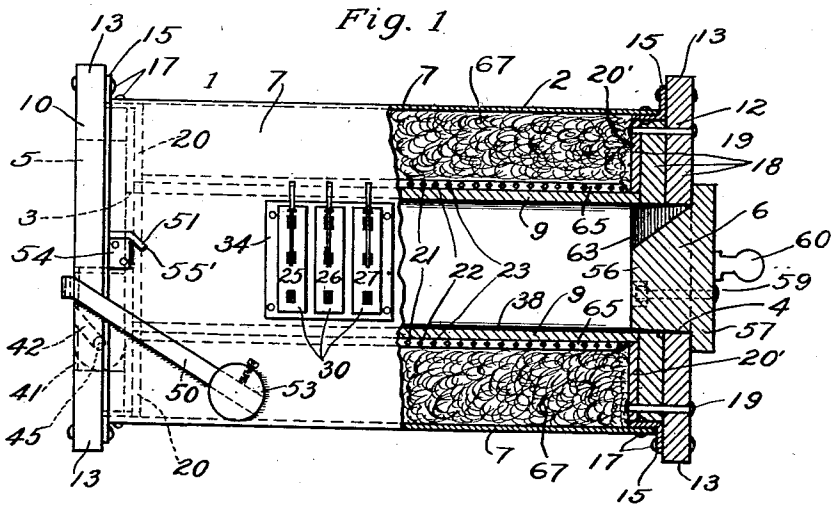
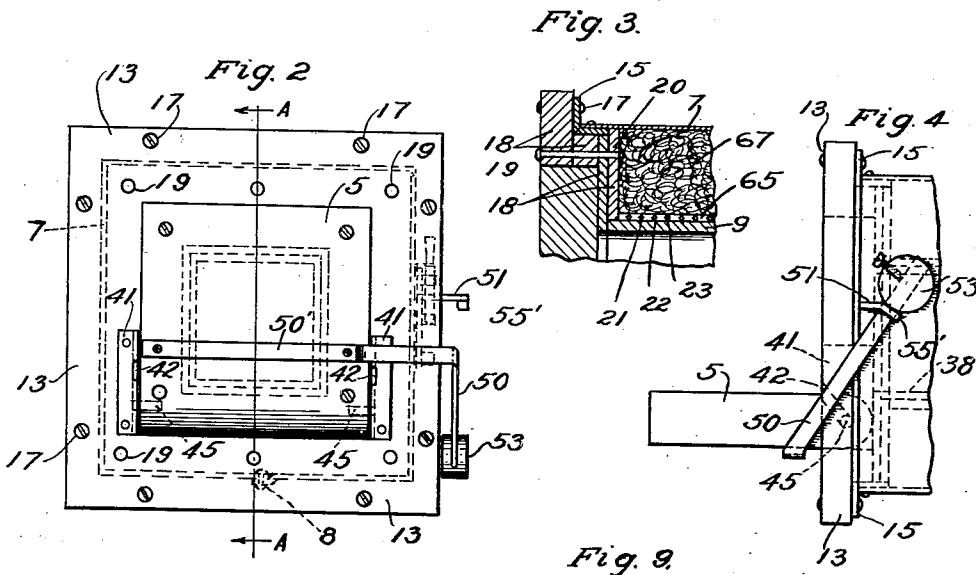
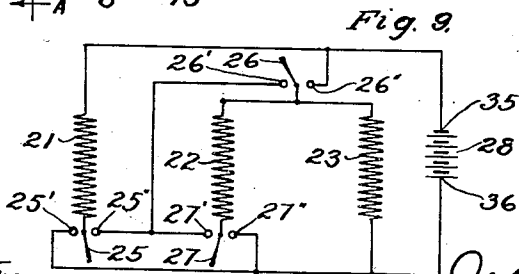


J. BLATCHFORD.
ELECTRIC FURNACE.
APPLICATION FILED AUG. 19, 1914.

1,129,842.

Patented Mar. 2, 1915.

2 SHEETS—SHEET 1.



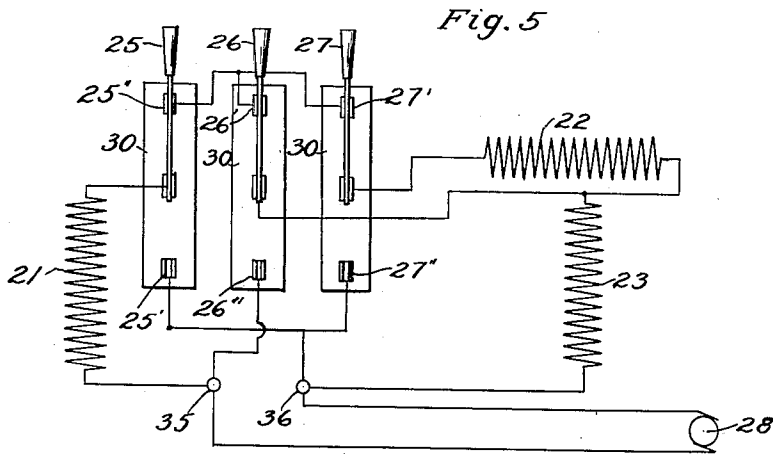
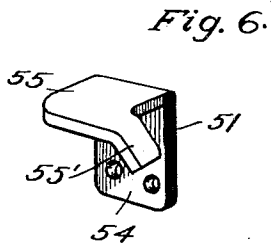
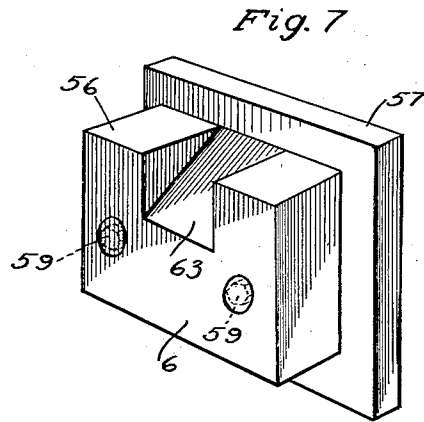
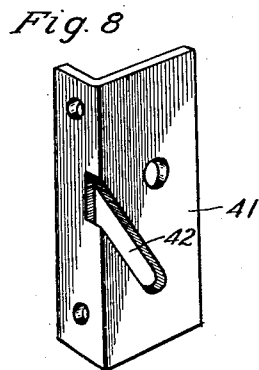
Witnesses:
Walter F. Stone.
T. M. Davis.

Inventor:
John Blatchford
By *Rumblers* Attys.

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2 SHEETS—SHEET 2.



Witnesses:
Walter F. Stone.
F. M. Davis.

Inventor:
John Blatchford,
By Hummel & Hummel
Atty's.

UNITED STATES PATENT OFFICE.

JOHN BLATCHFORD, OF OAK PARK, ILLINOIS.

ELECTRIC FURNACE.

1,129,842.

Specification of Letters Patent.

Patented Mar. 2, 1915.

Application filed August 19, 1914. Serial No. 857,468.

To all whom it may concern:

Be it known that I, JOHN BLATCHFORD, a citizen of the United States of America, and a resident of Oak Park, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

This invention relates to electric furnaces and especially muffle furnaces of the type having an electric heater element comprising sections of resistance adapted and arranged for connection in various ways to produce different degrees of heat.

The main objects of this invention are to provide an improved and simplified form of furnace of the above character especially adapted for laboratory use as well as commercial purposes, and having few and easily accessible parts adapted for ready control of temperature; to provide a furnace which may be used advantageously for ignitions and fusions, and for heat treatment in annealing and tempering tools and the like; to provide a casing of improved and durable construction and embodying improved means for distributing and retaining the heat in the furnace; and to provide an improved and more efficient arrangement and construction of heater element parts adapted to utilize within the furnace substantially all of the power taken from the source of current, and means for controlling the electrical relation of said parts to one another and to the source of power.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which:

Figure 1 is a side view of the furnace, the left end being in elevation and the right end in longitudinal vertical section on the line A—A of Fig. 2. Fig. 2 is an elevation view of the front or door end of the furnace. Fig. 3 is a fragmentary sectional view of the upper front part of the device on the line A—A of Fig. 2. Fig. 4 is like the left end of Fig. 1, but with the door open. Fig. 5 is a diagram showing the preferred arrangement of switches, heater resistance members and electrical connections therefor. Fig. 6 is a perspective view of the stop catch

for the door counterbalance arm. Fig. 7 is a perspective view of the closure plug for the rear end of the oven. Fig. 8 is a perspective view of one of the pair of pivot bearing angles for the door. Fig. 9 is a simplified diagram of electrical connections.

In the construction shown, the furnace 1 is of the muffle type and comprises a fire-proof frame or casing 2 preferably rectangular and oblong in shape and having openings 3 and 4 at its opposite ends, a door 5 being provided for the front opening 3 and a plug 6 for the rear opening 4.

The longitudinal walls of the casing 2 on all four sides are substantially double in character and each comprises an outer wall member, preferably of thin sheet metal, and a heavy inner wall of hard refractory material spaced therefrom, the outer covering preferably being formed integrally as a continuous outer shell or armor 7 from a single sheet of metal with its overlapping edges fastened together, as shown at 8 on the underside of the furnace. The inner wall member 9 is tubular and integral in character and is adapted to serve as a core or support for the heater resistance elements preferably wound thereon, as will be described.

The transverse members or ends 10 and 12 of the casing are preferably solid throughout and are formed to project somewhat at their edges 13 beyond the longitudinal walls to serve as bearing flanges or supports for the front and rear ends respectively of the furnace, and to protect the same. The said ends are each secured to the side walls by means of peripherally disposed angle bars 15 and by suitable fastening means 17 therefor, as rivets or screws. One flange of each angle bar lies against the back of the adjacent end wall flange 13 and the other angle flange lies against the plate 7 and preferably underlies the same. The four bars 15 at each end of the furnace are joined integrally by the inner flange, the outer or radial flange being cut at the corners to permit bending the stock in forming the bars. Each of the end members 10 and 12 is made up of laminations 18 fastened together, as by means 19, and each end preferably has on its inner

side a peripheral horizontally projecting rib adapted and arranged for seating the adjacent angle bars 15 on its outer side, together with the adjacent ends of the outer wall member 7, and for seating the inner wall member or core 9 on its inner side. The rib 20 on the front end is substantially similar to rib 20' on the rear end.

The heat generating resistance elements 21, 22 and 23 are each distributed spirally upon the core 9, the successive turns of the three unit spirals being arranged in turn or alternately so that the heat generated by each coil will be uniformly distributed throughout the whole length of the core, and so that the whole length of the furnace will be uniformly heated, regardless as to how many or which coils are used, or in what combination they are used.

Three single-pole double-throw knife switches 25, 26 and 27 are preferably provided for controlling and adjusting the circuit relation of the several resistance units with respect to each other, and to the source of current 28. Said switches are advantageously mounted on a separate base or block 30 of suitable insulation adapted to serve as a support for the switch and being adapted for mounting upon the side of the furnace, a plate 34 of insulation being interposed between wall shell 7 and blocks 30, as shown in Fig. 1.

The electrical connections are as follows: The first resistance 21 is connected between one side 35 of the source of current and the middle post of the first switch 25, the second and third resistances 22 and 23 being connected at one end of each to the middle post of the second switch 26, the opposite ends being connected respectively one to the middle post of the third switch 27, and the other to the opposite side 36 of said source, the first switch 25 having one outer post 25' connected to said opposite side 36 of the current source and its opposite post 25'' to the outer posts 26' and 27' of said second and third switches, the opposite outer posts 26'' and 27'' of said second and third switches being connected to the said one and opposite sides 35 and 36 of said source respectively. By means of this arrangement of connections between the three heater elements and switches, six different adjustments or steps may be had, resulting in six corresponding degrees of heat in the furnace.

The following table shows the relative values of current and corresponding temperature for the six different steps attainable, it being understood that E represents the voltage of the current source, R the resistance of coil 21, R' the resistance of coil 22 and R'' the resistance of coil 23, and that the respective currents for the several steps are indicated by I, I', and I'', I³, I⁴, and I⁵.

The resistances of coils 21, 22 and 23 are preferably alike in value.

Step.	Switch points closed.	Current.	
1	25'' and 27'	$I = \frac{E}{R \text{ plus } R' \text{ plus } R''}$	70
2	25'' and 26'	$I' = \frac{E}{R \text{ plus } R''}$	75
3	25'', 26' and 27''	$I'' = \frac{E}{R \text{ plus } \left\{ \frac{R' \text{ times } R''}{R' \text{ plus } R''} \right\}}$	
4	25' or 26''	$I^3 = \frac{E}{R} \text{ or } \frac{E}{R''}$	80
5	26'' and 27'' or 26' and 25'	$I^4 = \frac{E}{R'} \text{ plus } \frac{E}{R''} \text{ or } \frac{E}{R} \text{ plus } \frac{E}{R''}$	
6	26'' and 27'' and 25'	$I^5 = \frac{E}{R'} \text{ plus } \frac{E}{R''} \text{ plus } \frac{E}{R}$	85

The door 5 is formed and arranged to swing downward in opening from its normal vertical position of closure, and when open lies with its upper face in alinement with the furnace floor 38, as shown in Fig. 4, whereby it serves as a shelf or hearth.

Pivot bearings of an improved form are provided for mounting the door. Said bearings are disposed in horizontal alinement adjacent to the lower edge of the door on each side and are adapted to facilitate removing the door by lifting the same off from its bearings whenever desired. Each bearing comprises a stationary angle bar 41 disposed vertically and set in the side of the doorway with one flange facing forward and the other inward transversely of the opening. Each of said angle bars is provided with an inclined groove or slot 42 extending backward and downward in the inner flange. A pivot 45 projects horizontally from each side of the door in registry with said slots and each pivot is adapted to coact therewith, said pivots resting in the bottom of said slots when the door is in place, but being slidable upward and forward therein for removal of the door.

Combined stop and counterbalance means are provided, comprising an arm 50 and stop 51, said arm having one portion 50' disposed horizontally across the front of the door to which it is rigidly secured, and having a projecting portion bent backward and having a weight 53 secured adjustably thereon adjacent to its outer or free end. Said arm and weight are adapted and arranged to nearly counterbalance the weight of the door when the latter is open and to hold same in its closed position when the furnace is closed.

The catch or stop member 51 is mounted on one side of the frame adjacent to the

swinging portion of said arm, and in the path thereof, whereby movement of the door and arm is arrested when the door comes to its horizontal position in opening. Said stop comprises a vertical flange 54 adapted for securing directly to the wall of the furnace and a horizontal arm 55, the outer end of which 55' is carried backward and downward to receive the door arm. When the door is opened, the arm 50 comes to rest against the arm 55 back of the tip 55', and the weight 53 bears against said inclined tip.

The plug 6 at the opposite or rear end of the furnace comprises a refractory core or projection 56, adapted to fit within the rear opening of the furnace in combination with a flat flange member or plate 57, to which it is rigidly secured, in any manner desired, as by screws 59, the inner ends of which may be protected by fire clay, as shown in Fig. 7. A handle 60 is provided on the outer side of the flange plate whereby the plug may be controlled.

Vent means are provided for the furnace, comprising a slot 63 formed in the core of the plug, which slot is preferably disposed in the upper side of the core and the bottom of which is inclined downwardly and inwardly, whereby the size of the vent may be adjusted by pushing the plug farther in or partially removing it to decrease and increase the size of the vent respectively, as will be apparent from Figs. 1 and 7.

The outer wall or shell 7 of the furnace is preferably made of sheet iron in order to secure great strength and stability. The core 9 for the resistance conductors is preferably made of alundum in order to withstand the intense heat when the furnace is running at its maximum temperature. The resistance conductors are preferably laid in refractory cement 65 to maintain their spacing and to insure insulation from one another and from other parts of the furnace. The ends of the furnace may be formed of any hard and refractory material but are preferably formed of mineral board, so called. For the present purpose it has been found advantageous to use an asbestos compound known to the trade as "transite asbestos wood." The same kind of material is also used preferably for the door and flange plate of the plug, as it is a good non-conductor of heat.

Mineral wool 67 is preferably used for packing in the space between the resistance-wound core 9 and outer shell 7, although any heat resistant material having low conductivity for heat may be used. A refractory material of high electrical resistance and capable of withstanding a high degree of temperature without oxidation is used for heater elements, a resistance conductor known to the trade as "nichrome," being preferred.

This furnace is especially adapted for laboratory work and may be used to advantage for commercial purposes, both for ignitions and fusions and for annealing and tempering operations, particularly in the manufacture of small tools. It is especially economical in operation inasmuch as all of the power used is consumed in the heating coils within the furnace, regardless of whether part or all of the coils are used, and whether the furnace is running at a high or low temperature. For any given setting of the switches it will give a constant and uniform temperature which is quickly attained upon setting the switches. The furnace may be used conveniently and safely under all conditions and is substantially free from fire risk.

Although but one specific embodiment of this invention has been herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. In a device of the class described, a source of current and three heater resistances adapted for connection to said source either independently or in connection with one another, in combination with three single-pole double-throw switches, the first resistance being connected between one side of said source and the middle post of the first switch, the second and third resistances being connected at one end of each to the middle post of the second switch, the opposite ends being connected, one to the middle post of the third switch, and the other to the opposite side of said source, the first switch having one outer post connected to said opposite side of the current source and its opposite post to an outer post, on each of said second and third switches, the opposite outer posts of said second and third switches being connected to the said one and opposite sides of said source respectively.

2. An electric furnace comprising an outer casing member of rectangular box shape having flanged closure ends which project laterally and serve as bearings to support the device, said ends each having an opening one of which is fitted with a swinging door and the other with a plug adapted and arranged for opening to a greater or less degree, in combination with a refractory hollow core in said casing adapted and arranged to serve as an inner wall therefor, and a plurality of heater elements each distributed thereon and switching means therefor, said furnace having a vent passage at its rear end adapted and arranged for adjustment by said plug.

3. An electric furnace comprising a tubu-

lar double-walled body portion, the outer and inner walls of which are spaced apart in combination with transversely disposed end members, each provided with a backwardly projecting rib adapted and arranged to receive the said wall members on their outer and inner edges respectively and to hold the same in definite spaced relation, heater resistance conductors disposed upon the outer surface of said inner wall, said conductors being embedded in cement, refractory packing material filling the remaining space between said outer and inner walls, a door in one end of the furnace, and a diagonally slotted plug in the opposite end adapted and arranged for providing a vent of adjustable size.

4. An electric furnace comprising a hollow

core of refractory material, in combination with three sections of heater resistance material carried by said core and each distributed uniformly thereon, a source of current, three single-pole double-throw knife switches mounted on said furnace, and electric circuit means connecting said resistances, switches and current source, whereby said resistances may be connected in various ways with relation to each other and to the said source to produce different temperatures.

Signed at Chicago this 12th day of Aug. 1914.

JOHN BLATCHFORD.

Witnesses:

FRED M. DAVIS,

WILLIAM E. HANN.,