(No Model.) 3 Sheets—Sheet 1.

C. A. ROLFE.

AUTOMATIC CUT-OUT.

No. 580,957. Patented Apr. 20, 1897.

Fig. 2.

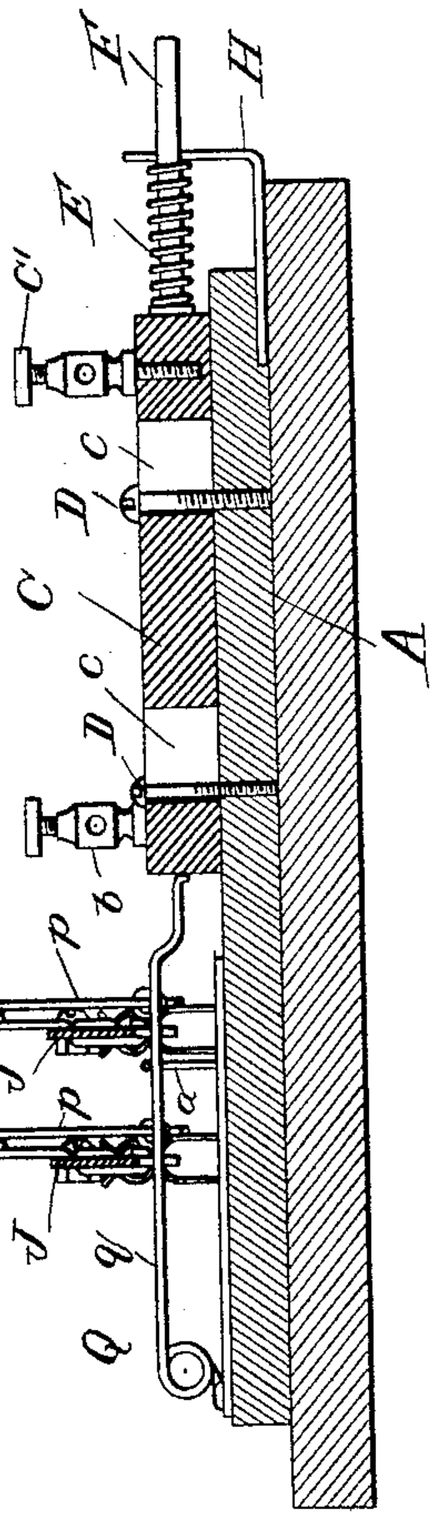


Fig. 3.

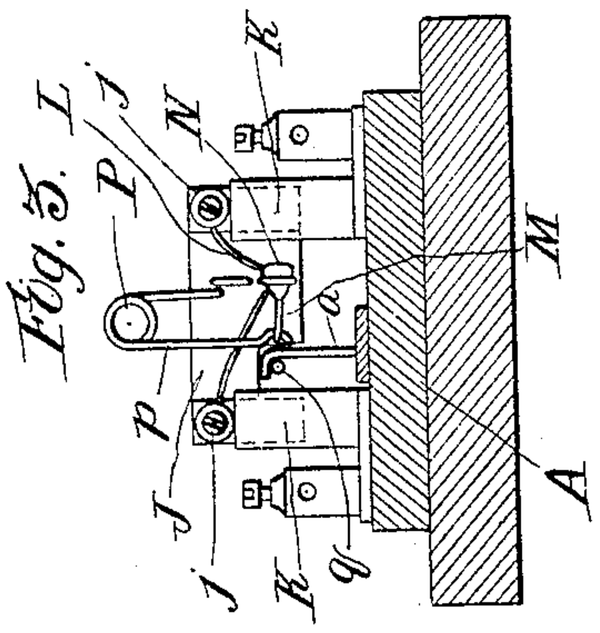


Fig. 4.

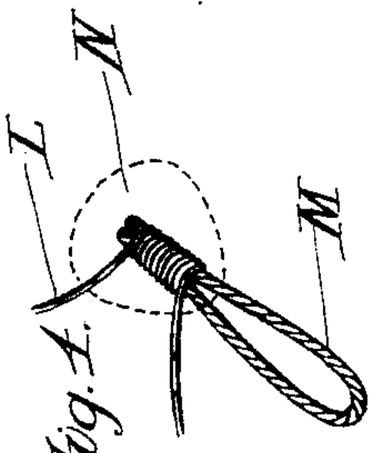
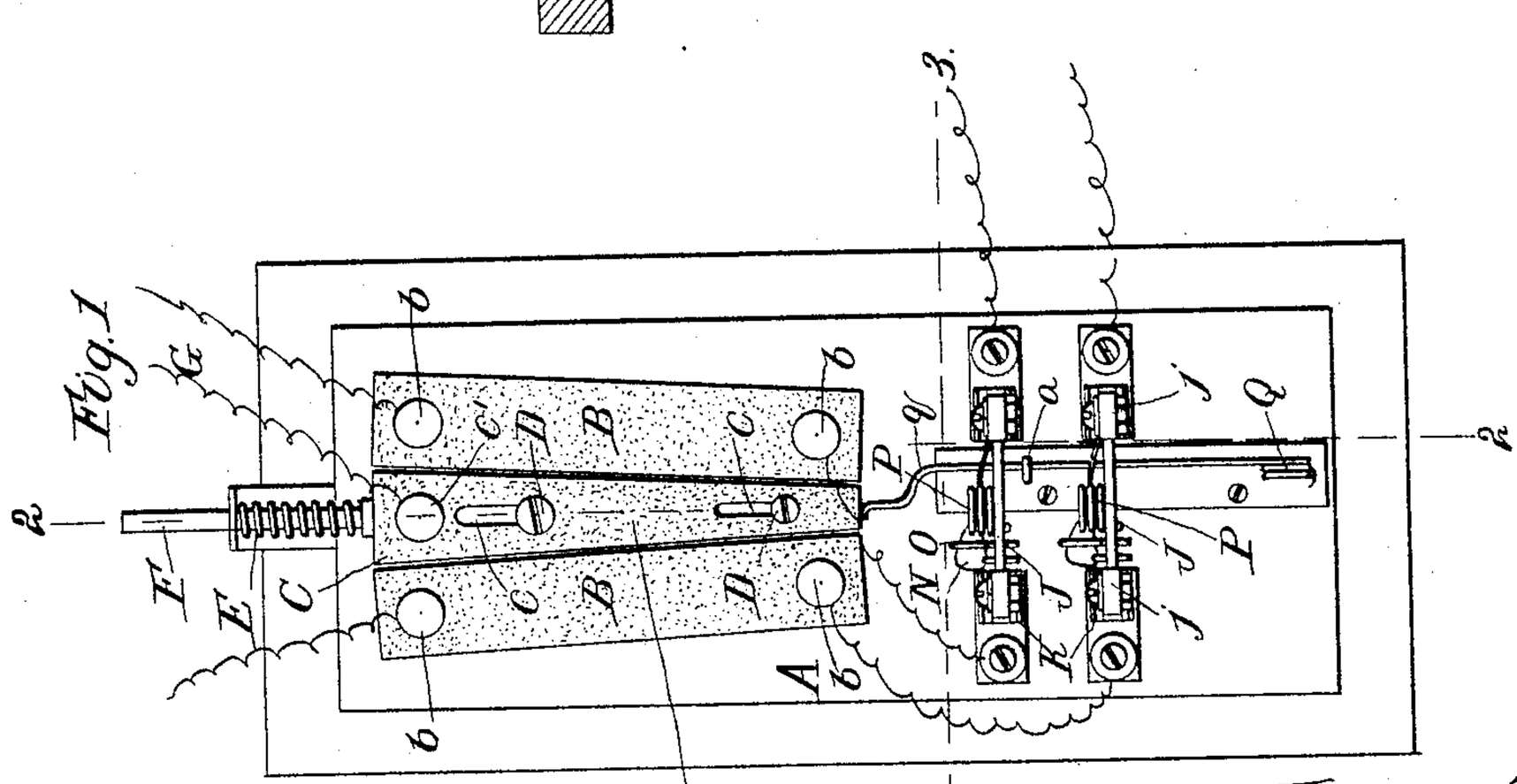


Fig. 1



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Inventor:
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(No Model.)

3 Sheets—Sheet 2.

C. A. ROLFE.

AUTOMATIC CUT-OUT.

No. 580,957. Patented Apr. 20, 1897.

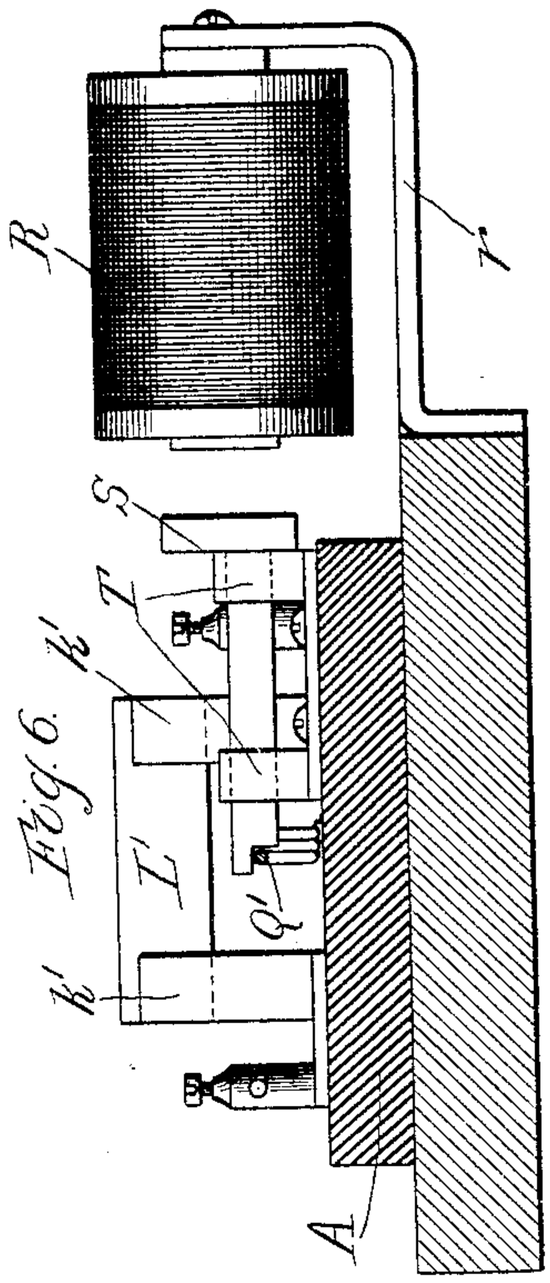

Fig. 6.

Fig. 5.

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3 Sheets—Sheet 3.

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AUTOMATIC CUT-OUT.

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Fig. 7.

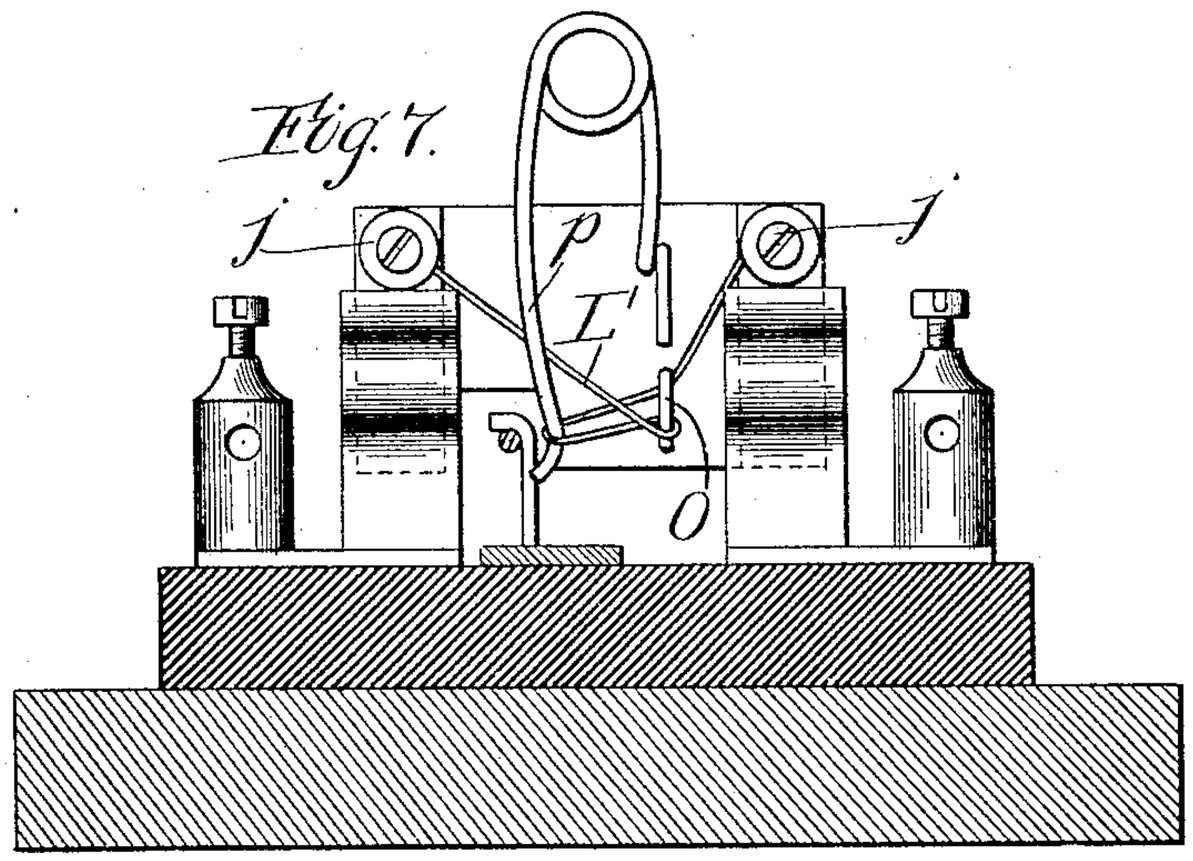
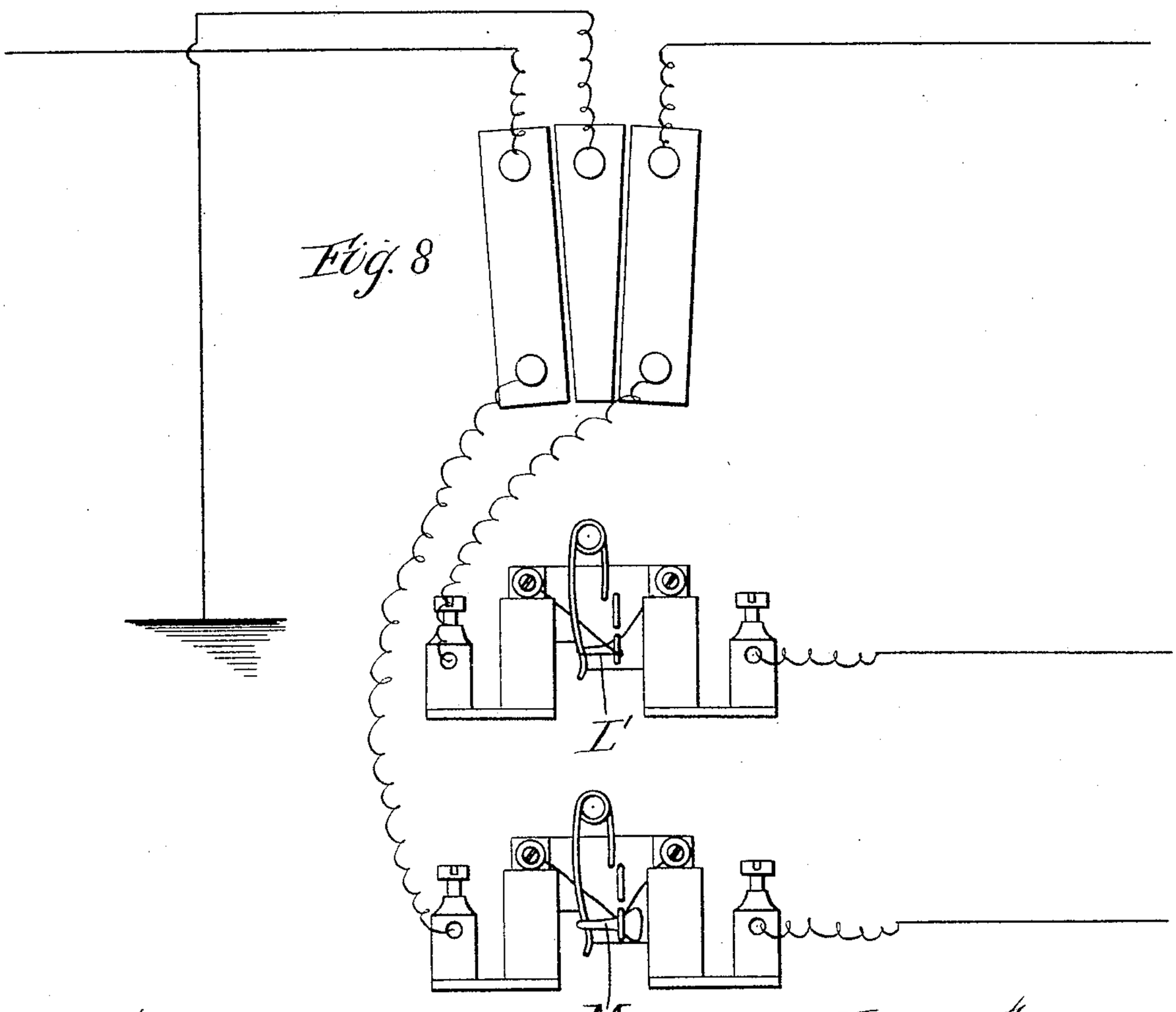


Fig. 8



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UNITED STATES PATENT OFFICE.

CHARLES A. ROLFE, OF CHICAGO, ILLINOIS.

AUTOMATIC CUT-OUT.

SPECIFICATION forming part of Letters Patent No. 580,957, dated April 20, 1897.

Application filed July 16, 1896. Serial No. 599,404. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. ROLFE, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Automatic Cut-Outs, of which the following is a specification.

My invention relates to that class of devices which are designed to protect electrical instruments and machines, especially the more delicate appliances employed for signaling purposes, from the destructive effects of lightning and of currents of greater strength than those which it is intended they should receive.

To secure such protection, my invention contemplates shunting or bridging the instrument by connecting together the conductors leading to and from the same when the current passing in the operating-circuit becomes greater than the construction of the instrument would safely warrant.

My invention further contemplates the complete removal of the instrument from the circuit by disconnecting it entirely from the branch or shunt into which the connection across its terminals places it simultaneously with the formation of such branch or shunt. The advantages of such an arrangement are obvious, for by it the instrument is efficiently protected from danger by being disconnected entirely from the operating-circuit the instant the current therein becomes too great for its safety, while at the same time the continuity of the operating-circuit is preserved by the simultaneous bridging of the instrument, or, to be more accurate, by the bridging of the break caused by the disconnection and consequent removal of the instrument from the operating-circuit. The instrument is thus saved and the endless annoyance and trouble caused by an open operating-circuit is avoided. For instance, in case there should be a number of instruments on the circuit and only one becomes affected by an unduly strong current it is evident that the utility of the circuit is not destroyed by the disconnection of such instrument. In case all the instruments are affected and cut out each one becomes operative as soon as replaced in circuit, since the continuity of the circuit is unbroken at any point. Hence it is unnecessary to replace all the instruments before rendering the line operative.

My invention further contemplates placing a conducting-terminal having a connection with the ground in close proximity with a portion or portions of the operating-circuit, whereby lightning drawn to the latter may leap or arc across the narrow intervening air-space and escape to the earth. The invention also contemplates the employment of this grounded conducting-terminal to connect the operating-circuit across the terminals of the instrument when such connection becomes desirable.

All the previously-mentioned advantages are thus procured, with the additional ones, first, that a very convenient arrangement is made possible for bridging the instrument, and, second, that should the atmospheric conditions be such that the lightning upon the line should refuse to leap the air-space to the grounded terminal it will operate the device to throw out the instrument and also ground both sides of the line by reason of the connection which the grounded terminal forms across the terminals of the instrument.

In the device more particularly described hereinafter for carrying out my invention a couple of conductors which are included in the operating-circuit are arranged adjacent to one another, and a third conductor is situated between the two, normally out of contact with both, but having a tendency to move into contact with and thereby establish connection between the same. This third conductor is desirably placed in very close proximity with those on either side of it and is connected with the ground. The adjacent surfaces of the conductors are also desirably made of large area, whereby the tendency of any lightning drawn upon the line to pass from the pair of conductors included therein to the third conductor or grounded conducting-terminal is perceptibly increased. This grounded terminal is held normally away from the pair of circuit-conductors and is automatically released when the current in the circuit becomes unduly great. Any one of a variety of appliances could be employed to release the same, but as a matter of further improvement I prefer to use for this purpose a thermal cut-out device for which I have ob-

tained Letters Patent of the United States No. 538,284. This device consists, essentially, in a movable holder for the terminals of a high-resistance wire, a suitably-held mass of fusible material, and a spring which is normally held under tension and which is tripped or released by the fusion or softening of said mass, the result of thus releasing the spring being that it will operate to cause the bodily removal of the high-resistance wire from the circuit. Such a cut-out is preferably included in the operating-circuit between the instrument and the previously-mentioned pair of conductors, and is arranged so that the operation of its spring releases also the third conductor or grounded terminal. By such arrangement the circuit is not only bridged around the instrument, closing and making continuous the same, but it is also broken and entirely disconnected from the instrument by the throwing out of the high-resistance portions of said thermal cut-out device, and the line is grounded by the contact which the grounded terminal makes with the pair of conductors.

In the accompanying drawings, Figure 1 is a plan of a device embodying my invention. Fig. 2 is a section of the same on line 2 2 in Fig. 1. Fig. 3 is a section on line 3 3 in Fig. 1. Fig. 4 is a detail view illustrating the method of arranging the high-resistance wire in connection with the mass of fusible material. Fig. 5 is a plan of a modified form of the device, and Fig. 6 is a section on line 6 6 in Fig. 5. Fig. 7 shows a modified arrangement for retaining the spring in tension. Fig. 8 is a diagrammatic view of an alternative method of connecting up the device.

The device is conveniently mounted on a base A, of non-combustible insulating material. Upon this base are mounted the plates B B, which are made of suitable conducting material and are placed at a slight angle with one another. Each plate is provided with a couple of binding-posts *b*, whereby they are included in either side of the circuit leading to the instrument to be protected. Between these plates is a third plate C, which is mounted upon the base A to permit its longitudinal movement, as by providing it with the slots *c*, through which the screws D are passed and secured to said base. The sides of this plate C are inclined or tapered to be parallel with the adjacent sides of the plates B B, whereby the downward motion of the plate C will cause it to contact at all points along its sides with the plates B B. This arrangement—namely, a couple of conductors included in the circuit and a third conductor normally disconnected from both, but capable of being moved into contact with the same—is greatly preferred by me, although the same result may evidently be accomplished by having the third conductor connected with one of the other two and arranged to be connected with the other one also, it being evident that the essential feature is to have the third conductor disconnected from at least one of the other two and capable of connecting the same. As a means for producing a tendency on the part of the plate C to move into contact with the plates B B, I have shown a coil-spring E surrounding the spindle F, with which the plate C is provided, which is retained in tension by being confined between the plate C and the bracket H, secured to the base A. The plate C is also provided with a binding-post *c'*, to which is attached the conductor G, which is understood to make suitable connection with the earth.

The movable plate C may be retained out of contact with the plates B B and permitted to move toward the same by any one of a number of suitable devices. I prefer, however, to use in this connection the thermal cut-out hereinbefore mentioned as patented by me. This device is shown in Figs. 1, 2, and 3, and is constructed, briefly, as follows: A plate J, of non-conducting material, is provided with metal end pieces *j*, which are held within and in contact with a pair of spring-metal jaws K. A fine wire L, of high resistance, bridges the space between the metal end pieces *j* on the non-conducting plate and is wrapped upon the shank of a hoop or loop M, which is then embedded in a mass N of substance or material which easily softens or becomes friable when subject to a moderate degree of heat. The stem portion of this fusible button extends through an eye O on the non-conducting plate, said eye being arranged to support the mass N (which for convenience may be termed a "fusible" button) and to further provide a stop against which the head or larger portion of the button is normally held by the tension of the spring P, secured upon the non-conducting plate and having one of its arms *p* in engagement with the hoop or loop M. The metal jaws K, the metal plates *j*, held by said jaws, and the wire L are all included in the circuit. When, therefore, an unduly strong current comes in the circuit, the heat developed in the fine wire will fuse the button and thereby liberate the hoop or loop to which said wire is attached, and thereupon the spring-arm engaging the hoop or loop will move in a direction to cause a sudden strain upon and a consequent rupture in the fine wire, which will usually break the circuit. For reasons pointed out in said patent, however, a second spring Q is arranged upon the base A and is provided with an arm *q*, which when free will extend upwardly or away from the base. The spring is, however, normally under tension, and to such end its arm *q* is held down by a catch *a* and arranged to extend under the non-conducting plate J. This plate J is removably held in circuit by the jaws K, and hence when the spring-arm is released from the catch *a* it will fly up, and in so doing will engage the plate J and throw the same out of engagement with the jaws, and thereby break the circuit. The spring Q is released from the catch *a* primarily by the melting or

softening of the fusible button, and to such end the arm of spring Q is held by catch *a* in position adjacent to the arm *p* of spring P and in the path traversed by said arm when the hook or loop M is released. When this latter operation occurs, the arm *p* of spring P will strike and throw the arm *q* of spring Q out of engagement with catch *a*, and thereupon the spring-arm will spring upwardly and kick the plate J, which carries the wire L, out of the spring-jaws, and thereby break the circuit.

The spring Q is conveniently situated upon the base A with its free end of the arm *q* against the plate C, and thereby serves as a stop or abutment to maintain the latter out of contact with the plates B B against the action of the spring E. A single plate J, constructed as described, could be employed to release the spring-arm *q*, but I prefer to use two, placing one on each side of the circuit with reference to the instrument to be protected and arranging both to operate to release the spring-arm *q*. This arrangement insures the complete disconnection of the instrument by removing a portion of the circuit on either side thereof and also has the advantage that should either one of the springs P or operating parts connected therewith become inoperative the other will very likely be still perfect and operative, and as the operation of either one will serve to release the spring-arm *q* the result will be as effective as if both were in good working order.

From the foregoing it is evident that I may vary the construction and arrangement of the thermal releasing mechanism, the essential features being a spring, as Q, serving as a stop for the plate C, and a mass of fusible material arranged to release this spring Q when fused or melted. It will be further evident that the coil of fine wire of high resistance is removably held in circuit and is contained in the mass of fusible material, and also that when the spring, as Q, which is normally held in tension by means of the fusible mass, is released by the fusion or softening of said mass it operates in a direction to throw out of circuit the support to which the ends of the fine wire are attached.

In place of a thermal cut-out for automatically releasing the plate C, I may employ a number of other devices, one of which is shown in Figs. 5 and 6. In this arrangement I include in the circuit an electromagnet, as R, which is conveniently mounted on the bracket *r*, secured to the base A, and which is inactive under the influence of the normal current passing in the circuit.

An armature S is placed opposite the poles of the magnet R and arranged to release the plate C when attracted by the magnet, which occurs when the current in the circuit becomes unduly great. To this end the armature S is provided with a rear extension *s*, which is arranged to slide longitudinally in a bearing T, secured to the base. This rear extension *s* could be set directly against the plate C, but as a matter of further improvement the spring Q′ is interposed, it being arranged to serve as a stop or abutment for said plate and held in tension by the rear extension *s* of the armature. A couple of movable conductors, as the bars L′, are then supported in the contacts *k′* above the spring Q′, whereby the spring, when released, flies up, and in so doing permits the plate C to come into contact with the plates B B, and also throws the movable conductors L′ out of circuit.

From the foregoing, taken in connection with the description of the thermal cut-out, it will be seen that in either case a stop or abutment is provided for the plate C, with means for removing the same, and also that a spring may be arranged to serve as such stop or abutment and to throw out from circuit one or more movable conductors when released.

With further reference to the conducting-plates B B and C, I may state that I find carbon an exceedingly satisfactory material for their composition. When made of this material and provided with large opposing surfaces placed in close proximity with one another, the lightning which may be drawn upon the line has little difficulty in leaping the intervening air-space to the plate C and thus escaping to the ground. The plates B B do not become charged at such times, as is the case with metal plates, and consequently there is seldom any disruptive discharge.

As a substitute for the fusible mass N for holding the spring P in tension I may employ the arrangement shown in Fig. 7, in which the wire L′ is composed of an easily-fusible conductor or fusible alloy and is looped about the spring-arm *p*, passed through the eye O, and connected to the end pieces *j*. The passage of a strong current melts the wire L′ and releases the spring-arm *p*.

I find it exceedingly advantageous to arrange the device as shown in Fig. 8, including in the circuit a spring held by a mass of fusible material and also one held by a fusible wire. In such case a sudden increase in the current, which might burn out the high-resistance wire used with the mass of fusible material without producing any noticeable effect upon the latter, will melt the fusible wire holding the other spring and thereby operate the device without fail. By thus combining the two an instrument will be perfectly protected against both "sneak-currents" and sudden increases in voltage.

What I claim as my invention is—

1. The combination of a cut-out device for removing the instrument from the line; means for connecting the line across the terminals of the instrument; and means, operating upon an excess of current in the line for simultaneously operating both the cut-out device and the connecting means.

2. The combination of a cut-out device for removing the circuit from the line; means

for connecting the line across the terminals of the instrument; and a thermal device, operating upon an excess of current in the line, for simultaneously operating both the cut-out device and the connecting means.

3. The combination of a cut-out device for removing the instrument from the line; means for connecting the line across the terminals of the instrument; means for grounding the line; and means, operating upon an excess of current in the line, for simultaneously actuating all of said instrumentalities, whereby the instrument is automatically cut out, and the line maintained intact and grounded.

4. The combination of a cut-out device comprising a couple of removable sections of circuit-conductor arranged for bodily removal from the circuit, for removing the instrument from the line; means for connecting the line across the terminals of the instrument; and means, operating upon an excess of current in the line, for throwing said removable sections of conductor out of circuit, and also for simultaneously operating said connecting means.

5. The combination of a cut-out device comprising a couple of removable sections of circuit-conductor arranged for bodily removal from the circuit, for removing the instrument from the line; means for connecting the line across the terminals of the instrument; a spring held normally in tension and arranged, when released, both to actuate the connecting means and to throw said removable sections of conductor out of circuit; and means, operating upon an excess of current in the line, for releasing said spring.

6. The combination of a cut-out device comprising a couple of bodily-removable sections of circuit-conductor whereof one removable section consists of a coil of high-resistance wire, for removing the instrument from the line; means for connecting the line across the terminals of the instrument; and a mass of fusible material arranged in connection with the coil of high-resistance wire, and arranged also to effect simultaneously both the removal of the removable sections of conductor and the operation of the connecting means when fused or melted, as set forth.

7. The combination of a coil of high-resistance wire arranged in connection with a mass of fusible material; a section of fusible conductor; and mechanical means, for removing the instrument from the line, arranged to be operated either by the softening or melting of the mass of fusible material, or by the fusion of the fusible conductor.

8. A cut-out device comprising a couple of conductors arranged for inclusion in the operating-circuit on each side of the instrument to be protected; a couple of removable sections of circuit-conductor between the instrument and the two first-mentioned conductors, whereof one consists in a coil of high-resistance wire supported by a mass of fusible material, and the other of a length of fusible wire; a third conductor arranged to establish connection between said two conductors; and means for effecting the connection of the latter by said third conductor, said means being arranged to be operated by the fusion either of the mass of fusible material or of the fusible wire, and being also arranged to simultaneously throw the removable sections of circuit-conductor out of circuit, substantially as set forth.

9. A cut-out device comprising a couple of conducting-plates; a third plate situated between the two and arranged to be brought into contact with the same; a spring tending to bring about such contact, a body of fusible material containing a coil of high-resistance wire which is removably held in circuit; and a second spring normally held in tension by the fusible mass and acting to maintain the first-mentioned spring in tension and arranged to throw the movable section of circuit-conductor out of circuit, and also to release the first-mentioned spring, when it is liberated by the fusion or softening of the mass of fusible material, substantially as described.

10. A cut-out device comprising a couple of adjacent conducting-plates, having their opposing sides inclined to one another; a third tapering plate, situated between the two first-mentioned plates, and arranged to be brought into contact with the same by a longitudinal movement; a spring tending to bring about such contact; a kicker-spring normally held in tension by a catch; a mass of fusible material containing a coil of high-resistance wire which is removably held in circuit; a spring held in tension by the mass of fusible material, and arranged to free the kicker-spring from the catch when it is liberated by the fusion or softening of the fusible mass, and the kicker-spring being arranged to throw the removable section of circuit-conductor out of circuit when thus released from the catch, substantially as described.

11. A cut-out device comprising a couple of carbon plates, a third carbon plate which has a ground connection, and is situated between the two first-mentioned plates and arranged to be brought into contact with the same; a spring tending to bring about such contact; a second spring normally held in tension, and arranged to resist the action of the first-mentioned spring; and a mass of fusible material arranged to release the second spring when fused or softened, and thereby permit the first-mentioned spring to bring the plates into contact, substantially as described.

12. A cut-out device comprising a couple of conducting-plates; a third plate situated between the two first-mentioned plates, and arranged to be brought into contact with the same; a spring tending to bring about such contact; a second spring normally held in tension and arranged to resist the action of the first-mentioned spring; one or more mov-

able conductors included in the circuit, and arranged to be thrown out of their coöperating contacts by the action of the second spring; and means for releasing the latter, substantially as set forth.

13. A cut-out device comprising a couple of adjacent conducting-plates, having their opposing sides inclined to one another; a third tapering plate, situated between the two first-mentioned plates, and arranged to be brought into contact with the same by longitudinal movement; a spring tending to bring about such contact; a kicker-spring normally held in tension by a catch, and serving to maintain the conducting-plates out of contact; a couple of springs normally held in tension, the one by a mass of fusible material containing a high-resistance wire which is removably held in circuit, and the other by a loop of fusible wire, and both arranged to free the kicker-spring from the catch when liberated, themselves, and the kicker-spring being arranged to throw the removable section of circuit-conductor out of circuit when thus freed, substantially as described.

14. In an automatic cut-out, the combination of a removable holder provided with a section of fusible conductor; a spring arranged upon the holder and normally held in tension by a loop formed in the section of fusible conductor; and a second spring normally held in tension and arranged to throw the removable holder out of its coöperating contacts when released, and to be liberated by the first-mentioned spring when the latter is released by the fusion of the fusible conductor, substantially as set forth.

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