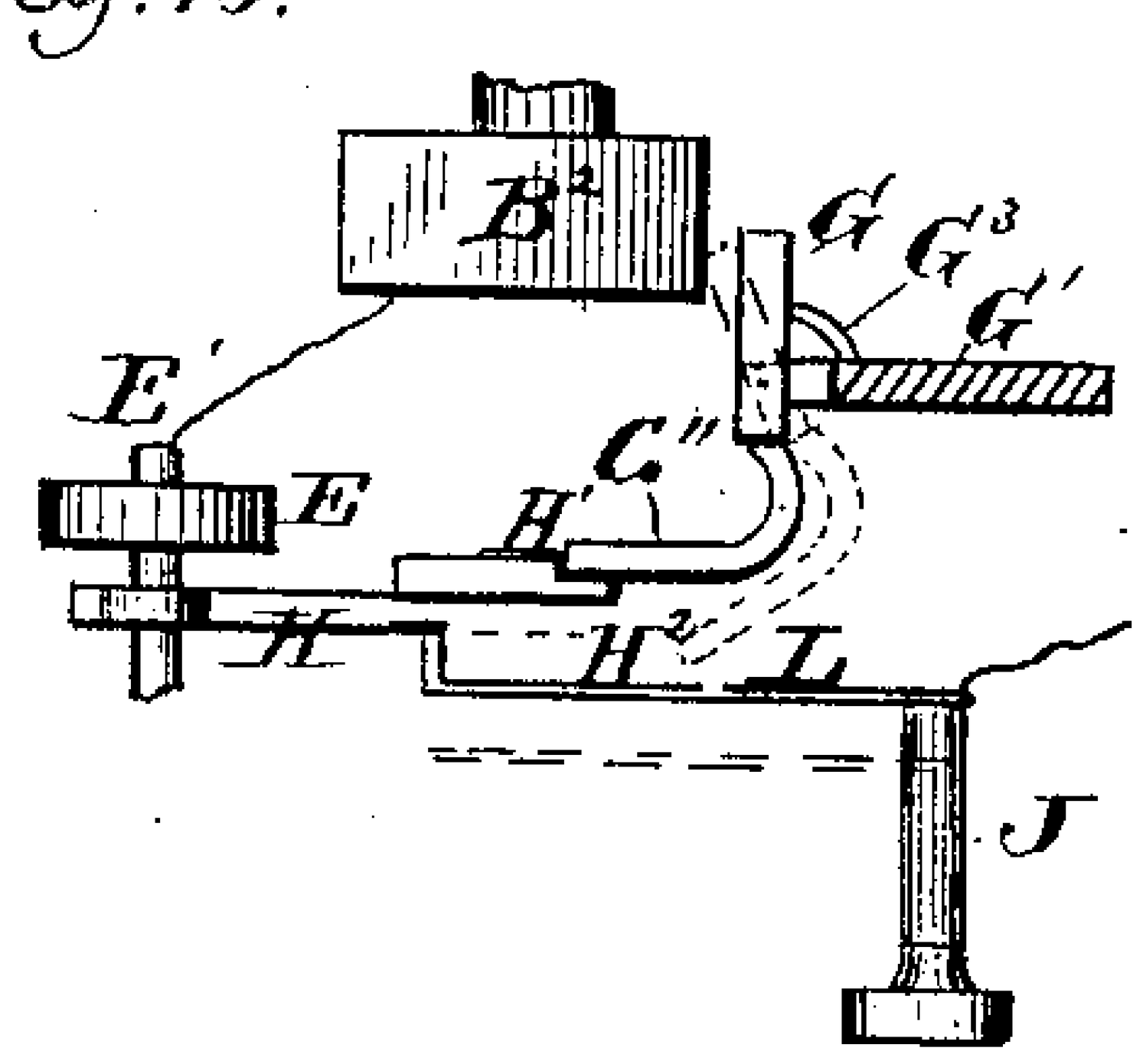
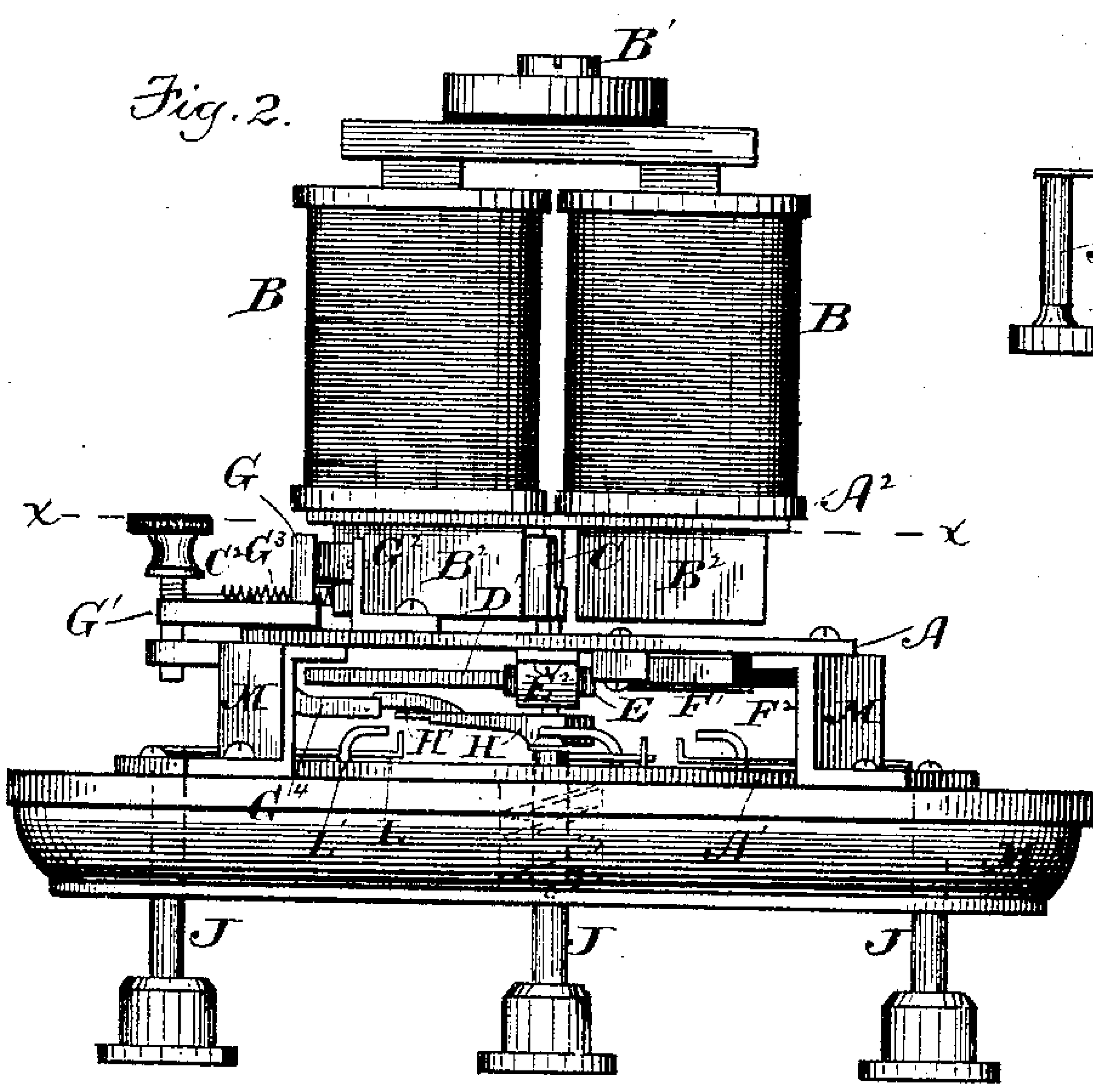


Fig. 2.



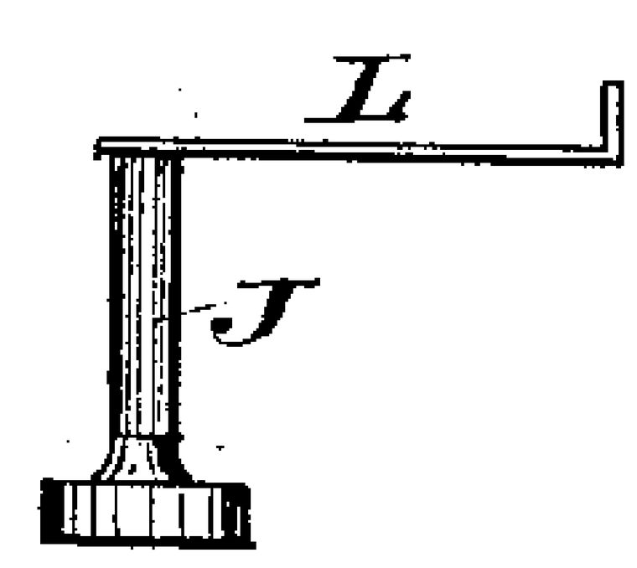
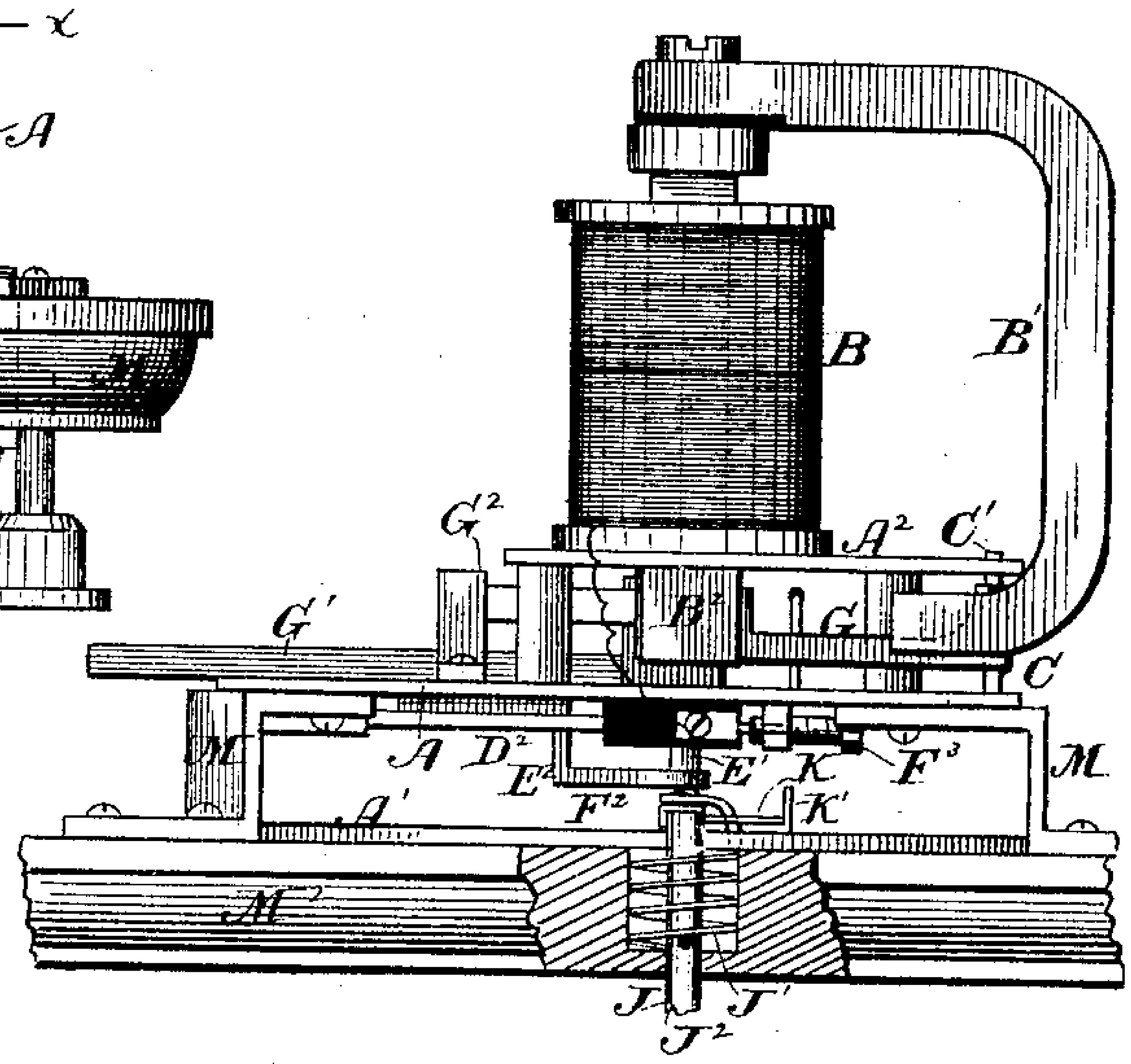


Fig. 3



Witnesses.
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A. L. White

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E. F. Frost
by Wright & Brown
Attys.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.)

3 Sheets—Sheet 2.

E. F. FROST.

INDIVIDUAL SIGNALING APPARATUS.

No. 320,923. Patented June 30, 1885.

Fig. 4.

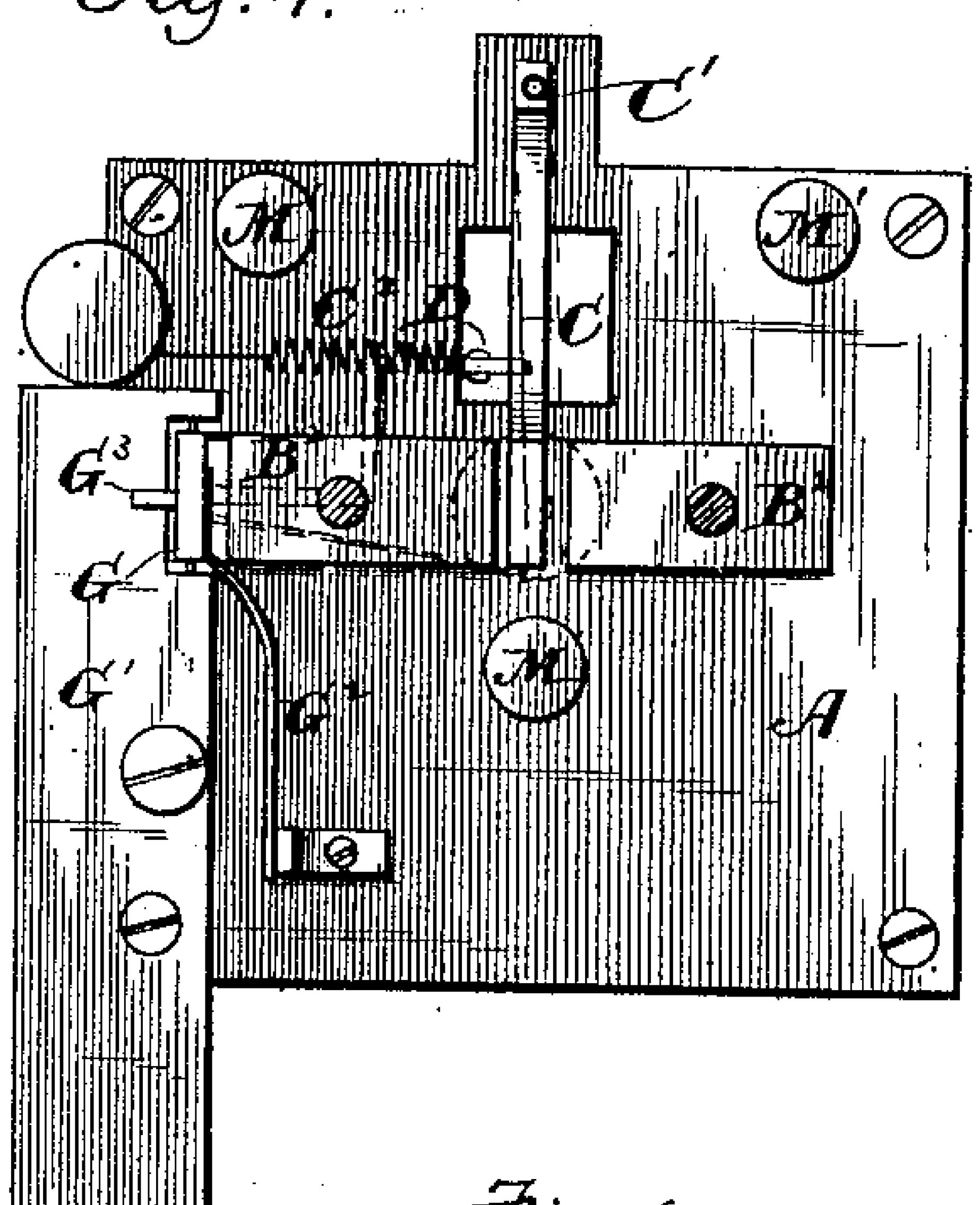


Fig. 5.

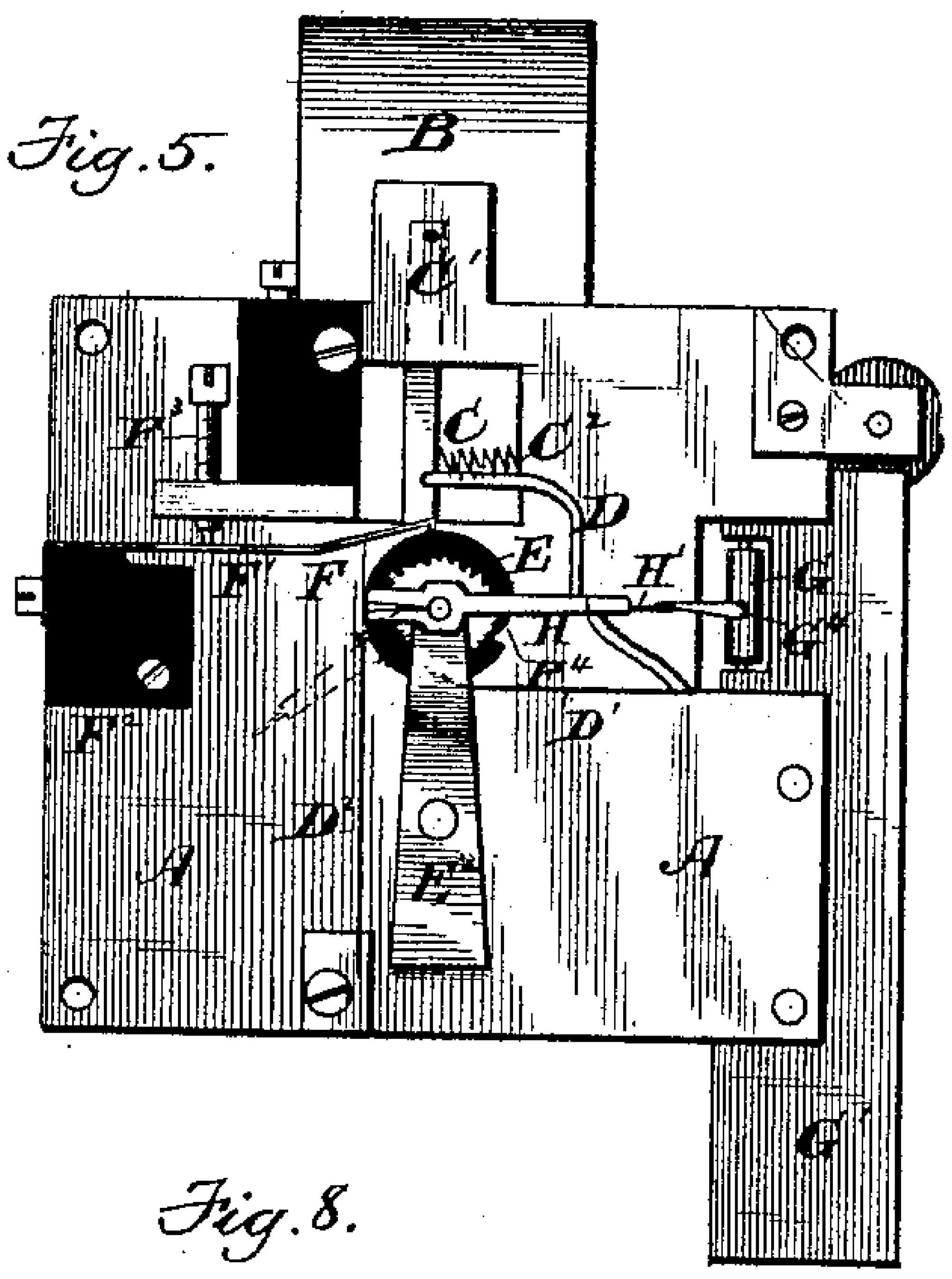


Fig. 6.

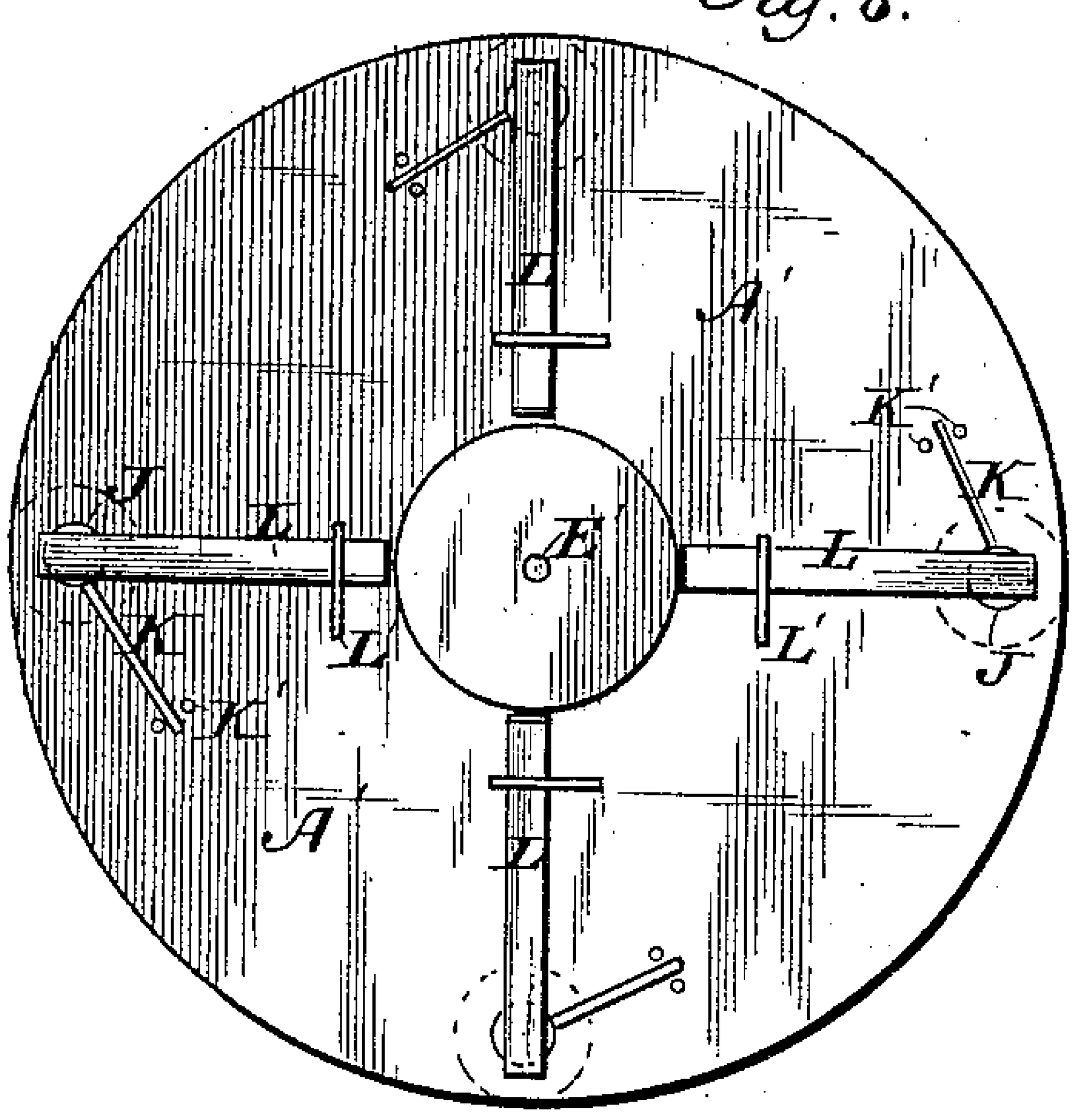


Fig. 8.

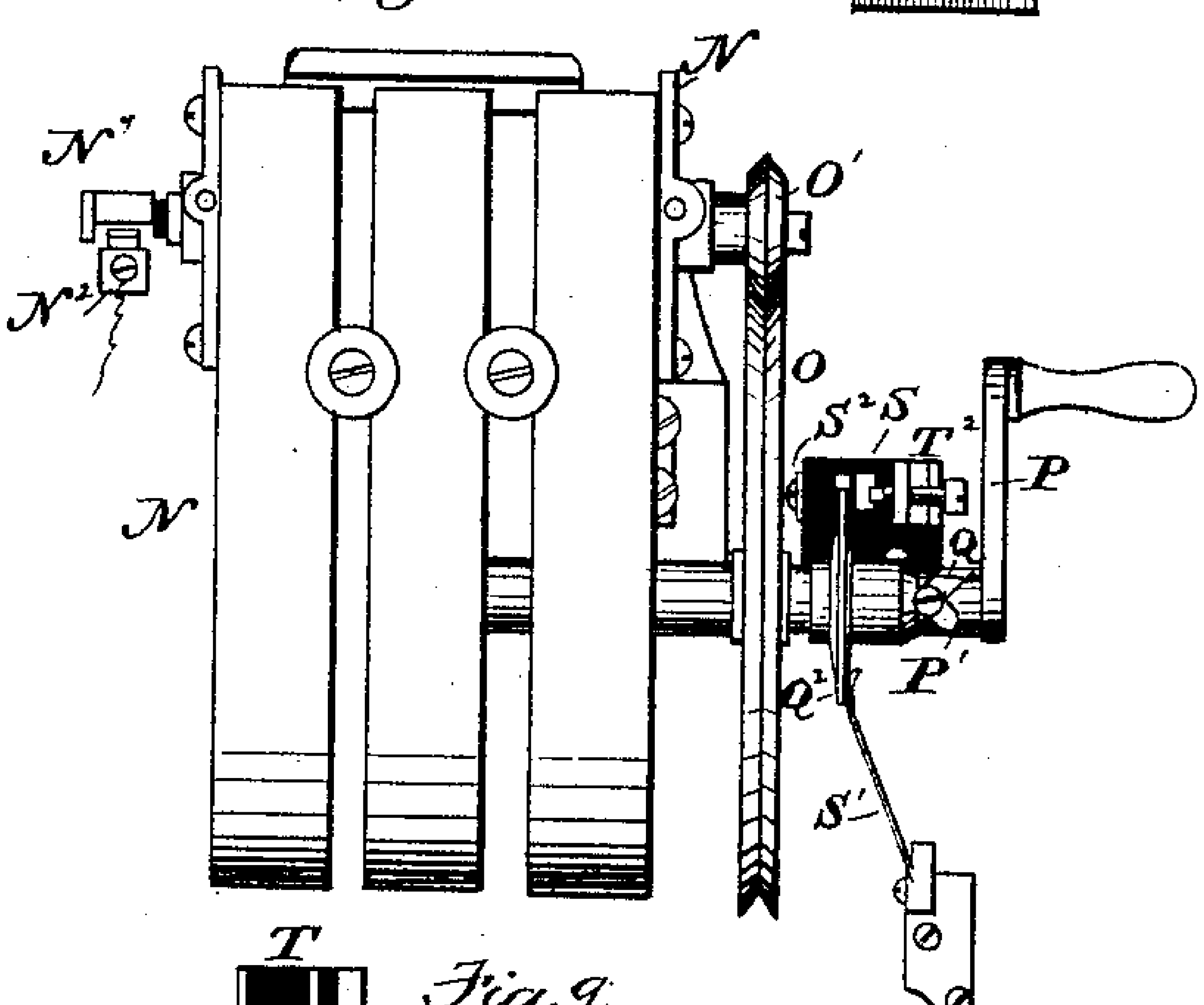


Fig. 7.

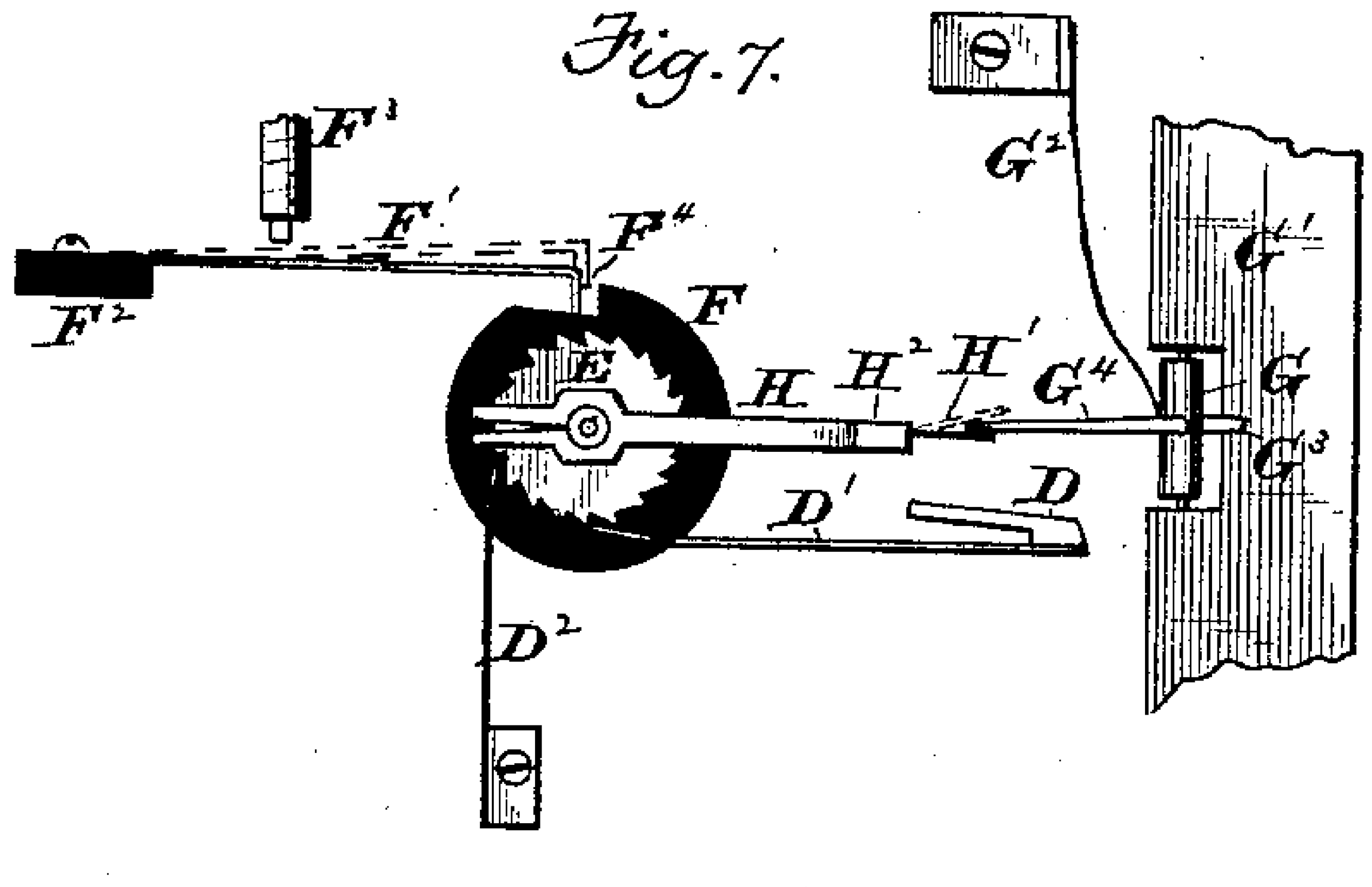
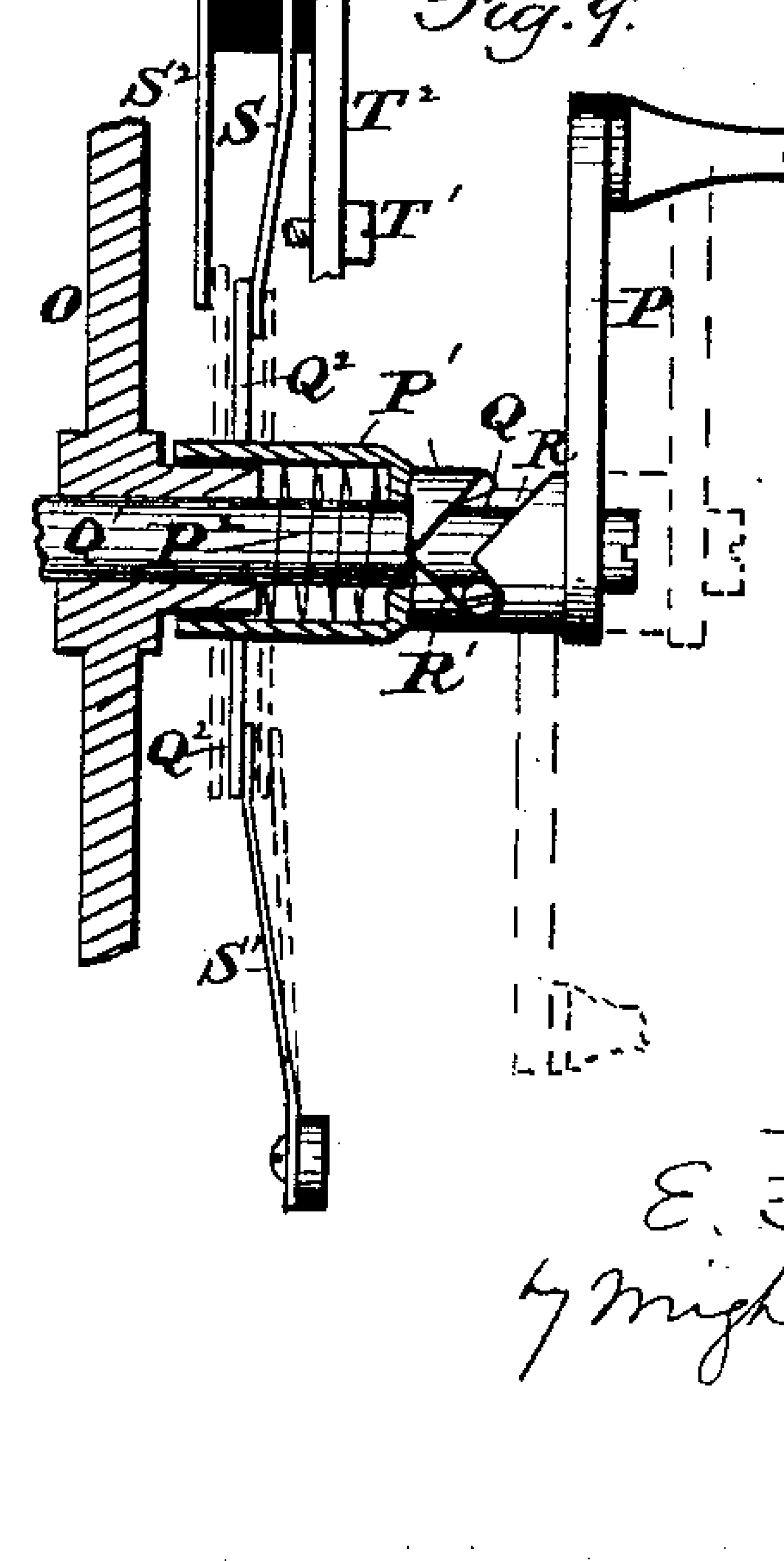


Fig. 9.



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(No Model.)

3 Sheets—Sheet 3.

E. F. FROST.

INDIVIDUAL SIGNALING APPARATUS.

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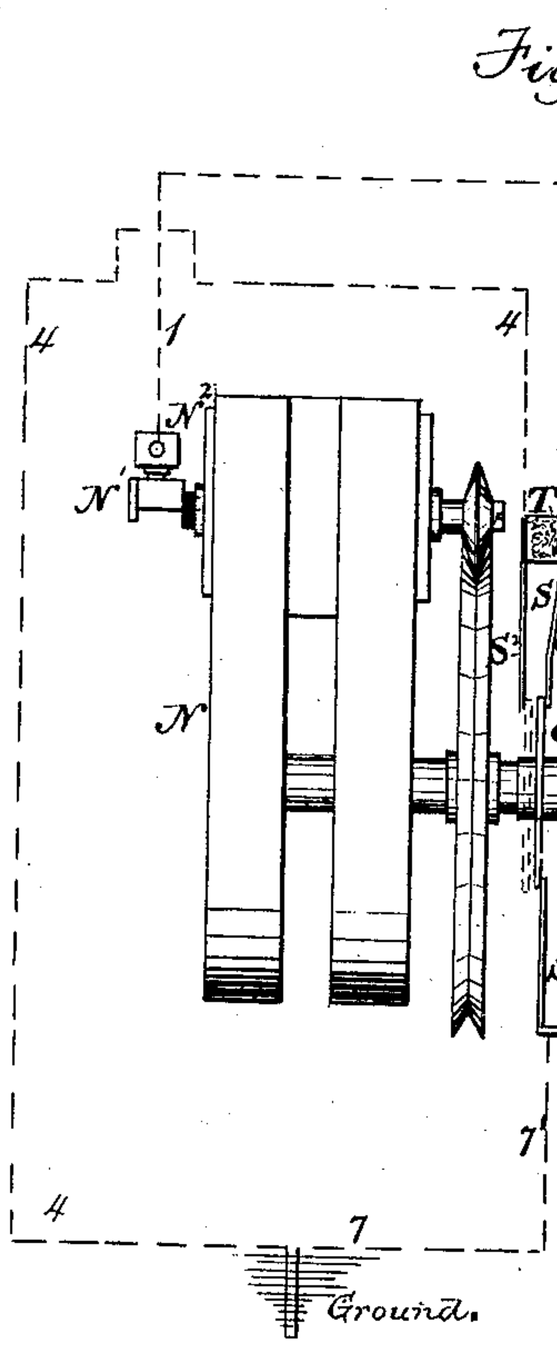
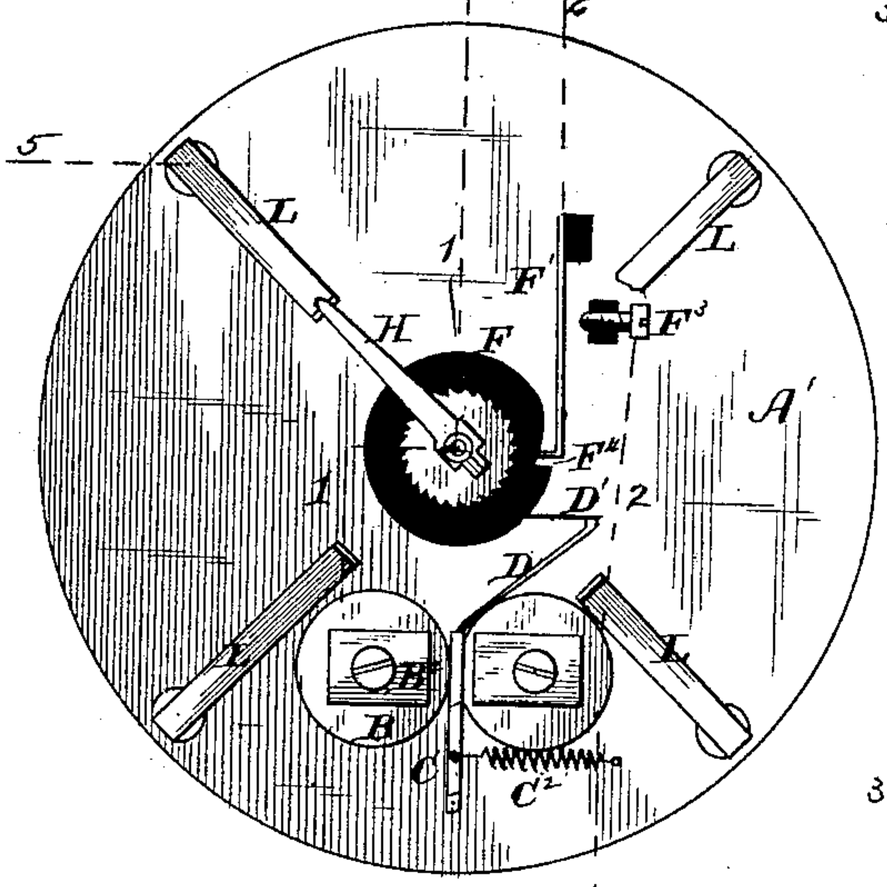
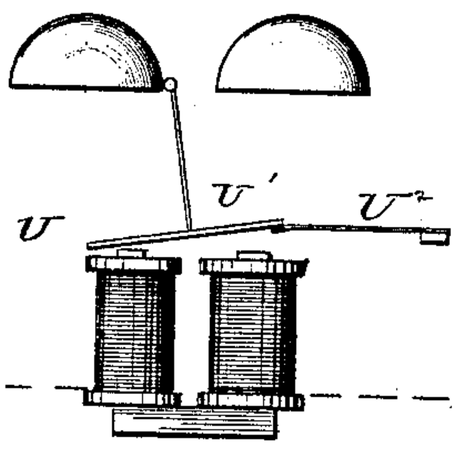
Fig. 11.







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A. L. White

Inventor
E. F. Frost.
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Attys.

UNITED STATES PATENT OFFICE.

ELLIS F. FROST, OF BOSTON, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO THOMAS W. GLEESON, OF SAME PLACE.

INDIVIDUAL SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 320,923, dated June 30, 1885.

Application filed June 3, 1884. (No model.)

To all whom it may concern:

Be it known that I, ELLIS F. FROST, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Individual Signaling Apparatus, of which the following is a specification.

My invention relates to certain improvements in individual telephone-signals of that class in which step-by-step devices are actuated by a current of given direction to circuit the bell, which is then actuated by impulses of reverse direction; and it consists in a novel combination of a transmitting apparatus with the signaling devices in such manner that any office may signal another on the same circuit without the aid of the exchange by means of a slight modification of the usual magneto-generating machine; also, in an improved form of magneto-generator for operating the signals; also, in a novel arrangement of the connections through the transmitting and magneto-generating devices.

My invention is fully set forth in the following specification and the accompanying drawings, in which—

Figure 1 is a top view of the box containing my apparatus to show the arrangement of the knobs and indicator-hand. Fig. 2 is an elevation of the apparatus as it appears on opening the box shown in Fig. 1 downward on its hinges, there shown. Fig. 3 is an elevation as viewed from the right of Fig. 2. Fig. 4 is a horizontal section on the line *x x*, Fig. 2, looking downward. Fig. 5 is an under side view of plate A and the attached parts, as viewed from beneath said plate in Fig. 4. Figs. 6, 7, and 10 are detached views of parts shown in the above view. Fig. 8 is a top, and Fig. 9 is a detached, view of the magneto and the switching devices thereon. Fig. 11 is a diagram of the connections.

In Figs. 2 and 3 an electro-magnet, B, has its armature inductively polarized by a permanent magnet, B′, the free end of said permanent magnet curving around and serving to polarize an armature, C, pivoted at C′, between the plates A A′, and with its free end formed to vibrate between the polar extensions B^2 of magnet B, being normally biased to the left of Fig. 2 by an adjustable coiled spring, C^2, as shown.

A curved arm, D, Fig. 5, is secured to said armature and carries a spring-pawl, D′, Figs. 5, 7, which engages the teeth of a ratchet-wheel, E, mounted on shaft E′, Figs. 2, 3, which latter is pivoted in plate A and bracket E^2.

When armature C is vibrated by electrical impulses of a definite polarity, the effect will be to advance wheel E step by step in a well-known manner, a retaining-pawl, D^2, preventing retrograde movement of said wheel. Shaft E′ passes through to the front M′ of the box, as shown in Fig. 1, and the whole arrangement is so far simply "Siemens' dial-telegraph," arranged to be operated by currents of one given direction while irresponsive to currents of the other direction.

A disk of insulating material, F, Fig. 7, is also secured to shaft E′, and has in its periphery, as shown, a notch, F^4, while a spring, F′, secured to but insulated from plate A by an ebonite block, F^2, is arranged to have its free bent end to rest on the periphery of said disk and to drop into the said notch when said disk arrives at a predetermined point in its revolution, and to thereby break its normal existing contact with an insulated screw, F^3. By contact between spring F′ and screw F^3 a short-circuit is formed around the magnet of a call-bell in a manner which will be shown hereainafter.

It is obvious that by placing notch F^4 in a different angular relation in each of a number of such apparatuses to a fixed starting-point common to all, and then placing them on one circuit and actuating them simultaneously, the bells will be successively included in circuit, but no two will be in contact at one time; also, if the bells be sensitive to currents of the reverse polarity to those operating the apparatus by stopping the same at the point where any desired bell is in circuit, the bell will be rung by a reversal of current without operating said apparatus and without ringing any of the other bells on the line.

As in a signal operated step by step in the manner described, there is liability of skip-

ping, I provide a unison device, (shown in Figs. 2, 4, 5,) which consists in an armature, G, pivoted in an opening of and polarized by a permanent magnet, G′. Said armature is arranged to be attracted by one of the polar extensions B^2 of magnet B on the passage of a current of the reverse polarity to that which operates armature C, and is normally removed from said polar extension by the action of a spring, G^2, secured to plate A, to an extent limited by a stop, G^3, secured to said armature and engaging magnet G′, as shown in Figs. 2, 7.

A bent arm, G^4, projecting downward from armature G in a manner shown in Figs. 2, 5, 7, 10, is tapered off at the end, as shown, and when armature G is not attracted is arranged to lie in the path of an elastic spring, H′, secured to an arm, H, which latter is secured to shaft E′. When armature G is attracted said arm G^4 is removed out of the path of spring H′. By this device the motion of arm H and wheel F is arrested at a definite point in their rotation, and held until released by reversing the current, which operation will remove arm G^4 from engagement with spring H′, and as this spring has been slightly strained by being forced against said arm by its actuating devices, it will, when released by said arm, spring into the position dotted in Fig. 7, so that, although arm G^4 will resume its former position in the path of said spring on the application of the current-operating armature C, yet it will now be on the other side of the spring H′, and will not arrest its motion until it has performed another revolution. In practice a few extra impulses will restore the lagging switch-arms to unison with the rest.

It now remains to describe the magneto and transmitting devices and the connections thereof.

In every signal a series of four or more push-knobs, J, are provided, projecting through to the top of the box, as shown in Fig. 1, and normally controlled by coiled springs J′, which push the knobs outwardly. (See Figs. 2 and 3.) Said knobs are adapted to be pushed inwardly by the operator. The said knobs are provided with flat springs L, extending inward toward shaft E′, Figs. 6, 10, and with their inner ends turned upward, as shown. If one of the knobs J be pressed the action will raise the attached spring L into the path of a contact-spring, H^2, secured to arm H, as shown in Fig. 10, in which the right-hand spring is shown as raised and in engagement with said contact-spring, the dotted lines showing the normal position of the same. The contact of said springs will arrest the motion of said arm, and also of all the parts attached to shaft E′, as it will short-circuit the magneto-machine in a manner to be explained in connection with the diagram of circuits, Fig. 11. This will also arrest the motion of all the apparatus upon the line.

The magneto-generator, Fig. 8, used in connection with my apparatus, is of the usual form, employing a Siemens armature, but is modified, to meet the requirements of my system of signaling, in a manner to be next described. One wire of the armature-coil is connected to the frame of the magneto in the usual manner, while the other end is connected to an insulated piece of the armature-shaft N′, which is cut away in such manner that it will at most only make contact with spring N^2 during a half of every revolution of said armature, and is so adjusted that all impulses thus produced are of the same polarity as they go to line—that is, if the armature be always turned in the same direction.

Crank P, by which the magneto is operated, is secured to a sleeve, P′, Figs. 8, 9, which turns easily on shaft Q′, to which latter is secured a large friction-wheel, O, engaging a smaller friction-wheel, O′, on the armature-shaft in a manner common in such generators.

Sleeve P′ is slotted, as shown in Fig. 9, at R R′, and in said slots slides a pin, Q, which is secured in shaft Q′ of wheel O. A coiled spring, P^2, placed, as shown, in the enlarged portion of sleeve P′, acts to force said sleeve to the right in said figures or into the position shown in Figs. 8, 11. A flange, Q^2, also secured to sleeve P′, when said sleeve is forced to the right, as described, in that position engages flat spring S, and forces it into contact with an insulated screw, T′, thereby short-circuiting the generating-armature itself in a manner well understood, the circuit being from N, spring N^2, line 1, line 6, screw T, flange Q^2, through the machine to N, as clearly seen in Fig. 11.

The two arms R R′ of the slot P′ are not of the same length; and, referring to Fig. 9, the dotted lines extending downward show the normal position of the crank-sleeve and flange Q^2, the full lines the position of the same when the crank is turned to force the pin Q into the shorter of the slots, and the dotted lines extending upward show the positions when the crank is turned in the reverse direction and said pin is forced into the longer slot.

As will be seen, when the crank is turned in the one direction, which is the direction to operate the signaling devices, the pin Q′, entering the short slot, forces sleeve P′ toward wheel O and flange Q^2 into the position shown in full lines in Fig. 9, and spring S will follow the flange so far without breaking contact with the same, and will break its previously-existing contact with screw T′, while another insulated flat spring, S′, also engaging said flange, is also arranged to follow the motion of the same to the extent that spring S does.

When the crank is turned in the reverse direction from the one just described, it will force pin Q into the longer slot R, and thus flange Q′ will be forced nearer to wheel O, and as springs S S′ will only follow it a limited

distance they will break contact with said flange, which will then make contact with another spring, S^2, and at the same time reversal of the motion of the armature of the magneto, caused by reversing the motion of crank P, will reverse the current from said machine, and this is the current used to ring the bell and for unlocking the arm H from check-armature G, as hereinbefore described.

Having thus described the more strictly mechanical devices, I will now describe the connections and working of the same, reference being had to diagram of connections, Fig. 11.

Let us suppose the office to be calling another on the same circuit. He will first press one of the knobs J corresponding to the office to be called, and then actuate the crank P of the magneto in such direction that the pin Q will enter the shorter of the slots R'. This will send a series of electrical impulses to line as follows: Piece N and spring N^2, wire 1, which connects both with arm H and magnet B, thence the current will pass through said magnet and by wire 2, screw F^3, spring F', and to line out, the disk F at this time being in such a position that it holds spring F' against the insulated stop F^3; returning through the ground-wire 7, spring S', flange Q^2, and thence to the body of the magneto, to which the other end of the armature-coil is connected. All the switches on the line starting from a unison-point will be actuated by the impulses so sent, step by step, as hereinbefore described, until the arm H in the calling-office has reached the spring L, which is attached to the depressed knob J, as shown in Fig. 10, when it will make contact with the same, with the effect of short-circuiting the magneto-generator in the calling-office by taking the current from wire 1 through arm H, spring L, wire 5, spring S, and flange Q^2, and, the magneto being thus shunted on itself, the entire apparatus upon the line will stop, and this will occur at the time that the spring F' in the called office has dropped into the notch in cam F and thus broken the short-circuit around the magneto-bell U in said office. The calling-operator will then reverse the motion of the crank P, thus forcing pin Q into the longer slot R, and at the same time of course reversing the current given by the magneto. Flange Q^2 will now be out of contact with springs S S' and in contact with spring S^2, and a reversed current will go to line by the following path: wire 1 to the line, as in the first-mentioned case, and returning by the ground, wire 4, and spring S^2 to flange Q^2, thus avoiding the short-circuit.

The bells in the various offices upon the circuit are made insensitive to impulses of the polarity used to operate the switches by being biased to one side by a spring, as shown in Fig. 11, and the current being reversed, as just described, the bell in the called office will be actuated, while the other bells are still shunted out of circuit, and the switches will be at rest because the currents now passing are not of proper polarity to operate them.

To restore to unison the operator will turn the crank P in the proper direction until, by the indicator-hands L^2, he sees that the apparatus has moved to the zero or unison point, and then by giving a turn to in the reverse direction he will actuate check-armature G to release arms H, as hereinbefore described.

Supposing the office to be called, the entering current will pass from the line by wire 2, spring F', screw F^3, magnet B, wires 1 6, screw T', and spring S to flange Q^2, and thence by spring S' and wire 7 to ground or the next office, the magneto being now short-circuited. The step-by-step devices will be operated until spring F' drops into the notch in cam F, and thus breaks the contact of the same with screw F, and the current will then be forced to pass by wire 3 through bell U, and said bell will be actuated by a series of currents of reverse character to those used in operating the ratchets, as before stated. It is therefore evident that a current of one polarity in actuating the dials thus serves, in combination with the dials, to individualize any one of a number of bells connected by the same circuit, and the employment of magneto-currents of given direction in the way and for the purpose herein stated I believe novel.

It will be of course understood that although I show but one instrument, a series of such instruments are to be connected up in the same line-circuit together, and that they are identical in every respect, with the exception of the position of the notch on the periphery of the disk F.

I claim—

1. In a system of individual electric signaling, a series of bells normally short-circuited, means, as indicated, for breaking the short circuit round the said bells and for including the bell-magnets each at its own time in the main circuit, a series of generators, one for each station, and electrical connections, substantially as described, adapted to generate and transmit magneto-electric currents of one direction to actuate the short-circuit-breaking mechanism and to include any predetermined bell in the main circuit, and to transmit, when reversely operated, currents of similar duration but opposite direction to ring the desired bell when so included, substantially as set forth.

2. The combination, in a system of electric signaling, of a series of magneto-generators adapted to transmit at the will of the operator intermittent currents of either direction, with a series of step-by-step mechanisms, each actuated by an electro-magnet and the polarized armature thereof, and with an auxiliary polarized armature for each mechanism of the series, said armature being adapted to engage a projecting arm of the step-by-step mechanism and to arrest the same once in

each revolution when influenced by currents of similar direction to those required to actuate the said mechanisms, but to release the said arm when currents of opposite direction are transmitted.

3. In an individual signaling system, a series of polarized bells biased to respond to intermittent currents of definite direction normally short-circuited, a series of electrically-actuated step-by-step rotary devices, each adapted to break the short-circuit round its own bell and to include the bell-magnet in the main-line circuit, a unison consisting of a rotating arm attached to each rotatory device and of a polarized armature engaging therewith at a like point in the revolution of all of the said rotatory devices, and a magneto generator at each station adapted to transmit pulsations of definite polarity to actuate the rotatory devices and to operate the unison, and when reversely operated to transmit pulsations of opposite polarity to release the unison and to ring the bell, substantially as described.

4. An individual electric signaling instrument comprising a magneto-electric generator provided with circuit-changing devices whereby currents of either polarity or direction may be transmitted to line as required, a polarized bell normally shunted or short-circuited, and adjusted to respond to currents of one given direction, an electro-magnetic step-by-step actuating mechanism adapted when operated to break the said short-circuit round the bell, an electro-magnet and polarized armature controlling the said actuating mechanism, and adjusted to operate only under the influence of currents of opposite direction to those which ring the bell, an auxiliary polarized armature arranged to engage a rotating arm attached to the actuating mechanism and to arrest the same at a constant point in each revolution thereof, and a series of stop keys and levers adapted when operated to stand in the path of said rotating arm and to make electric contact therewith and short-circuit the generator at the moment when the required distant bell is introduced into the circuit, substantially as and for the purposes described.

5. An individual electric signaling system comprising the following elements: a main circuit, a series of magneto-electric generators included in a shunt of said main circuit and provided with circuit-changing devices whereby currents of either direction may be emitted from said generator as required, an auxiliary and normally-open shunt-circuit for each generator adapted to be automatically closed when a suitable number of currents have been sent to line, a series of polarized bells biased so as to respond to currents of given direction only, and normally short-circuited, a series of step-by-step actuating mechanisms controlling the short-circuit round the said bells and adapted to break the same and include the bell in the main circuit after a definite number of currents of direction opposite to that required to ring the bell have been sent to line, circuit-closing devices actuated by the same mechanism for closing the auxiliary shunt-circuit of the home generator after the requisite number of actuating-currents have been sent, and an auxiliary polarized armature attached to each actuating mechanism to engage with a projecting arm thereof, whereby the several mechanisms may be brought to a common starting-point, as set forth.

6. In an individual telephone signal, and in combination with rotating devices operated step by step, an arm, H, secured to said devices, and an armature actuated by a current of one polarity and provided with an elastic tip, H′, arranged to be engaged by a second polarized armature actuated by currents of a reverse polarity, and to thereby arrest the motion of said step-by-step devices and to spring out of engagement with said armature when the same is actuated in the manner set forth.

7. In an individual telephone signal, and in combination with electrically-rotated step-by-step devices, and a magneto generator operating the same, a contact-arm, H, carrying spring H^2, secured to and rotated by said devices, a series of springs, L, circumferentially arranged around the axis of said arm and arranged to be individually brought into engagement with the same in the manner set forth, and connections whereby contact between said arm and spring will shunt said magneto upon itself.

8. In a telephone-signal, and in combination with signaling mechanism, a magneto generator actuated by a crank, in the manner set forth, and a sleeve, P′, and a contact-making flange, Q^2, thereon, and automatic means whereby when crank P is turned in the one direction said flange will make one series of contacts, and when said crank is turned in the other direction said flange will make another series of contacts, as and for the purposes specified.

9. In a telephone-signal, and in combination with electrically-rotated step-by-step devices, a magneto-generator actuating the same, switch devices actuated by said magneto, and connections, as set forth, whereby, when said magneto has been cut out of circuit by the said step-by-step devices, a reversal of the rotation of the crank of said magneto will operate said armature and switching devices thereon to change the circuit, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 24th day of May, 1884.

ELLIS F. FROST.

Witnesses:
T. W. GLEESON,
C. F. BROWN.