Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

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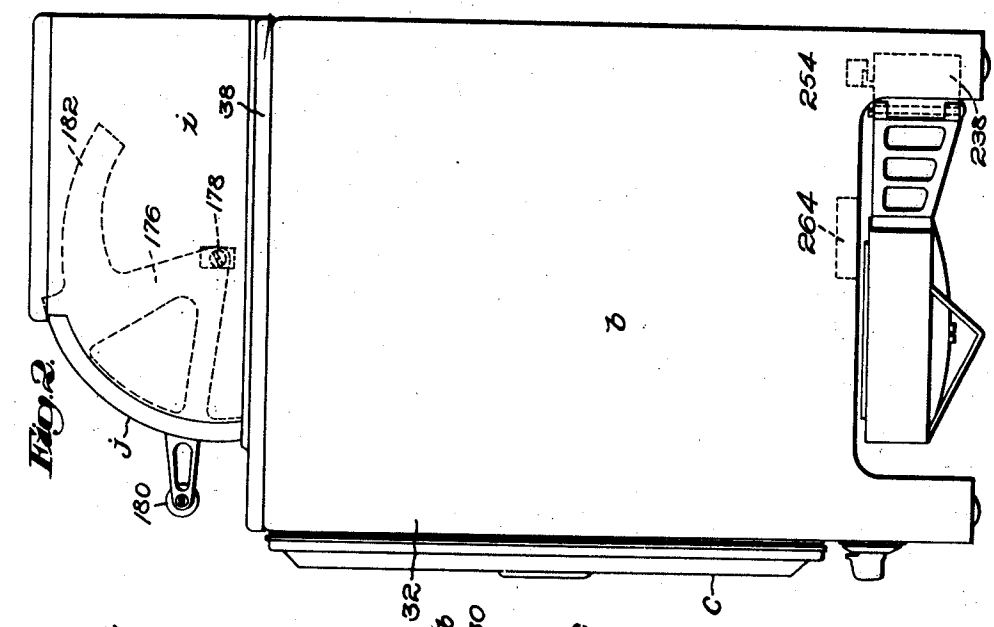

Fig. 2.

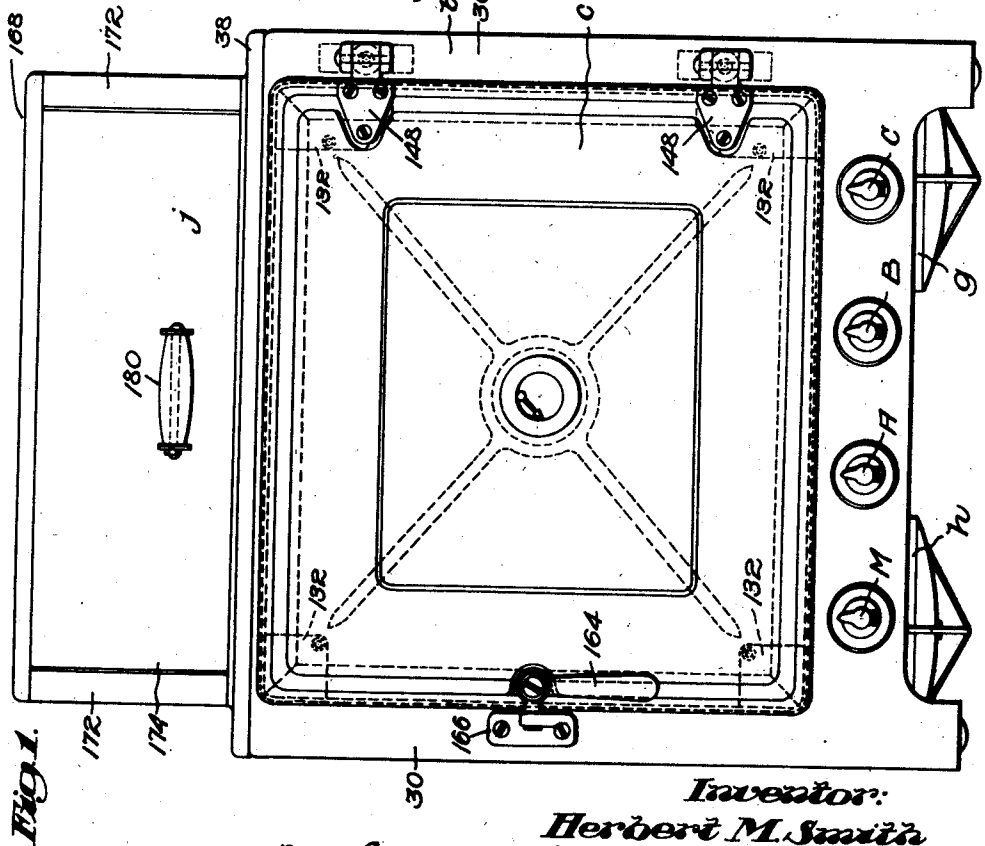

Fig. 1.

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Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 2

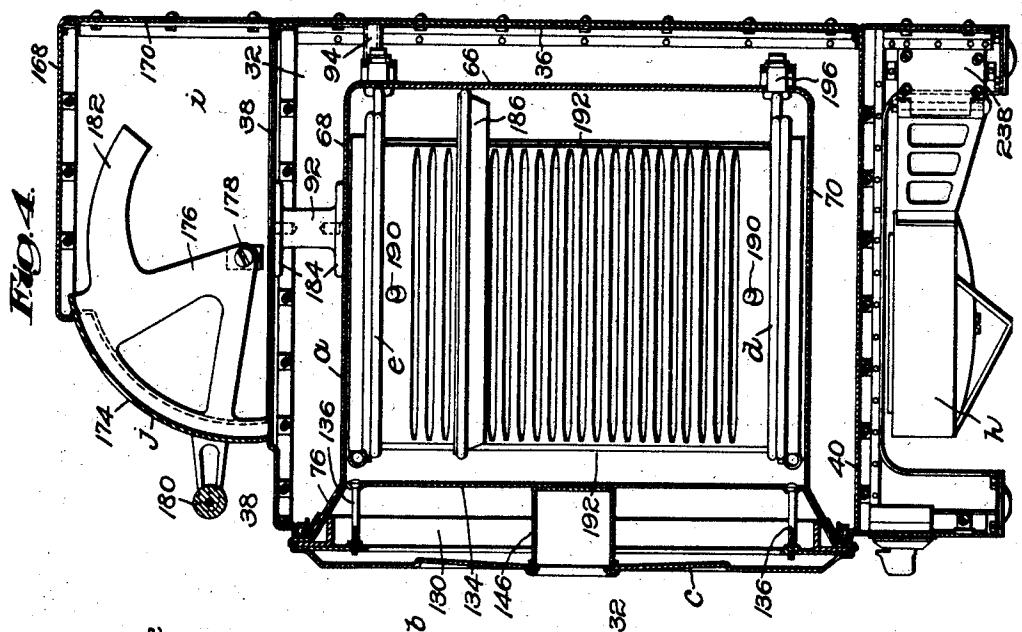

Fig. 4.

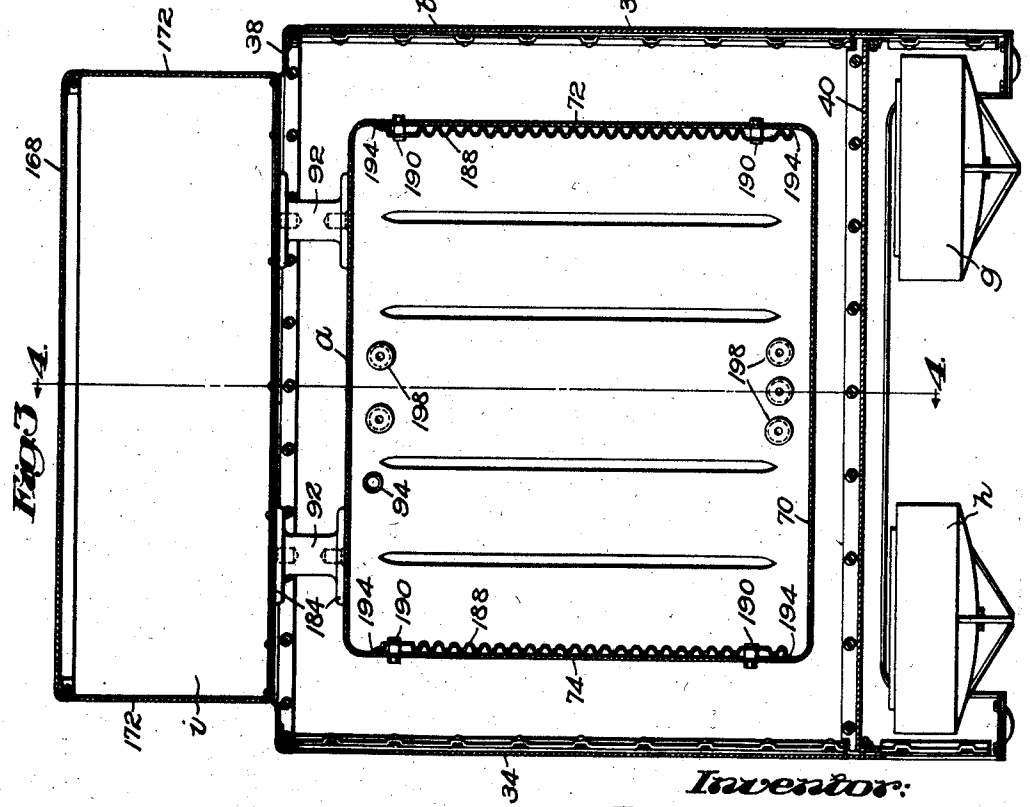

Fig. 3.

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Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 3

Fig. 5.

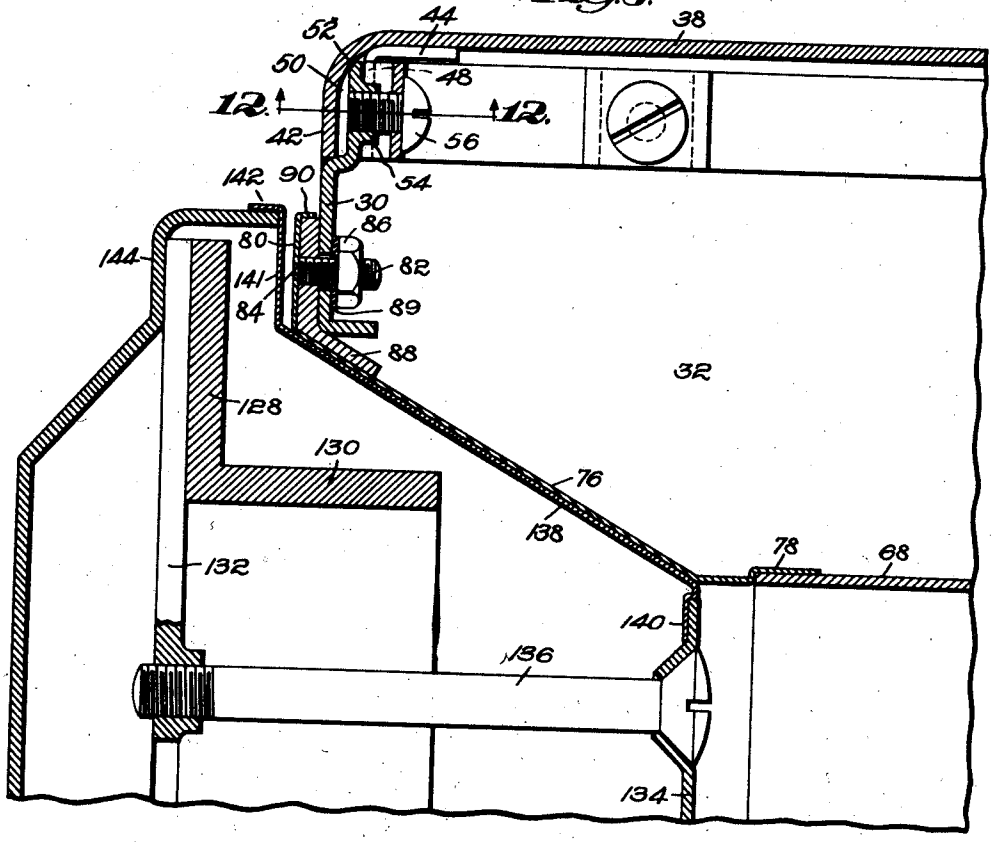
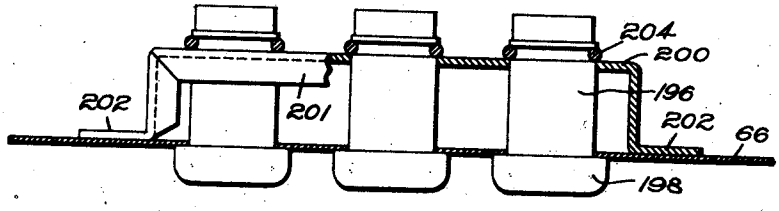


Fig. 6.



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Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 4

Fig. 7.

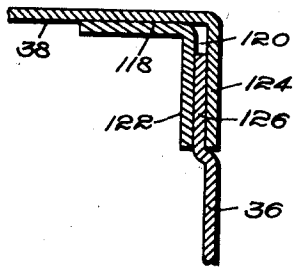


Fig. 8.

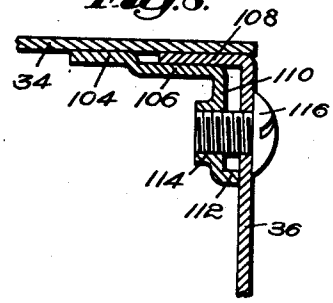


Fig. 9.

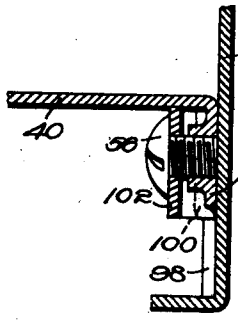


Fig. 9-A

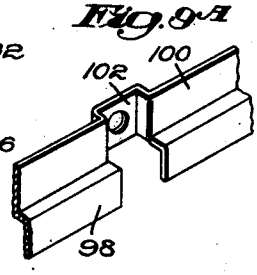


Fig. 10.

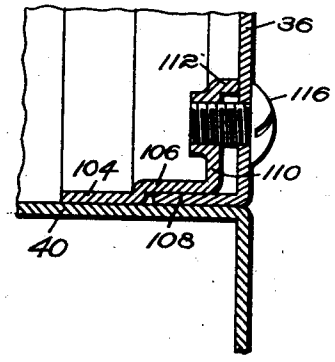


Fig. 11.

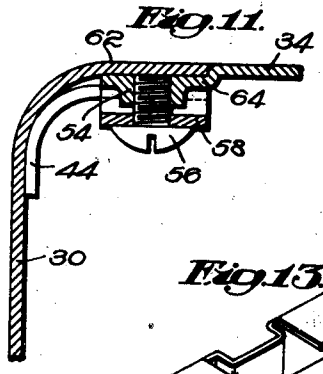


Fig. 12.

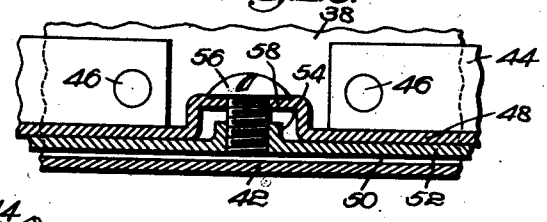
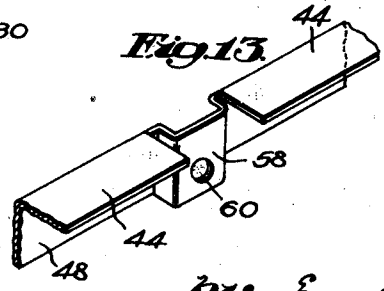


Fig. 13.



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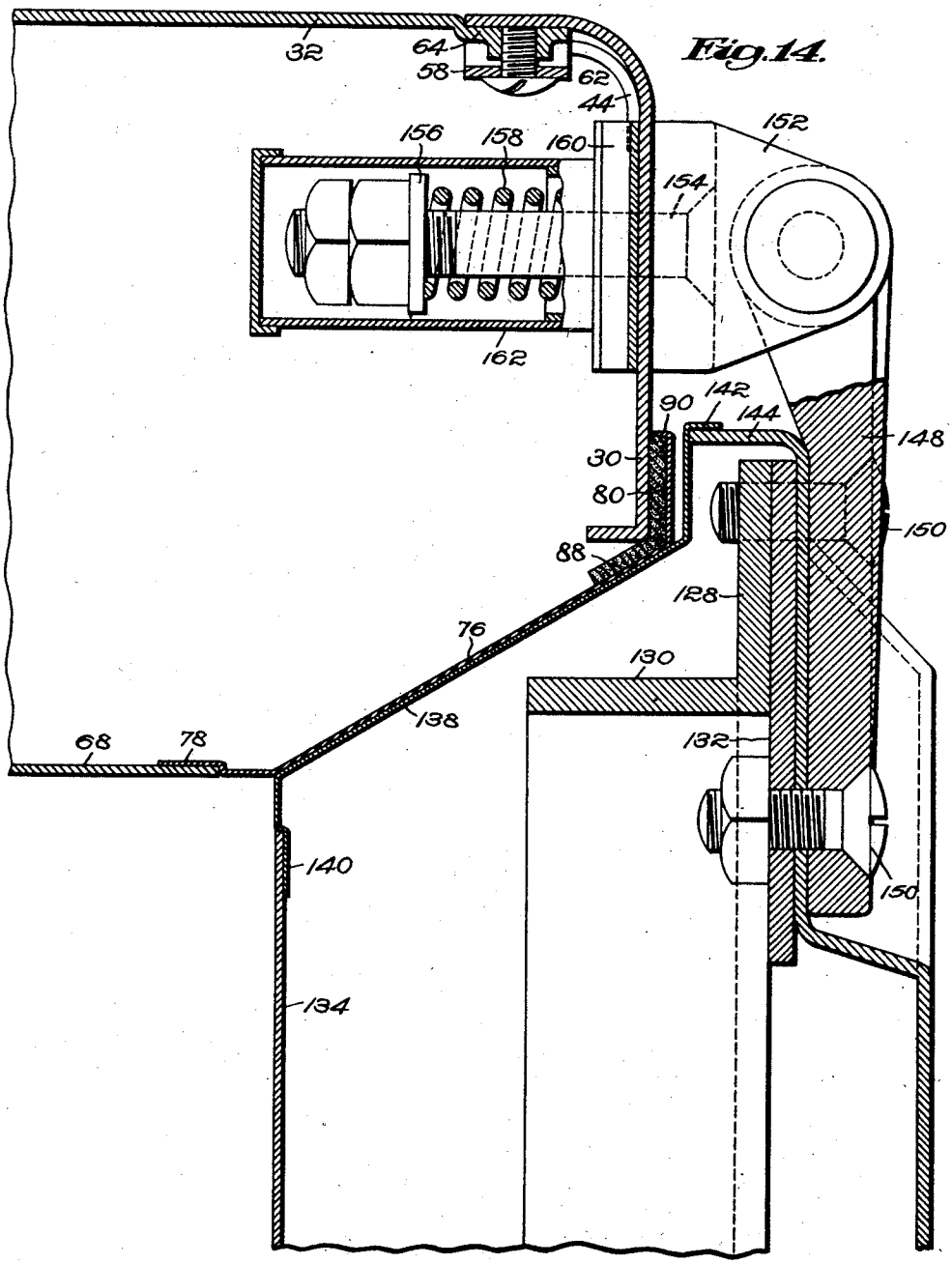
Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 5

Fig. 14.



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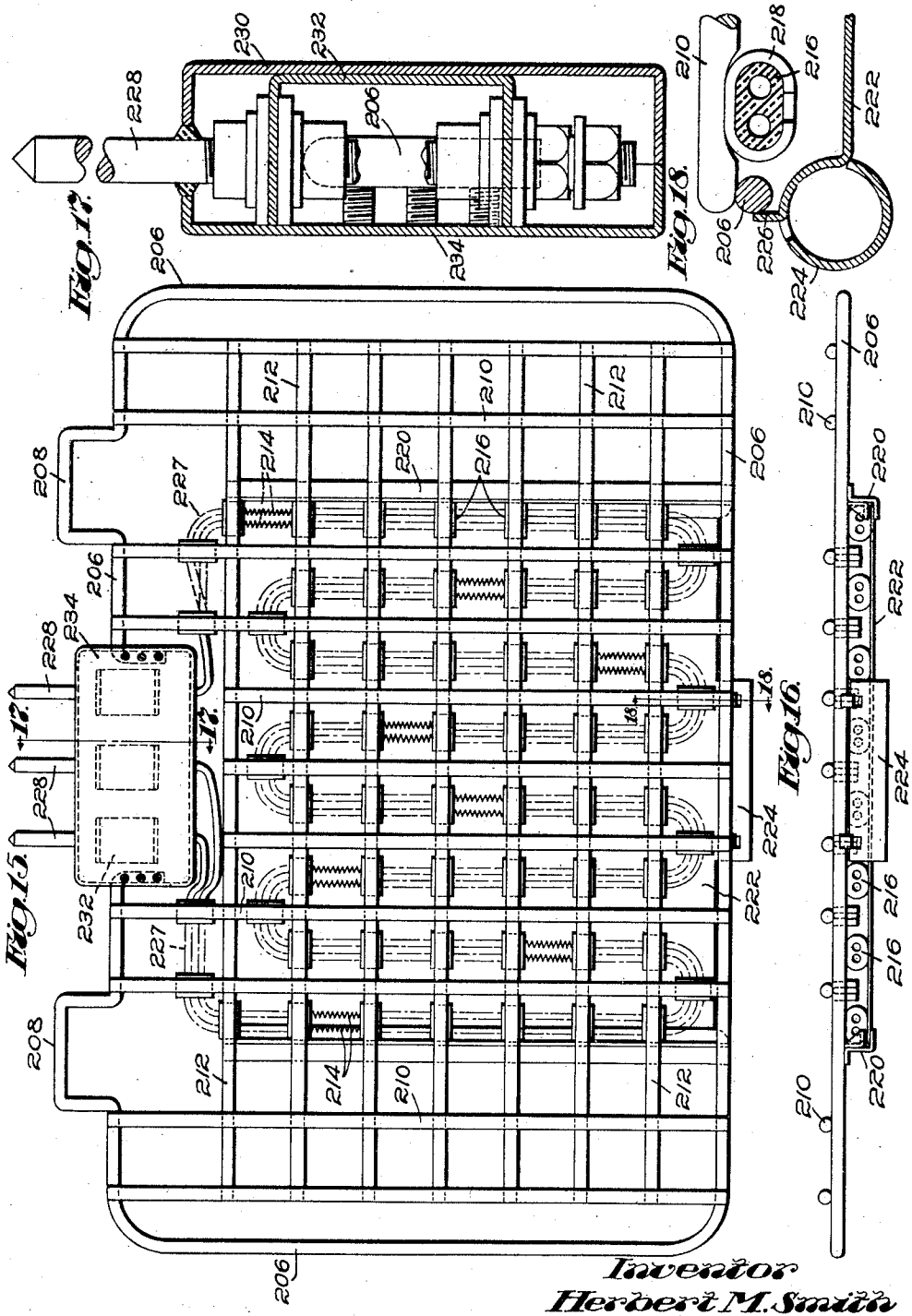
Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 6



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Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 7

Fig. 19.

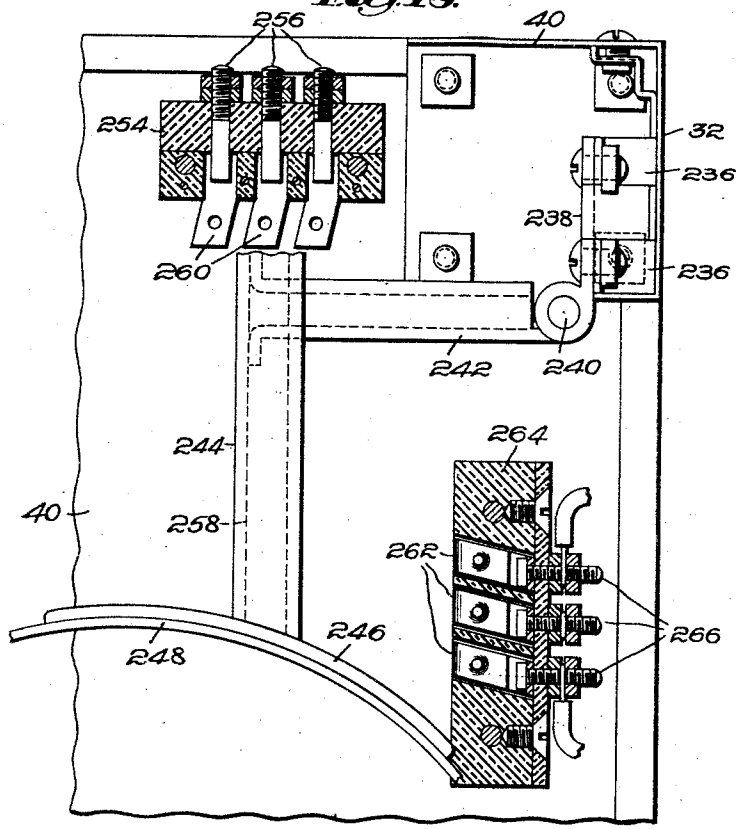


Fig. 20.

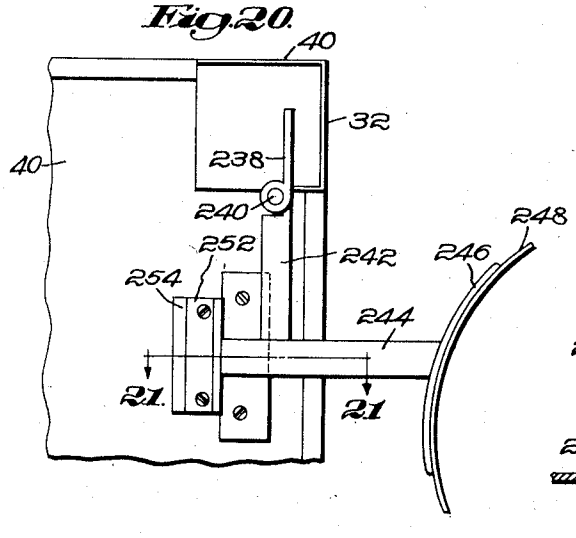
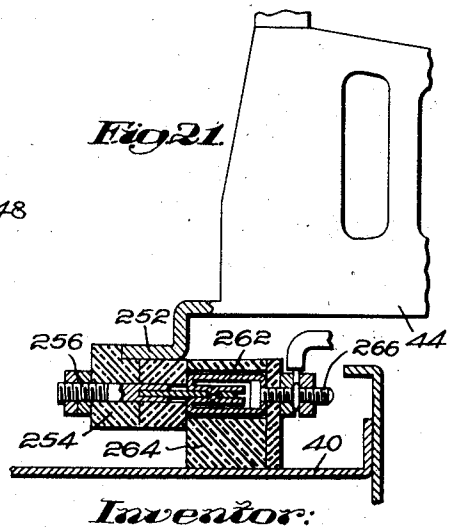


Fig. 21.



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Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 8

Fig. 22.

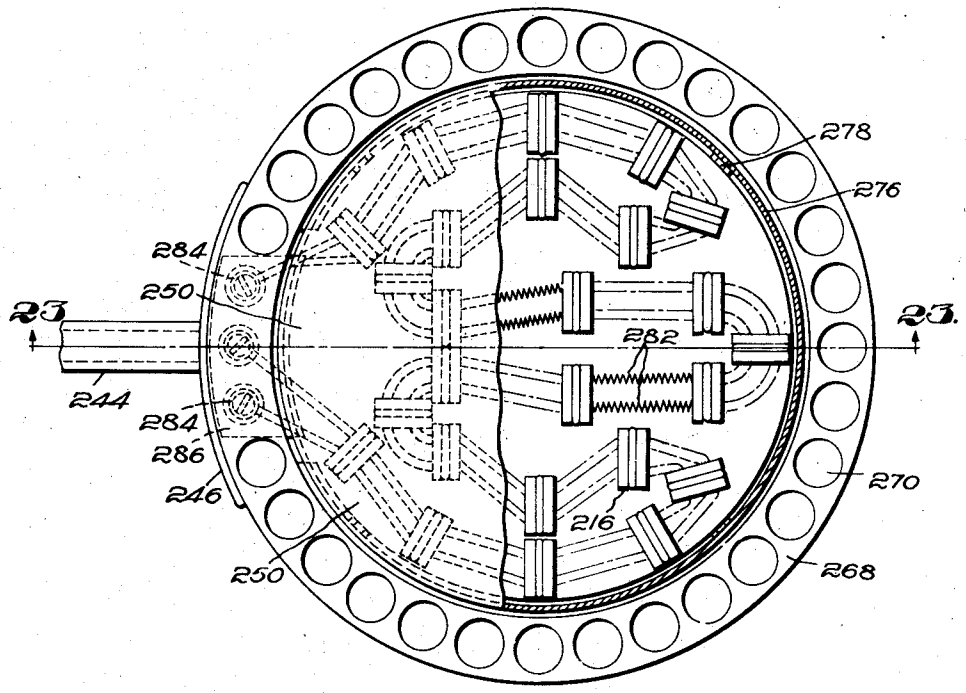


Fig. 23

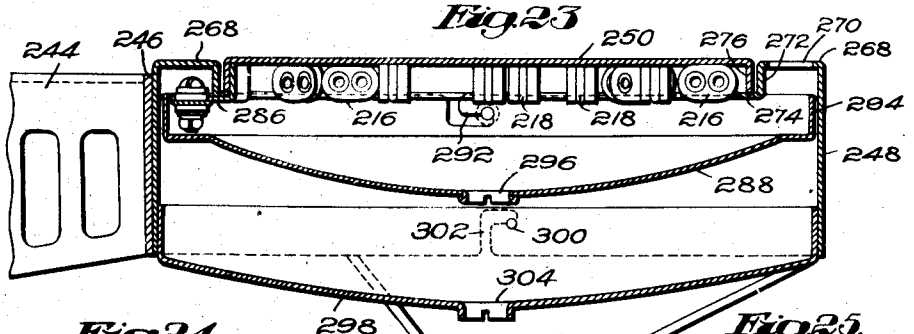


Fig. 24.

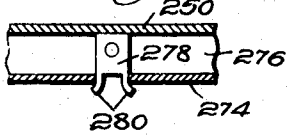
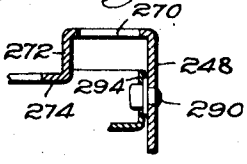


Fig. 25.



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Dec. 8, 1936. H. M. SMITH 2,063,407

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1930 9 Sheets-Sheet 9

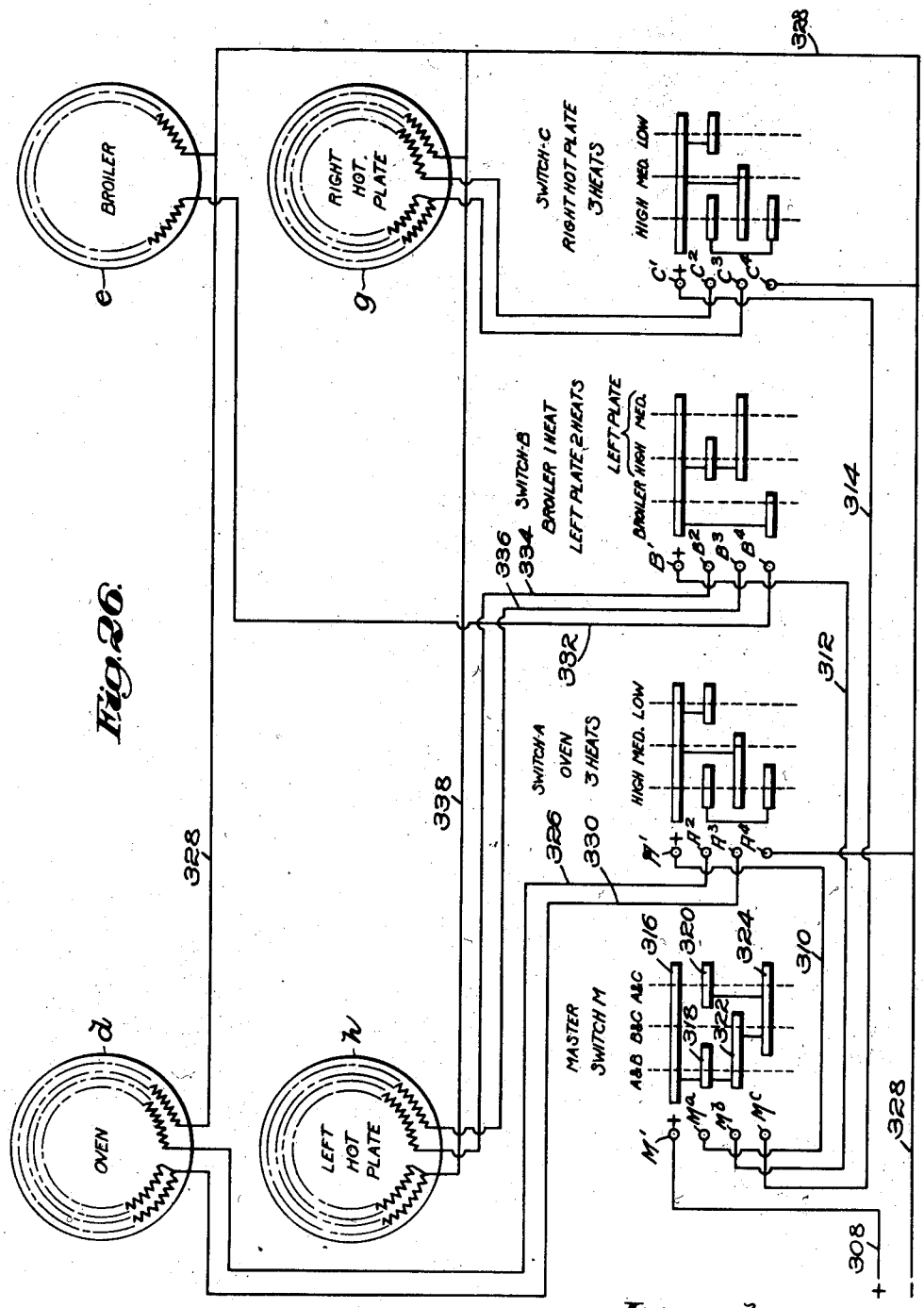

Fig. 26.

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UNITED STATES PATENT OFFICE

2,063,407

ELECTRIC HEATING DEVICE

Herbert M. Smith, Dedham, Mass., assignor to Thomson Electric Welding Company, Lynn, Mass., a corporation of Massachusetts

Application February 4, 1930, Serial No. 425,772

6 Claims. (Cl. 219—35)

This invention relates to electric heating devices, and more particularly to electric ranges, consisting in improvements designed to provide high thermal efficiency, compact, simplified and convenient arrangement and inexpensive but stout and durable construction, an attractive and pleasing exterior and such a combination of heating elements and control devices as to render it adapted for general domestic cooking purposes.

The invention will be best understood by reference to the following description when taken in connection with the accompanying drawings, while its scope will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a front elevation of an electric range embodying one form of the invention;

Fig. 2 is a side elevation of the same;

Fig. 3 is a cross-sectional elevation of the range shown in Fig. 1 looking from the front;

Fig. 4 is a longitudinal section on the line 4—4 in Fig. 3;

Fig. 5 is an enlarged vertical sectional detail taken through the top of the outer casing, the oven shell, throat and door and illustrating the construction of the oven throat and a portion of the door and the method of connecting the front panel of the outer casing to the oven throat and casing top;

Fig. 6 is an enlarged detail in plan showing the means for supporting the socket connections at the back of the oven shell;

Fig. 7 is a sectional detail in elevation of an enlarged scale showing the method of securing the casing back to the casing top;

Fig. 8 is a similar section in plan showing the method of securing the casing back to the side panels of the casing;

Fig. 9 is a sectional elevation showing the method of securing the side panels of the casing to the bottom panel;

Fig. 9a is a perspective of the connecting piece employed in joining the side and bottom panels;

Fig. 10 is a sectional elevation showing the method of securing the back panel to the bottom panel;

Fig. 11 is a section in plan, taken through one of the front corners of the outer casing, showing the method of securing the side and front panels;

Fig. 12 is a section taken on the line 12—12 in Fig. 5, through one of the angle pieces and the front panel to which it is bolted, looking from beneath and showing the angle flange secured to the adjoining top panel;

Fig. 13 is a perspective view showing a portion of one of the angle pieces employed between the top and front panels;

Fig. 14 is a sectional detail in plan showing a portion of the door construction and the method of hinging it to the walls of the outer casing;

Fig. 15 is a plan view showing the construction of the oven heating unit;

Fig. 16 is a front elevation of the heating unit shown in Fig. 15;

Fig. 17 is a section on an enlarged scale taken on the line 17—17 in Fig. 15, showing the terminal box;

Fig. 18 is a detail showing the attachment of the insulators to the heating unit;

Fig. 19 is a plan view in partial section looking from below, showing the mounting of one of the hot plates and the switch contacts therefor;

Fig. 20 is a more or less diagrammatic view, also looking from below, showing the position assumed by the hot plate and its contacts when it is swung from beneath the range into a position to be used;

Fig. 21 is a detail in sectional elevation, on an enlarged scale, taken on the line 21—21 in Fig. 20, showing the contacts closed;

Fig. 22 is a plan view of one of the swinging heating units with the hot plate partly broken away;

Fig. 23 is a sectional elevation taken through the hot plate on the line 23—23 in Fig. 22;

Fig. 24 is an elevational detail showing the method of fastening the hot plate to its supporting frame;

Fig. 25 is a sectional elevation taken through the edge of the hot plate support, showing the attachment of the reflector thereto; and

Fig. 26 is a diagrammatic representation of the circuiting connections and the controlling switches therefor.

Referring to the embodiment of the invention which is submitted for illustrative purposes, and more particularly to Figs. 1 to 4 of the drawings, the range comprises a heat insulated oven or inner shell *a* contained within an outer casing or shell *b*, the oven being provided at its front with a hinged insulated door *c*. The oven is separated from the outer casing by an insulating space at its top, bottom, the two sides and back, this space being preferably filled with suitable heat insulating material, such, for example, as mineral wool,

this material for the sake of clearness being omitted in the drawings except as indicated beneath the oven in Fig. 4.

Within the oven there is provided one or more removable heating elements, herein comprising an oven heater *d* at the bottom of the oven and a broiler unit *e* at the top thereof. The casing is supported on four legs, one at each lower corner, leaving a space between the casing bottom and the table or other support on which the range stands. Additional heating elements in the form of right and left hot plates *g* and *h* are provided outside the oven, being mounted on swinging arms by means of which either one may be swung out into a position of use at the side of the range or, when not required, swung back out of the way into the space referred to beneath the casing.

On the front panel beneath the door *c* is arranged a series of switches, hereinafter described more in detail, through which the current for all the various heating elements may be suitably controlled. On the top of the outer casing there is provided a compartment *i* enclosed within a casing having a door *j* adapted to be opened and closed and so arranged as to be heated from the oven *a* and provide a warming oven or chamber adapted to be maintained at a temperature less than that of the oven.

Referring first to the construction of the outer casing *b* (Figs. 1 to 4 and 7 to 14 inclusive), this is constructed of relatively light sheet metal and comprises a front panel **30**, side panels **32** and **34**, a back panel **36**, top **38** and bottom **40**. The front and side panels are joined together and to the top by internal fastenings, all panels being united so as to leave at the sides, front and top no externally visible screws, bolts or other fastenings. This provides for the top, front and sides a smooth exterior, capable of receiving enamel or other surface finish and presenting a pleasing and attractive appearance. By this method of construction, also, rounded corners may be had where desired, moisture proof joints provided and a light and inexpensive but structurally strong casing constructed.

The means utilized for joining the top of the front and side panels is best shown in Figs. 5, 12 and 13 taken in connection with Figs. 3 and 4.

Referring to Fig. 5, the top panel **38** has its front edge curled or turned over to provide a downwardly turned flange or lip **42** at substantially right angles to the top but leaving, if desired, a rounded corner. Secured to the under side of the top panel, near the turned over edge thereof and extending across substantially the entire width of the top, is an angle piece having the construction shown in Fig. 13. This comprises a flange **44** which is fastened to the under side of the top piece by any suitable means, as by spot welding, the latter being represented in Fig. 12 by the spots **46** which occur at suitable intervals lengthwise the angle piece. The angle piece is applied to the top so that its companion flange **48** is substantially parallel to the overturned top edge **42** but is separated therefrom to leave between the edge and the angle flange a space or groove **50** of substantial depth, extending the width of the top and adapted to receive the upper edge of the front panel **30**.

The entering edge of the front panel (Fig. 5) is in the form of a tongue **52** which is bent or offset inwardly from the plane of the front panel so that when inserted in the groove **50** the overlying edge of the top and the visible face of the front panel are brought into snugly fitting relationship, with the front panel face in substantially the same plane as that of the overturned edge. When the casing is applied, the small line crack or crevice between the edge **32** and the turned-in portion of the front panel is filled in with enamel or other filling, leaving a smooth, unbroken exterior at the joint.

To secure the tongue **50** to the angle piece, the former has fastening provisions cooperatively related to recesses formed in the opposed flanged side **48** of the angle piece. In the illustrative form of the invention such fastening provisions are conveniently had by punching up in the thin sheet metal tongue at suitable intervals a series of inwardly facing raised bosses **54** (Figs. 5 and 12), which bosses are then tapped to receive the threaded ends of fastening screws **56**. Recesses adapted to receive these fastening provisions are provided in the opposing flange **48** of the angle piece by bending the flange **48** inwardly (Fig. 13) at intervals corresponding to the threaded bosses **54** to form opposite each boss an offset raised portion **58**, the walls of which clear the bosses on the tongue **52**, the flange **44** being cut away or interrupted where such raised portions occur. Each raised portion of the flange is apertured at **60** (Fig. 13) to receive the fastening screw **56** which, when threaded into place, draws the tongue **52** against the bearing face of the flange **48** of the angle piece and serves to securely fasten together the edges of the front and top panels.

By this construction thin sheet metal panels may be employed, and, by the simple operation of punching up the bosses and threading the openings in the underlying panel edge, may be used to secure a structurally strong and externally smooth joint.

As will be seen from Fig. 3, a similar joint is provided between the top panel and each of the side panels, the side edges of the top panel being turned over and overlapping an offset tongue in the upper edge of each side panel and connection being effected by means of a similar angle piece.

A similar joint and fastening also is provided between the side panels and the front panel, the front panel in this case (see Fig. 11) having a turned over edge **62** overlying an inwardly offset tongue **64** on the side panel and the two edges being secured by a vertical angle piece so that a smooth exterior is presented. A rounded corner of relatively large radius is here provided and the flange **44** of the angle piece is bent over at such a curvature that it lies snugly against the inner face of the front panel to which it is spot welded at suitable intervals.

In assembling the range, the side panels are first united to the front panel and the top panel then united to the sides and front, after which the oven shell is placed in position. The oven shell is formed of sheet metal and comprises the back **66**, which may be grooved or corrugated to add to its rigidity, the top **68**, the bottom **70** and sides **72** and **74**. The shell is of generally rectangular cross section having an open front and a flared mouth or throat piece **76** (Fig. 5) by which it is secured to the front panel.

In order to increase the thermal insulation of the oven and reduce the heat conduction which

may take place through the door, the throat (Fig. 5) is constructed of sheet metal having a thickness less than, and herein substantially half, that of the oven shell, being united to the oven shell by an offset tongue 78 which overlaps the open end of the oven shell and is welded thereto.

To secure the oven shell to the front panel, the throat 76 has an out-turned flange 80 which overlies the edge of the door aperture in the front panel and is provided at suitable intervals with a series of fastening members in the form of threaded pins 82, each of which is electrically welded at 84 to the inside of the oven flange 80 and projects inwardly with ample clearance through apertures in the front panel. When the range is assembled, the oven shell is rigidly secured and clamped to the front panel by means of nuts 86, a strip of heat insulating material 88, such as asbestos or the like, being interposed between the front panel and the oven throat and an insulating washer 89 between the front panel and the nut, thereby to prevent metallic contact and prevent heat conduction from the oven shell to the panel. The extreme end of the flange 80 is turned over the insulating strip at 90 but maintained out of metallic contact with the panel.

The top 68 of the oven is also connected to the top 38 of the casing by two metallic spools 92 (Figs. 3 and 4) which not only serve to support the oven shell but provide a path of heat conduction to the warming oven *i*, as hereinafter more fully described.

The oven shell is further provided with a vent opening in the form of a thin sheet metal tube 94 (Figs. 3 and 4). This is welded to and opens through the back 66 of the oven shell and extends to and through the back 36 of the casing and through the intervening insulated space. The exterior open end of the tube may be suitably heat insulated from the back to minimize or prevent heat conduction thereto. This vent prevents the accumulation of pressure within the oven space by the generation of steam or other gases.

At the time the oven shell is secured to the front panel, as heretofore described, the bottom panel 40 of the casing *b* is secured to the front panel by the nuts 86 and threaded studs 82 which are used to clamp the bottom edge of the oven throat to the front panel below the door aperture. For this purpose the bottom panel has an upturned flange (see Fig. 4) which lies against the inner face of the front panel where the latter underlies the down-turned flange of the oven throat and is clamped securely thereagainst by the nuts 86. The front panel extends down below the bottom panel (as shown in Figs. 1 and 4) to form the front wall of the switch compartment and the front walls of the supporting legs, the joint between the front and bottom panels being concealed and externally invisible.

The side panels also extend below the bottom panel (see Figs. 2, 3 and 4) and are united each to the bottom panel by the connection illustrated in Figs. 9 and 9*a*. For this purpose (Fig. 9) each side of the bottom panel 40 is bent down at right angles to form a tongue or edge portion 96 which is provided at intervals with threaded bosses similar to those already described. A uniting member (Fig. 9*a*), slightly different in form from that shown in Fig. 13, is employed to clamp the two panel portions together. Such uniting member comprises a metal plate or strip extending substantially the full length of the side panel and having the flange 98 by which it is welded to the side panel below the bottom panel edge 96. Such uniting member is also provided with the offset flange 100 which overlies the edge 96 of the bottom panel and provides an extended bearing surface thereagainst, the flange 100, however, being provided at intervals with raised portions 102 which bridge the bosses where the latter occur in the bottom panel and carry the clamping screws by which the two panel portions are united. Here, as in the construction of Figs. 11 and 12, the clamping connections are all within the side panel and no connecting members are externally visible.

With the front, side, top and bottom panels of the casing united, the oven shell assembled therein as described and the electric conductors provided as required, the intervening space between the oven shell and casing is then filled with suitable insulating material and the back panel 36 fastened in place. The method of securing the back panel to the side and bottom panels of the casing is substantially the same as shown in Figs. 8 and 10. For this purpose (referring to Fig. 8) there is welded to each side panel 34 (or 32) a metallic plate or strip 104 which carries an angle piece having one flange 106 offset from the plate 104 to provide a grooved space between the flange and the side panel, into which the inturned edge or tongue 108 of the back panel is adapted to enter. The remaining flange 110 of the angle piece is turned at right angles to the flange 106 and is provided at its edge with an out-turned bearing member 112 against which the inner face of the back panel seats when fastened in position. At intervals lengthwise the flange 110, raised, tapped bosses 114 are provided, by means of which the clamping screws 116 may be utilized from the back of the panel to clamp the latter securely to its seat 112. The connection between the back and the bottom is effected by a similar connection, as shown in Fig. 10.

The connection between the back and top panels is shown in Fig. 7 and is secured by means of an angle strip 118, one flange of which is welded to the underside of the top panel leaving a groove 120 between the remaining flange 122 of the angle and the overturned edge 124 of the top panel. The upper edge of the back panel 36 is provided with an inwardly offset tongue 126 adapted to enter the groove 120 when the panel is in place.

In applying the back panel of the casing, the inturned side and bottom edges of the back panel are entered into the grooves provided at the side and bottom panels, and the tongue 126 raised into the groove 120 of the top panel, and the clamping screws 116 are then threaded into place securely clamping the back panel in position.

When completely assembled, all connections, except at the back, are internal and invisible, and the exterior presents a smooth, unbroken finish surface. The various panels are enameled and, after being joined together as described, the small cracks or crevices occurring at the joints may be filled in with sodium silicate, varnish or other suitable filler. This provides an exterior smooth enameled surface, the rounded corners at the front and top affording permanence to the enamel finish. The interior connections may be readily reached for purposes of repair or dismantling by removing the back panel and the insulating material. The angle

pieces which are employed at the corners to fasten together the panels stiffen the structure, providing the equivalent of an internal rigid frame.

Referring now to the construction of the door, and more particularly to Figs. 1, 4, 5 and 14, the latter is provided with an internal stiffening frame member 128, rectangular in outline and having the inturned stiffening flange 130. At each corner of the frame member 128 there is attached thereto, as by welding, a small corner plate 132 to which the inner sheet metal wall 134 of the oven door is secured by the clamping screws 136 (Fig. 5), there being provided one screw for each corner plate. To seat against the throat 76 of the oven shell when the oven door is closed, the latter is provided with the beveled wall 138 of sheet metal having an offset flange 140 overlapping the inner wall of the oven door and welded thereto, the beveled wall being preferably of lesser cross sectional thickness than and substantially one-half that of the wall 134 so as to cut down the heat conduction. In the closed position of the door the beveled wall 138 extends beyond the upturned flange 80 of the oven throat, is bent outwardly thereat to form the flange 141, and is provided with a forwardly turned tongue or flange 142 which overlaps the rim of the external door wall or panel 144. The outer door panel is enameled both inside and outside so that the enamel coating of the door panel prevents metallic contact and all substantial heat conduction between the edge of the outer door panel and the flanges 141 and 142 of the inner door panel. The inside enamel coating of the door panel also prevents any substantial heat conduction from the plates 132 (to which the inner panel is connected by the screws 136), so that an effective heat insulation is provided between the inner and outer walls of the door.

The door is provided with a central shell 146 having a closed bottom abutting against the inner wall 134 of the door and adapted to contain suitable temperature indicating apparatus.

The door is supported on hinges, the arms 148 (Figs. 2 and 14) of which overlie the walls of the front door panel and are bolted therethrough by means of bolts 150 to the underlying plates 132 fastened to the door frame 128, the weight of the door being thereby transmitted directly from the internal frame to the hinges. The hinge arms 148 (Figs. 1 and 14) are pivotally mounted on hinge supports 152 secured to the front panel of the casing by a bolt 154, means being provided within the casing whereby a suitable yielding movement is permitted the hinge supports to permit the beveled walls 138 of the door to seat firmly against the beveled throat of the oven shell when the door is closed.

To this end, the bolt 154 passes through the casing and carries at its end a washer 156 abutting against the end of the compression spring 158, the opposite end of the spring being seated against a plate 160 fastened to the inner wall of the front panel and providing an aperture through which the bolt 154 passes. The bolt and spring are provided with an enclosing casing 162 protecting the latter in its functioning from any loose insulating material packed around the same. The space within the door between the internal and external sheet metal walls thereof is preferably filled with heat insulating material (indicated in part only in Fig. 4), similar to that employed between the oven shell and the outer casing.

The edge of the door opposite the hinge edge is provided with a handle 164 pivotally connected through the outer sheet metal wall of the door to the frame member 128 and having a fastening adapted to engage a cooperatively related fastening member 166 secured to the front panel of the casing. The door is accordingly provided with all-sheet-metal interior and exterior walls, with the inner panel connected to the internal frame member through the four screws 136 and the outer panel connected thereto through the hinge and handle fasteners. The described construction of door provides a light but rigid, stout structure with a high degree of thermal insulation.

By forming the oven throat 76 of sheet metal, half the thickness of the oven walls, and the beveled wall 138 of the oven door of half the thickness of the inner door panel 134, the aggregate heat conductivity of the path presented by the throat and wall when the latter are in contact is no greater than that of the oven wall or panel alone.

Referring now to the warming oven compartment *i*, the latter is mounted on a slightly raised portion of the top panel 38 and is provided with a top 168 connected to the back 170 and the sides 172 by internal connections, substantially similar to those described as employed between the top panel and front and side panels of the casing *b*. The lower edges of the side panels are provided with inturned flanges which are bolted or otherwise fastened to the top panel of the casing, so that the warming oven, as well as the casing, presents a smooth, finished, unbroken exterior at the top, front and sides.

The open front of the warming oven is provided with a door 174 of parti-cylindrical form connected at each opposite end to a lever arm 176, the latter pivoted at 178 and so arranged that by means of the handle 180 the door may be raised and opened to permit access to the warming compartment or moved to the closed position shown in Figs. 1, 2 and 4. The lever arm 176 is provided with a rearwardly extending counterbalancing member 182 which acts as a stop when the door is open and so counterbalances the weight of the door that the latter tends to remain in either the full open or closed position.

The warming oven is designed to warm dishes or to maintain foods which have already been cooked in their warm state, and provision is made for maintaining a suitable temperature in the warming oven by heat conducted directly from the internal oven shell *a*. The heat for this purpose is conducted directly (Figs. 3 and 4) from the upper wall 68 of the oven shell through the metallic spools 92. Each spool is provided with enlarged ends 184 presenting each a broad, flat bearing surface, one of which is secured to the adjoining top wall of the oven shell and the other to the adjoining wall of the top panel of the casing. This affords a broad area of contact for the transmission of heat from the oven wall to the spool and from the spool to the bottom of the warming oven, but the amount of such heat thus conducted from the oven shell to the warming oven is cut down to what is required by reducing the intermediate cross section of the spool and thereby the heat transmitted to the warming oven. In use the cooking oven will be operated under relatively high temperatures,

several times that required or desirable in the warming oven. By a suitable selection of the cross sectional area of the heat conducting path presented by the reduced portions of the spools 92, a temperature may be maintained in the warming oven sufficiently high for all general purposes but prevented from reaching any undesirable stage and avoiding any unnecessary wastage in the heat diverted for this purpose from the cooking oven.

Referring now more particularly to Figs. 3 and 4, the upper and lower heating units *e* and *d* within the oven are removably supported upon horizontal guideways, which also permit the insertion of the usual racks, trays, pans or the like. As illustrative of these, the drip pan 186 is shown (Fig. 4) beneath the broiler unit *e*. Such guideways are herein provided by corrugated sheet metal plates 188 supported in front of each opposite side wall and removably fastened thereto by headed pins 190 projecting from the said walls and entering apertures in the plate. By sliding either plate upward it may be freed from the pins and withdrawn from the oven for any purpose, such as cleaning.

Each plate has its vertical edges 192 and horizontal edges 194 turned or bent outwardly toward the oven wall so that when positioned in the oven it seats upon its peripheral edges, spacing the body of the plate, including the corrugations, away from and out of contact with the oven walls and providing an air space between the body of the plate and the side wall of the oven.

Each plate is preferably provided with a polished reflecting surface facing the interior of the oven which tends to reflect the heat rays radiating from the electric heating element back toward the interior of the compartment and against the cooking utensils and food which is being cooked.

The reflecting plate and the air space between the plate and oven side walls accordingly increase the efficiency of the oven by increasing the heat applied to cooking and minimizing the heat transmitted to the oven shell.

The heating units *d* and *e* are provided with terminal plugs adapted to enter socket connections provided in the back wall of the oven, these socket connections being substantially the same in the case of each unit, except that two terminals and sockets only are employed for the broiler unit *e* while three are employed for the oven heater *d*.

A simple, inexpensive but effective construction for attaching the socket connections to the oven wall, while at the same time assuring the maintenance of a rigid alignment, is illustrated in Fig. 6. As there shown, each socket connection comprises an insulating shell 196 containing the electric contacts of any usual or suitable construction. Each shell extends through a closely fitting aperture in the rear wall 66 of the oven and has a shouldered head 198 seated thereagainst. To maintain the required alignment, a bracing member is employed in the form of a bridge or U-shaped sheet metal clip 200 having flanged edges 201 to impart stiffness, the feet 202 of the bridge resting loosely against the back of the oven wall. The rear end of each insulated shell projects through a closely fitting aperture in the back of the bridge 200 and the latter is held in place by a split spring ring 204 snapped into a groove in the projecting end of the shell.

When the oven is assembled, the shells are merely slipped through the apertures in the oven back, the bridging clip pushed over the end of the shells with its feet resting against the oven back and the spring rings snapped into position. By this inexpensive and simple expedient the socket shells preserve their required alignment under all conditions of use.

The oven heating unit *d* is shown in detail in Figs. 15 to 18 inclusive. As will appear from Figs. 15 and 16, this is formed by a rod 206 shaped into an outer frame, the sides of which are adapted to slide in guideways presented by the corrugated plates 188. The front part of the frame is bowed or bent forward at each side to form stops 208 which engage the rear wall of the oven and limit the movement of the unit when pushed into the oven. To the top of this outer frame are secured by welding a series of longitudinal rods 210 and to the underside of the rods 210 transverse rods 212 thereby forming a grid-like structure.

The resistor elements or heating wires 214 are supported in refractory insulator spools 216 positioned to present a continuous, extended circuitous path for the resistor wires. Each insulator is of oblong cross section (Fig. 18) and provided with two separated apertures through which the wires are passed. Each insulator is fastened to the underside of one of the cross rods 212 (or in some cases to the rods 210) by a clinching member 218 comprising a metallic wire in the form of a staple welded to a flattened portion on the underside of the rod and having its two ends clinched about a peripheral groove on the insulator spool. The insulators are thus held securely in position but may be readily removed for purposes of repair or replacement by bending open the ends of the clinching wire.

To the underside of the grid there are secured depending angle pieces 220 providing guide rests for a sheet metal plate 222 having a polished reflecting upper surface. The plate extends beneath the entire area traversed by the resistor element so that it is adapted to reflect upwardly into the oven the heating rays radiated downwardly from the resistor and prevent their striking the bottom wall of the oven, the plate being spaced from the bottom wall (see Fig. 4) when the heating element is in position. The plate also acts both as a catch pan for any liquids or material which may drop through the grid, and as a bottom protector for the resistor.

It will be seen that the resistor wires are thus located between the top grid and the bottom plate and are well protected against damage from any objects which might otherwise be brought in contact with them or effect a short circuit. The plate 222 has a forwardly extending lip which is curled over to provide a handle 224 by which it may be withdrawn at will from its guideways for the purpose of cleaning or for the examination or repair of the resistor elements or refractory insulators. The handle also has an upturned portion 226 (Fig. 18) which abuts against the rear portion of the rod 206 and acts as a stop, preventing the plate from being pushed in too far.

The ends of the resistor wires are connected to insulated conductors 227 of substantial cross section which extend beyond the limits of the pan or plate 222 and are carried into a terminal box through which connection is had to the forwardly projecting terminal plugs 228 adapted to enter the sockets 198 in the oven wall. The

resistor comprises two separated wires held by the insulator in parallel paths, the wires being joined at one end of the resistor by the conductors 227 and connected to one terminal plug 228, the opposite end of the resistor being separately connected one to each of the remaining terminal plugs, to afford means for securing through the controlling switch three different circuit connections, for high, low and medium heat respectively, as is hereinafter more fully explained.

The terminal box comprises a box compartment 230 (Fig. 17) rigidly secured to the frame by welding the ends of the rods 206 to the inner walls of the box. The terminal plugs 228 and their connections are insulated from but supported each by a piece 232 of U-shaped cross section welded to the bottom of the box compartment so that the terminals are rigidly connected to the frame. A box cover 234 is removably attached to the box compartment by screws threaded into the ends of the rods 206 so that by removal of the cover the terminals and their connections are readily accessible for purposes of repair or replacement. The terminal box is secured to a grid-like frame in such position that its flat cover top is at or below the top surface of the grid.

The described heating unit provides an inexpensive, simple construction but one in which the resistor is well protected against injury or short circuiting and where repairs and replacements may be easily effected.

The broiler unit *e* is of substantially the same construction as the oven heating unit *d* already described, except for the fact that it is provided with but two terminal plugs to which the opposite ends of both resistor wires are respectively connected, instead of having the split connection at one terminal as indicated in Fig. 15, and for the further fact that it is inserted in the oven in inverted position so that the reflector plate is above the heating element and reflects the heat rays downwardly.

It will be seen that with the two oven heating units in place, the sides, top and bottom of the oven shell are faced by reflecting plates spaced from the oven walls and adapted to reflect the heat inwardly toward the oven compartment.

Referring now to the hot plate units *g* and *h*, these are of substantially the same construction, and description of one only is necessary, the mounting and construction of the left-hand plate being shown in Figs. 19 to 25 inclusive taken in connection with Figs. 1 to 4 inclusive.

Referring to Figs. 19 and 20 which represent a plan view looking upward from beneath toward the bottom panel 40 of the casing and at the rear left corner thereof, the corner leg is provided with brackets 236 welded to the side panel 32 and to which there is bolted the hinge support 238 providing a pivot 240 for the arm 242. Secured to the end of the arm 242 at substantially right angles thereto is the arm 244 carrying at one end a curved plate 246 rigidly secured, as by welding, to the cylindrical shell 248 (Figs. 22 and 23) which carries the hot plate 250 and associated parts.

The opposite end of the arm 244 projects beyond the arm 242 and is provided with a raised angular projection 252 (Fig. 21) on which is mounted the terminal block 254. The latter is provided with three terminals 256 electrically connected to conductors which pass through a channel or conduit 258 within the arm 244 to the resistor elements within the cylindrical shell 248. Each terminal is electrically connected to a switch blade 260 projecting forwardly from the terminal block at a slight inclination.

When the hot plate is out of use and swung into the position represented in Figs. 1 to 4 inclusive and Fig. 19, the terminal block and switch blades occupy a position just beneath the bottom 40 of the casing and at the back thereof with all circuit connections broken. When the hot plate is swung out from beneath the casing it occupies a position represented in Fig. 20 at the side of the casing and where dishes or cooking utensils may be placed thereon. At the same time that the hot plate is swung into the position shown in Fig. 20, the switch connections are closed permitting energization of the heating element. The closing of the switch is accomplished through the switch blades 260 by causing the latter to enter between the resilient leaves 262 of stationary contacts carried by the terminal block 264 secured to the bottom panel of the casing, the contact leaves being also inclined at such an angle that the blade contacts 260 readily enter between them. The contacts 262 are electrically connected through the terminals 266 with the supply circuit under the control of the front panel switches, hereinafter described.

Referring to the construction of the swinging heating element and to Figs. 22 to 25 inclusive, the cylindrical supporting shell 248 is of sheet metal and has its upper end turned inwardly to provide an annular top rim 268 provided with a series of apertures 270. The inner edges of the rim are turned down to provide an annular wall 272 and terminate in an inturned annular flange 274.

The hot plate 250 is preferably constructed of some heat conducting, non-oxidizing iron alloy, such as "enduro", and is in the form of a round flat plate with down-turned edges 276 which rest upon the shell flange 274, the plate being supported so that its surface is at a slightly higher level than that of the rim 268. To fasten the plate to the shell, the plate rim has secured thereto (see Figs. 22 and 24), as by welding, a plurality (herein 4) of sheet metal pieces 278 having prongs 280 which pass through slots in the flange 274, and after being entered therein are bent outwardly to hold the plate in position.

The resistor wires 282 are secured in close relation to the plate, immediately beneath the same, by insulators 216, similar to those described in connection with the oven heating unit, the latter being clinched to the underside of the plate by staples 218 welded to the bottom of the plate and positioned about the plate to give the necessary elongated, circuitous path to the resistor wires. The resistor wires are connected to terminal screws 284 carried by a small angular clip or bracket 286, one flange of which (Fig. 23) is welded to the inner face of the downturned edge of the hot plate. The hot plate has edge contact only with the shell flange 274 leaving an annular air space between the sides of the hot plate and the walls 272 of the shell. The walls of the shell furthermore are enameled, so that direct metallic contact is interrupted by the intervening enamel between the down-turned edge of the hot plate and the shell flange 274 and between the latter and the sheet metal fastenings 278, which, with the annular air space referred to, prevents any sub-

stantial heat conduction from the plate to the shell.

Beneath the hot plate 250 and the resistor wires, and within the cylindrical shell, there is provided a concave plate 288 having a polished reflecting surface facing the underside of the hot plate. The reflector plate 288 is supported by the shell through three studs 290 (Fig. 25) projecting inwardly 120° apart from the inner walls of the shell and having each a projecting head which enters a right-angled slot 292 formed in the up-turned rim 294 of the reflector and constituting therewith a bayonet joint connection. The rim 294 is spaced from the walls of the shell, being supported only by the three studs referred to, so that heat conduction from the reflector to the shell is insignificant.

The reflecting plate 288 is provided with a central aperture 296 having a raised flange in which is formed a slot so that by the aid of a screwdriver or other flattened piece entered into the slot, the plate, after being slightly lifted, may be turned and removed from its attachment to the shell through the lower end thereof.

The bottom of the shell 248 is closed by the bottom plate 298 having an up-turned edge flange telescopically fitting within the cylindrical shell and retained therein by one or more pins 300 (herein three 120° apart) secured to and projecting outwardly from the flange and adapted each to enter a right-angled slot 302 formed in the lower edge of the shell and constituting therewith a bayonet joint connection, permitting the removal of the bottom plate. The bottom plate also is concaved and provided with a central aperture 304 having a flanged and slotted edge by means of which the bottom plate can be lifted and turned to release it from the bayonet joint connection.

It will be observed that the reflecting surface on the upper side of the plate 288 reflects the downwardly directed heat rays from the resistor back against the underside of the hot plate 250, preventing their radiation against the walls of the shell or against the bottom plate, thereby increasing the thermal efficiency of the heating element. Any substantial heat wastage by conduction or otherwise from the reflector plate is further prevented by the insulating air space between the reflector plate and the bottom plate and between the sides of the reflector plate and the enclosing shell.

By means of the apertures 270 in the outer rim of the cylindrical shell, the condition of the resistor may be readily observed from outside through the glow which can be seen through these apertures, and, when the unit is in its position of use, it can be easily seen whether it is connected for high, low or medium heat or whether the current is cut off. In the event that liquids spill or boil over from any cooking utensil mounted on the hot plate, they tend to enter the apertures 270 and fall upon the reflector where they will gravitate through the central aperture 296 to the bottom plate and out through the central aperture 304 therein.

To provide adequate support for the hot plate unit when it is in use and sustaining more or less weight, there are secured to the under side of the bottom plate 298 three rods 306 joined together at their ends to constitute a tripod support adapted, when the unit is in use, to rest upon the supporting surface carrying the range. To free or clear the tripod from the face of the supporting surface when the heating unit is swung back beneath the casing, provision is had such that the tripod is automatically lowered as the unit is swung out and slightly raised when the unit is swung back. To this end the supporting pivot 240 for the heating unit has a slight outward and forward inclination sufficient to cause the heating unit to swing out of a horizontal plane and clear the tripod from the underlying supporting surface when swung back into the position represented in Figs. 1 and 2.

Referring to the electrical connections and controlling devices for the described heating units, a terminal socket (not herein shown) is secured to the bottom panel of the casing near the back thereof and adapted to receive any standard form of plug connection through which it may be connected by flexible insulated conductors to the usual standard form of wall socket employed on the ordinary constant potential house lighting circuit. From the terminal socket on the casing, the conductors extend to the resistor controlling switches, and from the latter connections are carried to the stationary socket terminals 198 for the two oven units and the terminals 266 for the two hot plate units.

The resistor controlling switches (herein four in number) comprise (Fig. 1) a master switch M, a switch A controlling the oven heater *d*, a switch B for the broiler unit *e* and left hot plate *h*, and a switch C controlling the right hot plate *g*.

Any suitable type of switch may be employed, and; its mechanical construction being unimportant, is not illustrated,- the relation between the stationary and movable switch contacts and associated circuits, however, being clearly illustrated in the diagram of Fig. 26 hereinafter described.

Variations in the heat stage of the several heating elements are effected by changes in the connections of the two resistor wires carried by each, the two wires being connected in series for low heat, a single wire alone being connected in circuit for medium heat, and the wires connected in multiple for high heat.

Each switch A, B and C, besides its "off" position, has three "on" positions. The switch A in its three successive "on" positions connects the oven unit *d* for its high, medium and low heat stages respectively. The switch B in its first "on" position connects the broiler unit *e* for its single high heat stage, and in its two succeeding "on" positions connects the left hot plate *h* for its two stages of heat,—high and medium respectively. The switch C in its three successive "on" positions connects the right hot plate *g* for its high, medium and low heat stages respectively.

One object of the herein described system of control is to provide simple, inexpensive but effective means whereby the aggregate current input which may be availed of at any one time in the utilization of the various heating elements may be limited to an amount substantially less than the total aggregate capacity of all the heating elements and kept within an amount which may be safely taken from the ordinary house lighting circuit through the usual fuses and lighting sockets, while at the same time permitting such latitude in simultaneously employing various combinations of the heating elements

as will not hamper the use of the range for general domestic cooking.

The invention is not limited to any specific capacities accorded to the several heating elements, or to any particular number of heating stages provided in each, but, as a concrete illustrative example only, the capacity of the oven unit may be 660, 330 and 165 watts respectively for the high, medium and low heat stages; that of the broiler unit 660 watts; that of the left hot plate 660 and 330 watts for the high and medium heat stages respectively; and that of the right hot plate 800, 400 and 200 watts for the high, medium and low heat stages respectively. This represents a maximum aggregate capacity of 2780 watts if all heating elements are fully energized at the same time. This, on the ordinary 110 volt circuit, would exceed the current (14 amperes) to which the fuse of the ordinary lighting circuit as now commonly used is limited. And if three of the four heating elements are simultaneously fully energized, this limit would likewise be exceeded.

Accordingly, provision is made, and herein by means of the master switch M, such that while two of the heating elements may be simultaneously used in such combinations as meet all needs of ordinary cooking purposes, the aggregate capacity of the elements in use is kept within an amount substantially less than the total capacity of all elements. In the illustrative example above given, this limit of aggregate capacity would be not greater than 1460 watts, representing the sum of the maximum capacity assumed to be assigned to the right hand hot plate and assigned to the other elements.

Referring to Fig. 26, the positive main **308** connected to the base socket of the range casing is connected to the positive stationary contact M′ of the master or selector switch A. Other stationary contacts M^a, M^b and M^c are connected respectively to the stationary positive contacts A′, B′ and C′ of the resistor switches A, B and C by conductors **310**, **312** and **314**, thereby determining through the position of the master switch the particular resistor switches which may be utilized at any one time to energize their respective resistor elements.

The switch M is further provided with movable contacts **316**, **318**, **320**, **322** and **324** interconnected as shown in the diagram. These connections are such that in the first position of the master switch (the three "on" positions being represented diagrammatically by the vertical dotted lines) the positive main is connected to switches A and B rendering the latter available for control of their respective resistor elements, while the switch C remains disconnected and ineffective. Under these conditions the circuit is from positive main **308** to fixed contact M′, movable contact **316** to contacts **318** and **322**, from **318** to M^a, conductor **310** to positive contact A′ at switch A, and from **322** to M^b, conductor **312** to contact B′ at switch B.

This renders effective the switch A, so that by successive movement thereof to one or the other of its three "on" positions, it may bring the oven unit to its high, medium or low heat stage as desired. Similarly, the switch B is rendered effective, so that by moving it to one of its three successive "on" positions it may similarly energize the broiler unit or as an alternative may bring the left hot plate to its high or medium heating stage. Under these conditions, however, no current can be supplied to the right hot plate, so that the maximum input permitted in the first position of the master switch is limited to that represented by the maximum heat of the oven unit plus that either of the broiler or the left hot plate. Without the necessity of tracing the circuits, it will be seen that in the second position of the master switch the positive main **308** is connected through contacts **322** and **324** to the positive contacts B′ and C′ of the switches B and C, rendering the latter simultaneously effective, while the switch A is at the same time dead or ineffective. Similarly, in the third position of the master switch, the positive main is connected through contacts **320** and **324** to the positive contacts A′ and C′ and switches A and C, rendering the latter simultaneously effective, with the switch B dead or ineffective.

The circuit connections for controlling the oven unit will be apparent from the diagram. The stationary contact A^2 at the switch A is connected by conductor **326** to the end of one resistor wire for the oven heating unit, the corresponding end of the companion wire being connected to the negative main **328** leading to a base socket in the range casing. The opposite ends of the two resistor wires are joined and connected through conductor **330** to stationary contact A^3 at the switch A. In the first position of switch A, the interconnected movable contacts of the switch connect the positive terminal with conductor **330**, the current passing through the two resistor wires in multiple, and thence from one wire directly to the negative main, and from the other wire through conductor **326** to contact A^2 through the movable switch contacts to the stationary contact A^4 which is also connected to the negative main **328**. The circuit connections and switch contacts for the right hot plate *g* and the functioning of the switch C are substantially the same as those employed for the oven unit *d*, and require no detailed description.

The switch B in its first position connects the positive contact B′ with contact B^4 connected through conductor **332** to the joined ends of the resistor wires at the broiler unit *e*, the opposite joined ends of the resistor wires being connected to the negative main **328**, so that when rendered effective by the master switch M, the current passing through these resistor wires brings the broiler unit to its full heating stage.

In the second position of the switch B, the positive contact B′ is connected simultaneously to contacts B^2 and B^1, one of which is connected by conductor **334** to the end of one resistor wire on the left hot plate *h* and the other by conductor **336** to the corresponding end of the companion wire, so that the current passes through the two wires in multiple and to the negative main **328** through conductor **338** to which the opposite ends of both resistor wires are joined, bringing the heat to its high heat stage. In the third position of the switch B, the positive contact B′ is connected to contact B^3 and current will then pass through conductor **336** to the end of one of the two resistor wires, and through that wire alone to conductor **338** and negative main **328**, providing for the medium heat stage in the hot plate.

It will be seen that the master switch through which the current is applied to the several resistor wires acts as a selector, rendering ineffective one or another of the resistor switches and preventing the aggregate current input from

exceeding a maximum amount, substantially less than the total aggregate capacity of the four elements, while at the same time it affords numerous combinations between the four elements sufficient for domestic cooking.

It is to be understood that extensive changes may be made in the form, arrangement, relationship and mechanical construction of the individual elements constituting the range as shown in the illustrated embodiment thereof, all without departing from the broad spirit of the invention herein claimed, and that the individual elements herein described and claimed may be separately employed in combinations and connections other than herein shown where they constitute component parts of the disclosed form of range.

Having described my invention, what I claim is:

1. In an electric range, an internal oven shell and an external casing with intermediate heat insulation, said oven being formed with sheet metal walls, an angular throat for the open end of the oven formed of sheet metal, of lesser thickness than that of the oven walls, a door for the open end of the oven having an inner sheet metal wall closing the oven, and an angled sheet metal wall on the oven door adapted to seat against the angular throat of the oven and of lesser thickness than the inner wall of the door thereby to minimize heat conduction from the oven walls.

2. In an electric range, an internal oven shell and an external heat insulated casing, the oven having an angular throat extending through the door aperture in the front panel casing, an out-turned flange on the oven walls overlapping the walls of the front panel, inwardly projecting threaded studs attached to said flange and passing through the front panel, heat insulation between the front panel and the out-turned flange, and means within the casing engaging said threaded studs for clamping the flange to the panel.

3. In an electric range, an oven and an external heat insulated casing, an oven door hinged to the casing, said door comprising an internal, substantially rectangular door frame, an external sheet metal front panel, a sheet metal door lining secured to the frame, angular enclosing walls united to the lining extending through the door aperture and forming between the lining and front panel an enclosed heat insulating space also enclosing said door frame, a screw connecting the inner lining to said door frame, and hinge and handle connections connecting said external panel to said door frame.

4. In an electric range, an external casing and an internal oven with intermediate heat insulation, a door adapted to close said oven and a heat conducting member between a wall of the oven and a wall of the casing comprising a metallic spool having its ends bearing one against an outer wall of the oven and the other against an inner wall of the casing.

5. An electric range having a casing, an insulated oven within said casing, electric heating elements in said oven, a heating unit carrying a resistor externally arranged on said casing, a pivoted arm on which said unit is mounted, said casing presenting a space underlying the same into which the unit when out of use may be housed by swinging said arm, stationary contacts on said casing, and contacts carried by the arm adapted to engage with said stationary contacts when the unit is swung to a position of use and to be disengaged when swung to a position of disuse.

6. An electric range having a casing, an insulated oven within said casing, electric heating elements in said oven, supports for said casing, a heating unit externally arranged on said casing, a swinging arm carrying said unit pivotally mounted on said casing, to swing in a substantially horizontal plane beneath the casing, and a support for said unit adapted to be lowered when the unit is swung into a position of use.

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