

(No Model.)

2 Sheets—Sheet 1.

E. THOMSON.
ELECTRIC FURNACE.

No. 513,602.

Patented Jan. 30, 1894.

Fig. 1.

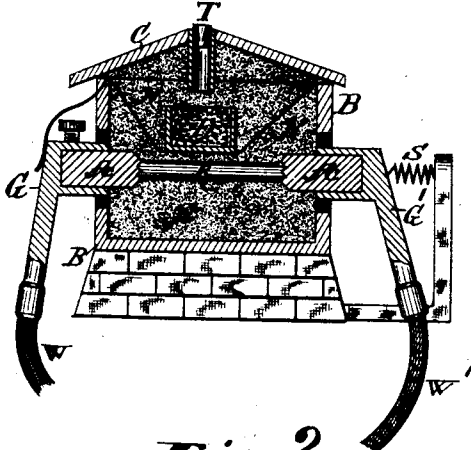


Fig. 3.

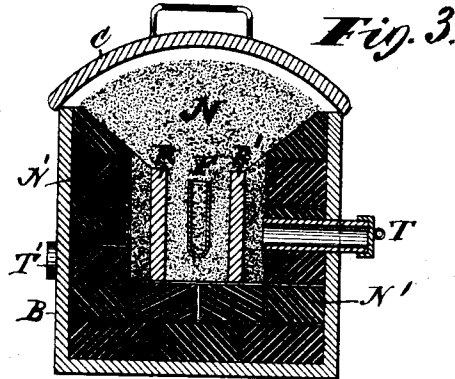


Fig. 2.

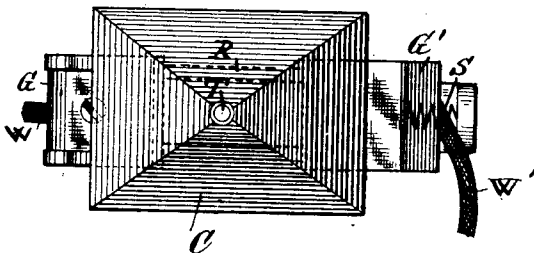


Fig. 4.

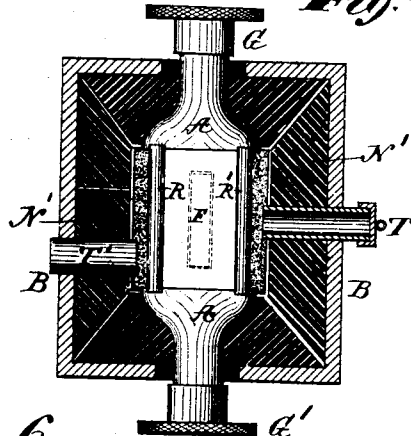


Fig. 5.

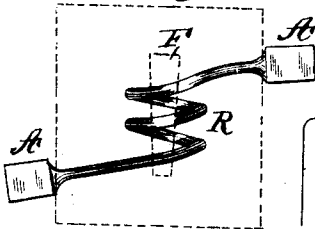


Fig. 6.

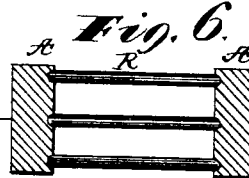


Fig. 7.

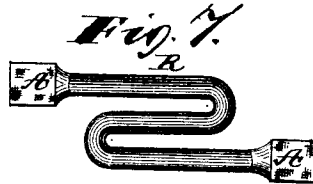


Fig. 9.

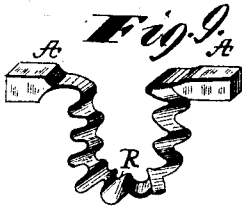
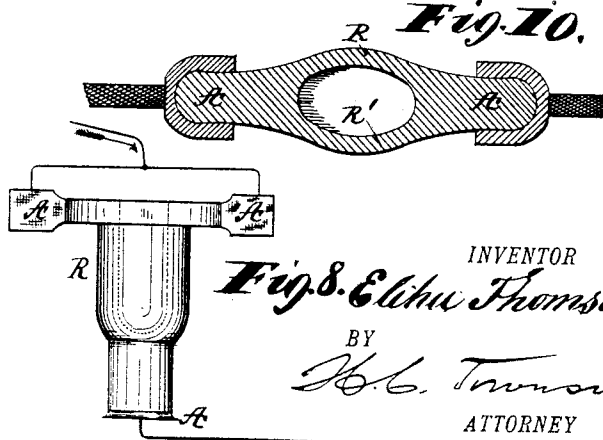


Fig. 10.



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Fig. 8. Elhu Thomson.

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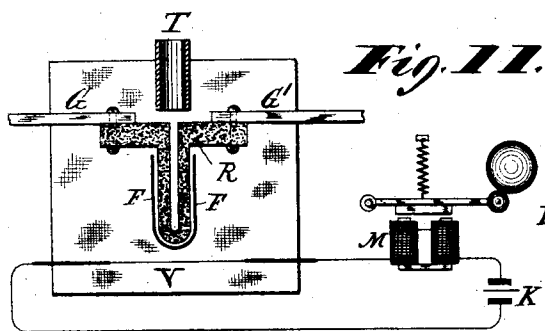


Fig. 11.

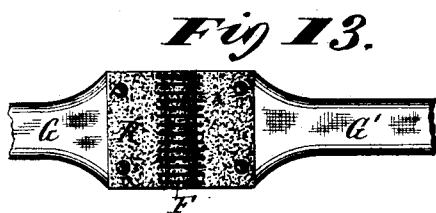


Fig. 13.

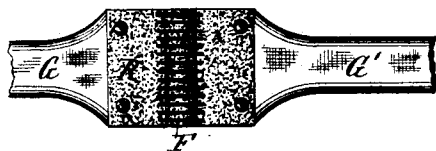


Fig. 14.

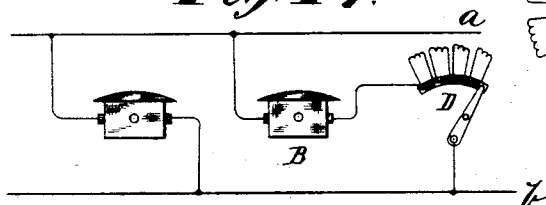


Fig. 15.

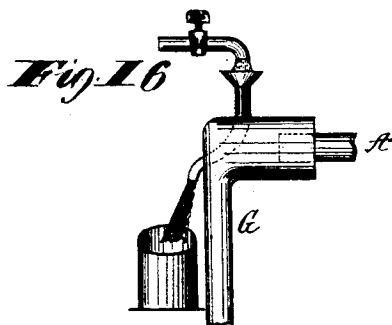


Fig. 16.



Fig. 17.

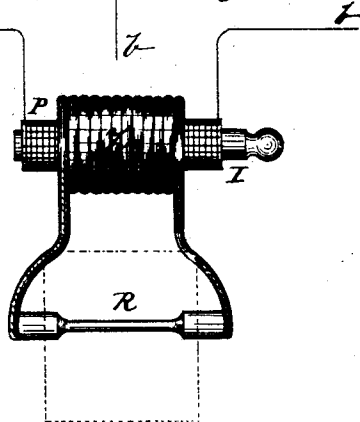
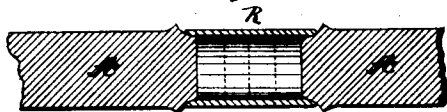


Fig. 18.



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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 513,602, dated January 30, 1894.

Application filed June 10, 1886. Serial No. 204,701. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented a certain new and useful Electric Furnace or Heat-Accumulator, of which the following is a specification.

My invention relates to the construction and operation of a furnace in which electricity is employed as the agent for producing heat.

The object of the invention is to provide an apparatus by which heat generated through the passage of an electric current in an electric conductor may be communicated to articles or substances requiring to be heated to a higher temperature than that which can be easily maintained or produced through the operation of ordinary combustion furnaces.

The invention is designed more especially to provide a heating or carbonizing furnace suitable for carbonizing incandescent lamp filaments or conductors, or for the reduction of refractory metallic oxides or in other operations requiring very high temperatures.

The object of the invention is also to provide an electric furnace in which there shall be little escape of heat energy and in which there shall be an opportunity for the ready and rapid accumulation of heat by the passage of the electric current through the electric conductor constituting a resistance to the passage of the current.

A further object of the invention is to permit the progress of the carbonizing or heating operation to be observed without risk of injury by access of air to the interior of the furnace and without appreciable loss of heat energy.

My invention consists in the novel combinations and features of improvements that will be described in connection with the accompanying drawings and then pointed out in the claims.

In my improved furnace I employ, first, a continuous electric conductor in which heat is generated by the passage of an electric current, and means for conveying such current to said conductor. By continuous I mean that the current may flow without any interruption such as would be produced by the separation of two portions of the con-

ductor after the manner of the carbon sticks or pencils in an electric arc lamp. The conductor of my furnace may be a continuous piece of carbon or other material integral throughout its length, or it may be made up of a number of pieces held in contact with one another.

Second. My furnace embodies a receptacle or space contiguous to the heated electric conductor and adapted to contain the objects to be heated.

Third. I employ a suitable non-conducting covering or envelope for preventing access of air to and escape of heat outwardly from the interior mass.

In addition I sometimes provide an observation tube or opening for noting the interior temperature of the furnace. I also combine with said furnace any suitable means for controlling the rapidity of the heating or cooling or both, by regulating the volume of the electric current flowing through the heat generating conductor.

A furnace constructed in accordance with my invention requires a current of but small energy or electro motive force inasmuch as I do not employ any electric arc or flame such as would be produced by a separation or break in the continuity of the conductors, and the heat generated instead of being dissipated in the gases evolved by the electric arc or flame, is retained and gradually accumulated until the desired temperature is secured. Hence all sudden heating and explosive effects are avoided and operations of the greatest nicety may be conducted with ease, such for instance as the carbonizing of shreds of cellulose, &c., for incandescent lamp filaments, the quality of which depends on a gradual carbonization up to the highest temperature, which operation it is very difficult to carry on with ordinary furnaces depending on the combustion and on the conduction and removal of gaseous furnace products. At the same time I am enabled to actually effect a saving of heat energy. The electric current used may be alternating, intermittent or continuous and may be derived from any source, as for instance dynamo machines of ordinary types yielding currents of considerable volume, or from batteries such for instance as secondary batteries, or from induc-

tion apparatus comprising primary and secondary coils, the primary coils being fed with alternating or intermittent currents from any suitable source. The heat generating conductor may be of carbon, nickel, platino iridium, or any other suitably refractory conducting material.

In the accompanying drawings: Figure 1, is a vertical central section of an apparatus embodying my invention. Fig. 2, is a plan of the same. Fig. 3, is a vertical central section of a modification. Fig. 4, is a horizontal section of the apparatus shown in Fig. 3. Figs. 5, 6, 7, 8, 9 and 10, represent modifications in the form of the heat generating conductor. Fig. 11, illustrates a device that may be employed for giving notice when a predetermined degree of heat is reached within the furnace. Fig. 13, is a plan of the form of heat generating conductor shown in Fig. 11. Figs. 12 and 14, illustrate diagrammatically arrangements for feeding two or more furnaces from the same electric conductor. Fig. 15, illustrates the application of an induction coil to furnishing the current for heating the conductor. Fig. 16, shows an improved form of clamp for the end of the conductor. Figs. 17 and 18, illustrate other forms of the conductor.

Referring to Fig. 1, B, B, indicate the casing of the apparatus which casing is formed of pottery, metal, brickwork or in any other desired manner and is provided with a properly fitting cover C, that can be removed at pleasure and serves to cut off air entirely from the interior of the furnace when the same is in use.

R, indicates a slab or bar of hard carbon or other material which rests at its ends preferably in enlarged blocks or pieces of carbon A, A, or other material, which latter are in turn clamped in blocks G, G', that enter through openings in the side of the case and are connected suitably with wires W, W', through which current is fed from any source in amount sufficient to produce heat in the conductor R. Surrounding the conductor R, is a mass of powdered carbon or charcoal N, which is a poor conductor compared with the conductivity of the rod R, itself. Other material might be used in place of carbon provided it be a slow conductor of heat.

F, indicates a substance or object to be heated, such for instance as a graphite box containing filaments as before mentioned, or scrap platinum or other material to be heated. The powdered packing of charcoal or other material fills the space around the conductor R, and the object F, and is kept in place by the casing B, B. A tube T, of graphite, platinum, or other refractory material and stopped at its upper end with a cap or plug of metal or mica to prevent air from entering the furnace projects through an opening in the cover C, as indicated. This tube may be employed to enable the operator to note the progress of the heating of the object F. It is desirable to secure the clamps G, to the blocks

A, by plating or otherwise so as to obtain a good electrical connection.

Where the conductor R, is a separate rod or slab an elastic thrust may be given to the clamps G, G, by a spring S, or otherwise, which serves in obvious manner to force the parts into close electrical connection.

It will of course be understood that the slab or conductor R, is of greater resistance than the other parts so that on the passage of current it heats rapidly or slowly, according to the strength of such current. The heat so produced cannot escape and each increment is added to the preceding and slowly communicated to the surrounding mass of heat non-conductor N, N, but only to its interior portion. The object F, which is placed as near conductor R, as practicable, soon experiences an accession of heat which may be continued to almost any degree limited only by the temperature at which the slab R, if of carbon, will vaporize, or if of metal, by the temperature at which it will fuse. No combustion of the conductor R, if of carbon, or transference of its particles takes place, and it will endure many repetitions of the heating process only becoming a better conductor and more dense and refractory by use.

The graphite tube T, may be opened occasionally to observe the interior temperature of the mass immediately adjacent to the object F, but care should be taken that air does not enter to such tube in quantity to permit combustion.

The tube T, should be made very small to prevent loss of heat, and it may sometimes be advisable to employ a charcoal plug for stopping its upper end so as to assist still further in the prevention of loss of heat.

In the modification shown in Figs. 3 and 4, two conductors R, R', are employed and arranged to form branches of the circuit between the clamps or blocks A, A. The bars or slabs are at sufficient distance apart to permit the object F, to be placed between them. Surrounding the slabs is a wall of bricks N', N', made from charcoal powder lightly cemented by sirup or tar and baked. These bricks give a low conductivity for electric current as well as for heat. The open space is filled with refractory powder as charcoal dust. The observing tube T, may be inserted at any convenient point as indicated, or a simple opening may be left in the wall of bricks N', as indicated at T', Fig. 4. When this opening is not in use it is to be kept filled with a charcoal plug. The apparatus is used in the same manner as that shown in Fig. 1. When the object placed within the furnace is sufficiently heated the current is switched off and the furnace allowed to cool before it is opened.

In Fig. 5, a conductor R, is shown in the form of a spiral of sufficient size to receive the object F, within its convolutions. It is preferable to make this form of conductor from metal inasmuch as it is liable to break-

age if made of carbon. In Fig. 6, the conductor is shown as made of three rods inserted into sockets in the plugs A, A.

In Fig. 7, the conductor is made of a rod bent on itself as indicated. This form, as well as that indicated in Fig. 9, is to be employed where a considerable length of conductor is needed for employment with a current of large electro motive force but small volume.

Where the volume of current is large the heat generating conductor may take the form of a crucible as indicated in Fig. 8, the connections for current being made at its upper lip and at its bottom respectively as shown. The object to be heated may be placed in the crucible or may be packed in such crucible in a mass of powder.

In Fig. 10, the conductor consists of a block or piece having an opening at its center. The parts R, R', at the side of the open space give the requisite resistance, while the heavier ends form proper conducting masses for conveying the current to the parts R, R'. The object to be heated may be placed in the open space. Instead of placing the object within the heat producing resistance it may be located outside of it as indicated in Figs. 11, and 13, where the conductor is shown in the form approximating a loop such as is sometimes employed in incandescent lamps. On this loop are placed the filaments of cellulose F, which are to be carbonized, the whole being surrounded with a non-conducting envelope of powder or other material as before.

It is very often desirable to limit the temperature to which the object shall be subjected to a determinate or definite one, such for instance as the temperature of the melting point of iron or of platinum, or of iridium, or of other material. In order that the operator may cut off the current at the instant that such temperature is reached I propose to employ a fusible wire or strip V, of a metal which will fuse at the limited temperature desired, and to connect such wire or strip into a circuit with a generator of electricity K, and an electro magnet M. The electro magnet M, controls any signaling device such for instance as the hammer of a bell, which bell hammer is carried by the armature lever of the electro magnet and is drawn by a spring into contact with the bell when the electro magnet ceases to be energized.

The conductor V, may be under light tension if desired, and so long as it is unfused the circuit is kept closed. When the melting point is attained the conductor V, fuses and the current is ruptured thus causing the bell to be sounded. Any other signaling or indicating device operated or controlled by electricity might be employed in place of that just described.

Several furnaces may be fed from one source of current as indicated in Fig. 12, where three similar furnaces B, B², B³, are shown arranged in series. Each furnace is shunted by a va-

riable resistance of any usual or desired form, by means of which the temperature produced within the furnace may be regulated. Thus furnace B, is partially shunted by variable resistance D', while furnace B², is completely shunted so that current will not flow through it, and it can cool off, while the resistance around B³, is set to cause such furnace to heat up quickly. The resistance around furnace B, is set to allow it to warm up gradually.

The furnaces or accumulators might be fed in multiple are as indicated in Fig. 14, and if desired might have a variable resistance included in the branches with them for the purpose of controlling the heat.

A very convenient method of operating the furnace is by the employment of current from an induction coil such as indicated at Z, Fig. 15. The primary P, of said coil might be fed by alternating currents from any source, while its secondary is formed of very coarse wire. The core of iron I, may be movable to regulate the current set up in the secondary, or the regulation may be effected in any other suitable manner usual in such cases.

In order to prevent over-heating of the clamps or connections G, they may be formed with a suitable passage through which a cooling fluid may circulate, such for instance as a stream of water. Such an expedient is indicated in Fig. 16.

As before intimated it is not essential that the conductor R, be in one continuous piece integral through its length. It may be, as indicated in Fig. 17, formed of blocks or sections pressed together, or it may be in the form of a tube consisting of rings or annuli pressed together between the blocks A, A, as indicated in Fig. 18. At the points of division thus provided an increased resistance is introduced which assists in the production of heat where a current of limited volume but of considerable electro motive force is employed.

What I claim as my invention is—

1. In an electric heat accumulator, the combination substantially as described, with a heating conductor consisting of the slab or bar of carbon, of powdered carbon, surrounding said slab or bar and an exterior carbon brick-work casing, as and for the purpose described.

2. In an electric heat accumulator, the combination of a heating conductor packed in a non-conducting powdered substance and itself consisting of blocks or sections of carbon pressed together, as and for the purpose described.

3. In an electric heat accumulator, the combination substantially as described, of the bars or slabs R, R, of carbon packed in a non-conducting powder N, and a casing of carbonaceous slabs or bricks N'.

4. In an electric heat accumulator, the combination with a chamber formed of non-heat-conducting material, of a heat conductor within said chamber consisting of a slab or

bar of carbon, a receptacle for the material to be heated also in said chamber, and powdered carbon surrounding said heating slab and receptacle, as and for the purpose set
5 forth.

5. In an electric furnace or accumulator, the combination of heat-producing conductor R, packed in a non-conductor of heat, a suitable retaining casing, and spring actuated
10 conducting blocks passing through openings

in the casing, as and for the purpose described.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 7th day of June, A. D. 1886.

ELIHU THOMSON.

Witnesses:

M. L. THOMSON,
OTIS S. THOMSON,