(No Model.)

F. KRAEMER & M. KRÜGER.

ELECTRIC HEATER OR RHEOSTAT.

No. 554,632. Patented Feb. 11, 1896.

Fig. 1.

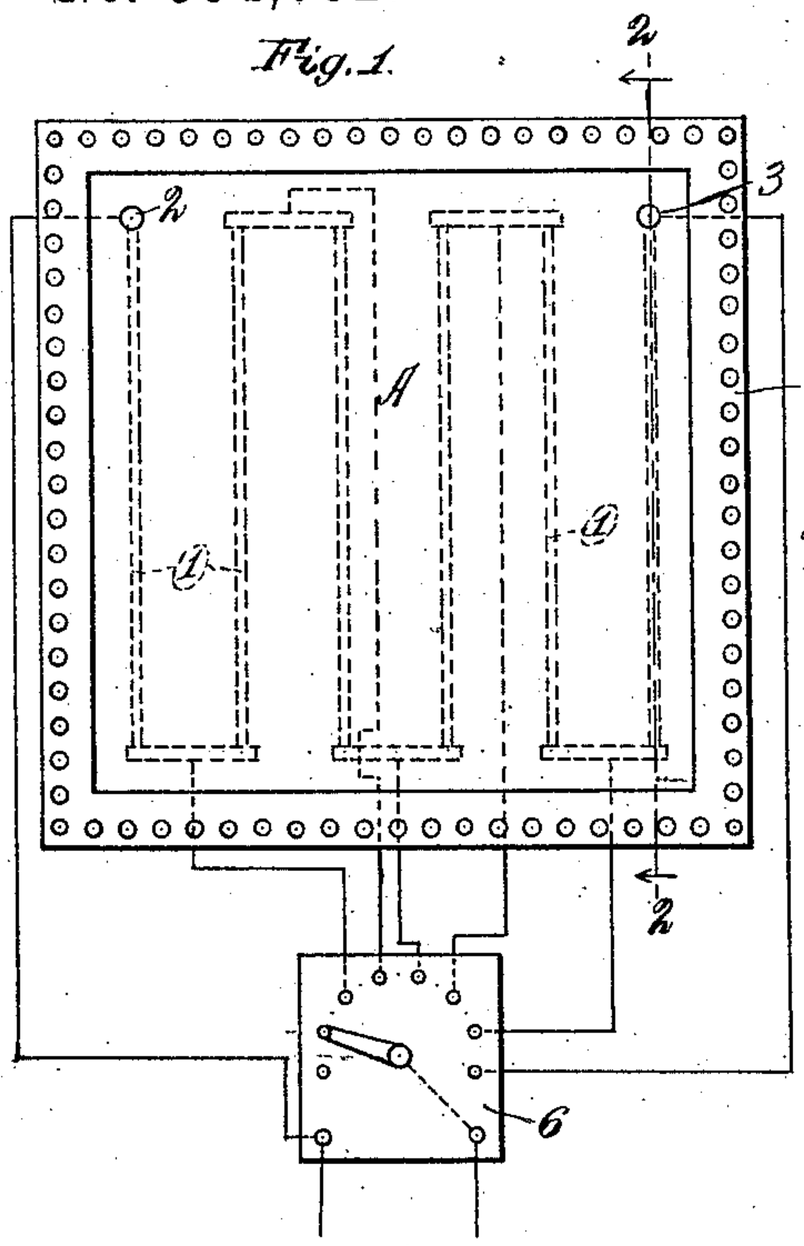


Fig. 2.

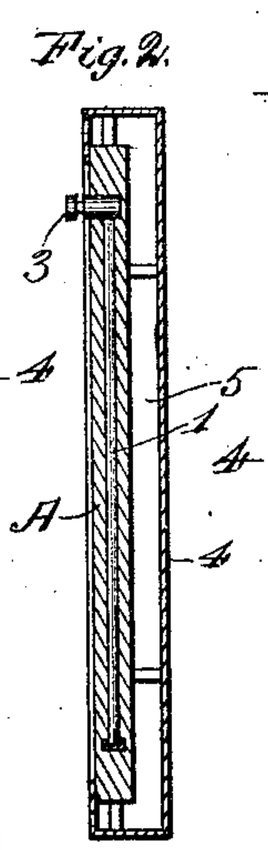


Fig. 3.

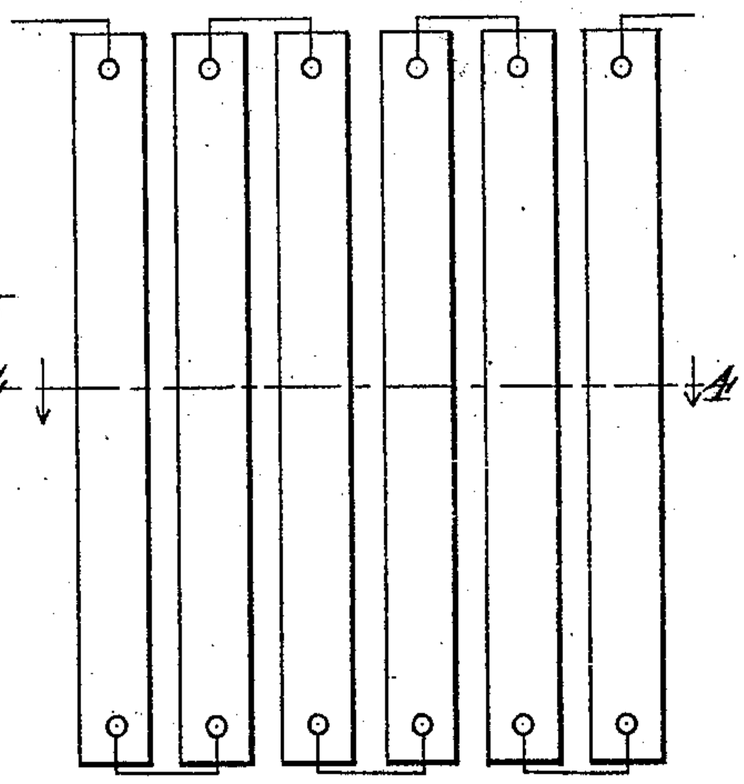


Fig. 4.

Fig. 5.

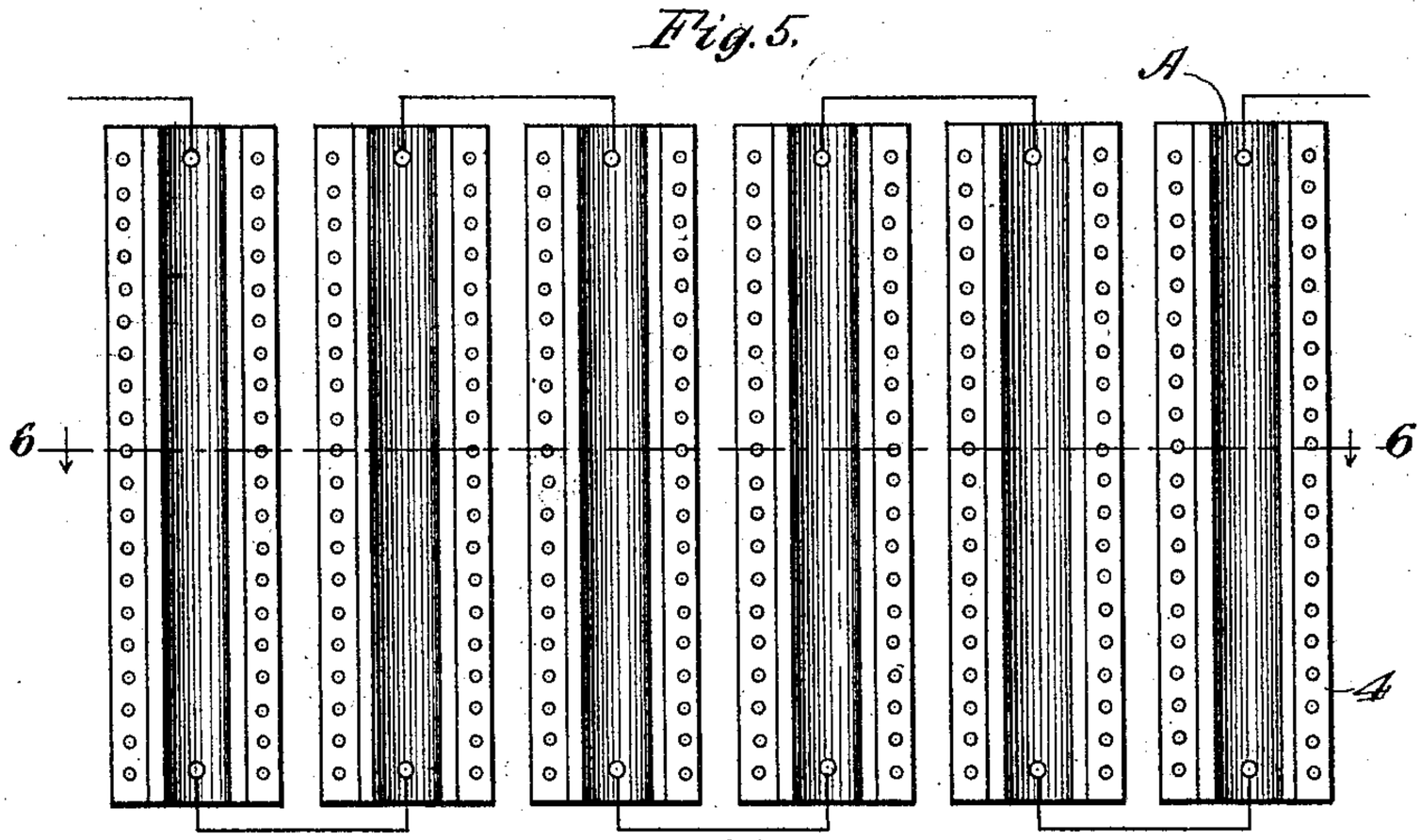
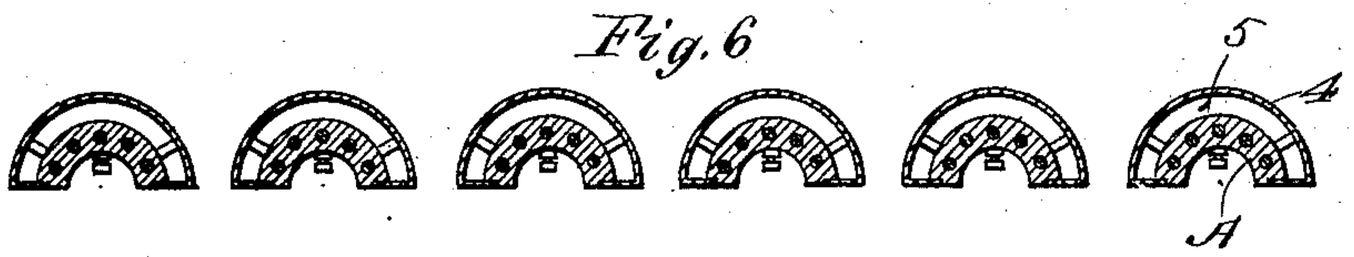


Fig. 6



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UNITED STATES PATENT OFFICE.

FRANK KRAEMER AND MAX KRÜGER, OF CHICAGO, ILLINOIS.

ELECTRIC HEATER OR RHEOSTAT.

SPECIFICATION forming part of Letters Patent No. 554,632, dated February 11, 1896.

Application filed January 7, 1895. Serial No. 534,008. (No model.)

To all whom it may concern:

Be it known that we, FRANK KRAEMER and MAX KRÜGER, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Heaters or Rheostats; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates primarily to the construction of electrical heaters, but it comprehends also the construction of rheostats and of combined rheostats and heaters, the objects aimed at being durability, cheapness, and in heaters the highest efficiency. To these ends the invention consists in the construction and combination of parts as hereinafter fully described and claimed.

In the accompanying drawings, Figure 1 represents a front elevation of a combined rheostat and heater constructed in accordance with our invention; Fig. 2, a vertical section on the line 2 2 in Fig. 1; Fig. 3, a front elevation of a modified construction; Fig. 4, a section on the line 4 4 of Fig. 3; Fig. 5, a front elevation of a further modification, and Fig. 6 a section on the line 6 6 of Fig. 5.

In the construction of these instruments we employ for the resistances sticks of prepared carbon of suitable length and of any preferred form in cross-section, and these we embed in a body composed of cement and sand moistened with water to form a plastic mass, this plastic mass being molded around said resistances and then subjected to pressure to bring it into close and intimate contact with the resistance-sticks.

All resistance materials employed in the construction of rheostats and heaters have a higher or lower coefficient of expansion and contraction under varying degrees of temperature, and it is therefore important that the body in which they are embedded shall have the same coefficient of expansion and contraction, for it is evident that if there be unequal expansion or contraction one part or the other is liable to be ruptured and destroyed. The materials for the body which we have found best suited to the purpose are Portland cement and sand (fine, sharp and sifted) mixed with water to form a plastic of suitable consistency to be readily and conveniently molded around the carbon resistance-sticks. When evenly and thoroughly dried the body so formed forms a complete insulator capable of withstanding any degree of heat to which the instrument may be subjected in use.

We are aware that rheostat and heater bodies have heretofore been formed of the materials named, but we are not aware that they have ever been used in connection with carbon resistance-sticks such as we propose to employ.

We have found that the materials specified, when mixed in different proportions, have varying coefficients of expansion and contraction, and that a mixture suitable for use in connection with resistances of one given material are entirely unsuitable for use in connection with resistances of different materials having a different coefficient of expansion.

By repeated and continued experiments we have found that the relative proportions of the ingredients of which the rheostat-body should be formed in order to give it the same coefficient of expansion and contraction that the carbon resistance-sticks have is one part of cement and two parts of sand mixed with one part (by volume) of water, and this mixture we therefore adopt as being best suited to the purpose.

In order to produce the best results it is necessary that the composition should be dried very slowly. Therefore after molding the same around the resistances we subject it in a suitable mold to a suitable pressure to solidify it and expel the water as far as practicable, after which it is slowly dried to prevent cracking. When thoroughly dried it is ready for use.

It has been demonstrated that the conductivity of carbon decreases with the rise of temperature up to a certain point—viz., the point of incandescence—after which it gradually increases. In other words, the coefficient of resistance gradually increases up to the point of incandescence, after which, under a further rise in temperature, it gradually decreases, from which it will be understood that

this material furnishes within itself a compensating resistance under varying conditions or degrees of temperature.

It is well known that in other materials, especially metals, heretofore used in the construction of rheostats and heaters, the coefficient of resistance constantly increases with the temperature, and, therefore, in order to compensate for this increasing resistance it has heretofore been proposed to employ composite resistances made up of alternate sections of metal and carbon. It will therefore be seen that we effect by the use of a single material or substance a result which has heretofore required the use of a combination of materials. The advantage, from an economical point of view, will be apparent.

It will further be understood from the following description that on account of the unequal expansion of the parts of a composite resistance-strip, such as above referred to, the same would be entirely unsuitable for our purpose or in our construction.

Referring now to the drawings, A indicates the body of a combined rheostat and heater, which consists of a base of plastic insulating material having carbon resistances 1 embedded therein. The said carbon resistances 1 consist of solid carbon sticks connected electrically together at their ends in an alternate manner—that is, the first stick is connected at its upper end with the binding-post 2 and at its lower end with the lower end of the second stick, which latter is connected at the upper end with the upper end of the third stick, and so on to the last stick, which is connected with the binding-post 3.

Where it is desired to use a heater in a limited space, we contemplate surrounding the heater with a metallic casing 4 and leaving a space 5 between said casing 4 and the heater A for the free circulation of air. In Figs. 1, 2, 5, and 6 we have shown the heater A thus incased, so that it may be placed in a wall or close against same, and the front portion of the said casing 4 is provided with perforations 5 to admit air to every portion of the heater and provide a more perfect radiation and circulation of heat.

In Fig. 1 we have shown the combined rheostat and heater connected with a switchboard 6 in the usual manner, so that any desired number of resistances can be thrown into the circuit and the heat regulated in this manner.

In Figs. 3, 4, 5, and 6 we have shown heaters composed of a series of piles all connected together. By means of a switchboard any or all of these piles may be thrown into the circuit, and thus regulate and control the temperature of the room. It will, of course, be understood that our invention may be embodied in a number of forms of heaters, and we do not wish to confine ourselves to the exact structures shown in the drawings, but contemplate changing the structure as found desirable in accordance with the space in which the rheostat is to be placed and other conditions.

Owing to the resistance offered by carbon our rheostat and heater can be made within a small compass, making it valuable as a starting-box for street-car motors. A rheostat of this kind can also be placed in the casing of an arc lamp and serve for a three, six, or nine ampère lamp. Besides the greater resistance offered by carbon it has another advantage over wire in that the increase of resistance proportionately to increase of heat being less than in wire makes it valuable in testing dynamos.

Our device can be used as a combined rheostat and heater by placing it into an electric-light circuit.

We claim as our invention—

1. A rheostat or electrical heater comprising a prepared carbon resistance-stick hermetically embedded in a plastic body composed of one part of cement, two parts of sand, and one part of water, substantially as described.

2. A rheostat or electrical heater comprising a series of prepared carbon resistance-sticks electrically connected and hermetically embedded in a body of plastic material composed of one part of cement, two parts of sand and one part of water compressed and dried, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

FRANK KRAEMER.
MAX KRÜGER.

Witnesses:
HARRY COBB KENNEDY,
RUDOLPH WM. LOTZ.