(No Model.)

E. W. JEWELL.

GRAPHITE RHEOSTAT.

No. 597,002. Patented Jan. 11, 1898.

Fig. 1.

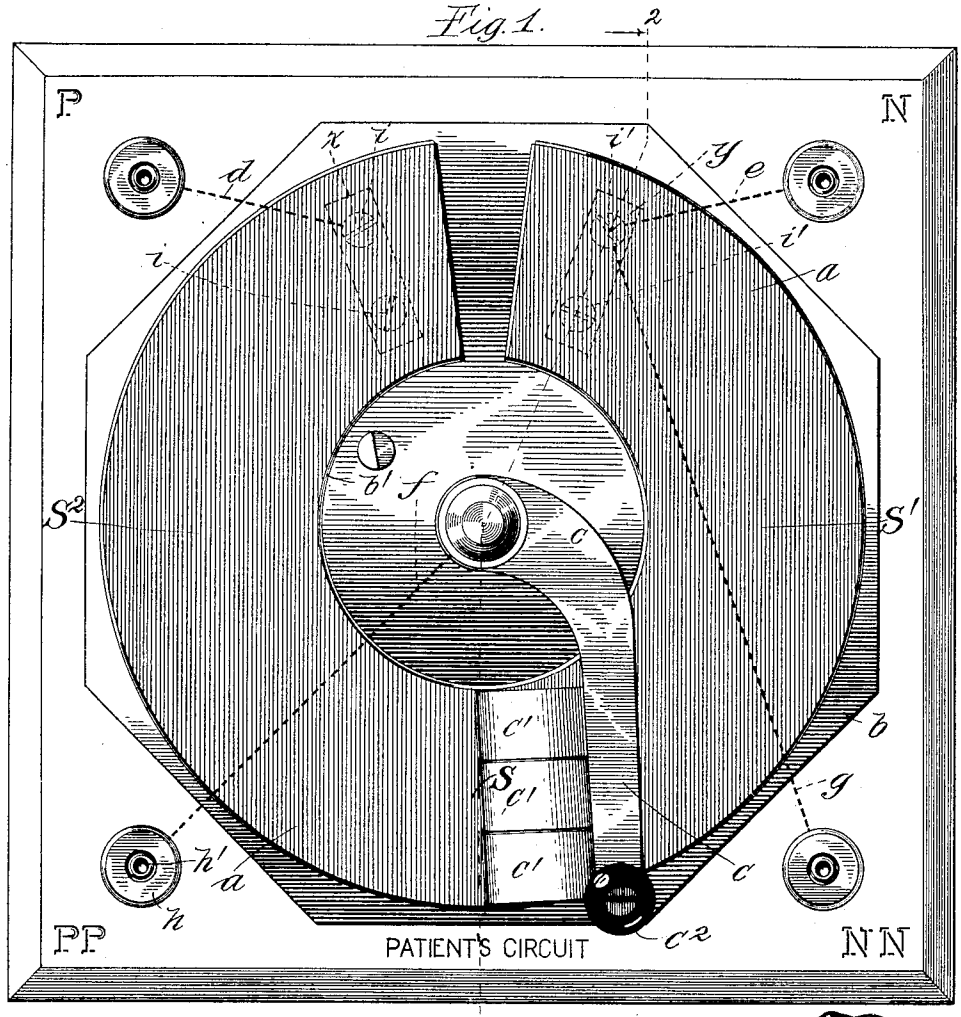
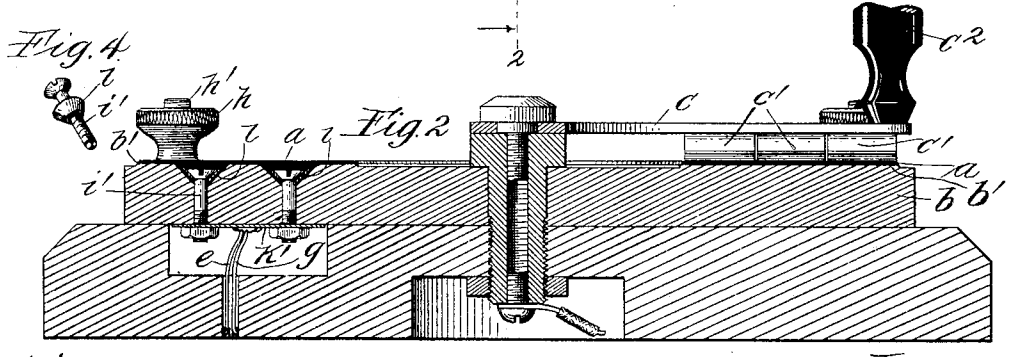


Fig. 4.



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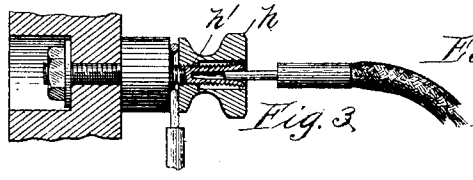


Fig. 3.

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UNITED STATES PATENT OFFICE.

EDWARD W. JEWELL, OF CHICAGO, ILLINOIS.

GRAPHITE RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 597,002, dated January 11, 1898.

Application filed May 8, 1897. Serial No. 635,658. (No model.)

To all whom it may concern:

Be it known that I, EDWARD W. JEWELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Graphite Rheostats, (Case No. 1,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to rheostats; and I have found it to be of special value in electrotherapeutic operations, where a very gentle and gradual variation of current in the working circuit is essential.

The resistance material which I employ is graphite evenly distributed upon an insulating-base, preferably of stone or slate. This resistance, of uniform cross-sectional area at all points, is introduced in shunt to the operating-circuit, one of whose terminals consists of a suitable contact-arm arranged to make a firm electrical connection with any part of the graphite resistance, the other terminal being at one end of the resistance.

In accordance with the law of divided circuits the voltage in the operating-circuit will vary directly with the increase or decrease of resistance in the shunt as the contact-arm is moved along the graphite, thus producing what may be termed a "uniformly-graded" resistance.

By this construction I am enabled to secure insensible variations in voltage, it being possible to change from the full strength of current down to zero in a perfectly uniform ratio with no sudden jerks which are unpleasant and injurious in medical treatment, and which have been almost impossible to avoid heretofore.

It has been impossible heretofore to construct a rheostat for electromedical work in which the variations in voltage could be made so gradual as to be insensible to the patient, especially in connection with dental surgery. It has been proposed to introduce a resistance of gradually-increasing cross-section in series with the operating-circuit. This, however, has been found inefficient, because it is extremely difficult to start or regulate the current by means of such a rheostat without causing a perceptible jerk in the current, and consequently intense pain to the patient.

By the use of my invention these harmful effects are avoided, and in starting a current, especially the increase from absolute zero to any required strength, is made in a perfectly uniform gradation, as a movement of the contact-arm through a given distance along any portion of the surface of the graphite will always change the voltage in the exact ratio in which such distance is proportioned to the total length of the graphite path.

My invention has been especially successful in operations of electrolysis and electric diffusion as performed in dental surgery, where the utmost care is necessary to prevent sudden changes in the strength of the current.

A further feature of my invention consists in an improved binding-post which will permit the connection of a second conductor without in any way disturbing a connection already made. I find this especially useful, for instance, in connecting a voltmeter across the circuit without disturbing the connections or operation of apparatus which may be included between the same two binding-posts.

My invention further contemplates an improved and novel method of maintaining a good electrical connection between the graphite and the conductor, attached thereto.

The accompanying drawings will assist in explaining the operation of my invention.

Figure 1 is a plan view, the electrical connections being indicated in dotted lines. Fig. 2 is a sectional view taken along the line 2 2 of Fig. 1. Fig. 3 is a detail view of the improved binding-post of my invention. Fig. 4 illustrates a screw provided with a conical washer of soft metal, which I employ in electrically connecting a conductor with the graphite resistance.

Like letters are used to designate like parts in all figures.

The graphite resistance a is applied uniformly to a raised portion b' of the slate base b. In the center of the base is pivoted an arm c, provided with metallic contact-springs c' c', which are maintained in firm sliding engagement with the surface of the graphite. The handle c^2 may be grasped to rotate the con-

tact-arm. The binding-posts P and N are for connection with the positive and negative terminals of the battery or other source of current. Conductor *d* serves to connect the post P with one end of the graphite resistance at the point *x*, while conductor *e* similarly connects post N with the other end of the resistance at the point *y*. Binding-posts P P and N N are respectively the positive and negative terminals of the working or patient's circuit, a conductor *f* connecting post P P with the contact-arm *c* and conductor *g* extending from the post N N to the point where conductor *e* is united with the end of the graphite resistance. Current entering at P will flow from the point *x*, through the graphite *a*, to the point *y*, going out by the post N. In this distinct circuit for the current it will meet with a uniformly-graded resistance, preferably of several thousand ohms. Between the points *x* and *y* there will be a difference of potential corresponding to the electromotive force of the current, with a uniform drop in that potential all along the line. Thus if the rheostat is used on a twenty-volt circuit the difference of potential between the middle point S of the rheostat and the point *y* will be ten volts, while at the points S' and S^2 it will be five volts and fifteen volts, respectively. If the contact-arm be placed at the point *y* and rotated in a clockwise direction, the difference of potential between the posts P P and N N will rise very gently and gradually from zero to the full twenty volts when it reaches the point *x*. The voltage in the patient's circuit thus depends upon the relative position of the contact-arm upon the graphite surface.

With the use of my invention current may safely and advantageously be taken from an ordinary one-hundred-and-ten-volt incandescent-lighting circuit even for the most delicate electrotherapeutic operations.

The screws *i i' i' i'*, which are used to make connection between the graphite resistance and the plates *k k'*, to which conductors are soldered, are preferably provided with conical washers of soft metal, such as block-tin. The graphite is firmly packed about the sides of the countersunk holes, in which the screw-heads rest. The conical block-tin washers *l* are interposed between the screw-heads and the graphite, so that when a nut is tightened upon the shank of a screw the washer is slightly expanded and forced into very firm engagement with the graphite. More graphite is then tamped into the countersunk hole to cover the head of the screw, and the union is complete. Conductors which it is desired to electrically connect with the graphite are preferably soldered to one of the plates *k k'*, according to which end of the graphite is to be connected.

The binding-post illustrated in Fig. 3 of the drawings I find to be a very valuable accessory. It has two points of advantage over the ordinary variety in that the binding-nut *h* may not be wholly removed and lost from the threaded stem *h'* of the post, the outer end of said stem being enlarged to retain the nut. The threaded stem or shank is also hollow to afford an auxiliary socket or seat for an auxiliary switch pin or plug, which may be inserted therein. I find it desirable to make permanent connections, so to speak, by means of the plug-and-socket device, when other connections may readily be made in the usual manner by the threaded binding-nut *h* without in any wise disturbing the first circuit. This mode of connection is most desirable, for it is essential in medical treatment, as I have before stated, to avoid suddenly making or breaking a circuit and also to avoid sudden changes of resistance in the working circuit due to loose or imperfect connections. Binding-posts such as I have described readily permit changes of connection without suddenly breaking or altering the condition of the circuit.

It is evident, of course, that the use of my invention is not restricted to electromedical work. In fact, I have found it very desirable as a field-rheostat for dynamo-electric machines.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a rheostat, the combination with an insulating-base, of a uniformly-graded graphite resistance mounted thereon, a contact-arm adapted to travel over and make firm electrical connection with said graphite resistance, binding-posts P N in electrical connection with each end of said graphite resistance, binding-posts P P and N N in electrical connection with the said contact-arm and one end of said graphite resistance respectively, and auxiliary sockets in said binding-posts adapted to receive independent switch plugs or connectors, substantially as and for the purpose described.

2. In a rheostat, the combination with a uniformly-graded graphite resistance in shunt with the working circuit, a contact-arm adapted to travel over said graphite resistance and forming one terminal of said working circuit, binding-posts for making suitable connections, and auxiliary sockets in said binding-posts adapted to receive switch plugs or pins, independent of such connections, substantially as described.

3. The combination with the base *b*, of a screw having an enlarged conical head, a countersunk portion in said base adapted to receive said screw-head, graphite applied to the sides of said countersunk portion, and a conical soft-metal washer interposed between the screw-head and graphite, substantially as and for the purpose specified.

4. In a binding-post, the combination with the threaded shank, of a threaded nut therefor, and an enlargement upon the end of said shank to prevent the total removal of said nut, substantially as described.

5. In a binding-post, the combination with the threaded shank, of a threaded binding-nut therefor, and a socket or seat in said shank adapted to receive a switch pin or plug, substantially as and for the purpose specified.

6. In an electrotherapeutic apparatus, the combination with a working or patient's circuit forming one distinct path for the electric current, of a thin layer of graphite evenly distributed upon an insulating-base forming a second path of high resistance for the current, a contact-arm arranged to travel along said graphite layer and make electrical contact therewith, the cross-sectional area of said graphite path being substantially equal at all points of adjustment of said arm, an electrical connection between said arm and one terminal of the patient's circuit, and an electrical connection between the other terminal of said patient's circuit and one terminal of said graphite path, said patient's circuit and said graphite path being thus in shunt relation to each other, whereby the voltage in said working circuit varies according to the relative position of said arm upon said graphite path, substantially as described.

In witness whereof I hereunto subscribe my name this 28th day of April, A. D. 1897.

EDWARD W. JEWELL.

Witnesses:

D. W. C. TANNER,

A. LYNN LAWRENCE.