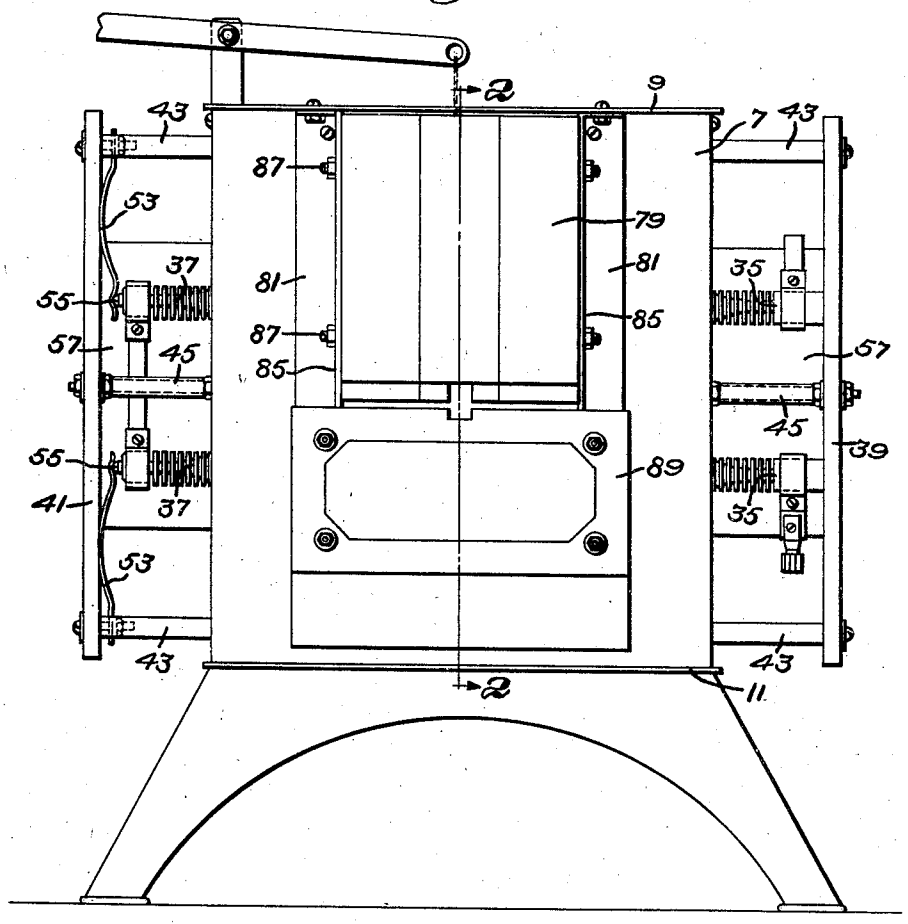
Aug. 9, 1938. P. B. CROCKER 2,126,454

ELECTRIC FURNACE

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Fig. 1.



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ELECTRIC FURNACE

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Fig. 2.

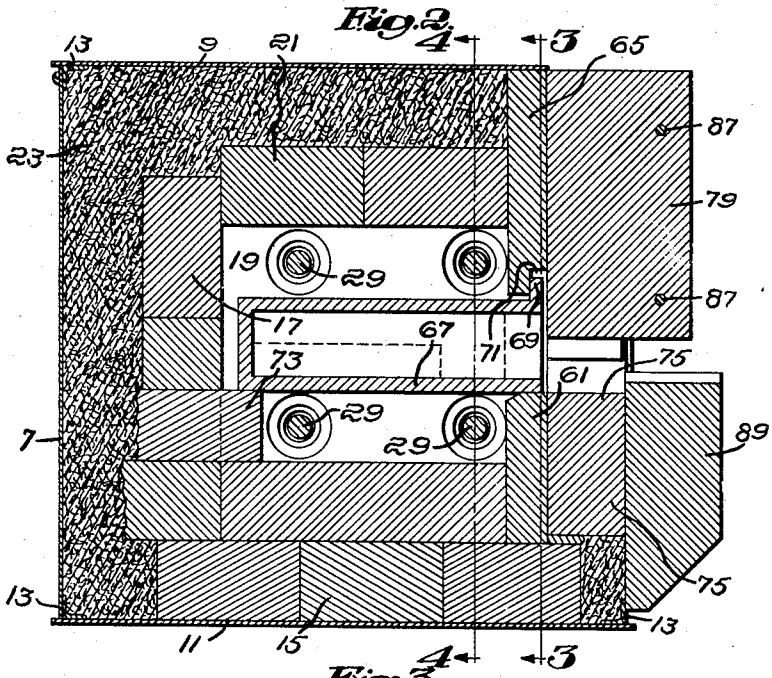


Fig. 3.

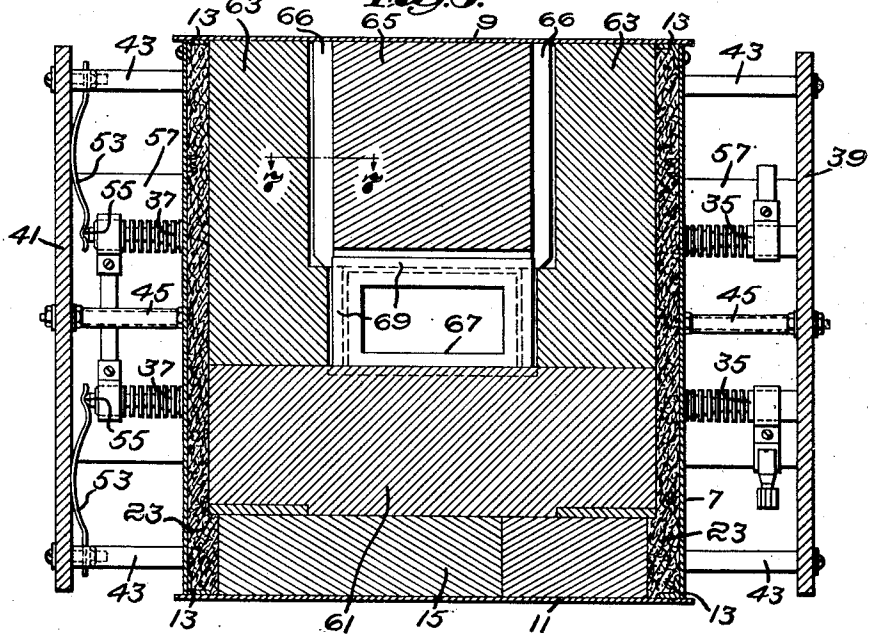


Fig. 4.



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Fig. 4.

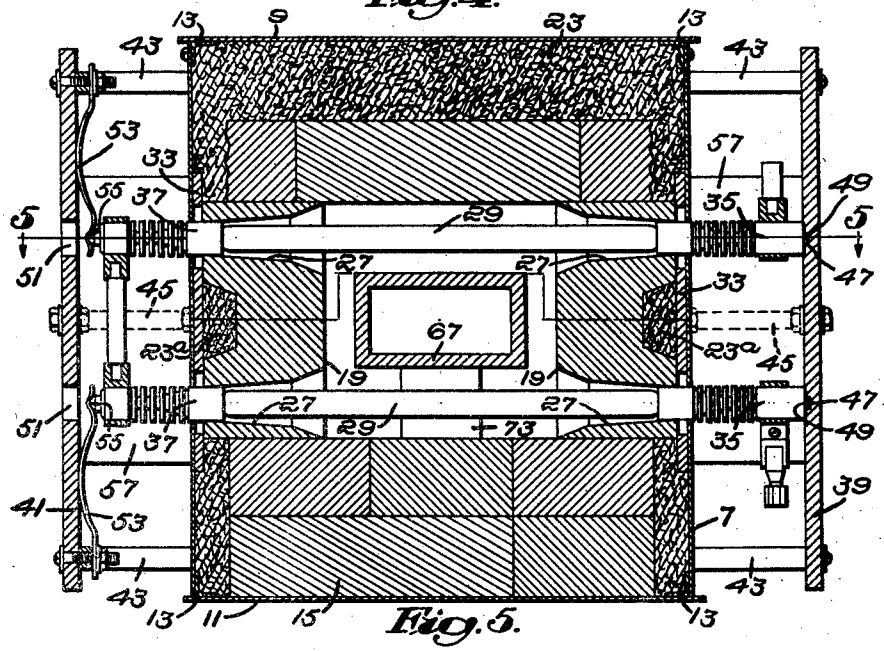


Fig. 5.

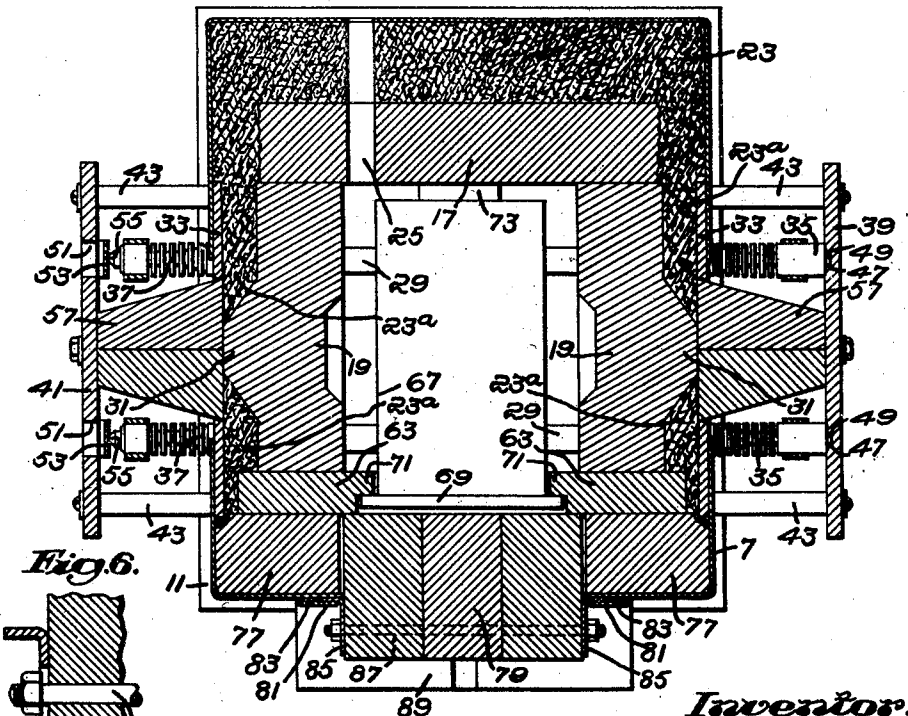
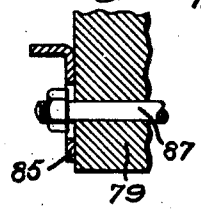


Fig. 6.



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Patented Aug. 9, 1938 2,126,454

UNITED STATES PATENT OFFICE

2,126,454

ELECTRIC FURNACE

Percival B. Crocker, Foxboro, Mass., assignor to The Sentry Company, Foxboro, Mass., a corporation of Massachusetts

Application November 5, 1935, Serial No. 48,326

10 Claims. (Cl. 13—20)

This invention relates to electric furnaces of the type utilizing resistors such as rods of silicon carbide or the like, and the object is to provide certain improvements in such furnaces facilitating their construction and promoting efficiency and convenience in use. Electric furnaces of the type referred to find an extensive application in hardening high speed steel, in which case it is desirable to provide for continual operation at temperatures of substantially 2300° F. This and higher temperatures are also used for many ceramic operations. The particular design of furnace which is here illustrated as an example of my invention is designed for operation under such conditions and, among other things, provides in a construction of simple form for a proper cooling of the terminals while minimizing heat losses.

My invention will be well understood by reference to the following description of the illustrative embodiment thereof shown by way of example in the accompanying drawings, wherein:—

Fig. 1 is a front elevation of the furnace;

Fig. 2 is a longitudinal section on the line 2—2 of Fig. 1;

Figs. 3 and 4 are vertical sections on the lines 3—3 and 4—4 of Fig. 2, respectively;

Fig. 5 is a plan section on the line 5—5 of Fig. 4;

Fig. 6 is an enlarged fragmentary sectional detail of the part shown in Fig. 5; and

Fig. 7 is a section on the line 7—7 of Fig. 3.

The furnace herein shown comprises essentially a chamber for receiving the work having walls of suitable refractory material and adapted to be heated internally by electric resistors. This chamber or enclosure is herein organized in a metallic casing comprising a shell 7 encircling the lateral walls and top and bottom plates 9 and 11 which may be secured thereto through angles 13. Received within this shell is a bottom wall 15, a rear wall 17, side walls 19 and a roof 21 supported from the side walls, all formed from suitable refractory blocks or shapes, the side walls 19 conveniently being each formed as here shown from a single block of special form as hereinafter more fully described. The rear and top walls may be spaced from the adjacent walls of the casing and are covered by heat-insulating packing material 23 interposed between the same and the casing. As indicated in Fig. 5, the rear wall 17 may be provided with the opening 25 for the insertion of a thermo-couple.

Referring more particularly to Fig. 4, the refractory blocks 19 which form the side walls are provided with suitable openings 27 to receive the ends of resistor rods 29 of silicon carbide or the like. I have herein shown four such rods disposed in a generally quadrate arrangement. At the location of these openings 27 the blocks 19 reach substantially to the inner wall of the casing or shell 7 but are cut away around the openings to provide for the interposition of heat insulating packing 23a in the manner shown in Figs. 4 and 5, the construction being such that each opening 27 comes to the outer side of the block through a projection or raised portion of somewhat frusto-conical form. I also prefer to provide between these projections through which the openings extend a centrally disposed raised portion 31 extending substantially to the plane of the inner wall of the shell, as best shown in Fig. 5, for a purpose to be described. To support the shell of the casing in alignment with the side wall and prevent its warping, the portion thereof facing the side wall is preferably lined with a sheet of asbestos board 33.

Current is supplied to the resistors 29 through terminals 35 and 37 engaging the ends thereof respectively within the openings 27, the terminals extending outwardly beyond the shell of the furnace chamber for air cooling, being here shown as provided with heat radiating fins. These terminals provide for connecting the resistors together and to a source of electrical energy in a manner unnecessary to describe in detail, the connection usually being in series.

To protect the terminals and their connections I provide shielding plates 39 and 41 in spaced relation to the side walls of the furnace chamber. These plates may consist of asbestos board or like non-conducting material and are herein shown as supported in overhanging relation from the sides of the chamber by means of suitable spacers 43 and 45.

Referring to Fig. 4, the right-hand terminal 35 is there shown as abutting the inner surface of plate 39 which is provided with a recess 47 to receive a stud-like projection 49 on the end of the terminal. The other plate 41 is provided with suitable openings 51 in alignment with the openings 27 in the side walls of the furnace chamber. Through these openings 51 the resistor rods 29 and the left-hand terminal 37 may be inserted into the position shown. Each pair of opposing terminals is held between the end plates, suspending the resistor 29 between them, by an end thrust between the plates which may be effected by suitable spring means acting on terminal 37. I have herein shown blade springs 53

secured to the shielding plate 41 and adapted to be swung into position over the openings 51 to engage under tension the ends of terminals 37. These terminals may be provided with button-like insulators 55 at their ends against which the springs bear. This arrangement with the springs as a whole insulated from the electric heating circuit is a most convenient and desirable one.

The description so far has been somewhat didactic. An understanding of the construction described may perhaps be facilitated by a further discussion at this point. In a furnace of the present kind the conditions as to heat conduction and insulation are somewhat paradoxical. The furnace shown, for example, is one designed for continued operation at temperatures at substantially 2300° F., which is approximately the conventional temperature for hardening high speed steel. Loss of heat from the working chamber is, of course, to be avoided. On the other hand, the terminals which support the resistors must be adequately cooled to prevent their rapid corrosion and failure. Herein the resistor rods 29 are shown as extending substantially to the exterior of the side wall 19 and the openings 27 thereabout are flared inwardly. It will be understood that all parts of the resistor generate heat and by this arrangement reflection of heat from the walls of the opening into the chamber and radiation and convection from about the ends of the resistors to the heating chamber is facilitated. At the same time the ends of the terminals 35 and 37 extend very slightly within the wall and are thus not unduly pocketed within a highly heated opening. The side walls 19 are constructed of firebrick or some like material not of high heat-insulating value. Consequently the elevated portions of the exterior face of the walls surrounding the openings 27 and extending to the casing provide a path for heat dissipation by conduction from the inner ends of the terminals while the distance to the fully exposed air-cooled portions thereof is short. At the parts of the sides of the furnace structure relatively remote from the positions of the terminals, the relatively efficient heat insulating material 23 and 23a minimizes heat loss.

To avail of this balanced construction whereby a heat loss at the point of contact between the terminals and the resistor rod is permitted, while practically the entire length of the resistor rod is utilized for useful heating purposes, the wall 19 may be relatively thin. The length of the flared opening surrounding the end of the resistor rod is thus short. To minimize the loss of heat from the interior chamber of the furnace while availing of the convenient construction within the metal case 33 and without interfering with the necessary heat loss at the terminals or their efficient cooling by air, I provide an additional thickness of insulating material in alignment with the side walls of the interior heated chamber in the form of blocks 57 interposed between the side walls and the shields 39 and 41, these blocks herein bearing on the elevated portion 31 of side wall block 19 hereinbefore referred to. These blocks 57 thus overlie the relatively thin wall 19 opposite the center of the heating chamber and, the resistor rods 29 being located in the corners of the heating chamber, the blocks 57 are received within the groups of terminals 35 and 37 and minimize the loss of heat from the central chamber while permitting both the radiation from the points of contact of the terminals and the resistor bars and the free circulation of air about the terminals to cool the same. As best seen in Fig. 5, to facilitate the cooling of the terminals the blocks 57 may be somewhat tapered outwardly as shown.

Referring now more particularly to Figs. 2, 3 and 7, the front of the furnace chamber may be closed in part by a throat, herein formed of a sill-like slab 61, slabs 63 forming the jambs of the opening and having rabbets 64 extending along the upper portions of their inner edge and a lintel-like slab 65 having flanges 66 received in the rabbet 64 and engaging the shoulder thereof. The jambs 63 and the lintel piece 65 define an opening giving access to the heating chamber. Suitable means are provided for receiving the work, which work-receiving means is herein exemplified as a muffle 67 extending within the furnace and having an open end received in said opening, the top and side edges of the muffle being provided with flanges 69 entering rabbets 71 in the slabs 63 and 65. The further end of the muffle 67 may be supported on a projecting end 73 of one of the blocks of the back wall.

Exteriorly of the throat formed by the slabs referred to and within the metal shell 17 there is provided a sill block 75 supporting (see Fig. 5) the jambs 77 defining between them a door-way in alignment with the opening to the heating chamber through which the muffle enters and with the lintel slab 65. A door 79 slides vertically between the jamb pieces. Guides 81 supported through the spacers 83 from the front of the shell 7 are adapted to receive flanges of angles 85 secured to the sides of the door to hold the latter in position and guide the same in its vertical movement. Herein the door 79 is, as best seen in Fig. 5, shown as composed of three vertical bricks which are held together by through bolts 87 to retain them between the fore and aft extending flanges of the angles 85. As seen in Fig. 6, the bolt-receiving openings in these flanges are somewhat enlarged, thus permitting the adjustment of the body of the door relative to the guide flanges to position it properly in its opening.

The door, being in direct alignment with the heating chamber and with the open end of the work-receiving muffle, is made substantially thicker than the jamb pieces 77 adjacent the same and projects outwardly from the casing. Secured to the latter at the exterior is a load shelf 89. The door closes on the sill 75 and the inner portion of the shelf, the door joint, as shown in Fig. 2, being preferably along a broken line. In Figs. 1 and 2 the door is shown slightly ajar.

It will be understood that the various blocks referred to are secured together by means of suitable refractory mortar or cement in accordance with the usual practices in masonry work.

I am aware that the invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire the present embodiment to be considered in all respects as illustrative and not restrictive; reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

I claim:

1. An electric furnace of the class described comprising walls of refractory material defining an interior chamber, a door giving access thereto, opposed walls of the chamber having aligned openings, resistor rods extending across the

chamber and having ends received in said openings, terminals engaging the ends of the rods and exposed beyond said walls for air cooling, and supplemental means retarding the transmission of heat extending outwardly from said walls between the terminals and in alignment with the chamber.

2. An electric furnace of the class described comprising walls of refractory material defining an interior chamber, a door giving access thereto, opposed walls of the chamber having aligned openings, resistor rods extending across the chamber and having ends received in said openings, terminals engaging the ends of the rods and exposed beyond said walls for air cooling, plates supported in spaced relation to said walls outward of the terminals and supplemental means retarding the passage of heat extending between said walls and plates in the space between the terminals.

3. An electric furnace comprising an enclosure having top, bottom, rear and side walls of refractory blocks, resistors extending between the side walls, a throat of refractory slab at the front having an opening, a muffle having a flanged front end forming a joint with the margins of said opening, a wall of brick exterior to said throat defining a door frame in alignment with the opening and a door in the frame.

4. An electric furnace comprising an enclosure having top, bottom, rear and side walls of refractory blocks, resistors extending between the side walls, a throat of refractory slab at the front comprising jambs and a separate lintel piece setting between the jambs and defining an opening, a wall of brick exterior to the throat comprising a sill and jambs at either side of the opening and a door between the jambs adapted to cover said opening and lintel piece.

5. An electric furnace comprising an enclosure having top, bottom, rear and side walls of refractory blocks, resistors extending between the side walls, a throat of refractory slab at the front comprising jambs and a separate lintel piece setting between the jambs and defining an opening, a muffle having a flanged front end forming a joint with the margins of the opening, a wall of brick exterior to the throat comprising a sill and jambs at either side of the opening and a door between the jambs adapted to cover said opening and lintel piece.

6. An electric furnace of the class described comprising a metallic casing, an enclosure of refactory blocks within the same comprising opposed walls having openings, resistor rods having ends received in said openings, the walls extending substantially to the casing adjacent said openings and exteriorly cut away about the same, heat insulating packing overlying the cut-away portions and a non-warping plate for the interior side wall of the casing overlying the said parts.

7. An electric furnace of the class described comprising a metallic casing, an enclosure of refractory blocks within the same comprising opposed walls having openings, resistor rods having ends received in said openings, the walls extending substantially to the casing adjacent said openings and cut away between said locations to define a similarly elevated point between the same, heat insulating packing within the casing at the cut-away portions, shields supported in spaced relation to said walls exteriorly of the casing, terminals engaging the rods and projecting into the space between said walls and shields for air cooling, and blocks between the terminals interposed between the shields and the said elevated points.

8. An electric furnace of the class described comprising an enclosure of refractory material defining an internal chamber, opposed walls having aligned, inwardly flaring openings, a centric group of resistor rods crossing the chamber at outer portions thereof having their ends extending into said openings nearly to the exterior of said walls, terminals extending slightly within the openings to engage the ends of the resistors and projecting in major part beyond said walls for air cooling, the outer surface of said walls being cut away to provide exterior elevated heat-radiating portions about said openings and adjacent depressed portions and heat insulating material received in said depressed portions to minimize heat loss from the space within the group of resistors.

9. An electric furnace of the class described comprising an enclosure of refractory material defining an internal chamber, opposed walls having aligned, inwardly flaring openings, a centric group of resistor rods crossing the chamber at outer portions thereof having their ends extending into said openings nearly to the exterior of said walls, terminals extending slightly within the openings to engage the ends of the resistors and projecting in major part beyond said walls for air cooling, the outer surface of said walls being cut away to provide exterior elevated heat-radiating portions about said openings and adjacent depressed portions, heat insulating material received in said depressed portions to minimize heat loss from the space within the group of resistors and an additional heat-intercepting body supported exteriorly of said walls and within the group of said heat-radiating portions.

10. An electric furnace of the class described comprising walls of refractory material defining an interior chamber, a door giving access thereto, opposed walls of the chamber having groups of openings entering the chamber adjacent other walls thereof and being aligned in opposed walls, a non-conducting shield plate of relatively large dimension in two directions supported from each of said walls in exteriorly fixed spaced, substantially parallel relation thereto to overlie the group of openings therein and extend beyond the same, one of said plates having openings aligned with the wall openings, resistor rods adapted to be passed through the plate openings and wall openings to extend across the chamber with their ends received in the wall opening, terminals back-supported by the other plate engaging the adjacent ends of the rods, terminals engaging the opposite ends of the rods, and springs carried by the inner surface of said one plate and movable across said openings to engage the ends of the latter terminals for suspending the terminals and the interposed rods between and from the plates.

PERCIVAL B. CROCKER.