(No Model.) 2 Sheets—Sheet 1.

W. H. BRISTOL.

RECORDING VOLTMETER.

No. 505,243. Patented Sept. 19, 1893.

Fig. 2.

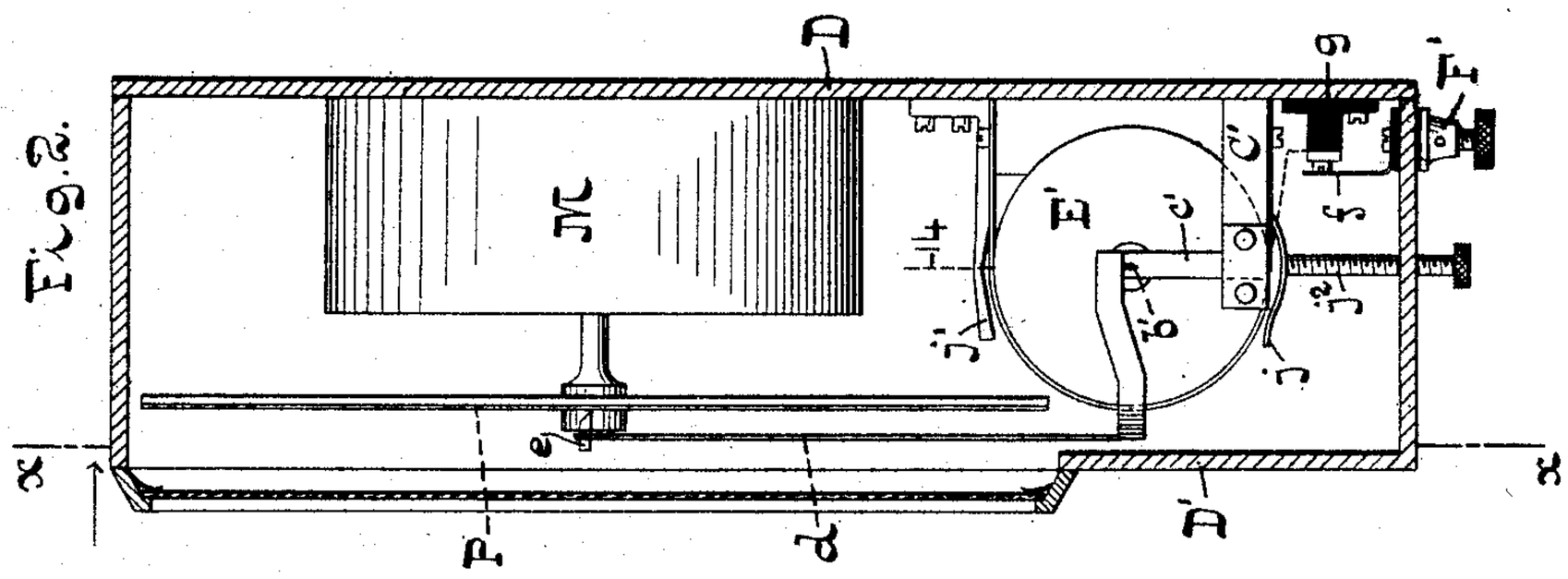
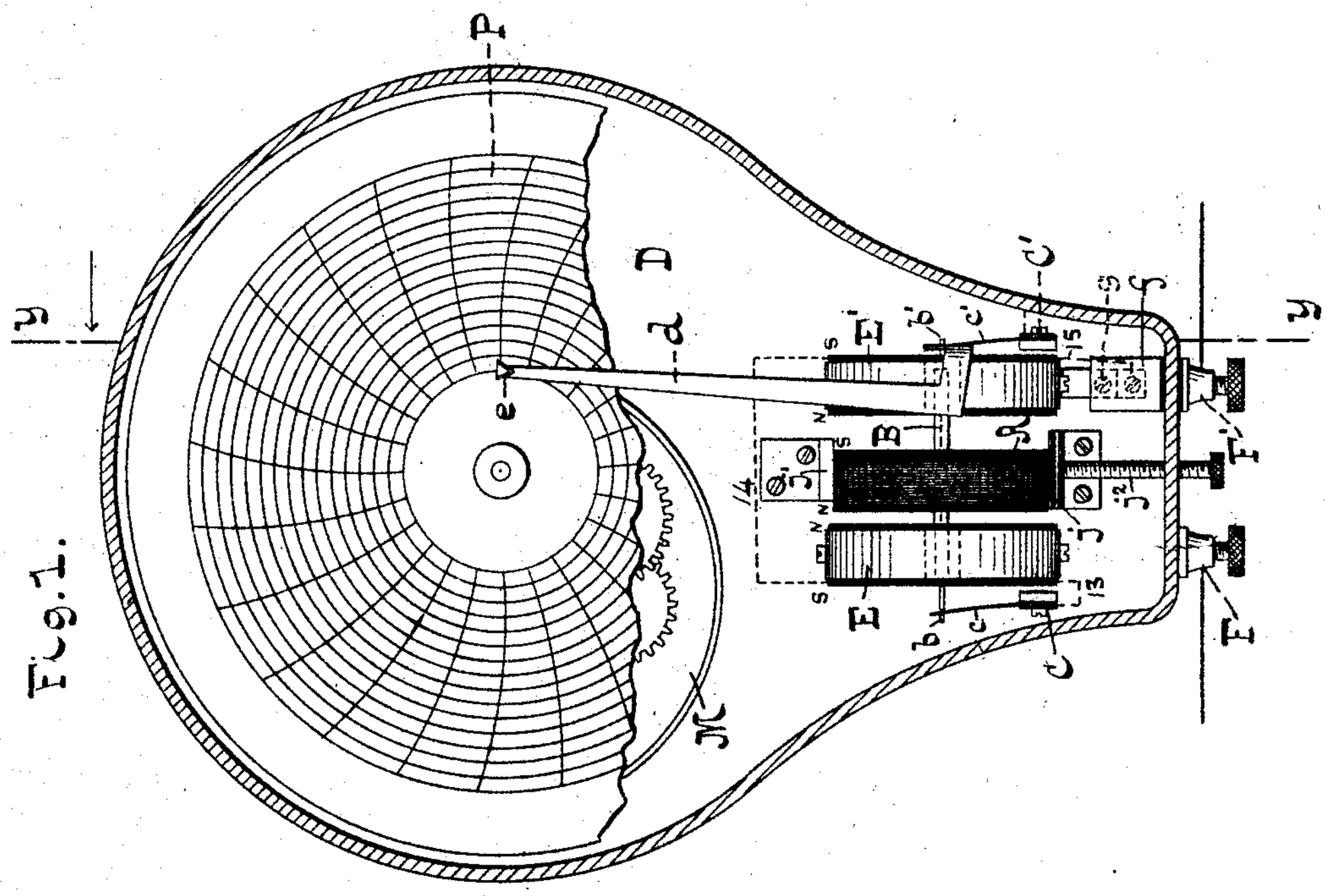


Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

W. H. BRISTOL.

RECORDING VOLTMETER.

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Fig. 6.

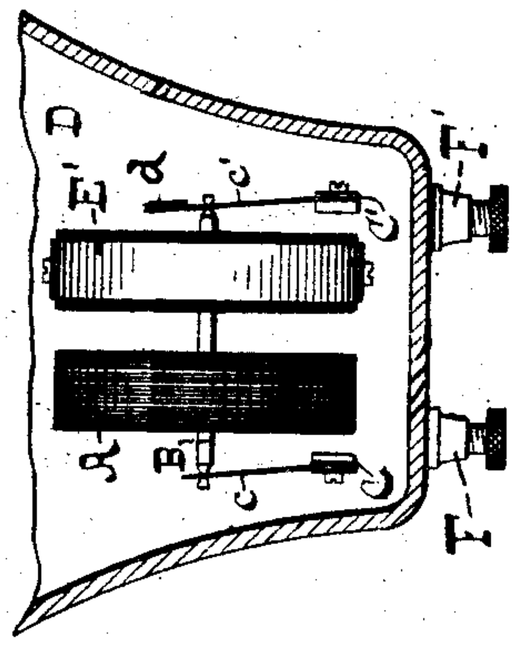


Fig. 7.

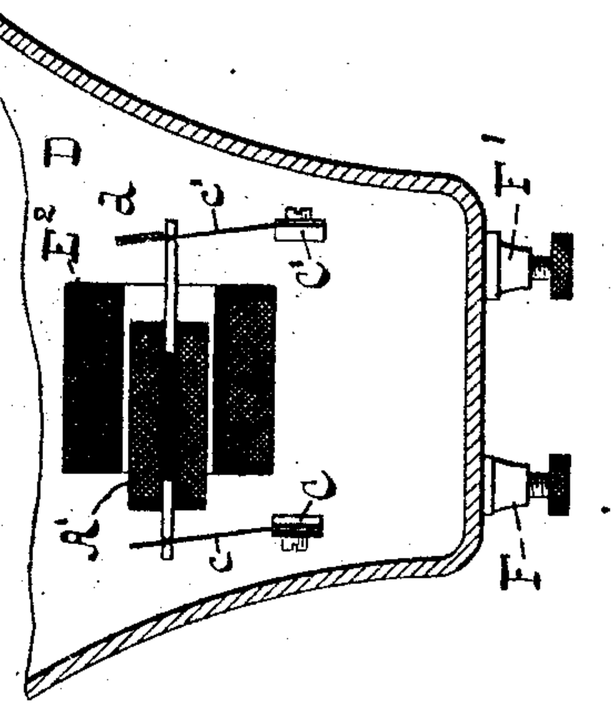


Fig. 4.

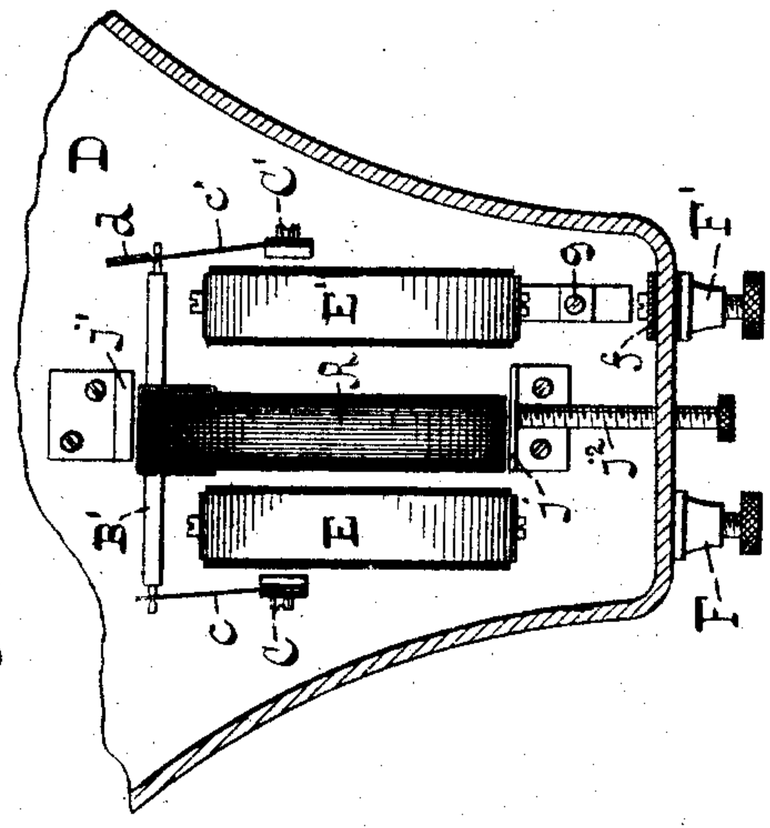


Fig. 5.

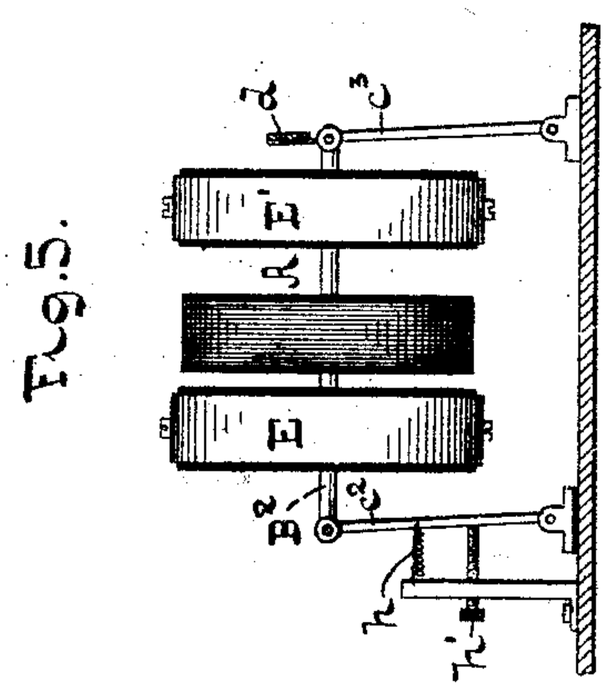
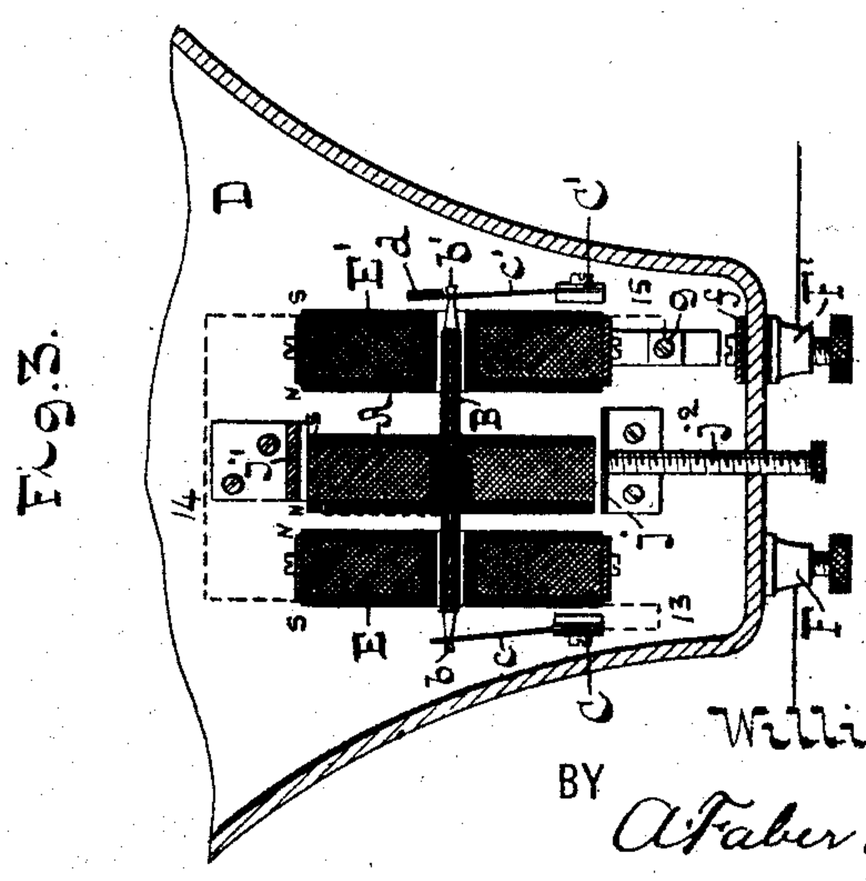


Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM H. BRISTOL, OF HOBOKEN, NEW JERSEY.

RECORDING-VOLTMETER.

SPECIFICATION forming part of Letters Patent No. 505,243, dated September 19, 1893.

Application filed April 17, 1893. Serial No. 470,640. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. BRISTOL, a citizen of the United States, and a resident of Hoboken, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Recording-Voltmeters, of which the following is a specification.

My invention has reference to electrical devices of that character especially adapted for employment in galvanometers, volt or ammeters, or similar instruments for indicating and recording an electrical current or the work done thereby.

The nature of my invention and its application to the instruments of the class above mentioned will best be understood when described in connection with the accompanying drawings, in which—

Figure 1 represents a vertical section in the plane *x x*, Fig. 2, of a voltmeter embodying my invention. Fig. 2 is a vertical cross section thereof in the plane *y y*, Fig. 1. Fig. 3 is a sectional elevation, part being broken away. Figs. 4, 5, 6 and 7 are elevations illustrating modified forms.

Similar letters of reference designate corresponding parts throughout the several views of the drawings.

Referring at present to Figs. 1 and 2, where I have illustrated a recording voltmeter, the letters E E′ designate two stationary solenoids, and A is a movable solenoid arranged between the two former solenoids, the same being moved toward the solenoid E′ when the several solenoids are vitalized. The general arrangement of the solenoids with relation to each other is similar to that of the Thompson electric balance and forms no part of my present invention. The solenoid A is rigidly mounted upon a horizontal support or shaft B, extending freely through the centers of the solenoids E E′ but not supported by the same. The main portion of the shaft consists of an insulating material, such as gutta percha or wood fiber, while its ends *b b′* are made of metal and connected respectively with the terminal wires of the movable solenoid A, (Fig. 3.) These metallic ends of the shaft B rest in vertical metallic supports *c c′* secured to posts C C′ projecting from the back D of the casing; the support *c* being however insulated from its post. The parts *c c′* I make quite thin and of a resilient conducting material, so that they form a flexible support permitting lateral motion of the solenoid A, while at the same time they return the same to and hold it in its normal position. The solenoid rested in these flexible supports is caused to move in substantially a right line, which fact is of considerable importance. As here shown the ends *b b′* of the shaft B are turned round and formed with grooves which fit into suitable V's cut into the supports *c c′*, so that the shaft is held to said supports. The bearings (one or both) may however, be of a knife edge construction, which has the advantage that the shaft is prevented from turning.

To one of the flexible supports (Figs. 1 and 2) is secured a pointer or arm *d*, which is carried outwardly and upwardly to bring its free end opposite to the zero point of an appropriate scale on a chart P when the solenoid A is in its normal position. The pointer or arm is provided with a suitable marking device, such as the pen or style *e*, and the chart is rotated by a suitable clock movement M.

F F′ are binding posts secured to the cover D′ of the casing. To the threaded shank of the post F′ is secured a spring contact plate *f* insulated from said cover and arranged in contact with a binding screw *g* insulated from the back D of the casing. The current entering at the binding post F (Fig. 3) passes through the metal of the back D, to post C′, from thence over flexible support *c′* to the terminal *b′* of the solenoid A; through the coils of the latter to the terminal *b;* thence to flexible support *c;* over wire 13 to solenoid E, and from thence by wire 14 to solenoid E′; over wire 15 to the binding screw *g*, and over plate *f* to binding post F′. The respective coils of the solenoids are so wound that the solenoids A and E′ present opposite poles to each other when vitalized, while the solenoids A and E present like poles,—and consequently solenoid A will move toward solenoid E′ under an increased and nearly uniform magnetic force,—the distance through which it moves varying according to the voltage of the current.

It will be noticed that in my present construction I dispense with the ordinary iron cores and armatures, in consequence whereof

there is no magnetic lag with a decreasing voltage of the current, and the pointer will always return to and give the same indication on the chart as with an increasing voltage. The instrument will in all cases give an absolutely correct indication of the voltage. Of course, if so desired, an instrument embodying electro-magnets could be made, the movable electro-magnet being mounted on the flexible supports before described. By insulating the opposite ends of the shaft B from each other and making the same the terminals of the movable solenoid A, which is therefore in electrical connection with the supports $c\ c'$, I avoid the use of connecting wires which would offer friction and resistance to the motion of the solenoid.

It is evident that the instrument is adapted either for the measurement of direct or alternating currents provided the proper charts are applied for the respective currents. A dynamometer can be constructed on the same principle by forming the solenoid A of fine wire and the solenoids E E′ of coarse wire.

With two solenoids and an intermediate movable solenoid, a nearly uniformly spaced scale is obtained. When this is not essential, or when an open scale is desired at either end of the range, I construct the instrument with but one stationary solenoid, as shown in Fig. 6. According to the nature of the scale desired the solenoids are wound either to mutually attract or repel.

In place of having the shaft B arranged to pass through the solenoids E E′, the solenoid A may be suspended from a horizontal support B′ (Fig. 4) arranged above the solenoids and retained in flexible supports $c\ c'$ as before. Also, the supports $c\ c'$ may be made rigid in themselves and hinged; one of the same being subjected to the action of a suitable spring. Such a construction I have shown in Fig. 5 where $c^2\ c^3$ are the pivoted supporting arms, connected to the shaft or bar B^2 upon which the solenoid is mounted, and h is the spring which returns the solenoid to, and holds it in its normal position with the aid of a stop h'.

To hold the movable solenoid rigid while the instrument is being carried or transported, any one of the usual devices may be employed, for instance, as here shown, (Figs. 1 and 2,) a plate j is arranged to engage with and lift the solenoid A against a stop j', when the screw j^2 is turned, thereby also lifting the shaft B out of its bearings.

In Fig. 7, I have shown but two solenoids and a modified arrangement of the solenoids. In this instance the movable solenoid A′ is arranged concentrically within the stationary solenoid E^2. As in the apparatus shown in Figs. 1 to 3 the solenoid A′ is mounted upon flexible supports.

It is of course to be understood that instead of connecting the solenoids in series, as here shown, they could be arranged in parallel, if so desired, to produce a certain total resistance, or they could be wound in any other way to produce any desired resistance.

While in the examples herein illustrated I have shown the movable solenoid supported from below, it is evident that the movable solenoid could be suspended in the flexible arms.

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

1. In an electrical measuring instrument, the combination of a stationary solenoid, a movable solenoid provided with metallic portions on its opposite sides insulated from each other and forming the electrical terminals of the same, and flexible metallic supports in electrical connection with the metallic portions of the movable solenoid, substantially as described.

2. In an electrical measuring instrument, the combination of a stationary solenoid, a movable solenoid mounted on a horizontal shaft having metallic ends insulated from each other and connected respectively with the terminals of the movable solenoid, and vertical flexible conducting supports provided with recesses in which the metallic ends of the shaft rest to form electrical connection between said supports and the movable solenoid, substantially as described.

3. The combination with the stationary solenoid, of a movable solenoid adapted to the same, a support for the movable solenoid provided with metallic ends insulated from each other and forming the terminals of the movable solenoid, and conducting supports in which said metallic ends rest, substantially as described.

4. In an electrical measuring instrument, the combination of a stationary solenoid, a movable solenoid adapted to the same, swinging conducting supports for the movable solenoid, and an indicating or recording arm attached directly to one of said supports and participating in the angular movements of the same, substantially as described.

Signed at New York, in the county of New York and State of New York, this 3d day of April, A. D. 1893.

WILLIAM H. BRISTOL.

Witnesses:
KLAS H. TERNSTEDT,
A. FABER DU FAUR, Jr.