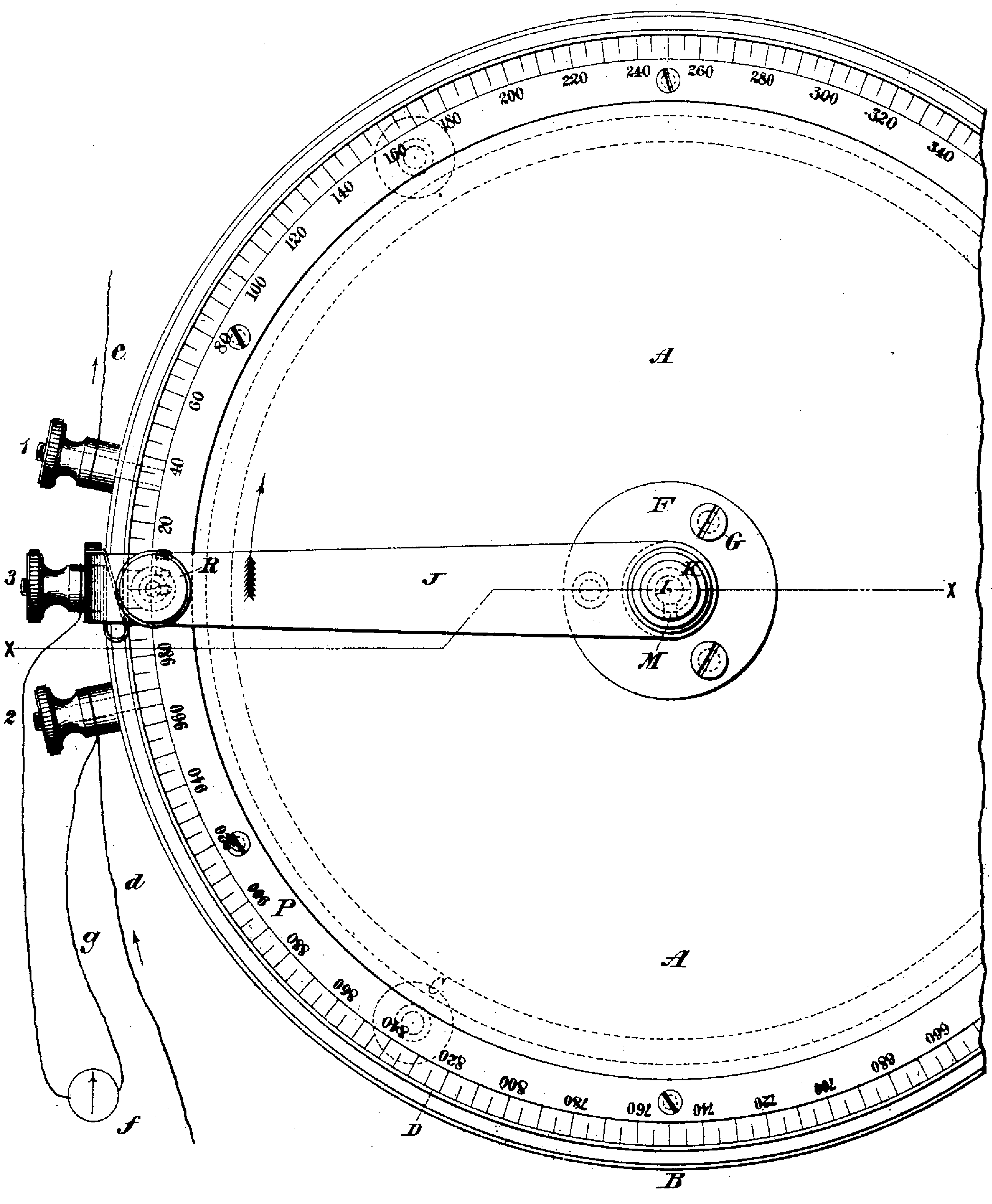
(No Model.) 2 Sheets—Sheet 1.

E. WESTON.

RHEOSTAT.

No. 446,490. Patented Feb. 17, 1891.

Fig. 1.



WITNESSES:

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William Goebel.

INVENTOR

Edward Weston

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ATTORNEY

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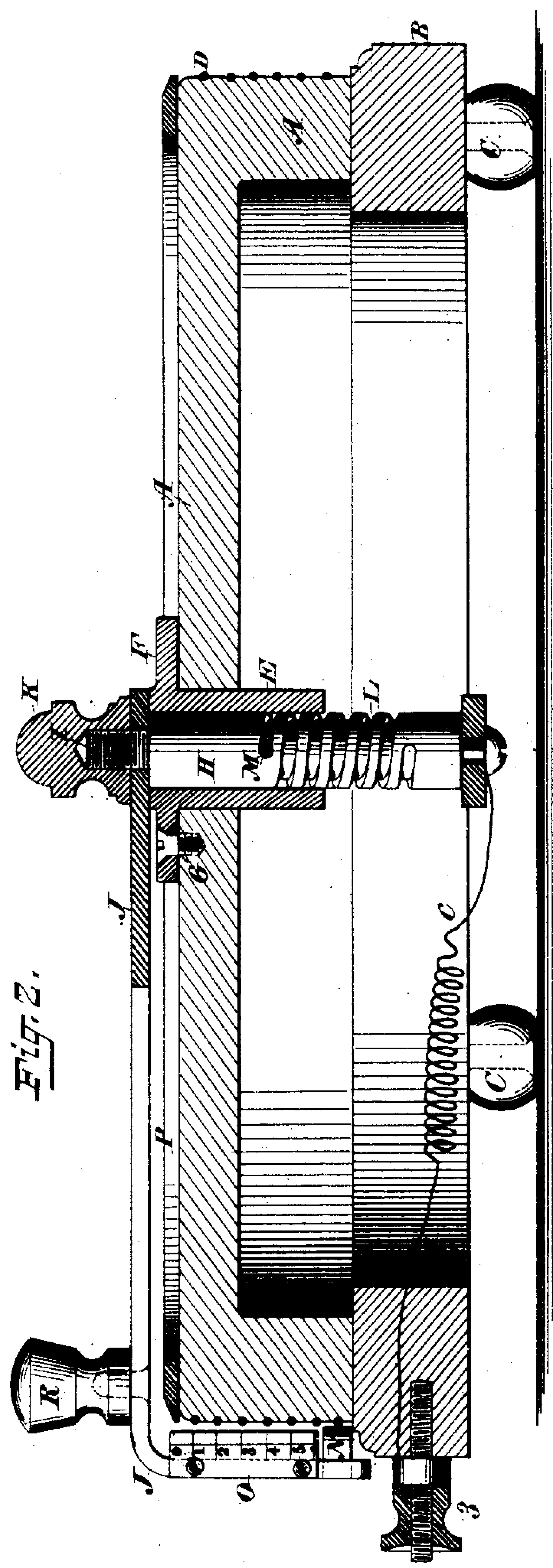

Fig. 2.

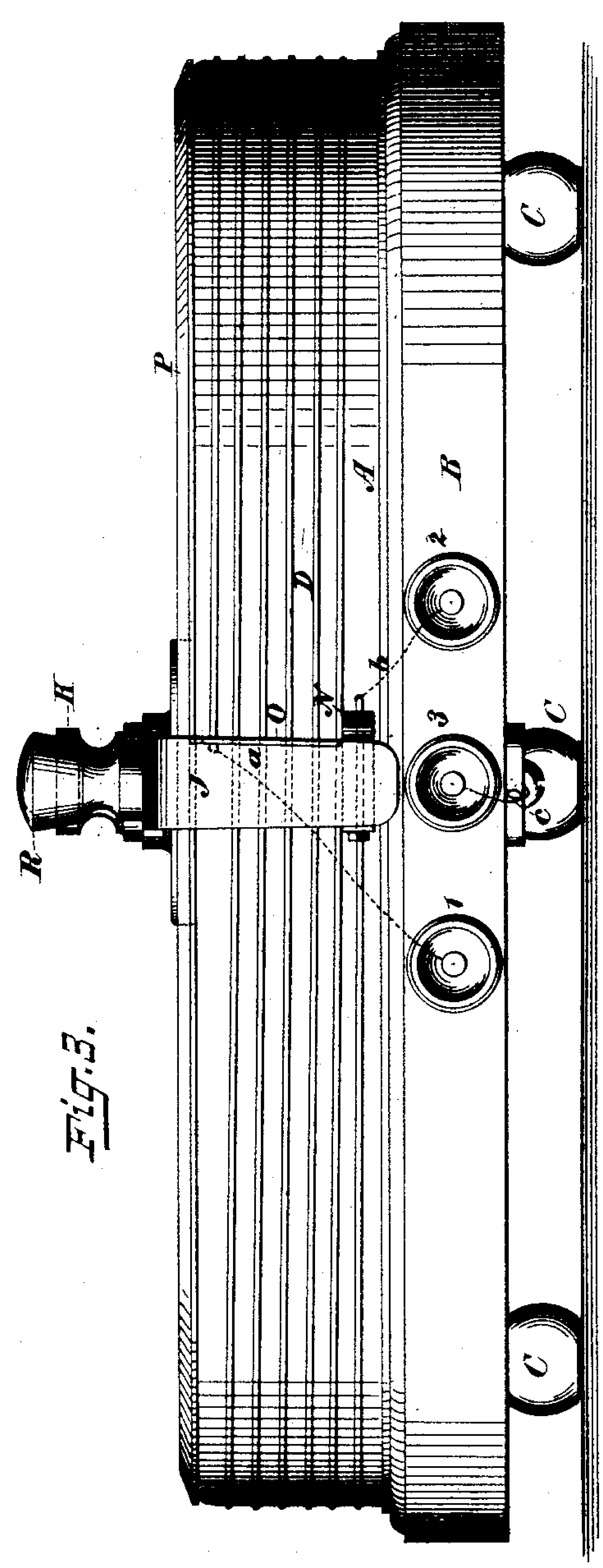

Fig. 3.

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UNITED STATES PATENT OFFICE.

EDWARD WESTON, OF NEWARK, NEW JERSEY.

RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 446,490, dated February 17, 1891.

Application filed February 28, 1889. Serial No. 301,501. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WESTON, of Newark, Essex county, New Jersey, have invented a new and useful Improvement in Rheostats or Potentiometers, of which the following is a specification.

My invention relates to an instrument having for its object the interposition of a desired electrical resistance in a circuit, the determination of a resistance the magnitude of which is unknown, the finding the difference of potential between two points in a circuit, and any other purposes to which it may be conveniently and usefully applied in the art of electro-measurement.

My invention consists in a movable body of conducting material arranged and operating to traverse a continuous spiral, also of conducting material, the circuit-terminals being connected to said body and to one end of said spiral, by which means the length of the spiral interposed in the circuit, either main or shunt, may be regulated with great accuracy and facility, and also in the construction and arrangement of the instrument, substantially as hereinafter specified and claimed.

In the accompanying drawings, Figure 1 is a plan view of my new rheostat or potentiometer. Fig. 2 is a vertical section on the line X X of Fig. 1, and Fig. 3 is a side elevation.

Similar letters and figures of reference indicate like parts.

A is a cylindrical drum, of wood or other non-conducting material, supported on a standard B, of like material, provided with feet C.

Upon the periphery of the drum A, and preferably countersunk therein, is spirally wound a metallic conductor D, of uniform thickness and homogeneous material, offering consequently a uniform resistance at all points to an electrical current passing through it.

Passing through the center of the drum A is a sleeve E, having a flange F resting upon the surface of said drum and secured thereto by screws, as G. The sleeve E forms a bearing or nut for the cylindrical shaft H, which passes through it. On the upper end of said shaft is a threaded projection I, which passes through the radial arm J and receives the nut K, whereby said arm J is rigidly secured to the upper end of the shaft H. The arm J extends radially above the upper surface of the drum A, and then turns downward to extend across its periphery. Said arm J is provided with a fixed handle R, so that the arm J may be operated as a crank-arm to rotate the shaft H in the sleeve E. On the shaft H is cut a screw-thread at L, and on the inner periphery of the sleeve E is provided a fixed pin M, Fig. 2, and dotted lines, Fig. 1, which enters the groove of said thread. Consequently when the shaft H is turned it is simultaneously caused to move longitudinally upward or downward in accordance with the direction of its rotation. The pitch of the screw L equals the pitch of the spiral formed by the conductor D.

At the lower extremity of the bent end of the arm J is provided a metallic brush or wiper N, which always bears against the exposed outer surface of the conductor D, and hence, by reason of the like pitch of said conductor and the screw L, follows said conductor.

Upon the downwardly-bent portion of the arm J is secured an index-scale O, having its edge parallel to the axial line of the drum A and marked in as many divisions as there are spaces between the turns of the spiral conductor D, each division being equal to the interval between successive turns of said conductor.

Upon the surface of the drum A is secured a circumferential scale P, laid off in equal divisions, here marked as one thousand.

Upon the periphery of the standard B is a binding-screw 1, which connects by a wire *a*, dotted lines, Fig. 3, with the upper end of the conductor D. A second binding-screw 2, also upon said standard, connects by a wire *b* with the lower end of said conductor. A third binding-screw 3, also upon said standard, connects by a wire *c* to the lower end of the shaft H.

I may use this instrument either as a rheostat or resistance-coil or as a potentiometer. As a rheostat it is operated in the following manner: One circuit-terminal is connected to binding-post 3 and the other circuit-terminal to binding-post 1. The resistance of the whole length of conductor D is known, and hence, said conductor being of homogeneous material and of uniform thickness, it follows that the resistance of any fractional portion of said conductor is proportional to the length of said portion. Consequently, in order to interpose in the circuit a desired resistance less than that of the whole conductor D, it is necessary simply to interpose a length of said conductor bearing to the total length a ratio equal to that of the desired resistance to the whole resistance. Assume the total length of the conductor D to be six meters and the drum A to measure circumferentially one meter. Hence when the arm J has been carried around one complete revolution the brush N on the end thereof will have passed over one-sixth of the total length of conductor D, or one meter. If the arm J is carried around but half a revolution, then the brush N will have traversed but one-half a meter of the conductor D, and so for any fractional part. The scale P being divided into thousandths therefore shows millimeters, and from this scale the length of the arc swept over by the arm J, and hence the length of the conductor passed over, may be read.

In the drawings the brush N is shown in contact with the lower end of the conductor D. Hence the whole length of said conductor is interposed in the circuit between the binding-screws 1 and 3. Suppose the arm J to be turned around one complete revolution. The shaft H then moving upward a distance equal to that between the last and next to the last turn of the conductor, the brush N will touch the next to the last turn at a point directly above that at which it before touched the last turn. Hence the last turn of the conductor will be cut out of circuit; or, in other words, but five-sixths of the whole length, or five meters, will be included in the circuit. Another complete revolution of the brush will leave but four meters of the conductor in circuit, another turn three meters, and so on. It will be seen from the drawings that when the whole conductor D is in circuit the zero-mark on the scale O comes opposite the circumferential edge of the scale P. Inasmuch as the divisions of the scale O are each equal to the interval between two turns of the coiled conductor D, it follows that when the arm has made one complete revolution the division marked "1" of the scale O will come opposite the edge of scale P, and thus as each successive revolution is made the scale O, being carried upward, will indicate the number of complete revolutions by the number which approximates the edge of scale P. Suppose now, merely for illustration, that the total resistance of the conductor D is six hundred ohms. Then the resistance of each complete turn of said conductor is one hundred ohms. Assume that it be desired to interpose in the circuit a resistance of 275.5 ohms. Starting from the position shown in the drawings, the arm J is carried around until the number "2" on the scale O comes opposite the edge of scale P. The operator then continues to move the arm J until its edge reaches the 750 mark on the scale P. He will then have two hundred and seventy-five ohms resistance in circuit. Then, as each division of the scale P represents one-fifth of an ohm, he continues moving the arm forward over two and a half of these divisions, when the total desired resistance above noted will be interposed, or, conversely, supposing it be desired to measure an unknown resistance, as with a Wheatstone bridge, when a balance, for example, is secured when the scale O shows the number "3" just above the edge of scale P, and on the scale P the edge of the arm J reaches the division marked "210." The resistance in circuit will then be three hundred and twenty-one ohms. Of course the total resistance of the conductor may be very much smaller than that here chosen for illustrative purposes—as, for example, but six ohms, in which case the instrument will measure to thousandths of an ohm, or but one ohm, in which the measurement will be to one six-thousandth of an ohm, and so on, as desired; and equally the scale P may be laid off in smaller divisions, and thus still greater accuracy of measurement attained. It will be apparent that in any event the manipulation and reading of the instrument are done in the same way. The operator has simply to rotate the arm J until the desired scale-reading is obtained, or until in resistance measurement the balance is found.

I will now describe the use of the instrument in the measurement of the difference of potential between two points on a circuit. It is well known that the potential decreases all the way round a circuit from the plus pole of a battery, for example, where it is highest, down to the minus pole, where it is lowest. The fall of potential between any two points is proportional to the resistance between those points, so that if we go around a circuit to a point where the potential has fallen through half its value then the current has at that point gone through half the resistances; or, conversely, if we go through half the resistance the potential will have fallen to half its value. Now if the part of the circuit on which we desire to measure the potential difference consists, as in the present instrument, of a conductor of uniform thickness and offers a uniform resistance to the current, the potential will fall uniformly, so that we can measure differences in potential with great accuracy by simply interposing an exactly-known length of the conductor carrying the current between the terminals of a shunt in which a voltmeter is included.

In Fig. 1 let one terminal of the main circuit, as *d*, connect with the binding-post 2 and the other terminal *e* connect with binding-post 1, the current passing through the whole conductor D in the direction of the arrows. Let a voltmeter *f* be connected in the shunt *g* with posts 2 and 3. From what has been already explained it will be apparent that by moving the arm J any fraction of the whole length of the conductor D can be thrown into the shunt g and this length accurately adjusted from the scale-readings. The voltmeter will then show the difference in potential existing between the shunt-terminals.

I claim—

1. An electrical measuring-instrument containing a fixed cylindrical support of non-conducting material, a fixed conductor disposed spirally upon the periphery of said cylinder, a conducting-body, and means for moving said conducting-body along the length of and in contact with said conductor, substantially as described.

2. An electrical measuring-instrument containing a fixed spiral conductor, a conducting-body, and means for moving said body along the length of and in contact with said conductor, and circuit-connections communicating, respectively, with the ends of said spiral conductor and with said movable body, substantially as described.

3. An electrical measuring-instrument containing a spiral conductor, a movable conducting-body in contact with and traversing said conductor, and a fixed index-scale disposed concentrically with said spiral conductor in proximity to said movable body and showing the extent of movement of said body in arc, substantially as described.

4. An electrical measuring-instrument containing a spiral conductor, a movable conducting-body in contact with and traversing said conductor, and an index-scale disposed transversely, the turns of said conductor moving coincidently with said movable body and showing the extent of movement of said movable body along said spiral, substantially as described.

5. An electrical measuring-instrument containing a cylindrical support, a conductor spirally disposed upon the periphery thereof, an arm disposed in proximity to said periphery parallel to the axis of said cylinder and movable both in the direction of said axis and in a circular path around said periphery, and a body of conducting material supported by said arm in contact with said spiral conductor, substantially as described.

6. An electrical measuring-instrument containing a cylindrical support, a conductor spirally disposed upon the periphery thereof, an arm disposed in proximity to said periphery parallel to the axis of said cylinder and movable both in the direction of said axis and in a circular path around said periphery, a body of conducting material supported by said arm in contact with said spiral conductor, and a scale upon said arm marked in divisions respectively proportional to the pitch of said spiral conductor and having its edge parallel to the axis of said support, substantially as described.

7. An electrical measuring-instrument containing a cylindrical support, a conductor spirally disposed upon the periphery thereof, a rotary shaft or rod having its axis coincident with the axis of said cylinder, the said shaft being movable longitudinally in the direction of its axis, an arm extending radially from said shaft over one of the circular faces of said cylinder and downward in proximity to the periphery of said cylinder, a conducting-body supported by said arm in contact with said spiral conductor, and an index-scale upon said cylinder-face, substantially as described.

8. An electrical measuring-instrument containing a cylindrical support, a conductor spirally disposed upon the periphery thereof, a rotary shaft, a rod having its axis coincident with the axis of said cylinder, the said shaft being threaded and turning in a fixed nut, an arm extending from said shaft, and a conducting-body supported by said arm in contact with said spiral conductor, the pitch of the thread upon said shaft being equal to the pitch of the spiral conductor, substantially as described.

9. The combination of the drum or cylinder A, the spiral conductor D on the periphery thereof, threaded shaft H, nut E, concentrically disposed in and with said cylinder, arm J upon said shaft H, brush N, and circuit-connections, substantially as described.

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Witnesses:
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