No. 611,724. Patented Oct. 4, 1898.

E. WESTON.

ELECTROMETER.

(Application filed Feb. 14, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

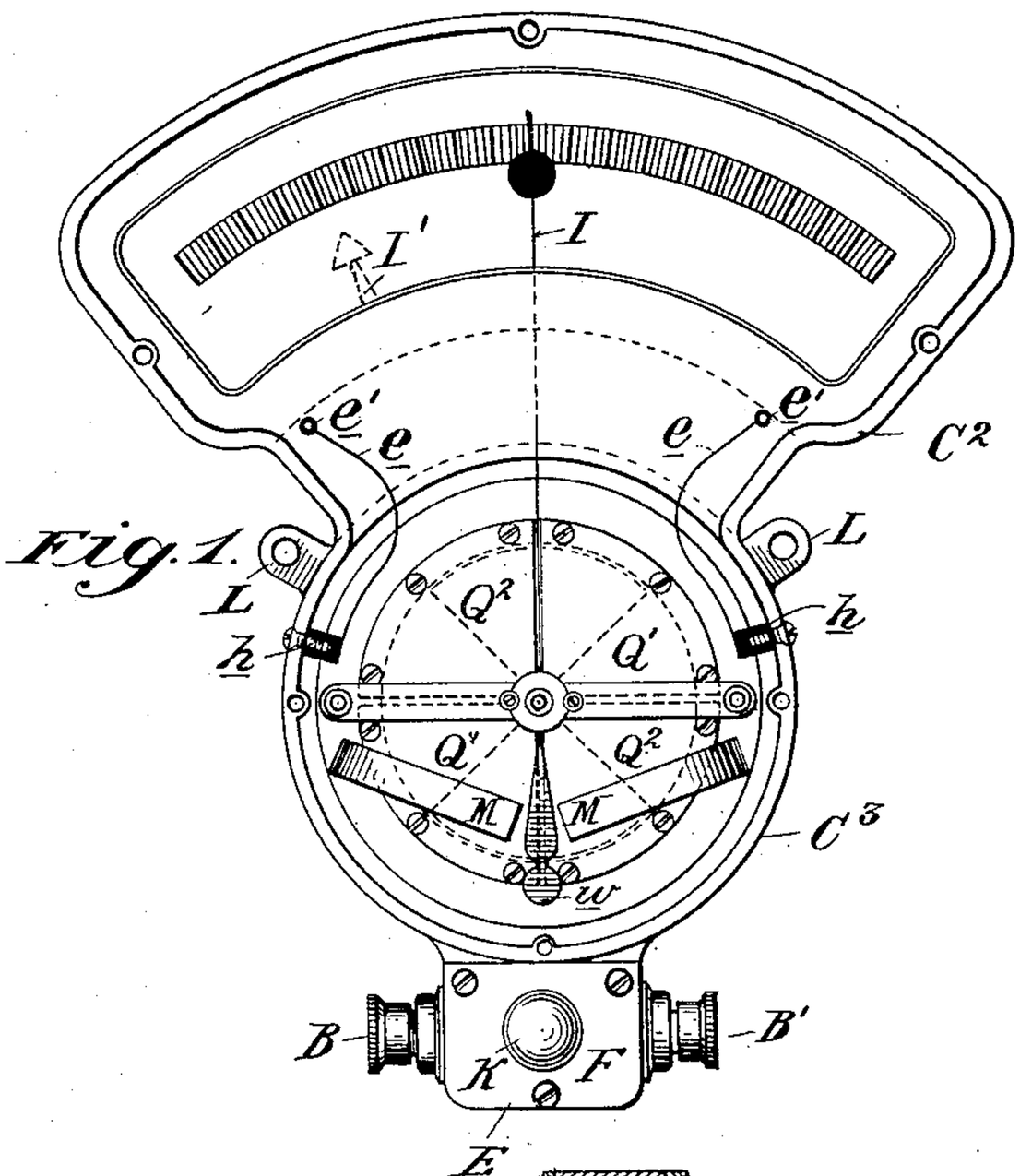
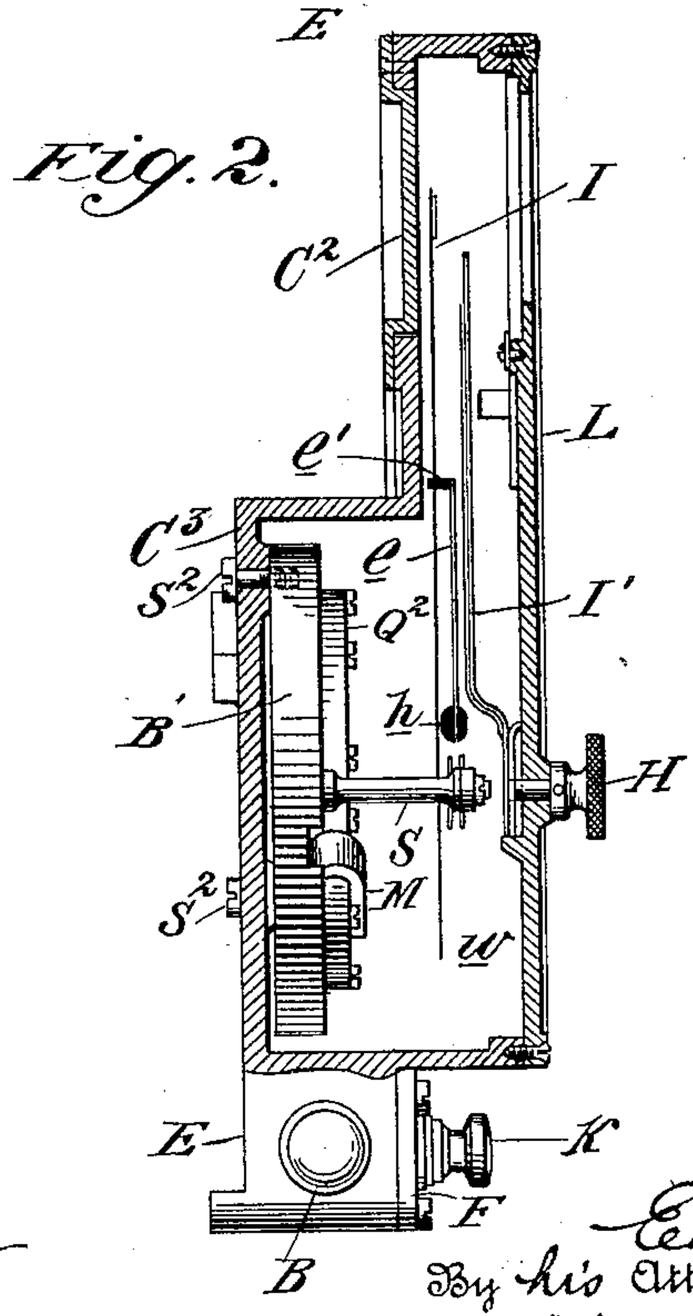


Fig. 2.



Witnesses
Edward C. Howland.
W. F. Keating

Inventor
Edward Weston.
By his Attorney
Charles D. Kintner

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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

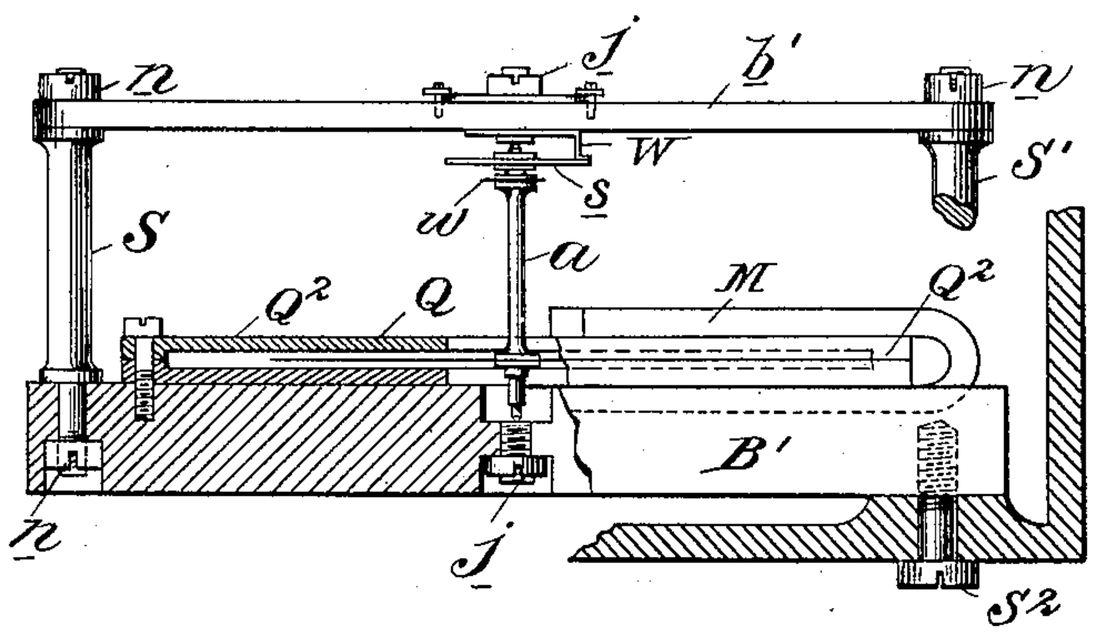


Fig. 4.

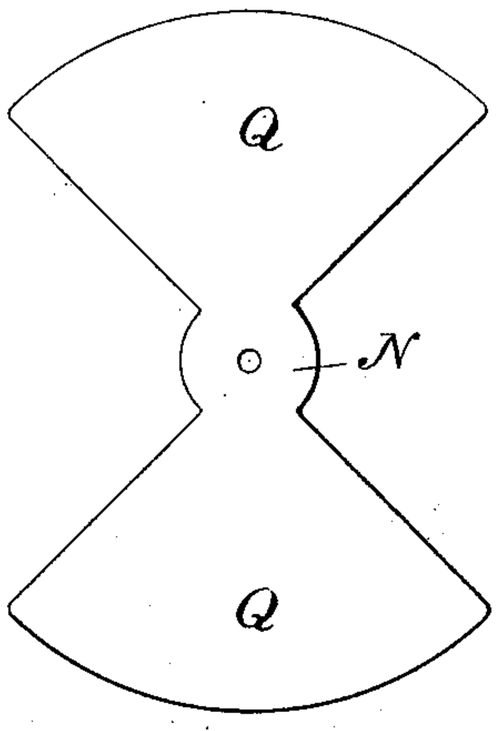


Fig. 5.

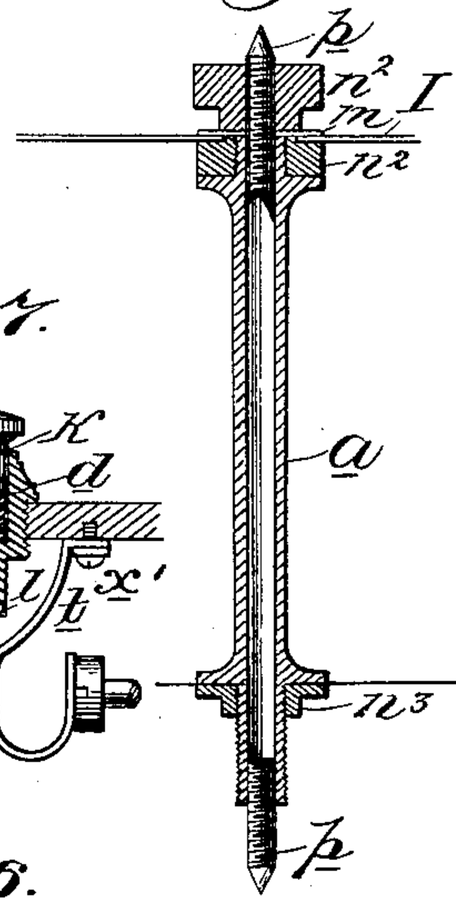


Fig. 7.

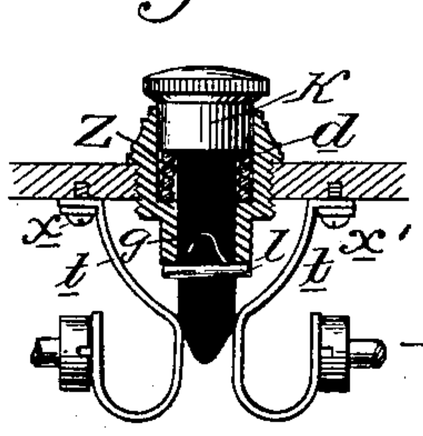
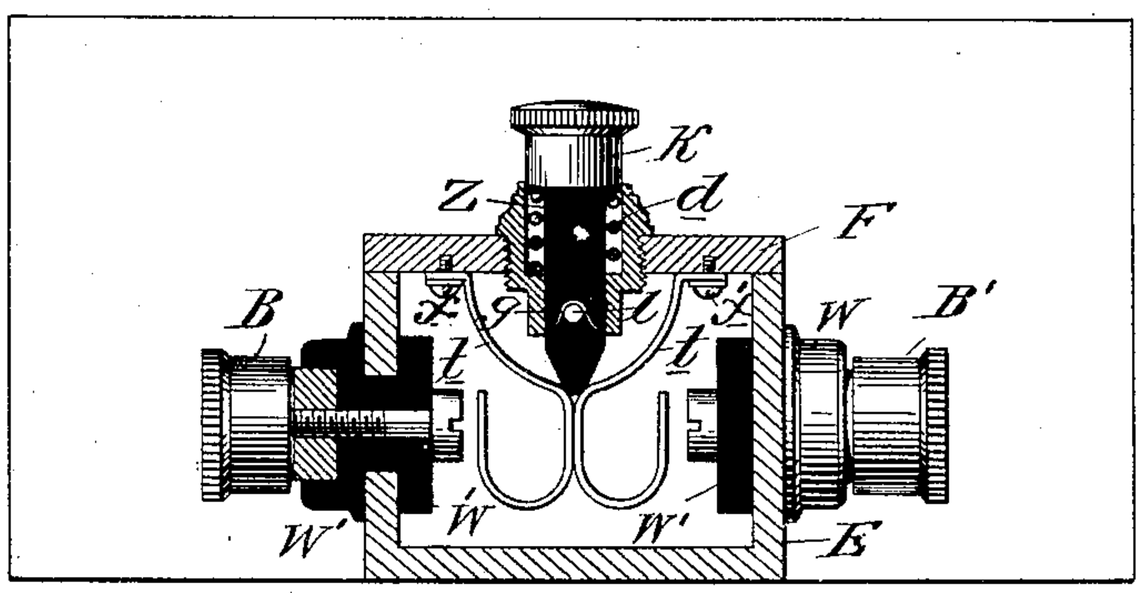


Fig. 6.



Witnesses
Edward C. Rowland.
M. F. Keating

Inventor
Edward Weston
By his Attorney
Charles J. Kintner

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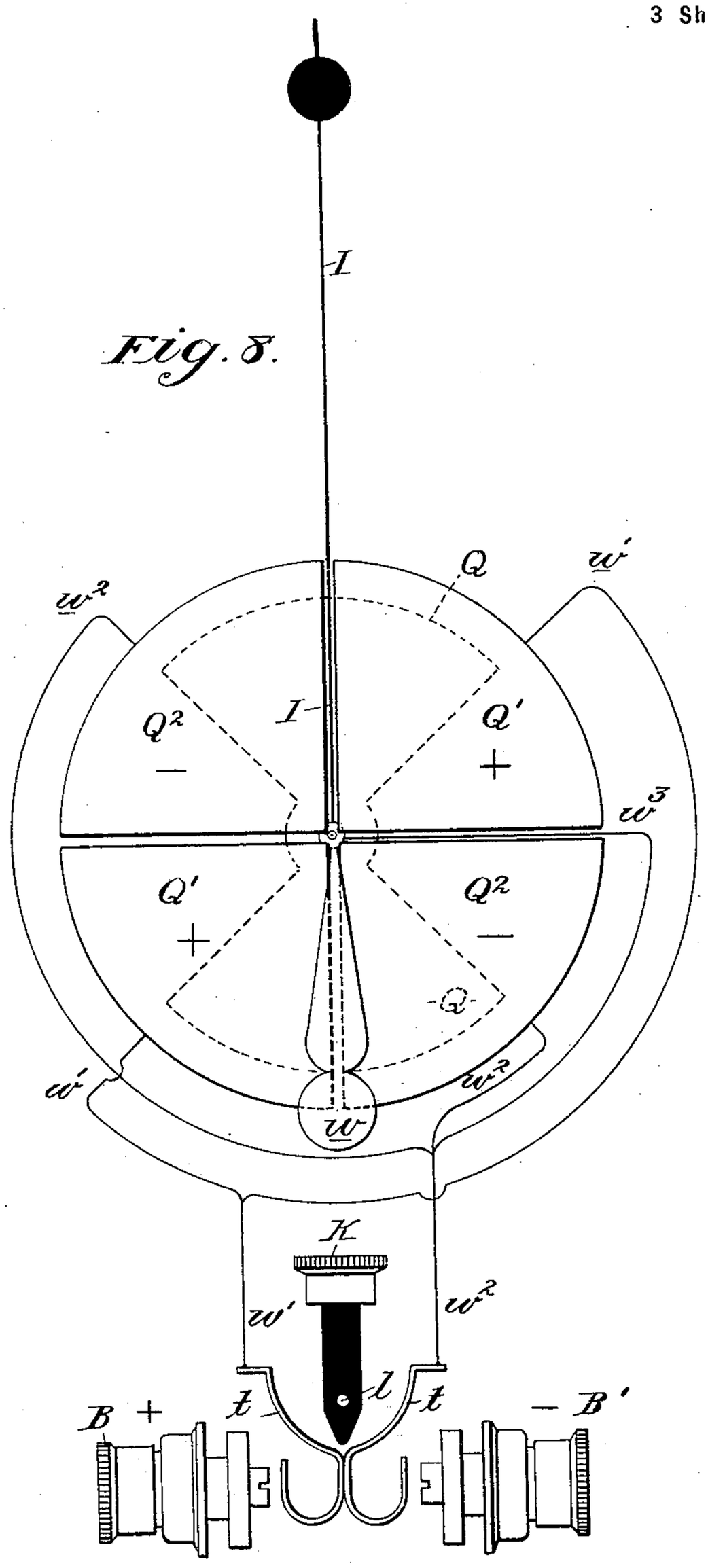
3 Sheets—Sheet 3.

Fig. 8.



Witnesses
Edward Howland.
M. F. Keating

Inventor
Edmond Weston
By his Attorney
Charles J. Kintner

UNITED STATES PATENT OFFICE.

EDWARD WESTON, OF NEWARK, NEW JERSEY.

ELECTROMETER.

SPECIFICATION forming part of Letters Patent No. 611,724, dated October 4, 1898.

Application filed February 14, 1898. Serial No. 670,188. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WESTON, a subject of the Queen of Great Britain, residing at Newark, in the county of Essex and State of New Jersey, have made a new and useful Invention in Electrometers, of which the following is a specification.

My invention is directed to improvements in that type of instruments known in the art as "quadrant-electrometers"—such, for instance, as is disclosed in a prior patent granted to me by the United States Patent Office on the 4th day of December, 1894, and numbered 530,145; and its objects are, first, to devise an instrument which shall be more compact in structure and better adapted for commercial use than is the instrument disclosed in the before-mentioned patent; second, to so construct the movable parts of such an instrument that they shall be as light as possible, arranged within as strong an electrostatic field as can be attained, and all effectively insulated from the inclosing casing; third, to devise a switch which shall render it possible to simultaneously electrostatically charge the quadrants of the instrument and the movable needle and discharge the same in as simple and positive a manner as possible; fourth, to arrange such switch in a chamber or case independent from but substantially integral with the case which incloses the instrument, whereby any damaging arc effects which might result from short circuits at the switch will be prevented and also any possibility of injuring the delicate parts of the instrument itself, and, fifth, to provide stable or permanent means for bringing the electrostatic armature or needle to rest as quickly as possible after it and its controlling-quadrants have been subjected to a charge.

My invention will be fully understood by referring to the accompanying drawings, in which—

Figure 1 is a plan view of my improved electrometer, the top of the casing being removed in order to better disclose the interior structure thereof. Fig. 2 is a longitudinal sectional view taken through the casing of the instrument and showing the interior structure of the operative parts thereof in elevational view as seen looking at Fig. 1 from the left toward the right hand side of the drawing. Fig. 3 is a part-sectional part-elevational view taken through the instrument and as seen looking at Fig. 1 from the bottom toward the top of the drawing, a part only of the inclosing case being shown in sectional view and one of the supporting-standards broken away. Fig. 4 is a plan view of the electrostatic armature or needle which controls the movable parts of the instrument. Fig. 5 is a vertical sectional view of the hollow pivot-shaft which supports the electrostatic armature or needle and the index-needle, a part of each of said needles being shown in position, the manner of securing the same to the shaft being also illustrated. Fig. 6 is a sectional view taken through the body of the switching chamber or casing and illustrating the switch-controlling mechanism, partly in sectional and partly in side-elevational view, the binding-posts of the instrument being also shown in elevation. Fig. 7 is a similar detail view showing the switch in closed position; and Fig. 8 is a diagrammatic view showing the circuit connections between the binding-posts, the switch, the quadrants, and the electrostatic armature or needle of the instrument, the index-needle being also shown.

In my prior patent above referred to I have described and claimed an electrometer in which the quadrants of the instrument and the movable electrostatic armature or needle are arranged in cylindrical form, said needle being carried by a pivot-shaft supported by jewel-bearings, the pivot-shaft provided with spirally-disposed conducting-springs for restoring the needle to normal position, and the springs in turn connected electrically with the needle and the exterior circuit.

One feature of the present invention lies in the substitution of a flat quadrant or disk-like electrostatic armature or needle for the cylindrical-shaped armature or needle of the before-mentioned patent and correspondingly-arranged flat quadrants between the inner or open ends of which said needle is adapted to revolve, it being supported upon a pivot-shaft stepped at its opposite ends in jewel-bearings adjustably supported, respectively, by the base of the instrument and a bridge-piece carried by standards, one end

of the pivot-shaft being provided with a spiral spring mechanically and electrically connected to the shaft and to the bridge-piece in turn.

Referring now to the drawings in detail, in all of which like letters of reference represent like parts wherever used, for a full and clear understanding of my invention, such as will enable others skilled in the art to which it most nearly relates to construct and use the same, C^2 represents the inclosing casing of the instrument, which is preferably of cast-iron and having the conformation shown in Figs. 1 and 2, C^3 being a downwardly-extending portion of cylindrical form for inclosing the major portion of the operative parts.

E is a chamber or casing for inclosing the controlling-switch, and in the present instance is cast integral with the chamber C^3, which incloses the instrument proper, and has an opening into the latter to enable the conductors to be properly connected up with the stationary and movable parts of the instrument, as will be described more particularly in connection with Fig. 8 of the drawings.

B′ is a base of insulating material, preferably of hard rubber or vegetable fiber, secured to the bottom of the cylindrical part C^3 by screws S^2 S^2 S^2.

Q′ Q′ and Q^2 Q^2 are four independent quadrants constructed, preferably, each of two thick sheets of brass accurately turned or dressed in such manner that when placed together in the position shown in Figs. 1 and 3 there is left between them an open disk-like field within which the quadrants Q Q of the electrostatic armature or needle N revolve.

a is a hollow or tubular pivot-shaft made, preferably, of aluminium and screw-threaded interiorly and exteriorly at its opposite ends for the purpose of receiving pivot-pins *p p* and clamping-nuts n^2 n^2 n^3, the lower nut n^2 of the pair at the upper end being of insulating material, preferably ivory, and the upper nut n^2 of metal, adapted to hold an aluminium index-needle I and spiral spring *s* in position, *m* being a sheet of mica for insulating the needle I from the shaft *a*, while the lower nut n^3 is adapted, as shown, to hold or secure the electrostatic armature or needle N, made, preferably, of a sheet of aluminium and having quadrant form Q Q, as shown in full-sized view in Fig. 4.

j j are jewel-bearings for the pivot-pins *p p*, one of said bearings being secured in the insulating-base B′ and the other at the center of an electrical conducting bridge-piece *b*′, preferably of brass, supported upon standards S S′, *n n n* being nuts for securing these parts together.

W (see Fig. 3) is an angular-shaped conducting-arm secured to the under side of the bridge-piece *b*′, its function being to furnish mechanical and electrical connection between the spirally-disposed spring *s* and the pivot-shaft *a*, the electrical connections between these parts being not substantially different from those disclosed in my prior patent above referred to.

The index-needle I is provided at one end with a pointer adapted to move over a scale properly calibrated to indicate the readings for which the instrument is constructed, and its other end is flattened in the manner shown at *w* in Figs. 1 and 8 for the purpose of serving as a counterweight.

e e are metallic buffer-springs secured by insulating-blocks *h h* and screws to the inside of the instrument and provided at their free ends with downwardly-extending insulating-sleeves *e*′ *e*′, located in the path of the index-needle I, (see Fig. 2,) their function being to prevent any possibility of damage to the delicate indicating-needle I in the event of a sudden throw thereof to either side on connecting it (the instrument) in circuit, said dampening-springs being insulated for the purpose of preventing any possible escape of the statical charge from the electrostatic needle N when the instrument is in use.

M M are permanent magnets secured to the insulating-base B′ in such manner that their polar ends establish a magnetic field about one end of the quadrant-shaped armature or needle N, their function being to produce a dampening effect thereon and cause the same to settle quickly after the instrument has been connected in circuit with the source of electrical energy the potential of which it is desired to ascertain.

I′ is a second index needle or hand which is pivotally secured to the under side of the lid L of the instrument and is provided with an operating-handle II for mechanically setting the pointer of said needle at any point of the scale (see Figs. 1 and 2) in order that the same may display to a person at a distance some fixed point thereon with relation to which it is desired to compare the movements of the index-needle I when actuated by the current. This feature *per se* constitutes no part of the present invention, but is made the subject-matter of claims in a prior application filed by me in the United States Patent Office on the 7th of December, 1897, and bearing Serial No. 661,100, and no claim is therefore made to its structure here otherwise than in combination with other elements.

The switch-chamber E is provided with a removable lid F, of hard rubber, vegetable fiber, or like insulating material, to the under side of which are secured, by screws *x x*′, two curvilinear switching contact-springs *t t*, resting normally against each other when the instrument is out of circuit, as clearly shown in Figs. 6 and 8, B and B′ being binding-posts provided with hard-rubber covers of well-known form and having their inner or metallic portions located in the path of the free ends of the switching-springs *t t*, W′ W′ being insulating-washers for insulating the op-

erative parts of the instrument from the inclosing metallic casing.

Z is a switch-actuating pin, of insulating material, provided with an insulating head or knob K, said pin being secured in the insulating-cover by a screw-threaded socket or sleeve, and *d* is a retractile spring for normally holding it in the position shown in Fig. 6.

l is a metallic pin extending through the insulating-pin Z, and *g* is a double inclined groove in the lower part of the socket or sleeve which supports the switching-pin, the arrangement being such that when the head K is forced downward and turned ninety degrees, as shown in Fig. 7, it will remain locked in its lower position with the outer ends of the pin *l* resting against the lower end of the socket or sleeve, while the contact-springs *t* and *t* are simultaneously forced outward against the inner ends of the terminals of binding-posts B B′.

Referring now to Fig. 8 for a full and clear understanding of the circuit connections of the instrument, B B′ represent the binding-posts of the instrument, as before, and *t t* the switching-springs. To the upper ends of these springs are secured insulated conductors *w*′ and w^2, which pass therefrom through an opening or openings in the partition between the two inclosing chambers E and C^3, the conductor *w*′ dividing into two branches running, respectively, to the two oppositely-disposed quadrants Q′ Q′, the conductor w^2 into three branches, two of which w^2 w^2 run to the oppositely-disposed quadrants Q^2 Q^2, located between the before-mentioned quadrants Q′ Q′, while the third branch runs to the electrostatic armature or needle N, the circuit being, as before described, through the bridge-piece *b*′, Fig. 3, the angular arm W, spiral spring *s*, pivot-shaft *a*, to the quadrants Q Q.

The operation is obvious on inspection of Fig. 8, it being apparent that if the switch K be forced downward and the binding-posts B and B′ be connected, respectively, to the positive and negative poles of an electrical generator the voltage of which it is desired to measure, supposing the instrument to be calibrated for a voltmeter, the two quadrants Q′ Q′ will be charged positively, the two quadrants Q^2 Q^2 negatively, while the two quadrants Q Q of the electrostatic armature or needle will also be negatively charged, thereby causing the index-needle I to vibrate from left to right and indicate upon the scale, Fig. 1, the voltage of the current to be measured. The indicating-needle I will be caused to settle immediately by virtue of the action of the magnetic field due to the permanent magnets M M upon the lower quadrant Q of the propelling electrostatic armature or needle.

I do not limit the hereinbefore-disclosed improvements to the particular details of structure shown and described, as it is obvious that the same may be departed from in many respects and still come within the scope of my claims, hereinafter made. Nor do I limit the use of the improvements to electrometers, as it is apparent that many of the details of structure hereinbefore described might be adopted in connection with various forms of electrical measuring instruments, and my claims are designed to include all such cases.

I believe it is broadly new with me to combine the stationary and movable parts of an electrostatic measuring instrument in a compact form which will adapt it for commercial use and to inclose the same within a metallic casing, the operative parts of the instrument being wholly insulated from such casing, so that there is no possibility of discharging the instrument in the event of the casing coming into contact with a conductor connected with a surface or body—such, for instance, as the earth—having lower potential than the charging source, and my claims are generic as to this feature. I believe it is also broadly new with me to arrange the switching-contacts of an electrical measuring instrument in a chamber or casing independent from but substantially integral with the chamber or casing which incloses or surrounds the operative parts of the instrument.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. An electrometer having its quadrants so arranged as to constitute a disk-like field, and a disk-like armature or needle sustained upon a pivot-shaft and adapted to rotate in said field, in combination with a metallic casing surrounding all of said parts and insulated therefrom, substantially as described.

2. An electrometer having its quadrants so arranged as to constitute a disk-like field, a disk-like armature or needle and an index-needle supported by a pivot-shaft, in combination with a metallic casing inclosing or surrounding all of said parts and insulated therefrom, substantially as described.

3. An electrometer having its quadrants so arranged as to constitute a disk-like field, in combination with a disk-like armature or needle and an index-needle supported by a pivot-shaft, together with buffer-springs and an inclosing or surrounding metallic casing, all of said parts being electrically insulated from said casing, substantially as described.

4. An electrometer consisting of stationary and movable electrostatic parts, and an indicating-needle for the movable part, all of said parts being wholly inclosed in a metallic casing and electrically insulated therefrom, substantially as described.

5. An electrometer consisting of stationary and movable electrostatic parts wholly inclosed within a metallic casing and electrically insulated therefrom, the movable parts being made of aluminium, substantially as described.

6. An electrometer consisting of stationary and movable electrostatic parts and an index-needle operatively connected to the movable

part, together with magnetic means for establishing a magnetic field around the movable part, all of said parts being inclosed in a metallic casing and insulated therefrom, substantially as described.

7. An electrical measuring instrument provided with a fixed and a movable part inclosed in a metallic casing, in combination with a circuit-controlling switch therefor inclosed in an independent casing substantially integral with the first-named casing whereby any damaging arcing at the switch is prevented from injuring the instrument, substantially as described.

8. An electrical measuring instrument having a fixed and a movable part inclosed in and insulated from a metallic casing, in combination with a switching-chamber independent from the first-named chamber and inclosing a switch for the operative parts of the instrument, together with insulated conductors running from said switch to the operative parts thereof, substantially as described.

9. An electrical measuring instrument having the operative parts thereof inclosed in a casing, in combination with an independent casing or chamber substantially integral with the first-named casing or chamber and a switch inclosed in said independent casing, together with insulated conductors running therefrom to the operative parts of the measuring instrument, substantially as described.

10. A switch for an electrometer consisting of two conducting switching contacts or springs normally connected to each other and to the movable and stationary parts thereof, in combination with electrodes or terminals adjacent to said switching springs or contacts, together with means for separating the contacts and bringing them into connection with the terminals, substantially as described.

11. A switch for an electrometer consisting of two conducting switching contacts or springs resting normally against each other and connected to the operative parts of the instrument, in combination with terminals located in the path of said contact-springs and electrically connected with the binding-posts of the instrument, together with means for separating the contact-springs and simultaneously placing them into contact with said terminals, substantially as described.

12. A switch for an electrometer consisting of contact-springs resting normally against each other and connected to the operative parts of the instrument with their free ends located in the path of terminals connected to binding-posts, in combination with means for separating the springs, and additional means for locking them in their separated positions, substantially as described.

13. An electrical measuring instrument provided with binding-posts electrically insulated from the inclosing casing, in combination with a switch having yielding contacts supported by the casing but insulated therefrom and electrically connected to the operative parts of the instrument, said switch being provided with means for separating the yielding contacts and placing them in contact with the binding-posts and means for locking them in the latter position, substantially as described.

14. In an electrometer a hollow pivot-shaft provided at its opposite ends with pivot-pins, in combination with an electrostatic armature or needle and an indicating-needle, together with means for securing said armature and needle to the shaft, substantially as described.

15. In an electrometer a hollow pivot-shaft and an electrostatic armature or needle and an indicating-needle secured thereto, said parts being composed of aluminium, in combination with pivot-pins secured in the opposite ends of said pivot-shaft, substantially as described.

16. In an electrometer a hollow pivot-shaft having secured thereto an electrostatic armature or needle and an indicating-needle, the indicating-needle being electrically insulated from the shaft, substantially as described.

17. In an electrometer a hollow pivot-shaft having secured thereto an electrostatic armamature or needle and an indicating-needle, the indicating-needle being electrically insulated from the shaft, in combination with pivot-pins secured in the opposite ends of the shaft, substantially as described.

18. An electrometer provided with a stationary electrostatic field and a disk-like electrostatic armature or needle supported by a pivot-shaft, in combination with a conducting retractile spring connected to said shaft and to the stationary part of the instrument, together with circuit connections running from the terminals thereof to said parts, substantially as described.

In testimony whereof I have hereunto subscribed my name this 8th day of February, 1898.

EDWARD WESTON.

Witnesses:
F. BRISTOW,
C. J. KINTNER.