March 11, 1952 J. A. JOHNSON 2,589,088

DRYING CLAYWARE AND OTHER GOODS

Filed July 25, 1947 3 Sheets-Sheet 1

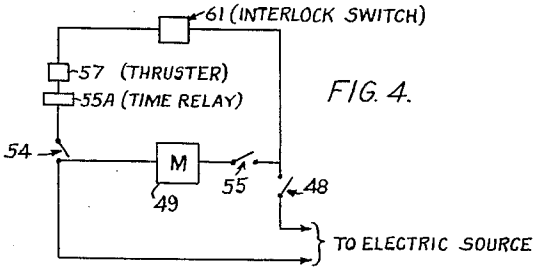
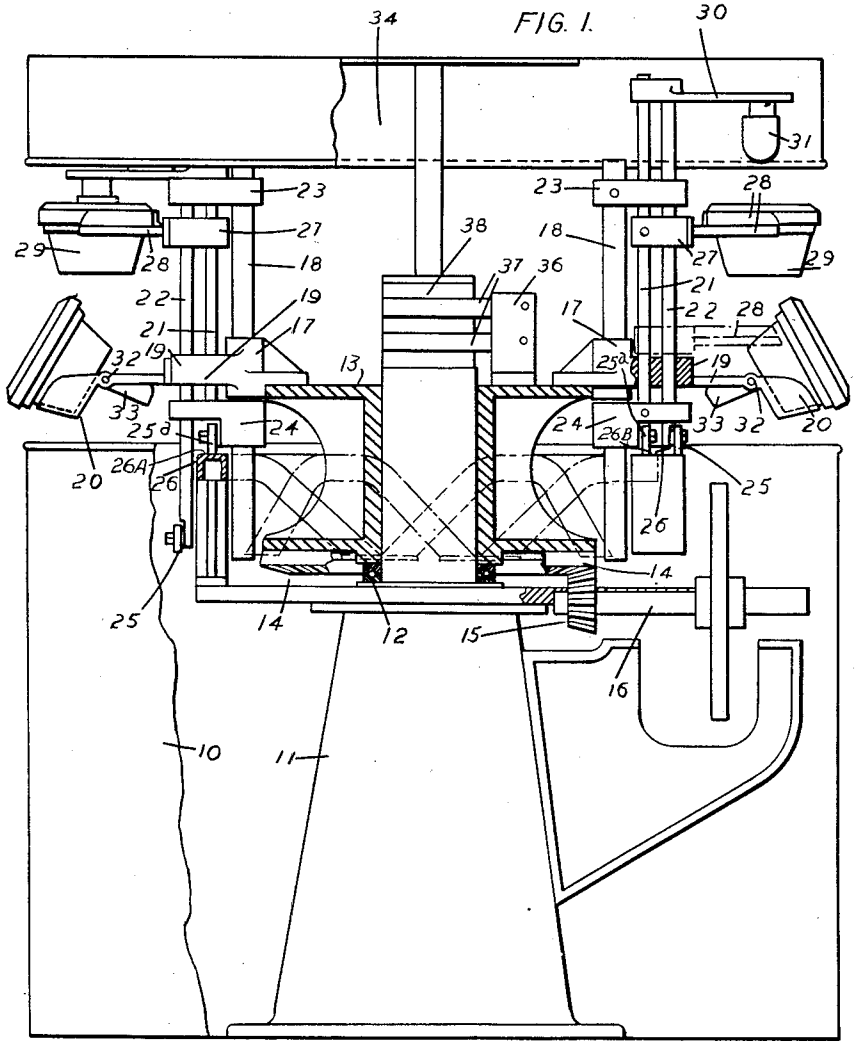


FIG. 4.

FIG. 1.



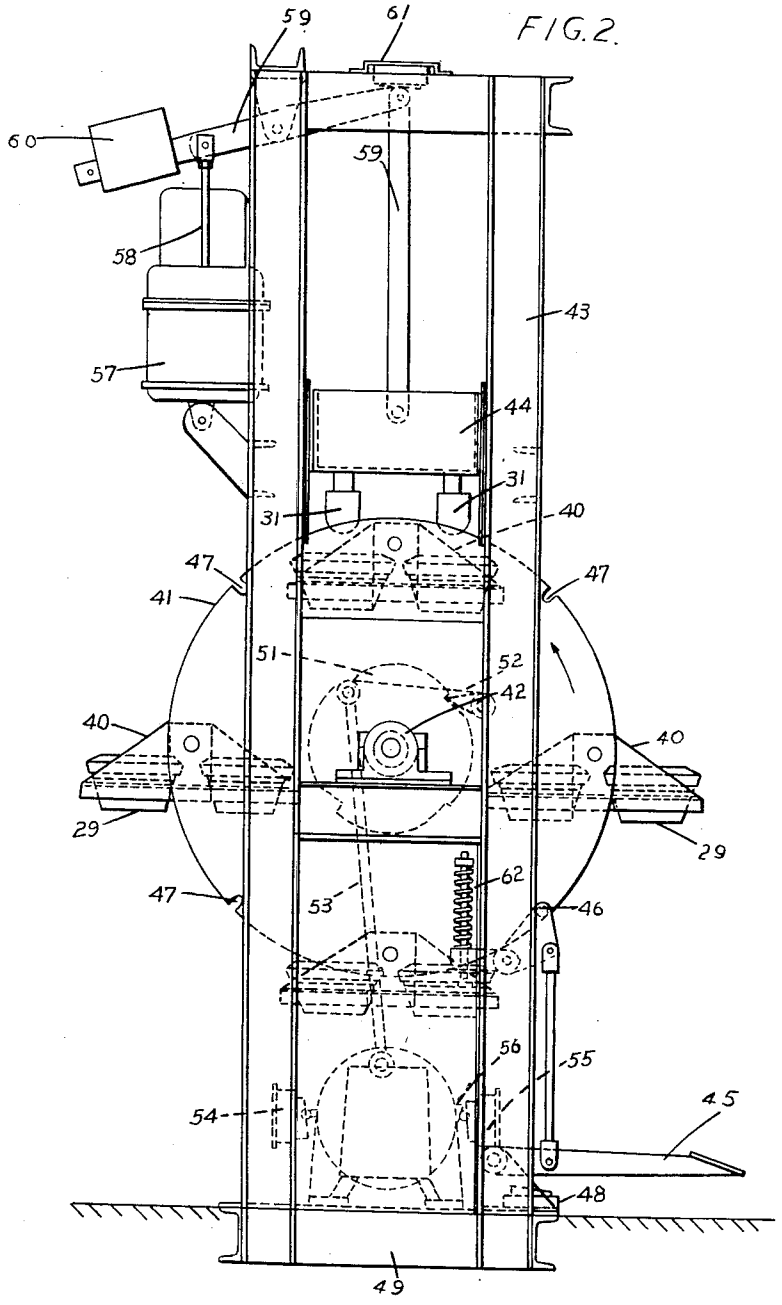
Inventor,
JOHN ARTHUR JOHNSON,
By
Attorney

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FIG. 2.



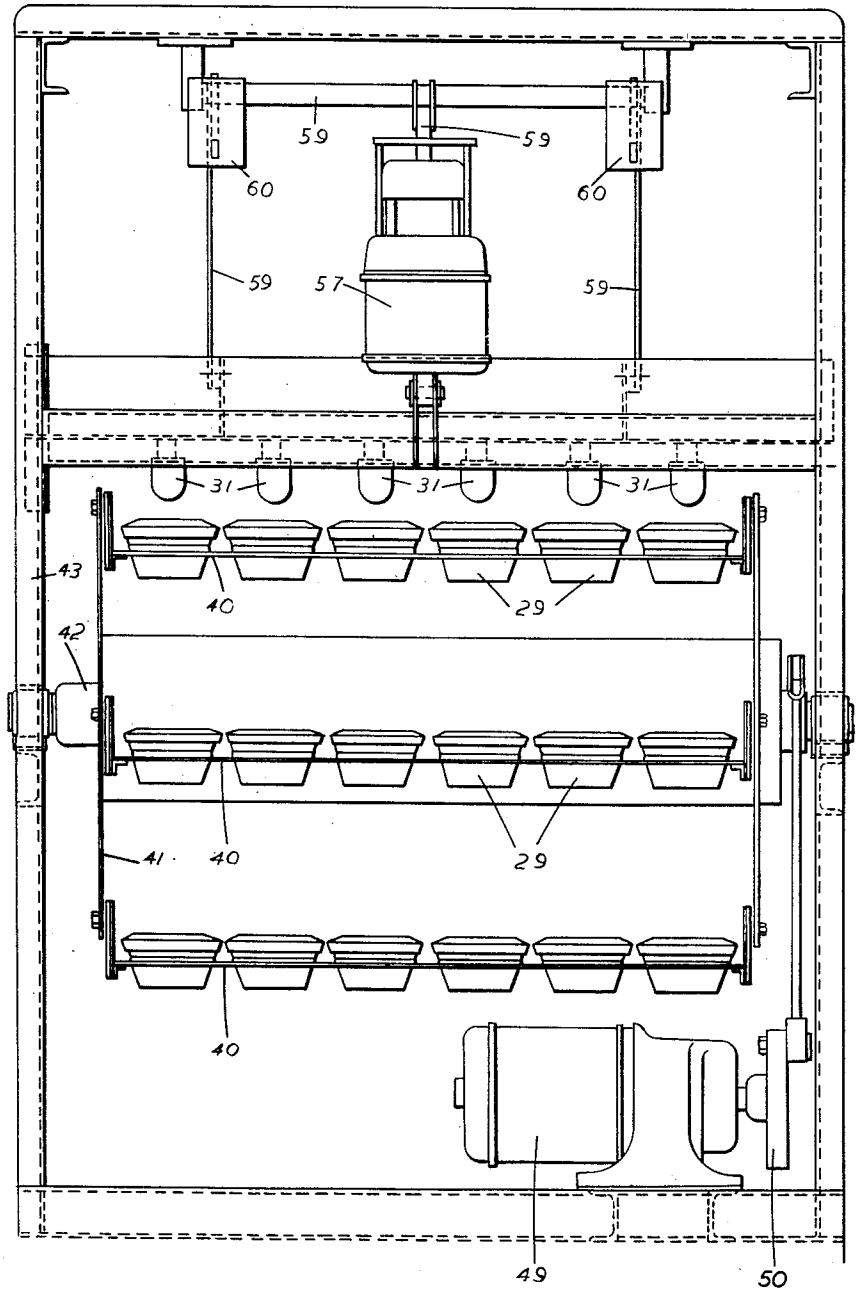
Inventor
JOHN ARTHUR JOHNSON,
by
Byrd Attorney

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FIG. 3.



Inventor,
JOHN ARTHUR JOHNSON,
by
Attorney

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DRYING CLAYWARE AND OTHER GOODS

John Arthur Johnson, Stoke-on-Trent, England

Application July 25, 1947, Serial No. 763,478
In Great Britain July 8, 1944

12 Claims. (Cl. 34—87)

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This invention relates to the drying of clayware and other goods; it is primarily intended for drying ceramic hollow-ware such as cups, although it may also be applied to flat ware such as plates.

The main objects of the invention are to provide more rapid, convenient and effective methods of drying, to provide compact and efficient apparatus for carrying out the improved methods, and generally to improve the technique in the drying of clay ware and other goods. A further object is to ensure that the more rapid drying of clayware is effected without damage to the moulds.

The invention consists in a method of drying according to which the pieces to be dried are placed in close proximity to heater elements the contours of which correspond with the outline of the pieces and which are interposed between the pieces and their sources of heat, so that there is a confined and localised radiation of heat from the heater elements on to the pieces.

It is necessary that there shall be a clearance between the heating face of the heater element and the face of the piece to be dried, and the amount of this clearance will necessarily vary according to the thickness of the piece, the nature of the material to be dried, the amount of moisture in the material and the time allowed for drying. It is desirable that the clearance shall be as nearly uniform as possible, or in other words, that the heater element shall correspond as closely as possible with the shape of the piece; obviously an exact correspondence will not usually be practicable, since a different contour would be needed for every different shape of cup or other article; it will therefore probably be preferable to employ heater elements of domed or truncated conical shape which will suffice for a range of shapes. It is possible, however, to provide a range of different contours which can be interchanged on the rack, table or other structure on which the drying is carried out.

A simple way of carrying out the invention is to provide a table top having a number of circular upstanding members which serve to locate moulds therein in inverted positions. Centrally within each such locating ring is an upstanding domed or truncated conical contour, which when the mould is placed in position extends upwards within the cup or the like. Under the table top is a casing or enclosure and each domed or similar formation has a downwardly extending cylindrical or other extension within this enclosure. Each such extension receives heat from a gas burner or electric radiant, so that the domed top becomes very hot. The air may be exhausted from the enclosure by a fan or the like to avoid excessive humidity. This arrangement is only suitable for hollow-ware, as flat ware would fall out of the moulds when these were inverted.

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It is preferred, however, to carry out the invention by providing travelling supports for the goods to be dried and arranging so that during their travel the goods shall be brought into close proximity with the heating elements, either by movement of the goods or the heating elements or both. Apparatus of this nature will now be described with reference to the accompanying drawings.

Referring to the drawings which form a part of this specification:

Figure 1 is a vertical sectional elevation of one form of apparatus.

Figure 2 is an end view of another form of apparatus, the electrical circuit being omitted.

Figure 3 is a side view of the apparatus shown in Figure 2, and

Figure 4 is a diagrammatic representation of the electric circuit used in connection with the apparatus shown in Figures 2 and 3.

Referring to Figure 1, a boxing or casing 10 houses a central pedestal 11 upon which by means of a ball bearing 12 a drum 13 is rotatably mounted. The drum carries a bevel wheel 14 which is driven by another bevel wheel 15 mounted on a shaft 16 connected to any suitable source of power. The drum carries a series of brackets 17 equally spaced around it, each bracket carrying a vertical pillar 18 and being extended at 19 to carry a mould support 20 and also to act as a guide for two rods 21, 22. The rod 22 passes through upper and lower guides 23, 24. The rod 21 is secured to the member 24 and passes through the member 23. The rod 22 has a roller 25 mounted on its lower end and the member 24 carries a roller 25a. The rollers work in a camway 26 having an inner path 26A and an outer path 26B, the roller 25A riding along the path 26A while the roller 25 rides along the path 26B. The member 23 is secured to the pillar 18. The member 24 slides up and down the pillar 18. The rod 21 has fixed on it a bracket 27 carrying the forked arms 28 which partly encircle and hold a pottery mould 29. The other rod 22 is freely slidable through the bracket 27 and carries on its upper end a bracket 30 to which a heater element 31 of heat radiating material conforming to the shape of the clay-ware piece is attached and heated by an internal electrical resistance element from a rotating collector 36 carried by the drum 13 which takes current by means of brushes 37 from a stationary distributor 38. The lower mould support 20 is pivoted at 32 to the member 19 and is held vertical by a counterbalance weight 33. When a mould is deposited into the support as shown, however, the weight of the mould overcomes the counterbalance and the support is tilted outwards, in which position the removal of the dried piece from the mould is greatly facilitated. In operation a mould containing a piece to be dried is first placed on the

arms 28 at the right hand side of Figure 1, and as the drum structure rotates the action of the cam-way becomes effective. First the rod 22 is allowed to lower itself through its guides, which lowers the heater element 31 into the mould so that the drying of the piece commences. In this position the heater element and the mould rotate together for any suitable distance, determined by the pattern of the inner and outer paths 26A and 26B of the cam-way. The parts are shown in this position at the left hand side of Figure 1. It will be understood that the structure will only rotate slowly so that any reasonable drying period can be allowed for. At the conclusion of this period the pattern of the path 26B cam-way raises the rod 22 again, and so withdraws the heater element from the mould. As perhaps more clearly shown at the left hand side of Figure 1, while the inner path 26A is present, the outer path 26B is discontinued in order to permit the roller 25 to drop so that the heater element will enter the mould. At about the same position, or so soon thereafter as may be convenient or desirable, the mould itself is allowed to be lowered by the lowering of the other rod 21 under the action of the cam-way, and the arms 28 deposit the mould into the pivoted support 20. The weight of the mould now tilts this support against the action of its counterbalance 33, and the support in tilting removes the mould from the forked arms 28: the latter are therefore free to be lifted again to their original height ready to receive another mould when they have travelled round to the loading position again. Meanwhile the dried piece is removed from the mould in its lowered tilted position, and the mould is left on the tilted support to be carried back to the point of loading. During this travel the empty mould can be removed at any suitable point, whereupon the counterbalance weight restores the support to the vertical position, ready to receive the mould on the next cycle of the machine. The heater elements are located normally within a hood 34 and when the heater element together with its carrying bracket is lowered into the mould the heater element 31 and bracket 30 pass through the open bottom of the hood. The heat from the hood is carried away by a suitable vent.

Referring to Figures 2 and 3 the moulds 29 are carried by trays 40, any suitable number of moulds to a tray. The trays, four as shown or any other convenient number, are carried lengthwise of a rotary drum (or any other suitable means of support, for example a chain conveyor) capable of intermittent part-rotary movement. The end plates 41 of the drum are mounted in bearings 42 in a frame 43. The frame also carries above the drum in a vertically sliding manner a heating unit 44 carrying a corresponding number of depending heater elements 31 to the number of moulds 29 in each tray 40. The trays are loaded at one side, say for example at the right hand side of Figure 2, and the drum is then rotated throughout 90° so that this loaded tray in the arrangement shown, although this is not essential, is in the top dead centre position. In this position the heater elements 31 now descend vertically into the moulds and dry the pieces. Meanwhile the next tray is in the loading position being filled with moulds. A sufficient time for drying having elapsed, the drum is rotated through a further 90°, the now dried pieces being removed at the opposite side of the machine from the loading position, while the second tray of moulds is in the drying position and the third is being loaded.

When the drum is again rotated through 90°, the first tray of empty moulds descends into the bottom dead centre position, the second tray descends into the unloading position, the third tray is in the drying position, and the fourth tray is being loaded. With a further 90° rotation the cycle is completed, the moulds are taken from the first tray and refilled. The four positions of rest may be altered to allow the third stage to be used for allowing the moulds and pieces to cool, and the fourth for unloading. The rotation of the drum is commenced by the operator pressing down a pedal 45 which withdraws a stop roller 46 from a recess 47 in the end plate 41 of the drum. With reference to Figure 4, it can be seen that the actuation of the pedal simultaneously operates a starting switch 48 of the circuit for electric motor 49. The motor rotates a crank disc 50 which during its first 180° rotation moves a ratchet plate 51 and pawl 52 through 90° by means of a connecting rod 53; the drum is thereby rotated through the required amount of 90° at a time. The remaining 180° movement of the crank disc is idle stroke and has the effect of returning the pawl plate and pawl to their original positions in readiness for the next 90° movement of the drum. The circuit to the motor is broken by a limit switch 55 which is actuated by a cam 56 on the periphery of the crank disc 50. When the crank disc has completed the first 180° movement the cam 56 actuates a limit switch 54 which completes the circuit to energize a time relay 55A, the relay being of conventional type. The energization of the relay 55A actuates a thruster mechanism 57 preferably of the electric solenoid type. As clearly shown in Figure 2, the plunger 58 of the thruster mechanism is operatively connected to the drying unit 44 by levers 59 and when the solenoid is energized, the plunger 58 will move upwardly and, as a consequence, lower the drying unit 44 so that the heater elements will enter the moulds. This timing relay is adjustable so that the drying time can be varied, and at the conclusion of the time the relay 55A open-circuits the thruster which is thereby de-energised and its plunger 58 falls to its lowered position as shown under the action of counterbalance weights 60. The heater elements 31 are thus withdrawn to their raised position clear of the moulds. This action operates an interlock switch 61 on the top of the frame which completes the circuit ready for the operator to initiate the next movement of the drum by depressing the pedal 45. The interlock switch 61 ensures that the heater elements are into the top position clear of the moulds before rotation can take place. The pedal 45 will be disengaged by the operator, or automatically, as soon as the drum begins to rotate, so that the locking roller 46 can ride on the drum flange until the next recess 47 is reached, when a spring 62 will act to force the roller into the recess and stop the machine.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. Apparatus for drying clay-ware including a movable carrier, a group of heater elements of heat radiating material conforming to the shape of the clay-ware pieces carried by said carrier, a source of heat for said heater elements, a second movable carrier in spaced relation with the first carrier, means on said second carrier for supporting the clay-ware pieces to be dried, means for moving said carriers, and further means for imparting movement to at least one

of the carriers toward the other of said carriers whereby the heater elements are brought into spaced nested relation to the clay-ware pieces to be dried so that the radiation of heat from said heater elements is confined to the surfaces of the pieces in proximity to the heater elements.

2. Apparatus as claimed in claim 1 wherein means is provided to move said carriers intermittently and further means is provided to move one of the carriers toward the other carrier during the interval between the intermittent movements.

3. Apparatus for drying clay-ware including a series of heater elements of heat radiating material conforming to the shape of the clay-ware, a series of supports for the clay-ware, means for imparting travelling movement to the heater elements and means for imparting corresponding travelling movement to the clay-ware, further means for moving the heater elements into spaced nested relationship to the clay-ware while travelling so that the radiation of heat from said heater elements is confined to the surfaces of the clay-ware in proximity to the heater elements.

4. Apparatus for drying clay-ware comprising a rotary structure, a series of supports for clay-ware pieces on said structure, a series of heater elements of heat-radiating material conforming to the shape of the clay-ware pieces on said structure, means for rotating the structure, and means for moving the clay-ware pieces and the heater elements toward and away from each other during rotation of the structure whereby said pieces and said heater elements are thereby brought into spaced nested relation so that the radiation of heat from said heater elements is confined to the surfaces of the pieces in proximity to the heater elements.

5. Apparatus as claimed in claim 4 wherein the movement of the pieces and heater elements toward and away from each other is effected by cam mechanism.

6. Apparatus according to claim 4 wherein the movement of the pieces and heater elements toward and away from each other is such as to cause the heater elements to move into spaced nested relation with the pieces and to remain in such relationship for a sufficient period of time for drying and then move the heater elements away from the pieces.

7. Apparatus according to claim 4 including two separate vertically spaced series of supports for the clay-ware pieces, pivotal mountings on the lower series, counterbalance weights associated with said mountings, and means causing the upper series of supports to descend, the effect of such descent being to deposit the clay-ware pieces on to the lower supports, thereby overbalancing said counterweights and tilting the lower supports so that the pieces are thereby removed from the upper supports, said means thereafter causing the upper supports to rise again in readiness for re-loading with fresh clay pieces.

8. Apparatus according to claim 7 wherein the means causing the movement of the upper series of supports includes members operatively associated with the supports and a cam-way along which said members travel.

9. Apparatus for drying clay-ware comprising a drum, a series of trays swingably supported by said drum adapted to carry a series of clay-ware pieces, means for imparting a succession of limited rotary movements to the drum, a structure associated with said drum, a series of heater elements of heat-radiating material conforming to the shape of the clay-ware pieces on said structure, and means for bringing the heater elements

into spaced nested relation with the pieces in at least one of the positions into which the trays are carried by the intermittent rotation of the drum so that the radiation of heat from said heater elements is confined to the surfaces of the pieces in proximity to the heater elements.

10. Apparatus according to claim 9 including means for arresting the drum after each of its rotary movements, and means associated with the drum for actuating the structure to bring the heater elements into drying relationship with the pieces, and for returning the heater elements to their former position preparatory to further rotation of the drum.

11. Apparatus according to claim 9 including a motor, a crank disc driven by said motor, said crank disc being adapted to drive the drum, switches actuated by said crank disc, one of said switches being adapted to stop the motor and another to energise a time relay, a thruster mechanism actuated by said time relay, said thruster being adapted after the motor has stopped to depress said heater elements for a predetermined period, said thruster being then de-energised and the heater elements returned, and an interlock switch associated with the motor circuit, said interlock switch being operated when the heater elements are returned and operating to complete the circuit ready for the motor to be re-started.

12. An apparatus for drying clay-ware comprising a movable carrier, a heater element of heat radiating material conforming to the shape of the clay-ware piece carried by said carrier, a source of heat for the heater element, a second movable carrier in spaced relation to the first named carrier, means on the second carrier to support the clay-ware piece to be dried, means to move said carriers, and further means to impart movement to at least one of the carriers toward the other of the carriers whereby the heater element is brought into spaced nested relation to the clay-ware piece so that the radiation of heat from the heater element is confined to the surfaces of the piece in proximity to the heater element.

JOHN ARTHUR JOHNSON.

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