(No Model.)

4 Sheets—Sheet 1.

J. J. WOOD.

LIGHTNING ARRESTER.

No. 441,999. Patented Dec. 2, 1890.

FIG. 1.

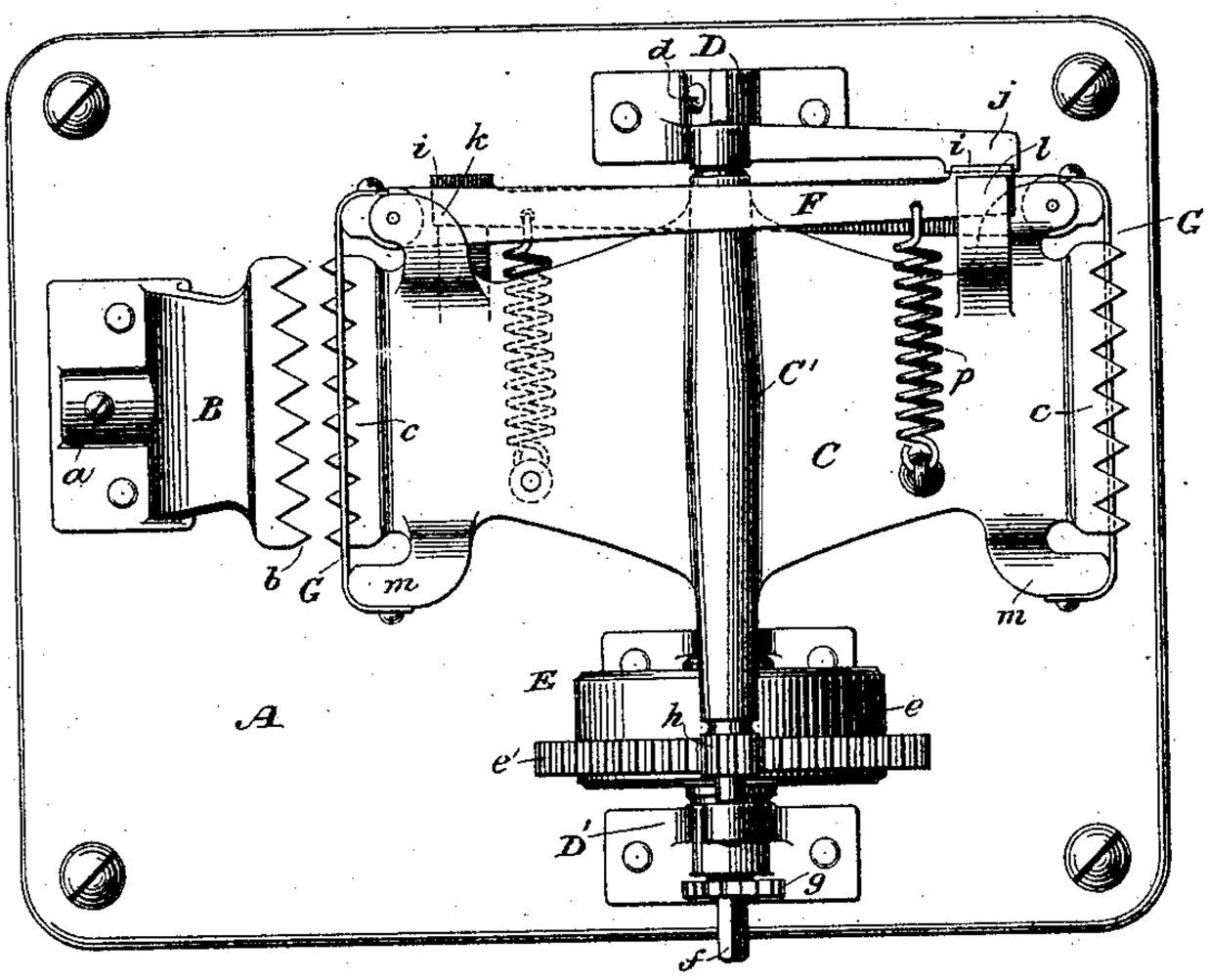


FIG. 3.

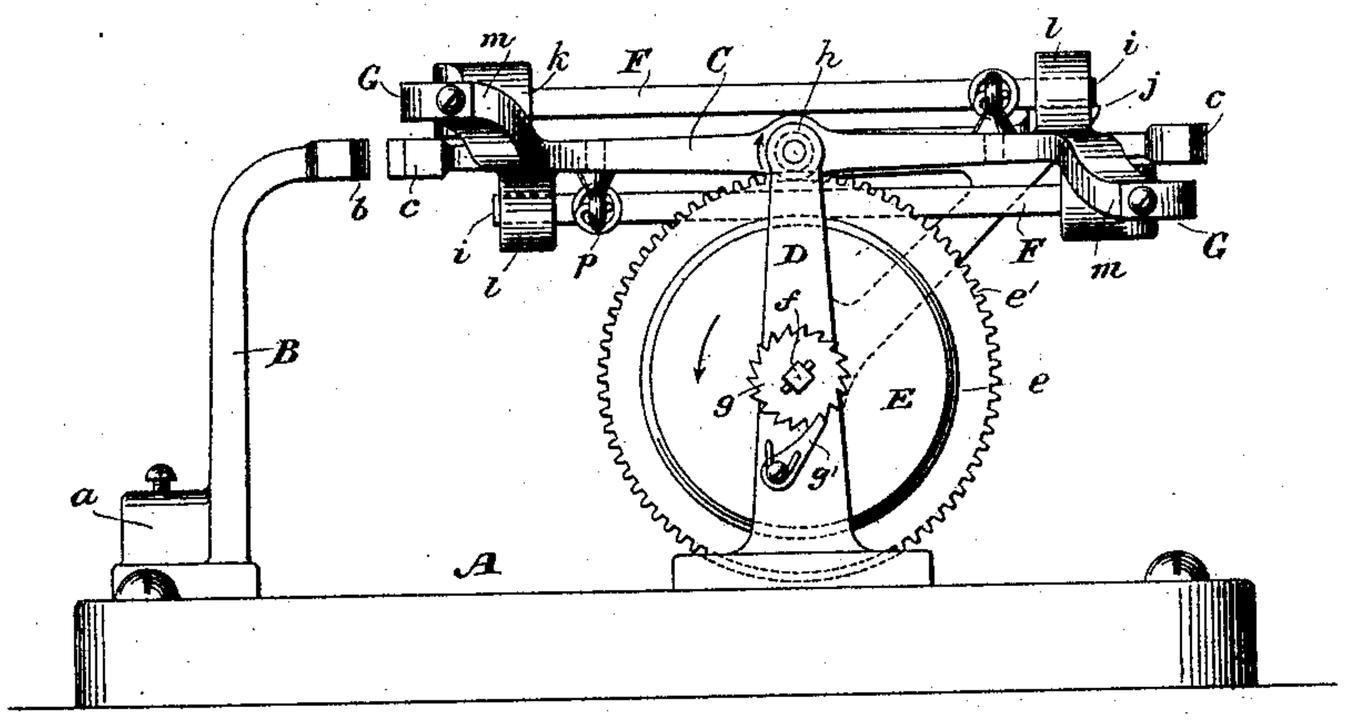
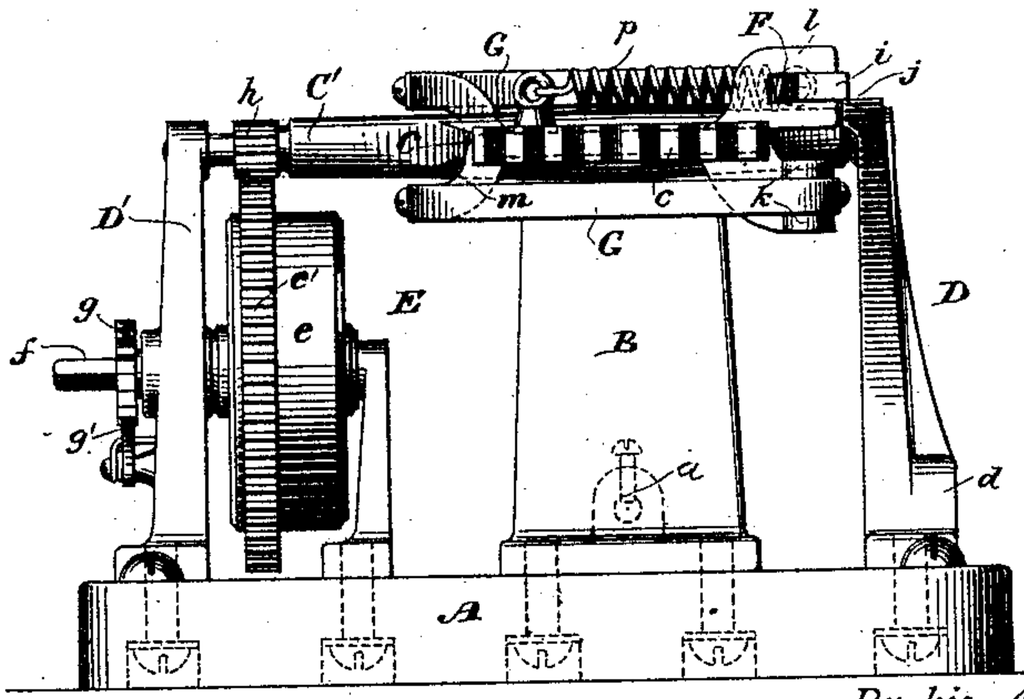


FIG. 4.



WITNESSES:

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INVENTOR:

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(No Model.) 4 Sheets—Sheet 2.

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FIG. 2.

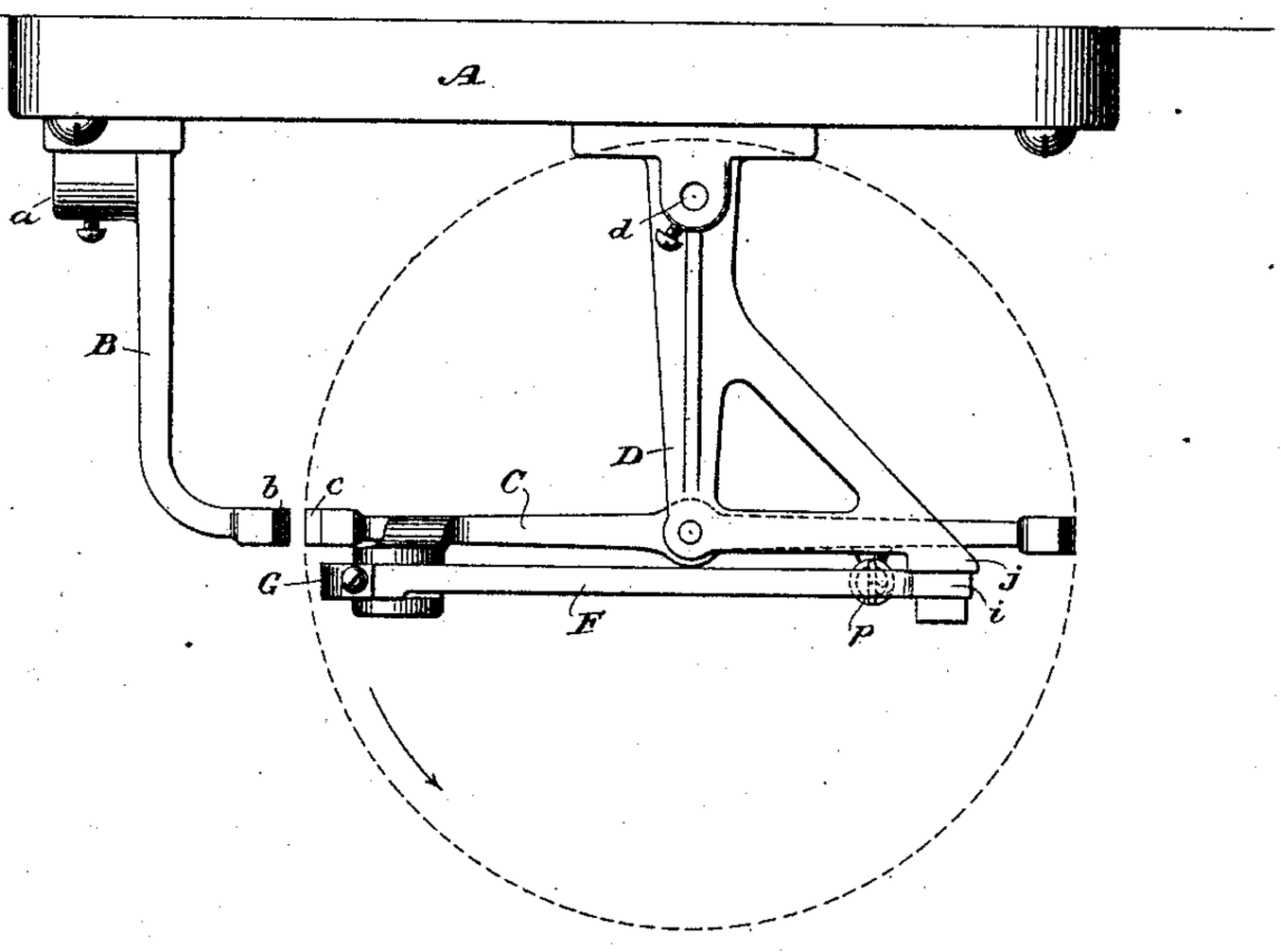

FIG. 5.

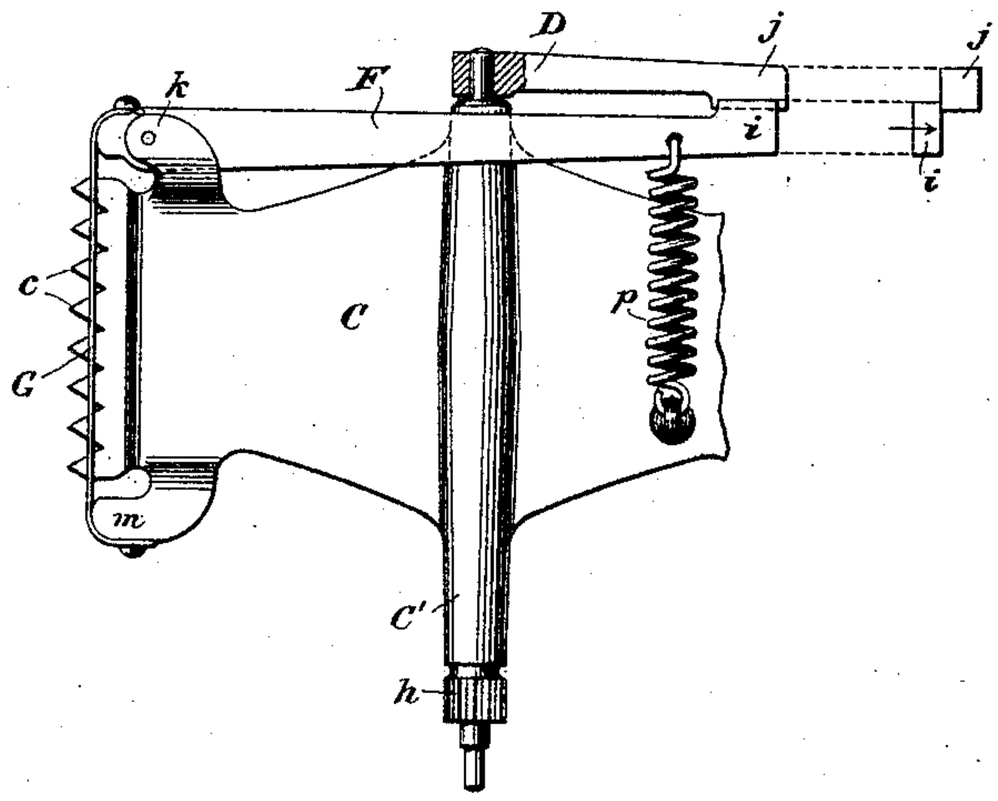

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FIG. 6.

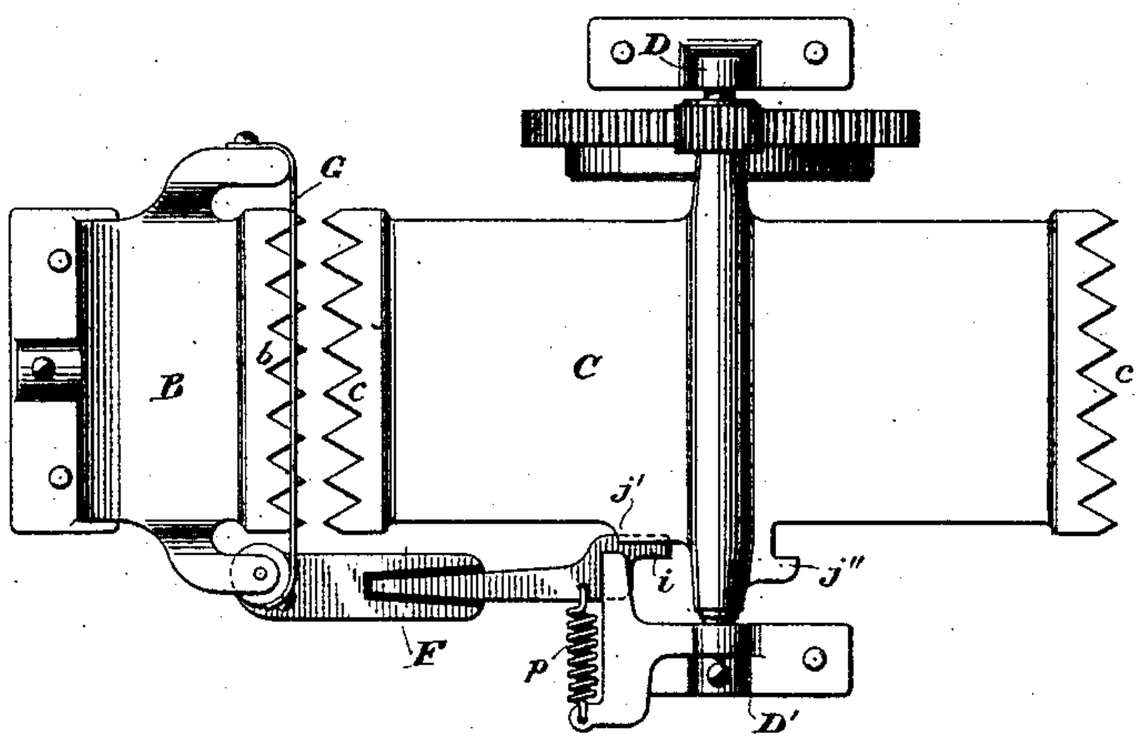
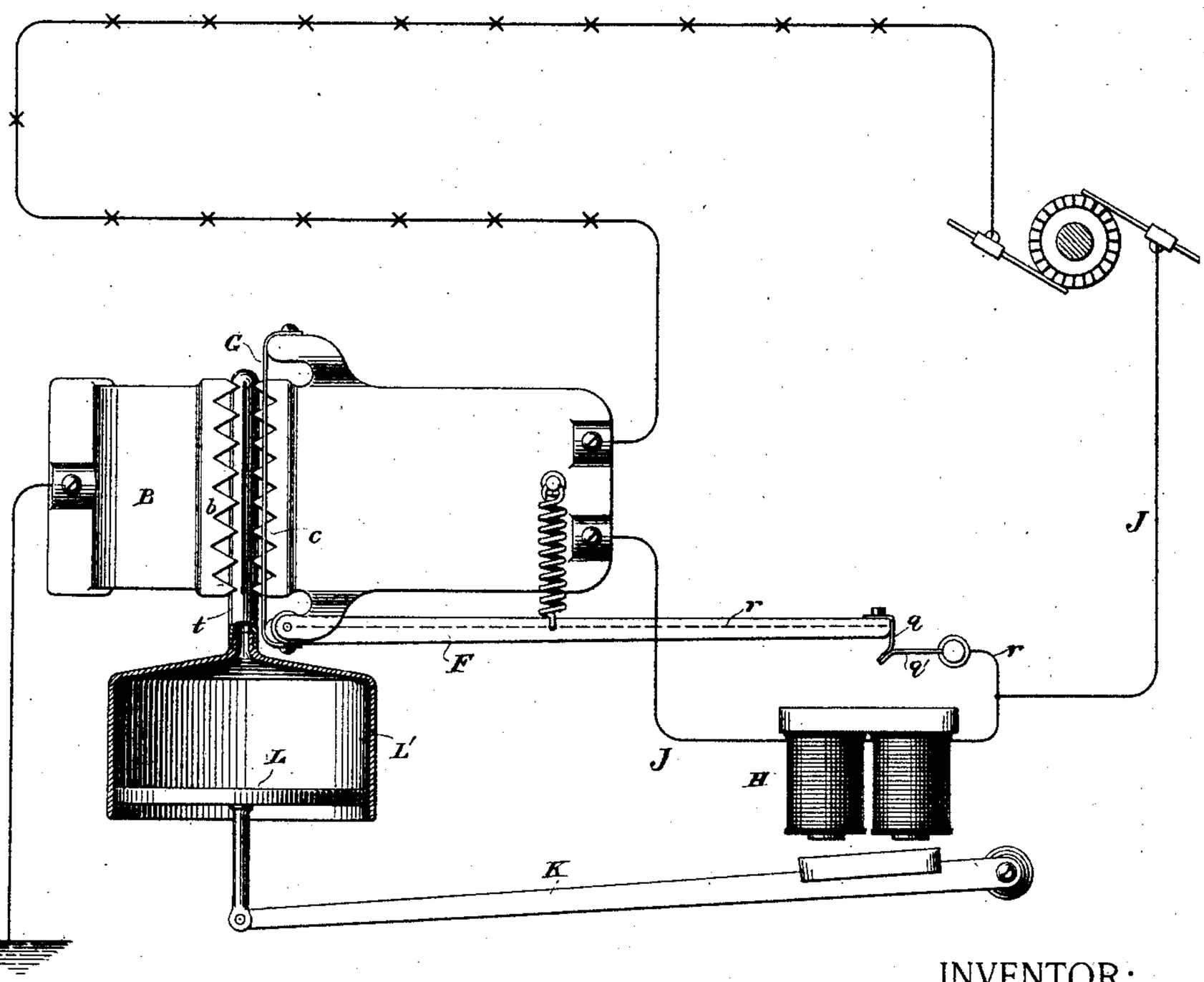


FIG. 7.



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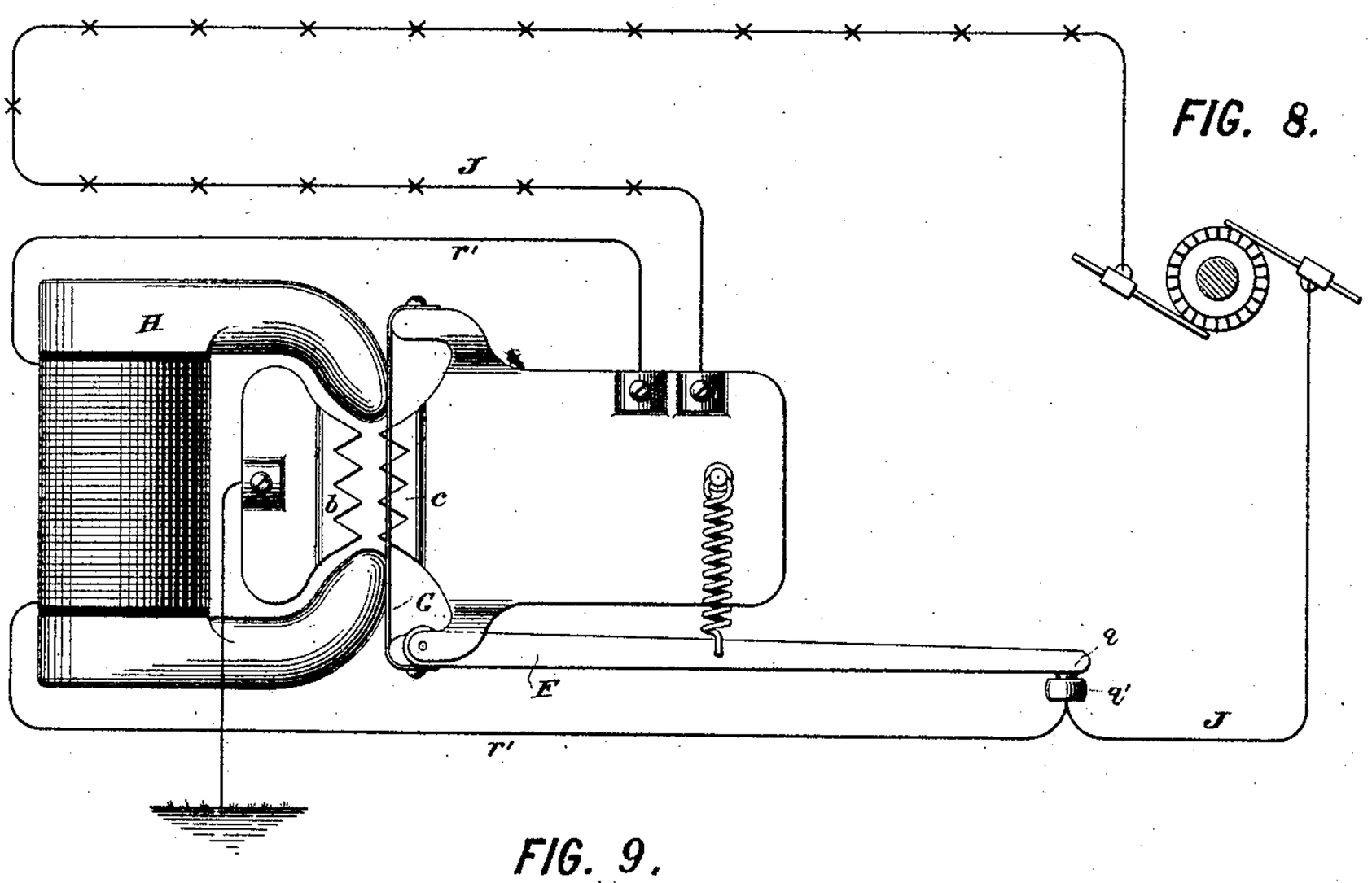
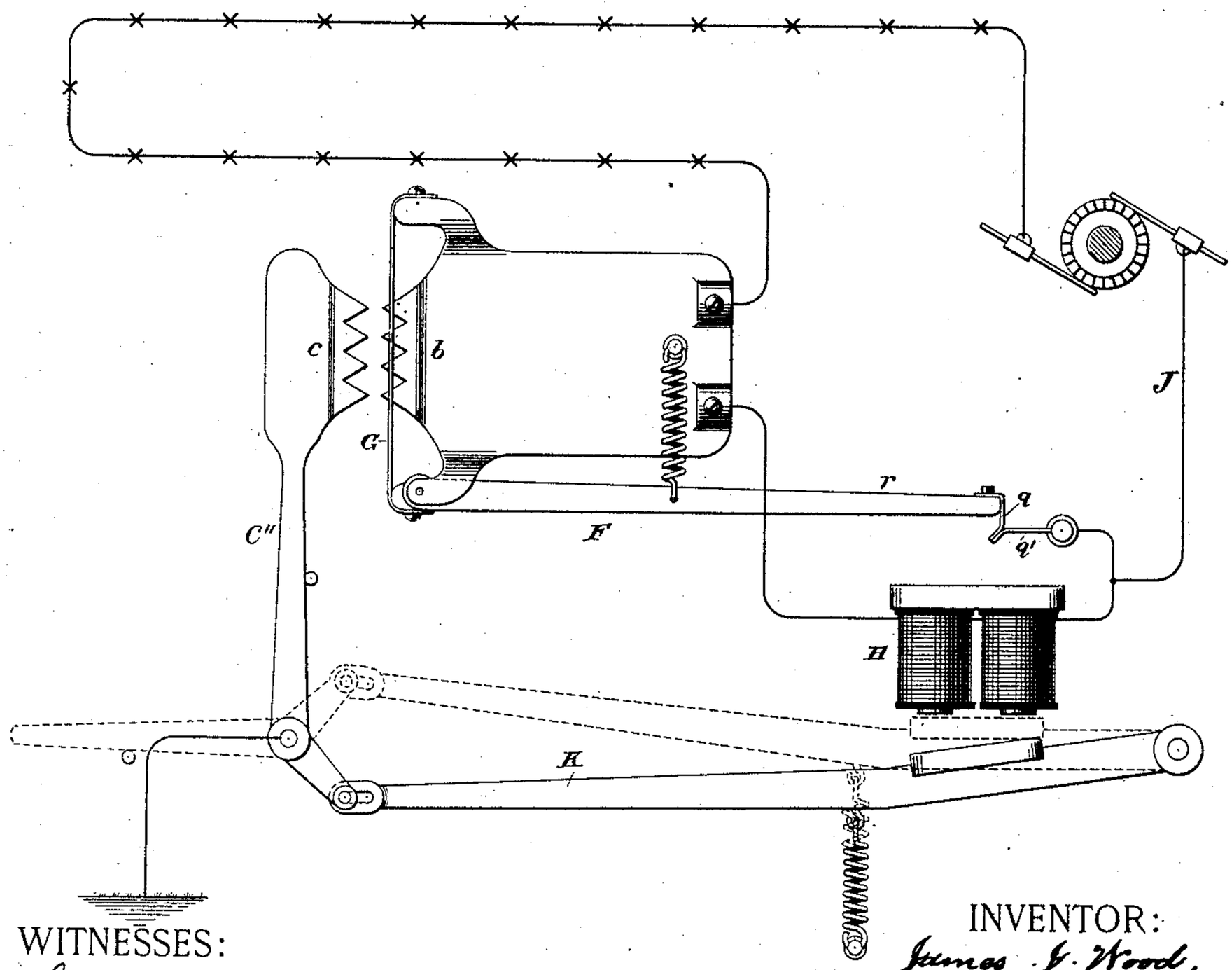


FIG. 8.

FIG. 9.



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UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF BROOKLYN, NEW YORK.

LIGHTNING-ARRESTER.

SPECIFICATION forming part of Letters Patent No. 441,999, dated December 2, 1890.

Application filed July 14, 1890. Serial No. 358,672. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Lightning-Arresters, of which the following is a specification.

This invention relates to lightning-arresters applicable to the ground connections of electric circuits generally for conducting lightning charges to earth. In the use of such lightning-arresters on circuits carrying currents of high voltage—such as those for arc lighting—it frequently occurs that the static discharge between the points or serrations of the plates of the lightning-arrester will cause the starting of an arc from one plate to the other, which will continue as long as the current on the circuit continues to be generated, unless it be in some way ruptured or extinguished. Several attempts have been made to provide automatic means for extinguishing such arcs and restoring the lightning-arrester to operative condition ready to conduct away the next static discharge. My invention provides an improved device for this purpose.

According to my invention I arrange a thermic device in sufficiently-close proximity to the serrated plates of the lightning-arrester to cause it to be heated by an arc between said plates, and I utilize its consequent expansion to set in operation a device for rupturing the arc. The thermic device is arranged out of the path of the lightning discharge, so that it cannot be injured thereby, but is heated solely as a consequence of the formation of the arc following the discharge.

The arc-rupturing device may operate in general in any of the ways heretofore known. For example, it may separate the serrated plates until the arc is ruptured by attenuation, or it may blow out the arc by a puff of air, or it may subject the arc to the repulsive action of an electro-magnet of sufficient strength to extinguish it.

According to the preferred embodiment of my invention I construct the arc-rupturing device to operate on the principle of separating the serrated plates. One of the plates is fixed and the other is movable, being mounted on a rotatable part having a motive device for rotating it, tending constantly to rotate and normally restrained from rotation by a catch or detent which is held in engagement by the action of the thermic device. The preferred form of this thermic device consists of a strip of suitable metal stretched along one of the serrated plates close enough to be heated by an arc between them, but out of the path of the lightning discharge. It is stretched between a fixed support and the arm of a lever connected with or constituting a detent. A spring is arranged to exert continually a stretching tension against the strip. When an arc occurs following a lightning discharge, the strip is heated by the arc and elongates, relaxing the spring and enabling the latter to withdraw the detent, whereupon the motive device becomes effective and the movable plate is rotated far enough from the fixed plate to sever the arc. By preference the rotative part carries two or more serrated plates, and is constructed by moving one such plate away from the fixed plate to bring another into proximity therewith and thereupon to stop, thus restoring the lightning-arrester ready for a second operation. By preference the thermic device, detent, and spring are duplicated for each such movable plate, and are carried therewith by the rotative part.

Figure 1 of the accompanying drawings is a front elevation of the preferred construction of my improved lightning-arrester. Fig. 2 is a plan thereof. Fig. 3 is an inverted plan or bottom view thereof. Fig. 4 is a side elevation thereof viewed from the right in the preceding figures. Fig. 5 is a fragmentary front elevation similar to Fig. 1, but omitting certain parts to show the others more clearly. Fig. 6 is an elevation similar to Fig. 5, illustrating a modification. Fig. 7 is a sectional elevation of a modification.

I will first describe the construction shown in Figs. 1 to 5. All the parts are mounted on a base-plate A of insulating material, preferably slate. A metal standard B is fixed to this plate, and is formed at its end as a serrated plate *b*. It is best constructed with a binding-socket *a* for connection with the line-wire, a rotatable part C, constructed preferably in the form shown, of a flat plate extending on opposite sides of its pivotal axis

and carrying or being formed integrally with serrated plates *c c* at its opposite sides or margins. This plate is formed with an axial shaft or spindle C′, the opposite ends of which are journaled in bearings in the frames D D′, projecting from the base-plate A. The upper one D of these frames is formed with a socket *d* for connection with the wire leading to earth. The serrated plates *b* and *c* are such as are commonly used in lightning-arresters, being set with their points opposite to and slightly removed from each other, so that the lightning discharge may jump across between them and pass from the plate *b* to the adjacent plate *c*, thence through the plate C, its upper journal and its upper bearing-frame D to the ground-wire.

A motor E, of any suitable kind, preferably a clock-work device, is provided to impart to the rotatable part C a normal tendency to rotate. In the construction shown this motor consists of a spring-barrel *e*, containing a coiled spring, as usual in clock-works, the inner end of this spring being fixed to a spindle *f* and the outer end to the barrel. The spindle *f*, the end of which is square to be turned by a clock-key, carries a ratchet-wheel *g*, engaged by a pawl *g′*. The spring-barrel *e* is formed with external gear-teeth *e′*, meshing with a pinion *h*, fixed on the spindle C′. There is thus imparted to the rotatable part C a tendency to revolve in the direction of the arrow in Fig. 2, as shown by the dotted circle therein. It is, however, normally restrained from revolving by a detent consisting of a lever F, the end *i* of which engages a fixed stop *j*, formed on an arm or bracket projecting laterally from the standard D. This lever F is pivoted near one end to one side of the plate C, between pivotal ears *k k*, formed thereon. Its short arm is fastened to one end of the thermic device G, which consists of a strip or ribbon or wire of copper, platina, or other suitable metal, the other end of which is fastened to an arm or bracket *m*, formed also on the plate C. The strip G is thus extended parallel with the row of serrations of the plate *c* and only slightly removed therefrom, being close enough thereto to be heated and expanded by radiation of heat from an arc between the plates *b c*. It is, however, out of the path of the lightning discharge, so that it is not liable to be injured by the passage of the fluid to earth. The lever F receives the tension of a spring *p*, which reacts against the plate C, and tends both to strain or elongate the thermic strip G and to withdraw the lever end *i* from engagement with the stop *j*. The free end *i* of the lever is guided by being held freely between two arms or fingers *l l*. The lever F and its connecting parts are best shown in Fig. 5. The action of the spring *p* in tending to move the lever end *i* out of engagement with the stop *j* is resisted by the thermic strip G until the latter is heated by the passage of an arc, whereupon by its expansion it enables the lever F to tilt and disengage its end from the stop, whereupon the motor E becomes effective to rotate the plate C, thus separating the serrated plate *c* from the plate *b* and rupturing the arc. The rotatable plate C carries a duplicate series of the thermic and detent devices described, and when it has executed half a revolution it is arrested by the end *i* of the second lever F striking against the stop *j*. The other serrated plate *c* is thus brought into operative position in proximity to the fixed plate *b* ready for the next operation. The strip B of the serrated plate which has just received the arc quickly cools and restores its lever F to the normal position, ready upon the next operation to rearrest the rotatable plate C. This plate, with the parts which it carries, thus executes a half-revolution each time that an arc is formed by a lightning discharge. The occasional rewinding of the motor E—say, for example, every few weeks or months, or even as often as after each prolonged thunder storm—is all the attention that the instrument will ordinarily require. An ordinary lightning discharge which is not followed by an arc will have no effect upon the mechanism, since it does not generate sufficient heat to expand the thermic device.

My invention may be modified in many ways without departing from its essential features. That which is characteristic of my invention is the utilization of the heat of an arc between the serrated plates for setting in operation an arc-rupturing device. The utilization of this heat may be through the medium of any thermic device in the nature of a thermometer or pyrometer. In the case of an arc-rupturing device which operates by the separation of the serrated plates it is not necessary that one of the plates be duplicated in order that the second or duplicate plate may take the place of the one which has just received the arc. This, however, is preferable, in order that if a second discharge should quickly follow the first the lightning-arrester may be prepared to receive it. Aside from this consideration, the second or duplicate serrated plate carried by the movable part C might be omitted, and the movable part might execute a complete revolution, bringing the plate back to position ready to act again, provided that during this revolution the thermic strip G has time to cool and contract, in order to restore and re-engage the detent; or the movable part might execute a half-revolution and be stopped there by the detent until the thermic strip G has sufficiently cooled, whereupon by the movement of the lever F it could be released and permitted to make the other or remaining half of the revolution, bringing it back to its starting-point ready for the next operation. In such case it would be best to provide a duplicate serrated plate *c*, in order that during the moment of rest at the end of the half-revolution and while the thermic strip was cooling the lightning-arrester might

be operative to receive a second discharge. This modification is illustrated in Fig. 6, which also shows the thermic strip G mounted in stationary manner adjacent to the fixed plate *b*, so that the strip and the lever F remain stationary instead of revolving with the plate C. The free end *i* of the lever engages two stops *j' j''* on the plate C. Normally it engages the stop *j'*; but upon the release of the plate it is stopped after a half-revolution by the stop *j''* until the strip G cools enough to disengage the lever therefrom, whereupon the plate C makes another half-revolution. It is not essential that the movable serrated plate *c* be moved rotatively, as it might be reciprocated by a suitable rearrangement of the operative mechanism, (see Fig. 9;) or the movement might be applied to both the plates *b* and *c* to separate and restore them. Various arrangements for effecting these purposes have been used in arc-rupturing devices.

Fig. 7 shows the application of my invention to an arc-rupturing device which acts by blowing out the arc. Both the serrated plates *b* and *c* are immovable. The lever F carries at its free end a circuit-closing contact *q*, which normally touches a contact *q'* and closes a shunt-circuit *r*, which conducts the current in the circuit J around an electro-magnet H, short-circuiting this magnet, so that normally its armature is retracted. The armature-lever K carries at its end a piston L, working loosely in a cylinder L', from which leads a discharge-nozzle *t*, arranged to direct a blast of air between the two serrated plates *b* and *c*. When the strip G is heated by an arc, the spring *p* draws the lever F and moves its contact *q* away from the contact *q'*, thereby breaking the shunt *r* and causing the entire current in the circuit J to flow through the magnet H, whereby this magnet is strongly excited and attracts its armature, forcibly pulling up the lever K and moving the piston L suddenly into the cylinder L', so that it compresses the air therein and causes a puff of air from the nozzle *t* to blow between the serrated plates and blow out the arc.

Fig. 8 shows another modification, wherein the arc is extinguished by the repulsive action of an electro-magnet. Both plates *b* and *c* are immovable, being arranged between the poles of a horseshoe-magnet H'. Normally the current on the circuit J passes through the lever F and contacts *q* and *q'*, thereby short-circuiting the loop *r'* of the circuit, which includes the coils of the magnet. Then the strip G is heated by an arc. The lever F separates the contacts *q q'*, thereby directing the current through the magnet and exciting it, whereupon the lines of force between its poles extinguish the arc.

Fig. 9 shows a simple construction for extinguishing the arc by separating the serrated plates. The movable plate *c* is mounted on a lever C''. Normally the lever F is in a shunt *r*, short-circuiting a magnet H. Upon the expansion of the strip G the lever F separates the contacts *q q'*, breaking this shunt and diverting the entire current through the magnet. Its armature is thus attracted and the armature-lever K is vibrated upwardly. The free end of this lever is jointed to the lever C'', so that by this movement the latter lever is vibrated, moving the plate *c* away from the plate *b* far enough to break the arc.

The modification shown in Figs. 7, 8, and 9 are illustrated as examples, showing how my invention may be applied in connection with other means of rupturing the arc than the preferred means shown in Figs. 1 to 5.

Throughout this specification I have referred to the respective terminals or discharge-plates of the lightning-arrester as "serrated" plates. It is usual and preferable to make these plates serrated; but their serration is not essential to my invention.

I am aware that lightning-arresters have been patented wherein a thermic conductor is provided designed to be heated by the passage of a current to earth in case of a lightning discharge and designed to operate a device for breaking the earth-current; but in all such cases prior to my invention, so far as I am aware, the thermic device has been arranged in the path of the lightning discharge, so that it is liable to be burned out and rendered inoperative by the first discharge that passes over it. Such thermic lightning-arresters have never gone into use for this reason, as I believe.

My improved arrester I believe to be the first in which the thermic device is arranged out of the path of the lightning discharge, so that it is not liable to injury by the discharge, while it is in position to be heated by the earth-current resulting from the discharge. It is preferably entirely out of the circuit; but my invention does not exclude the arrangement of the thermic device in the electric circuit, provided it be not placed in that part thereof traversed by the static discharge.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. The combination, with the discharge-plates of a lightning-arrester, of an arc-rupturing device and a thermic device arranged out of the path of the lightning discharge and in position to be heated by an arc between said plates, and adapted by its consequent expansion to set the arc-rupturing device in operation.

2. The combination, with the discharge-plates of a lightning-arrester, of an arc-rupturing device tending to operate to extinguish an arc between said plates, and a thermic device normally restraining said rupturing device, arranged out of the path of the lightning discharge in position to be heated by an arc between said plates and adapted when expanded thereby to release said rupturing device.

3. The combination, with the discharge-plates of a lightning-arrester, of an arc-rupt-

uring device consisting of means for mechanically separating the plates, and a thermic device arranged out of the path of the lightning discharge in position to be heated by an arc between said plates and adapted by its consequent expansion to set the arc-rupturing device in operation.

4. The combination, with the discharge-plates of a lightning-arrester, of an arc-rupturing device consisting of a rotatable part carrying one of said plates, adapted by its rotation to move said plate away from the other, and a motive device for rotating said part, and a thermic device arranged out of the path of the lightning discharge in position to be heated by an arc between said plates and adapted by its consequent expansion to set said motive device in operation.

5. The combination, with the discharge-plates of a lightning-arrester, of an arc-rupturing device and a thermic device consisting of an expansible strip extended adjacent to one of the plates out of the path of the lightning discharge, a lever to which said strip is fastened, and a tension device acting against said lever to stretch said strip in operative connection between said lever and the arc-rupturing device, adapted on the movement of said lever due to the expansion of the strip to set the arc-rupturing device in operation.

6. The combination of two discharge-plates, the one movable relatively to the other, a movable part carrying said movable plate, a motive device tending to impart movement to said part, a detent normally restraining said part from movement, and a thermic device adapted to normally restrain said detent and arranged out of the path of the lightning discharge in position to be heated by the arc between said plates.

7. The combination of a fixed discharge-plate, a rotatable part carrying a movable discharge-plate, a motive device tending to rotate said part, a detent for restraining it from rotation, consisting of a fixed stop, and a movable lever carried by said movable part, a thermic strip arranged out of the path of the lightning discharge in position to be heated by an arc between said plates and connected to said lever, and a spring arranged to exert a tension against said lever tending to stretch said strip and disengage the lever from said stop.

8. The combination of a fixed discharge-plate, a rotatable part carrying a plurality of discharge-plates, each adapted in different positions of said part to stand in juxtaposition to said fixed discharge-plate, a detent consisting of a stop device for arresting said rotatable part in positions in juxtaposition to said respective plates, and a thermic device arranged out of the path of the lightning discharge in position to be heated by an arc between said plates and adapted by its consequent expansion to release the detent and permit the rotation of the rotatable part to rupture the arc.

9. The combination of a fixed discharge-plate *b*, a rotatable part C, carrying two discharge-plates *c c*, a fixed stop *j*, two detent-levers F F, carried by the part C, and each adapted to engage said stop and arrest said part, thermo-expansive strips G G, arranged in proximity to the plates *c c* and connected to the respective levers, and springs *p p*, arranged to exert a tension against said levers.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:
ARTHUR C. FRASER,
GEORGE H. FRASER.