R. S. BICKNELL.

ELECTRIC FURNACE.

APPLICATION FILED OCT. 26, 1913.

1,093,968. Patented Apr. 21, 1914.

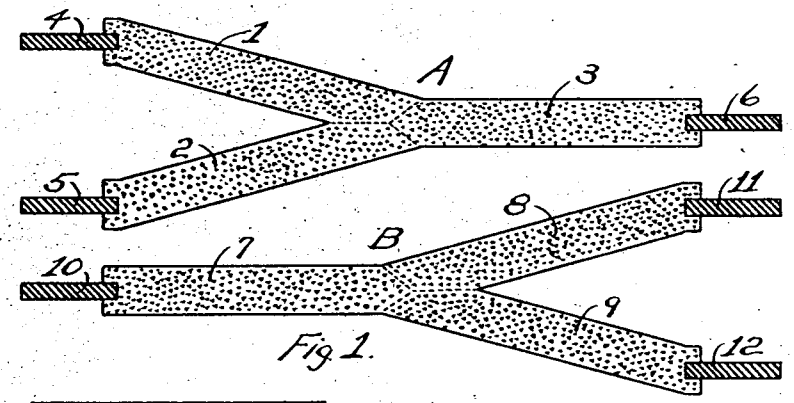


Fig. 1.

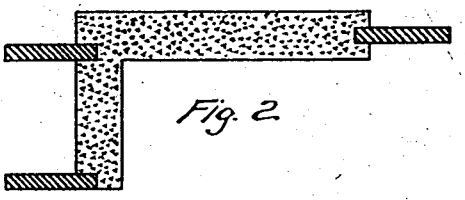


Fig. 2.

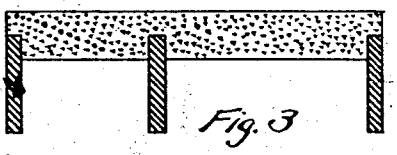


Fig. 3.

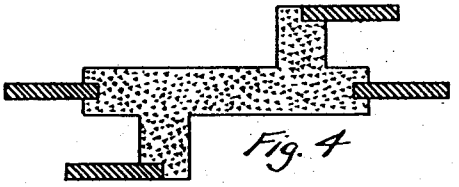


Fig. 4.

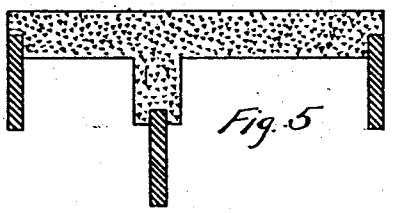


Fig. 5.

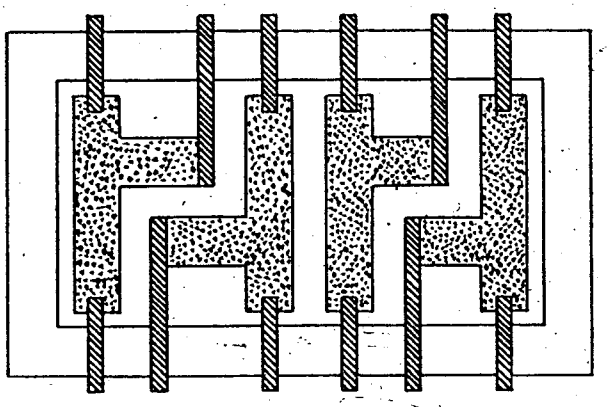


Fig. 6.

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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE.

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To all whom it may concern:

Be it known that I, RICHARD STUART BICKNELL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

My invention relates to an electric furnace of the resistance type, in which a non-metallic resistor, which has more than two electrodes, and which is arranged in such a manner so that by changing the path of the current, the resistance of the circuit or circuits comprised by the resistor is raised or lowered, is combined with one or more non-metallic resistors similar or otherwise. The non-metallic resistors that I use are carbon resistors, graphite resistors, etc.

My invention is not limited to electric furnaces but may be applied to electric ovens, etc.

It has been found that the resistance of the resistors in electric furnaces of the resistance type is not usually dependable. This is due, primarily, to two causes, (1) the lack of uniformity of the resistance materials ordinarily employed for resistors and (2), the alterations due to the passage of the current through them while in operation. In order to meet these requirements and obtain a furnace capable of operating on various capacities, and at the desired temperatures; in other words, capable of regulation and adjustment, some means must be employed so that the desired amperage may be obtained as simply and quickly as possible. In the past, this has been ordinarily accomplished by regulating the voltage on the furnace terminals. This regulation of voltage has been accomplished by a transformer delivering several voltages on the secondary or by means of a generator capable of delivering various voltages according to the requirements. Another method of regulation which consists in altering the resistance per unit of length of the resistor has likewise been employed.

The practical utility of my invention consists, in most cases, in dispensing with machinery for purposes of regulating and adjusting the furnace. A furnace according to my invention can be operated on direct or alternating current. When alternating current is used the furnace is usually operated without a transformer having numerous taps for regulation and adjustment. As a specific illustration, a furnace may be designed in accordance with my invention so that it may be operated on a line of 220 volts, alternating or direct current without a regulating transformer or regulating dynamo electric machine. My invention also possesses the following advantages; it permits of cheap construction, ease of operation, and excellent regulation and heat distribution.

I will now describe my invention in detail, using for the purpose diagrammatic drawings, Figures 1 to 6, inclusive, but it is to be understood that my invention is in no way limited to such, or arrangements of such drawings.

Fig. 1 shows two similar branched resistors A and B embodying the principle of my invention, and each resistor has three branches, 1, 2, 3, and 7, 8 9 respectively. The electrodes or terminal connections 4. 5, 6, 10, 11, 12 are connected as shown. With these resistors a number of arrangements are possible, but for purposes of illustration of the principle of my invention, the possible arrangements of one branched resistor will be considered first. In the resistor A, let the branch 1 have a resistance of one ohm, the branch 2 a resistance of two ohms, and the branch 3 a resistance of three ohms. With the resistor A there is a possibility of six arrangements as follows: (1) with the terminals of a direct current line on the electrodes 4 and 5, the resistance of the circuit consists of the two branches 1 and 2, having resistances of one and two ohms respectively, makes the total resistance of that portion of the circuit comprised by the resistor three ohms. (2) Similarly, the terminals of the line may be connected to 4 and 6 which makes the resistance four ohms, and (3) to 5 and 6 which makes the resistance five ohms. (4) Also, electrodes 5 and 6 may be connected to the positive terminals of the line, and 4 to the negative terminal of the line. In this case the resistance of the resistor will be two and one-fifth ohms. (5) With 4 and 5 connected to the positive terminal and 6 to the negative, the resistance of the resistor will be three and two-thirds ohms. (6) With 4 and 6 connected to the negative terminal, and 5 to the negative the resistance of the resistor will be two and three-quarters ohms. It will then be seen that for this branched resistor, the con-

nections may be made so that the six resistances, two and one-fifth ohms, two and three-quarters ohms, three ohms, three and two-thirds ohms, four ohms and five ohms, may be obtained. If a voltage of 110 volts should be applied to this resistor, it will be seen that inputs of 5500 watts, 4400 watts, 4033⅓ watts, 3300 watts, 3025 watts, and 2420 watts, respectively will be obtained. With the other branched resistor B in combination with the resistor A, arranged in series or in parallel, each capable of six arrangements, it will readily be seen that a number of arrangements to secure different resistances, are possible. For the resistor B, any type or types of resistors may be substituted and this combination will still be in accordance with my invention.

By employing two or more branched resistors in groups, or by arranging branched resistors with the known types of resistors, it is possible to obtain a wide range of resistances in a set of resistors with practically any interval between the different resistances as is desired. To accomplish this purpose, the resistors may be arranged in parallel or in series, or in groups in parallel, each parallel group connected in series, or in any other suitable manner.

Figs. 2, 3, 4, and 5 show a number of types of single resistors which may be combined in any suitable way.

Fig. 6 shows a combination of four resistors which is a flexible and desirable arrangement.

As stated, my invention is not limited to use with direct current, but may be employed with alternating current. However, when alternating current is employed, to obtain high power factors, the number of resistors should be equal to a whole multiple of the number of phases, and this multiple is ordinarily 1, 2, 3, or 4, but it is to be understood that my invention is not limited to such specific application.

Frequently a number of electrodes are grouped and serve the purpose of one, so the meaning of the word "electrode" in this specification includes a plurality of electrodes when they are grouped in such a manner so that they could be replaced by a single electrode to accomplish the same purpose, substantially. A plurality of electrodes, substantially adjacent, and permanently electrically connected, are also considered as one electrode in this specification. Any suitable terminal electrical connections of the resistors are also considered as electrodes.

Having thus fully and clearly disclosed the nature of my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In an electric furnace of the resistance type, the combination of a non-metallic resistor, having more than two electrodes, and arranged in such a manner so that by changing the path of the current the resistance of that portion of the circuit or circuits comprised by the resistor is raised or lowered, with one or more non-metallic resistors.

2. In an electric furnace of the resistance type, the combination of a non-metallic resistor, which has more than two electrodes, and which is arranged in such a manner so that by changing the path of the current the resistance of that portion of the circuit or circuits comprised by the resistor is raised or lowered, with one or more similar non-metallic resistors.

3. In an electric furnace of the resistance type, the employment of a plurality of branched non-metallic resistors, which are arranged so that by changing the path of the current the resistance of that portion of the circuit or circuits comprised by the resistors is raised or lowered, and each of which resistors has more than two electrodes.

In testimony whereof, I have signed my name in the presence of two subscribing witnesses.

RICHARD STUART BICKNELL.

Witnesses:
MARX HIRSCH,
ALCAN HIRSCH.