(No Model.)

F. C. WAGNER.

ELECTRO-THERMAL CURRENT REGULATOR.

No. 419,740. Patented Jan. 21, 1890.

Fig. 1.

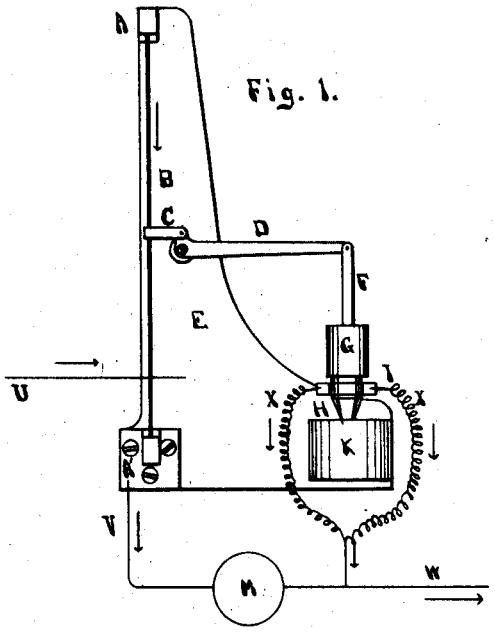


Fig. 2.

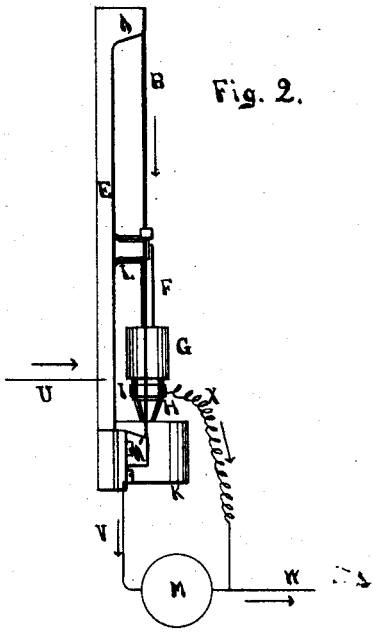
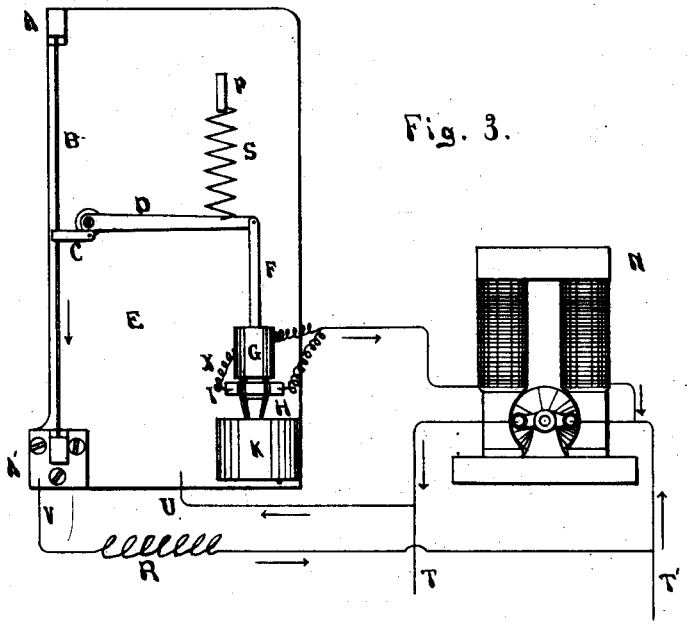


Fig. 3.



WITNESSES:

W. E. Coleby.

Chas. A. Wagner

INVENTOR.

Frank C. Wagner

UNITED STATES PATENT OFFICE.

FRANK C. WAGNER, OF ANN ARBOR, MICHIGAN.

ELECTRO-THERMAL CURRENT-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 419,740, dated January 21, 1890.

Application filed September 28, 1889. Serial No. 325,446. (No model.)

To all whom it may concern:

Be it known that I, FRANK C. WAGNER, a citizen of the United States, residing at Ann Arbor, county of Washtenaw, and State of Michigan, have made a new and useful invention in Electro-Thermal Current-Regulators, of which the following is a specification.

My invention relates to that type of regulating devices which are actuated by the thermal effects of a current of electricity.

The nature and object of my invention will be fully understood by referring to the following specification and accompanying drawings, and particularly pointed out in the claims at the end of said specification.

In the accompanying drawings, Figure 1 is a side elevation of my improved regulator, showing the manner of connecting it with an electric meter and a working-circuit for the regulation of said meter. Fig. 2 is an end elevation of the same. Fig. 3 shows a modified form operatively connected with a shunt-wound dynamo and a working-circuit for the regulation of said dynamo.

E is a metallic supporting-plate, having substantially the same coefficient of expansion for heat as the actuating-wire B in its state of actual tension.

A is a projection cast on plate E and forms a support for one end of the actuating-wire B.

A′ is a metallic standard firmly secured to but insulated from supporting-plate E, and forms a support for the other end of wire B.

B is a metallic wire so chosen in respect of size and specific resistance as to be sensibly heated by the passage of the actuating-current. This wire B is connected at its opposite ends under strain to the metallic standards A A′.

C is a link hinged at one end to the short arm of bent lever D. Through an insulating-bushing in the other end of link C passes the wire B. Bent lever D is pivoted upon a lug L, cast in plate E, and is hinged at the end of its long arm to rod F.

G is a cylinder of insulating material, fastened firmly to rod F and recessed at its lower end to form a socket for carbon piece H.

H is a piece of carbon cemented to cylinder G and of a shape and specific resistance adapted to produce the required variation of resistance as it dips to different depths in the conducting-fluid contained in cup K. The upper portion of H is copper-plated and soldered to a conducting-ring I, from which the current passes by flexible cables $x\,x$ out to the external circuit.

K is a metallic cup electrically connected to supporting-plate E and containing a conducting-fluid, as mercury, into which dips carbon piece H.

In Figs. 1 and 2, M represents an electric meter connected into the circuit, as shown.

In Fig. 3, N is a shunt-wound dynamo connected up for its own regulation.

In Figs. 1 and 2 the electrical current enters from the working-circuit at u, passing into supporting-plate E. Here it divides, one portion traversing standard A, wire B, standard A′, conducting-wire V, and electric meter M to the working-circuit at W. The remainder of the current passes through cup K, the conducting-liquid contained therein, carbon piece H, conducting-ring I, and flexible cables $x\,x$ to the working-circuit at W. As the current in the working-circuit increases, wire B expands under the heating action of the current, allowing link C to move to the right, thus dipping carbon piece H to a greater depth in the conducting-fluid of cup K and decreasing the resistance of the shunt around the meter. Evidently a decrease of current in the working-circuit will contract wire B and withdraw H from the conducting-fluid, thus increasing the resistance of said shunt. This combination is useful where the indications of the electric meter increase faster than in direct proportion to the current, for by the use of this current-regulator such continuously-decreasing proportions of the total increasing current of the working-circuit are passed through the meter as to make the indications of the meter directly proportional to the total working-current. The total working-current may be sent through wire B by obvious changes in the electrical connections producing a like result.

In Fig. 3 a modified form is shown, where bent lever D is inverted and the spring S is introduced pulling upward, so that with the expansion of B, due to an increased current, carbon piece H is withdrawn from the con-

ducting-fluid of cup K, and the resistance thereby increased. The current enters supporting-plate E from one of the main conductors T at *u*. Here the current divides, as before, one portion passing through wire B and resistance R back to the other main conductor T′, the other portion traversing cup K, piece H, cable *x*, and the field-magnets of shunt-wound dynamo N back to main T′. It is evident that if an increase of electro-motive force is produced in the mains wire B receives an increase of current, thereby expanding and allowing the spring S to withdraw carbon piece H from the conducting-liquid, so that the current through the field-magnets of dynamo N is decreased, thus tending to reduce the electro-motive force in the mains T T′ to its normal value. It is evident that standard A may also be made separate from plate E and insulated therefrom, in which case there need be no electrical connection whatever between the actuating-circuit and the regulated circuit—a useful form in alternating-current work.

Any other means for producing a continuously-varying resistance may be used in place of that shown—as, for example, a series of carbon plates subjected to a varying pressure by the movement of the actuating-wire. I do not limit myself, therefore, to any special mechanism for producing a continuously-varying resistance, nor to any special method of introducing the herein-described electro-thermal current-regulator into a working-circuit.

What I do claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. In an electro-thermal current-regulator, the combination of a stretched metal strip, a support therefor having sensibly the same coefficient of expansion, a continuously-variable resistance device, and mechanical connections, such that the transverse movement of the stretched metal strip operates said resistance device.

2. The combination, with an electro-thermal meter, of an electro-thermal current-regulator operating to vary continuously the flow of current to said meter, as and for the purpose described.

3. In an electro-thermal current-regulator, the combination of a stretched metal strip, a support therefor having sensibly the same coefficient of expansion, and a continuously-variable resistance device operated by said metal strip.

FRANK C. WAGNER.

Witnesses:
M. E. COOLEY,
CHAS. W. WAGNER.