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(73) Proprietor: **K&S (201) LIMITED**
31 Ironmarket
Newcastle-under-Lyme
Staffordshire (GB)

(72) Inventor: **WEDGWOOD, Sidney, Interdri Limited,**
Spencroft Road
Holditch Industrial Estate,
Chesterton
Newcastle-under-Lyme,
Staffordshire ST5 (GB)

(74) Representative: **Sales, Robert Reginald**
Swindell & Pearson,
48 Friar Gate
Derby DE1 1GY (GB)

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Description

This invention concerns improvements in or relating to apparatus for, and a method of, drying ware, and to automatic ware forming machines.

In a conventional automatic ware forming machine, such as for making mugs, clay is supplied into a plaster of paris mould. The mould is subsequently moved to a making machine where the clay is pressed into the required shape to form ware. The mould is then passed under a plurality of streams of hot air or gas to dry the ware prior to the removal thereof from the mould for subsequent processing. A plurality of such moulds are generally carried on the machine by an endless chain or belt, or on a carousel.

DE 3104499 discloses a drying oven including a chamber in which a large number of ceramic articles can be located. An air flow is provided through the chamber such that reduced pressure is provided therein.

According to the present invention there is provided ware drying apparatus comprising a mould upon which ware can be carried, the mould defining a chamber for the ware, selectively operable means for substantially closing the chamber, means for producing below ambient pressure in the chamber, and means for applying heat therein, characterised in that the apparatus is arranged such that ware is locatable between the heat applying means and the mould.

Preferably the apparatus includes means for providing a flow of gas through the chamber. The gas flow may be of air or any other suitable gas or mixture of gases.

The closing means may comprise a cover engageable with an upper part of the chamber.

The cover and/or chamber may be movable relative to each other in a substantially vertical direction between a lowered position of the cover engaging the chamber and a raised disengaged position.

One or more apertures may be provided in the apparatus through which the flow of gas may enter into the chamber. The or each aperture may be provided in the cover.

The apparatus may also comprise means for sealingly closing a hole in a lower part of the chamber. The lower hole closing means may be operable by virtue of below ambient pressure being produced in the chamber.

The lower hole closing means may comprise a closure member movable between a position closing said hole and a position clear from said hole, the position preferably being spaced beneath the hole.

The heat applying means is preferably constructed so as to be locatable within hollow ware

when the chamber is closed. Alternatively the heat applying means may be locatable substantially adjacent flatware within the chamber.

The heat applying means may comprise an electrical heating element which may be mounted on the cover. The heating element preferably provides radiant heat and is desirably controllable. The heating element preferably comprises a plurality of heating zones which may be separately controllable. The heating element may be an infra red radiation source.

One or more of the apertures permitting gas to enter the chamber may be provided adjacent the heat applying means such that gas entering the chamber is warmed.

The means for producing below ambient pressure may comprise a vacuum pump in communication with the interior of the chamber, preferably through the cover.

The communication with the vacuum pump may provide an outlet from the interior of the chamber through which the gas may flow. Preferably the means for producing below ambient pressure substantially causes the gas flow through the chamber.

Alternatively, the means permitting gas to flow through the chamber may be provided by pores in the mould structure. A coating may be applied to the mould to reduce the porosity to a suitable value.

Also according to the present invention there is provided an automatic ware forming machine including drying apparatus according to any of the preceding thirteen paragraphs.

The ware forming machine preferably comprises a plurality of moulds movable along an endless path. Certain of the moulds are arranged to locate in part of the endless path at any one time, and the drying apparatus is preferably in operative relationship with the moulds when the latter are in said part of the path, preferably providing a drying unit for each mould in said part of the path. Said part of the endless path is desirably positioned between a location where clay can be shaped in moulds to form ware and a location where shaped ware can be removed from the moulds.

Said part of the endless path may comprise zones such that different drying conditions may be applied to the moulds in each zone.

The machine may include means for introducing warm air on to the moulds subsequent to removal of the shaped ware and prior to filling with clay. The warm air introducing means is preferably in communication with an arrangement for warming air by passing air over the heat applying means of the drying apparatus not located in moulds.

The drying apparatus may be mounted on a movable carrier located above said part of the

endless path and selectively lowerable to engage with respective moulds on the path and the carrier may comprise a rotatable carousel.

The machine may be operable on any of hollow ware, flatware, cast ware, moulded ware, and pressed ware.

Further according to the present invention there is provided a method of drying ware in a mould, the method comprising substantially closing the mould, producing below ambient pressure in the closed mould, and applying heat, characterised in that the ware is located between the heat applying means and the mould.

A flow of gas may be provided through the mould.

The below ambient pressure may be produced during only a part of the drying method. The below ambient pressure may be ceased when the percentage of water in the ware has been reduced to a predetermined percentage, which may be in the range 2-6%.

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings in which:-

Fig. 1 is a diagrammatic sectional side view of part of an automatic ware forming machine according to the invention;

Fig. 2 is a plan view of the machine of fig. 1;

Fig. 3 is a diagrammatic side view of part of the machine of fig. 1;

Fig. 4 is a diagrammatic sectional side view of part of an automatic ware forming machine according to a second embodiment of the present invention;

Fig. 5 is a diagrammatic view of a part of an automatic ware forming machine according to a third embodiment of the present invention;

Fig. 6 is a similar view to fig. 1 of a modified machine according to the invention; and

Fig. 7 is a diagrammatic plan view of an automatic ware forming machine according to a fourth embodiment of the present invention;

Figs. 1 to 3 of the drawings show an automatic ware forming machine 10 suitable for forming hollow ware such as mugs. The machine 10 has an endless track 12 defined by side rails 14, 16 with a chain 18 running on the inner side rail 16. A first part 20 of the track 12 follows a substantial part of a circle, and a second part 22 extends therefrom to define an elbow outside of the circle.

A plurality of pairs of mould carriers 24 are respectively movably located on the rails 14, 16 with the outer carrier 24A mounting a guide wheel 26 and the inner carrier 24B being mounted on the chain 18. Mounted between each pair of the carriers 24 is an open ended frusto conical mould casing 28. A suitably shaped plaster of paris mould 30 is carried in the casing 28. A passage 32 is

provided through the base of the mould 30 to permit air to be sucked therefrom during the locating and shaping of clay therein. A washer 34 mounted on a vertically movable spindle 36 is located within a cavity 38 below the passage 32 such that in a raised position the washer 34 closes the lower end of the passage 32.

Provided at the downstream end, of the second part 22 of the track relative to the direction of movement of the chain 18, is a making machine 40 which shapes clay into ware within the moulds 30. Immediately upstream of the making machine 40 is a clay extruder 42 for supplying a required amount of clay into the moulds 30. Upstream of the extruder 42 is an area 44 where warm air can be blown onto the moulds 30 when empty to provide drying thereof prior to filling with clay. At the upstream end 46 of the second part 22 is a product transfer device (not shown) for removing ware after drying from the moulds 30 by for example means of suction.

Coaxially mounted above the first part 20 of the track is a carousel 48 which mounts around the perimeter a plurality of vertically aligned rams 50. A cap 52 is provided on the lower end of each ram 50. A downwardly pointing lip 54 is provided around the periphery of the cap 52 with an annular seal 56 on its lower edge. The cap 52 is dimensioned to sealingly close the upper end of a respective one of the mould casings 28, when lowered thereonto, and hence close the respective mould 30 within a chamber C. A cylindrical heating element 58 extends coaxially beneath the cap 52, and is of a size to fit within an item of ware 60 in the mould 30. An electric lead 62 extends through the cap 52 from the element 58. A passage 64 also extends through the cap 52 and connects via flexible piping 66 to a vacuum pump.

In use, the chain 18 and carousel 48 are driven and indexed relative to each other. As a mould 30 passes beneath the extruder 42 a required amount of clay is supplied therefrom. The making machine 40 subsequently presses the clay into the required shape against the sides of the mould 30 to form an item of ware. As the clay is being supplied into the mould 30 and shaped therein air is sucked through the hole 32 by a further vacuum pump (not shown) to assist these processes. As a mould 30 moves on to the first part 20 of the track it passes beneath the carousel 48 which is indexed to lower a cap 54 thereonto by the action of a respective one of the rams 50. When a cap 54 is thus fitted suction is applied through the piping 66 and passage 64. The reduced pressure created within the mould 30 causes the washer 34 to rise and thus close the passage 32. Simultaneously heat is applied internally of the mould 30 by the element 58. Heat and suction are applied as the mould travels around the

first part 20 until the second part 22 of the track is reached whereat the ram 50 raises the cap 52 off the mould 30. The ware 60 is subsequently removed from the mould 30 by the product transfer device and warm drying air blown onto the mould 30 at the area 44. The warm drying air may have been heated by passing over the heating elements 58 which are in a raised position.

In a second embodiment as shown in Fig. 4, relatively narrow inlet passages 63A are provided extending through the heating element 58. The inlets 63A connect the interior of the mould 30 with inlet passages 63B extending through the cap 52 to the exterior thereof. The suction of the vacuum pump draws air into the chamber C from outside through the inlets 63A,B. As air flows through the inlets 63A,B it is heated by the element 58. The air flows from the inlets 63A,B, through the chamber C and exits through the passage 64. This flow of warm air facilitates the drying of the ware by assisting the removal of the relatively wet atmosphere within the chamber C, through the passages 64 and replacing it with warm dry air. The warm air flow enables the temperature in the chamber C, to be reduced whilst still achieving effective drying. This is energy efficient and may help prolong the life of moulds. Instead of using air a supply of a specific gas or mixture of gases may be connected to the inlets 63B.

It is to be appreciated that the dimension and numbers of inlets 63A,B are predetermined relative to the capacity of the vacuum pump and the degree of reduced ambient pressure required in the chamber C. The making machine 40 can be used in forming and drying cast ware, moulded ware and pressed ware, including hollow ware and flatware.

Fig. 5 shows a part of a ware forming machine according to a third embodiment of the present invention, for drying flatware. The machine includes a mould casing 128 mountable between a pair of carriers (not shown) similar to the carriers 24A,B. A plaster of paris mould 130 is carried in the casing 128. A passage 132 is provided in the base of the mould 130 to permit air to be sucked therefrom during the locating and shaping of the clay therein. A washer and spindle arrangement (not shown) may be provided to close the end of the passage 132, to be operable in a similar manner to the washer 34 and spindle 36 described above.

A cap 152 is provided on the lower end of each ram on the carousel 48. The cap 152 has a downwardly extending wall 154 around its periphery which seals with the casing 128 on its lower edge, in a similar manner as hereinbefore described, to form a chamber C₂. A planar ceramic heating plaque 158 extends beneath the cap 152 to a position directly above the ware in the mould 130. The heating plaque 158 includes a plurality of

coaxial heating elements arranged in annular zones to enable the heating effect of the plaque 158 to be varied across the radius thereof. For example, if the ware is of relatively small diameter, (a saucer) then the heating effect may be required less towards the periphery of the casing 128 and more towards the centre. Consequently the zones towards the centre of the plaque 158 only would be activated. Electric leads 162 extend through the cap 152 from the plaque 158 to a heating control (not shown). The plaque 158 is an infra red radiation source, but any other suitable heating means may be used.

A passage 164 extends through the cap 152 and connects to a vacuum pump. One or more further passages 163 extend through the wall 154. These passages 163 provide inlets into the chamber C₂. Air is drawn into the chamber C₂ through the inlets 163 under the influence of the suction provided by the vacuum pump. The air flows through the chamber C₂ and exits through the passage 164. As it flows through the chamber C₂ the air is warmed by the plaque 158. The flow of air through the chamber helps the removal of water in the atmosphere of the chamber and thereby facilitates drying of the ware. Insulation 165 may be provided on the underside of the cap 152 to help reduce heat loss through the cap 152.

Fig. 7 Shows a ware forming machine 200 according to a fourth embodiment of the present invention, for drying flatware. The machine 200 has an endless track 212 which is substantially rectangular but one end of the rectangular extends outwardly to define an elbow 222. The track may take any conventional form such as illustrated in Figs. 1-3 and will thus not be described in any detail. A plurality of mould casings 128 bearing moulds 130, of the type illustrated in Fig. 5, are movably located on the track, their movement being precisely indexed.

Each side of the rectangle has a section 270 defining positions for ten adjacent casings 128. Between the respective sides of the rectangle are defined four further sections 272 of ten positions for the casings 128. Means are provided for moving the casings 128, normally all ten simultaneously on each section, between respective sections. Such moving means may comprise pivoting lift bars (not shown).

A cap 152 (Fig. 5) is provided above each of the positions of the sections 272. The cap 152 is movable by a ram to engage or disengage a casing 128 provided there beneath to permit drying of an article of flatware held in the casing.

A ware making machine 240 is provided at the apex of the elbow 222. Upstream of the making machine 240 are mould cleaning and mould conditioning equipment (not shown). Further upstream from this equipment is a stage (not shown) where

the ware is unloaded from the casings 128. The unloading stage may connect to a similar apparatus for white drying the ware. In such similar apparatus the ware is obviously not mounted in mould but suitable shape closable containers are provided in which the ware is supported. The white drying apparatus may subsequently connect to a kiln.

In use, the track 212 rotates in a clockwise directions as shown in Fig. 7. Movement of the track is precisely indexed to ensure that the casings 128 thereon move at precisely the required time and move to the exact required position. When ten casings 128 fill each of the positions in the section 270 the casings will be moved at a required time by pivoted arms to the respective positions in the lowermost (as shown in Fig. 7) section 272. In the section 272 caps 152 are lowered onto the casings 128 to provide a first drying at a required temperature for a required period. It has often been found advantageous in the first heating section 272 to only apply heat and not reduced pressure, thereby stabilising the ware. At the required time the casings are moved to the next section 272 where a further drying process is applied this time under reduced pressure. Two further such drying stages are carried out in the further section 272 and the casings 128 are finally moved onto the upper run of the track 212. The casings are then moved, again precisely indexed, to the unloading station where the ware is removed for subsequent drying and firing. The casings 128 and moulds 130 therein are thereafter cleaned and conditioned.

There are thus described automatic ware forming machines with a number of advantageous features. The provision of reduced pressure in the mould lowers the boiling point of water thus providing for enhanced drying. The suction from the vacuum pump and where provided the flow of gas through the chamber remove the steam and water vapour created away from the ware further enhancing drying. Closing the mould provides for more localised and thus efficient heating of the ware. Locating the heating element within the ware for hollow ware, and closely adjacent the ware for flat ware, and the ware being located between the heating element and the mould provides for less heating of and thus damage to the mould. Accordingly the required drying can be carried out more efficiently and quickly.

With the described machines the drying times have been reduced to 50-55 seconds from 90-100 seconds for hollow ware and from 19-20 minutes to 3-4 minutes for flatware. Accordingly it has been possible to make a machine with twenty-eight moulds rather than the conventional forty-five which thus reduces the floor space required which is often of a premium. This machine is ideally

suited for relatively small runs, in that gas is not required nor is the removal of burnt waste gases.

The drying process hereinbefore described refers primarily to the drying stage commonly termed "mould release". This is a state of dryness which when reached allows the ware to be removed from the mould. The percentage of water in the ware at this stage is usually in the range 10-15%.

Often the next stage is to further dry the ware, subsequent to removal from the mould, until the percentage of water in the ware is in the range 1-2%. This is commonly termed "white drying". The present invention may readily be used to "white dry" ware. In this instance the ware is placed on a support such as a perforated plate, within a substantially sealed container. An outlet to a vacuum pump and a heating element is provided within the container substantially as hereinbefore described. Gas inlets may also be provided in the container as described above. During operation, the pump causes an atmosphere in the container of below ambient pressure and also, if applicable, a flow of gas through the container as above. The vacuum pump may be turned off before the ware has been finally dried perhaps when the water content is in the order 3-5%. The removal of below ambient pressure prior to final drying has been found to reduce the likelihood of the dried ware cracking.

Various other modifications may be made without departing from the scope of the invention as defined in the accompanying claims. For example, as illustrated in fig. 4, the washer for closing the passage through the mould may be replaced by a short stroke ram 70 which closes the bottom surface of the mould casing 28 and hence mould 30. The moulds and/or caps may be moved by different means and the caps could be raised and lowered other than by the described rams, or the moulds could themselves be raised and lowered rather than the caps.

Also, the cap 52,152 and the corresponding lip 54 and wall 154 may seal directly onto the mould 30,130. This makes the provision of the casing 28,128 unnecessary. In such cases, the inlets for the gas may be provided by the pores in the structure of the mould. Further, a coating may be applied to the mould to reduce the porosity of the mould to a suitable value such that the drying process as hereinbefore described will function. Alternatively or additionally moulds of material other than plaster of paris may be used.

Claims

1. Ware drying apparatus (10) comprising a mould (30,130) upon which ware (60) can be carried, the mould (30,130) defining a chamber (C) for the ware (60), selectively operable

- means (52,152) for substantially closing the chamber (C), means (64,164) for producing below ambient pressure in the chamber (C), and means (58,158) for applying heat therein, characterised in that the apparatus (10,200) is arranged such that the ware is locatable between the heat applying means (58,158) and the mould (30,130).
2. Ware drying apparatus according to Claim 1, characterised in that the apparatus (10) includes means (32,63B,132) for providing a flow of gas through the chamber (C).
 3. Ware drying apparatus according to Claim 2, characterised in that the gas flow is of air.
 4. Ware drying apparatus according to any of the preceding Claims, characterised in that the closing means comprises a cover (64,164) engageable with an upper part of the chamber (C).
 5. Ware drying apparatus according to Claim 4, characterised in that the cover (64,164) and/or chamber (C) are movable relative to each other in a substantially vertical direction between a lowered position of the cover (64,164) engaging the chamber (C) and a raised disengaged position.
 6. Ware drying apparatus according to Claims 2 or 3, or Claims 4 or 5 when dependent on Claims 2 or 3, characterised in that one or more apertures (32,63B,132) is provided in the apparatus (10) through which the flow of gas may enter into the chamber (C).
 7. Ware drying apparatus according to Claim 6 when dependent on Claims 4 or 5, characterised in that the or each aperture (63B) is provided in the cover (52).
 8. Ware drying apparatus according to any of the preceding Claims characterised in that the apparatus (10) comprises means, (34) for sealingly closing a hole (32,132) in a lower part of the chamber (C).
 9. Ware drying apparatus according to Claim 8, characterised in that the lower hole closing means (34) is operable by virtue of below ambient pressure being produced in the chamber (C).
 10. Ware drying apparatus according to Claims 8 or 9, characterised in that the lower hole closing means comprises a closure member (34) movable between a position closing said hole and a position clear from said hole.
 11. Ware drying apparatus according to any of the preceding Claims, characterised in that the heat applying means (58) is constructed so as to be locatable within hollow ware (60) when the chamber is closed.
 12. Ware drying apparatus according to any of Claims 1 to 10, characterised in that the heat applying means (158) is locatable substantially adjacent flatware within the chamber.
 13. Ware drying apparatus according to any of the preceding Claims, characterised in that the heat applying means (58,158) comprises an electrical heating element.
 14. Ware drying apparatus according to Claim 13 characterised in that the heating element (58,158) is controllable.
 15. Ware drying apparatus according to Claim 14, characterised in that the heating element (158) comprises a plurality of heating zones.
 16. Ware drying apparatus according to Claim 15, characterised in that the heating zones are separately controllable.
 17. Ware drying apparatus according to any of Claims 13 to 16, characterised in that the heating element (158) is an infra red radiation source.
 18. Ware drying apparatus according to Claim 4 or any of Claims 5 to 17 when dependent on Claim 4, characterised in that the heat applying means (58,158) is mounted on the cover (52,152).
 19. Ware drying apparatus according to Claim 6, or any of Claims 7 to 18 when dependent on Claim 6, characterised in that one or more of the apertures (63B) permitting gas to enter the chamber (C) is provided adjacent the heat applying means (58) such that the gas entering the chamber, (C) is warmed.
 20. Ware drying apparatus according to any of the preceding Claims, characterised in that the means for producing below ambient pressure comprises a vacuum pump in communication with the interior of the chamber (C).
 21. Ware drying apparatus according to Claim 20 when dependent on at least Claim 4, charac-

- terised in that the vacuum pump communicates with the interior of the chamber (C) through the cover (52,152).
- 22.** Ware drying apparatus according to Claims 20 or 21 when dependent on at least Claim 2, characterised in that the communication (64,164) with the vacuum pump provides an outlet from the interior of the chamber (C) through which the gas may flow. 5 10
- 23.** Ware drying apparatus according to Claim 22, characterised in that the means for producing below ambient pressure substantially causes the gas flow through the chamber (C). 15
- 24.** Ware drying apparatus according to Claim 2, or any of Claims 3 to 23 when dependent on Claim 2, characterised in that the means permitting gas to flow through the chamber is provided by pores in the mould (30,130) structure. 20
- 25.** Ware drying apparatus according to Claim 24, characterised in that a coating is applied to the mould (30,130) to reduce the porosity to a suitable value. 25
- 26.** An automatic ware forming machine characterised in that the machine includes drying apparatus (10) according to any of the preceding Claims. 30
- 27.** A ware forming machine according to Claim 26, characterised in that the machine comprises a plurality of moulds (130) movable along an endless path (212). 35
- 28.** A ware forming machine according to Claim 27, characterised in that certain of the moulds (130) are arranged to locate in part (272) of the endless path (212) at any one time, and the drying apparatus is in operative relationship with the moulds (130) when the latter are in said part (222) of the path (212). 40 45
- 29.** A ware forming machine according to Claim 28, characterised in that a drying unit is provided for each mould (130) in said part (272) of the path. 50
- 30.** A ware forming machine according to Claims 28 or 29, characterised in that said part (272) of the endless path is positioned between a location where clay can be shaped in moulds (130) to form ware and a location where shaped ware can be removed from the moulds (130). 55
- 31.** A ware forming machine according to any of Claims 28 to 30, characterised in that said part (272) of the endless path comprises zones such that different drying conditions may be applied to the moulds (130) in each zone.
- 32.** A ware forming machine according to any of Claims 30 or 31, characterised in that the machine includes means for introducing warm air on to the moulds (130) subsequent to removal of the shaped ware and prior to filling with clay.
- 33.** A ware forming machine according to Claim 32, characterised in that the warm air introducing means is in communication with an arrangement for warming air by passing air over the heat applying means (158) of the drying apparatus not located in moulds (130).
- 34.** A ware forming machine according to any of Claims 27 to 33, characterised in that the drying apparatus (10) is mounted on a movable carrier located above said part (272) of the endless path and selectively lowerable to engage with respective moulds on the path.
- 35.** A ware forming, machine according to Claim 34, characterised in that the carrier comprises a rotatable carousel.
- 36.** A method of drying ware (60) in a mould (30,130), the method comprising substantially closing the mould (30,130), producing below ambient pressure in the closed mould (30,130), applying heat, characterised in that the ware (60) is located between the heat applying means (58,158) and the mould (30,130).
- 37.** A method according to Claim 36, characterised in that a flow of gas is provided through the mould (30,130).
- 38.** A method according to any of Claims 36 to 37, characterised in that the below ambient pressure is produced during only a part of the drying method.
- 39.** A method according to Claim 38, characterised in that the below ambient pressure is ceased when the percentage of water in the ware (60) has been reduced to a predetermined percentage.
- 40.** A method according to Claim 39, characterised in that the predetermined percentage is in the range 2-6%.

Patentansprüche

1. Vorrichtung (10) zum Trocknen von Ware, mit einer die Ware (60) tragenden Form (30, 130), wobei die Form (30, 130) eine Kammer (C) für die Ware (60) bildet, mit selektiv betreibbaren Mitteln (52, 152) zum festen Verschließen der Kammer (C), mit Mitteln (64, 164) zum Erzeugen eines unterhalb des Umgebungsdruckes liegenden Unterdrucks in der Kammer (C) und mit Mitteln (58, 158) zur Anwendung von Wärme in ihr, dadurch gekennzeichnet, daß die Vorrichtung (10, 200) so ausgebildet ist, daß die Ware zwischen den Wärmeanwendungsmitteln (58, 158) und der Form (30, 130) anordenbar ist. 5
2. Vorrichtung zum Trocknen von Ware nach Anspruch 1, dadurch gekennzeichnet, daß die Vorrichtung (10) Mittel (32, 63B, 132) zum Durchführen eines Gasstroms durch die Kammer (C) enthält. 10
3. Vorrichtung zum Trocknen von Ware nach Anspruch 2, dadurch gekennzeichnet, daß der Gasstrom aus Luft besteht. 15
4. Vorrichtung zum Trocknen von Ware nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Verschlußmittel eine Abdeckung (64, 164) enthalten, die mit einem oberen Teil der Kammer (C) in Eingriff bringbar ist. 20
5. Vorrichtung zum Trocknen von Ware nach Anspruch 4, dadurch gekennzeichnet, daß die Abdeckung (64, 164) und/oder Kammer (C) relativ zueinander in einer im wesentlichen vertikalen Richtung zwischen einer abgesenkten, mit der Kammer (C) in Eingriff stehenden Position und einer angehobenen, außer Eingriff stehenden Position der Abdeckung (64, 164) bewegbar sind. 25
6. Vorrichtung zum Trocknen von Ware nach Anspruch 2 oder 3, oder Anspruch 4 oder 5, wenn abhängig von Anspruch 2 oder 3, dadurch gekennzeichnet, daß eine oder mehr Öffnungen (32, 63B, 132) in der Vorrichtung vorgesehen sind, durch die der Gasstrom in die Kammer (C) eintreten kann. 30
7. Vorrichtung zum Trocknen von Ware nach Anspruch 6, wenn abhängig von Anspruch 4 oder 5, dadurch gekennzeichnet, daß die oder jede Öffnung (63B) in der Abdeckung (52) vorgesehen ist. 35
8. Vorrichtung zum Trocknen von Ware nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Vorrichtung (10) Mittel (34) zum dichten Verschließen eines Loches (32, 132) in einem unteren Teil der Kammer (C) enthält. 40
9. Vorrichtung zum Trocknen von Ware nach Anspruch 8, dadurch gekennzeichnet, daß die das untere Loch verschließenden Mittel (34) aufgrund von in der Kammer (C) erzeugtem, unterhalb des Umgebungsdrucks liegenden Unterdruck betätigbar sind. 45
10. Vorrichtung zum Trocknen von Ware nach Anspruch 8 oder 9, dadurch gekennzeichnet, daß die das untere Loch verschließenden Mittel ein Verschlußglied (34) enthalten, das zwischen einer das Loch verschließenden Position und einer vom Loch freien Position bewegbar ist. 50
11. Vorrichtung zum Trocknen von Ware nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Wärmeanwendungsmittel (58) so ausgebildet sind, daß sie bei geschlossener Kammer innerhalb einer hohlen Ware (60) anordenbar ist. 55
12. Vorrichtung zum Trocknen von Ware nach einem der Ansprüche 1 bis 10, dadurch gekennzeichnet, daß die Wärmeanwendungsmittel (158) innerhalb der Kammer einer flachen Ware im wesentlichen gegenüberliegend angeordnet werden können.
13. Vorrichtung zum Trocknen von Ware nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Wärmeanwendungsmittel (58, 158) ein elektrisches Heizelement enthalten.
14. Vorrichtung zum Trocknen von Ware nach Anspruch 13, dadurch gekennzeichnet, daß das Heizelement (58, 158) steuerbar ist.
15. Vorrichtung zum Trocknen von Ware nach Anspruch 14, dadurch gekennzeichnet, daß das Heizelement (158) eine Mehrzahl von Heizzonen enthält.
16. Vorrichtung zum Trocknen von Ware nach Anspruch 15, dadurch gekennzeichnet, daß die Heizzonen gesondert steuerbar sind.
17. Vorrichtung zum Trocknen von Ware nach einem der Ansprüche 13 bis 16, dadurch gekennzeichnet, daß das Heizelement (158) eine Infrarotstrahlungsquelle ist.

18. Vorrichtung zum Trocknen von Ware nach Anspruch 4 oder einem der Ansprüche 5 bis 17, wenn abhängig von Anspruch 4, dadurch gekennzeichnet, daß die Wärmeanwendungsmittel (58, 158) an der Abdeckung (52, 152) befestigt sind. 5
19. Vorrichtung zum Trocknen von Ware nach Anspruch 6 oder einem der Ansprüche 7 bis 18, wenn abhängig von Anspruch 6, dadurch gekennzeichnet, daß eine oder mehrere der Öffnungen (63B), die Gas in die Kammer (C) eintreten lassen, den Wärmeanwendungsmitteln (58) benachbart angeordnet sind, so daß das in die Kammer (C) eintretende Gas erwärmt wird. 10 15
20. Vorrichtung zum Trocknen von Ware nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Mittel zum Erzeugen des Unterdrucks eine mit dem Inneren der Kammer (C) in Verbindung stehende Vakuumpumpe enthalten. 20
21. Vorrichtung zum Trocknen von Ware nach Anspruch 20, wenn abhängig mindestens von Anspruch 4, dadurch gekennzeichnet, daß die Vakuumpumpe durch die Abdeckung (52, 152) hindurch mit dem Inneren der Kammer (C) verbunden ist. 25 30
22. Vorrichtung zum Trocknen von Ware nach Anspruch 20 oder 21, wenn abhängig mindestens von Anspruch 2, dadurch gekennzeichnet, daß die Verbindung (64, 164) mit der Vakuumpumpe einen Auslaß aus dem Inneren der Kammer (C) bildet, durch den hindurch das Gas strömen kann. 35
23. Vorrichtung zum Trocknen von Ware nach Anspruch 22, dadurch gekennzeichnet, daß die Mittel zum Erzeugen des Unterdrucks den Gasstrom durch die Kammer (C) im wesentlichen verursachen. 40 45
24. Vorrichtung zum Trocknen von Ware nach Anspruch 2 oder einem der Ansprüche 3 bis 23, wenn abhängig von Anspruch 2, dadurch gekennzeichnet, daß die den Gasstrom durch die Kammer ermöglichenden Mittel durch Poren in der Struktur der Form (30, 130) gebildet werden. 50
25. Vorrichtung zum Trocknen von Ware nach Anspruch 24, dadurch gekennzeichnet, daß eine Beschichtung auf die Form (30, 130) aufgebracht ist, um die Porosität auf einen geeigneten Wert zu reduzieren. 55
26. Automatische Warenformmaschine, dadurch gekennzeichnet, daß die Maschine eine Trocknungsvorrichtung (10) nach einem der vorstehenden Ansprüche enthält.
27. Warenformmaschine nach Anspruch 26, dadurch gekennzeichnet, daß die Maschine eine Mehrzahl von Formen (130) enthält, die entlang eines endlosen Weges (212) bewegbar sind.
28. Warenformmaschine nach Anspruch 27, dadurch gekennzeichnet, daß bestimmte der Formen (130) sich zu jeder Zeit in einem Teil (272) des endlosen Weges (212) befinden und die Trocknungsvorrichtung in Wirkbeziehung mit den Formen (130) steht, wenn diese in dem genannten Teil (222) des Weges (212) sind.
29. Warenformmaschine nach Anspruch 28, dadurch gekennzeichnet, daß in dem genannten Teil (272) des Weges für jede Form (130) eine Trocknungseinheit vorgesehen ist.
30. Warenformmaschine nach Anspruch 28 oder 29, dadurch gekennzeichnet, daß der genannte Teil (272) des endlosen Weges zwischen einer Stelle, wo zur Bildung der Ware Ton in die Formen (130) eingebracht werden kann, und einer Stelle, wo geformte Ware aus den Formen (130) entnommen werden kann, angeordnet ist.
31. Warenformmaschine nach einem der Ansprüche 28 bis 30, dadurch gekennzeichnet, daß der genannte Teil (272) des endlosen Weges Zonen enthält, so daß in jeder Zone verschiedene Trocknungsbedingungen auf die Formen (130) angewandt werden können.
32. Warenformmaschine nach einem der Ansprüche 30 oder 31, dadurch gekennzeichnet, daß die Maschine Mittel zum Einführen von Warmluft auf die Formen (130) anschließend an das Entfernen der geformten Ware und vor dem Befüllen mit Ton enthält.
33. Warenformmaschine nach Anspruch 32, dadurch gekennzeichnet, daß die Warmlufteinführungsmittel mit einer Einrichtung zum Erhitzen von Luft durch Leiten der Luft über die Wärmeanwendungsmittel (158) der nicht in den Formen (130) angeordneten Trocknungsvorrichtung in Verbindung stehen.
34. Warenformmaschine nach einem der Ansprüche 27 bis 33, dadurch gekennzeichnet, daß

die Trocknungsvorrichtung (10) auf einem bewegbaren Träger montiert ist, der oberhalb des genannten Teils (272) des endlosen Wegs angeordnet und wahlweise absenkbar ist, um mit den jeweiligen Formen auf dem Weg in Eingriff zu gelangen.

35. Warenformmaschine nach Anspruch 34, dadurch gekennzeichnet, daß der Träger ein drehbares Karussell enthält.

36. Verfahren zum Trocknen von Ware (60) in einer Form (30, 130), wobei das Verfahren ein festes Verschließen der Form (30, 130), Erzeugen eines unterhalb des Umgebungsdrucks liegenden Unterdrucks in der geschlossenen Form (30, 130) und Anwendung von Wärme enthält, dadurch gekennzeichnet, daß die Ware (60) zwischen den Wärmeanwendungsmitteln (58, 158) und der Form (30, 130) angeordnet ist.

37. Verfahren nach Anspruch 36, dadurch gekennzeichnet, daß ein Gasstrom durch die Form (30, 130) hindurch vorgesehen ist.

38. Verfahren nach einem der Ansprüche 36 oder 37, dadurch gekennzeichnet, daß der Unterdruck während nur eines Teils des Trocknungsverfahrens erzeugt wird.

39. Verfahren nach Anspruch 38, dadurch gekennzeichnet, daß der Unterdruck beendet wird, wenn sich der Wassergehalt in der Ware (60) auf einen vorbestimmten Gehalt verringert hat.

40. Verfahren nach Anspruch 39, dadurch gekennzeichnet, daß der vorbestimmte Gehalt im Bereich von 2-6% liegt.

Revendications

1. Appareil (10) de séchage d'articles, comprenant un moule (30, 130) sur lequel des articles (60) peuvent être portés, le moule (30, 130) définissant une chambre (C) pour les articles (60), des moyens (52, 152) actionnables sélectivement pour fermer substantiellement la chambre (C), des moyens (64, 164) pour produire une pression inférieure à l'ambiante dans la chambre (C), et des moyens (58, 158) pour y appliquer de la chaleur, caractérisé en ce que l'appareil (10, 200) est agencé en sorte que les articles peuvent être placés entre les moyens applicateurs de chaleur (58, 158) et le moule (30, 130).

2. Appareil de séchage d'articles selon la revendication 1, caractérisé en ce que l'appareil (10) comprend des moyens (32, 63B, 132) pour fournir un écoulement de gaz à travers la chambre (C).

3. Appareil de séchage d'articles selon la revendication 2, caractérisé en ce que l'écoulement de gaz est de l'air.

4. Appareil de séchage d'articles selon l'une quelconque des revendications précédentes, caractérisé en ce que les moyens de fermeture comprennent un couvercle (64, 164) pouvant se mettre en prise avec une partie supérieure de la chambre (C).

5. Appareil de séchage d'articles selon la revendication 4, caractérisé en ce que le couvercle (64, 164) et/ou la chambre (C) sont mobiles l'un par rapport à l'autre dans une direction sensiblement verticale, entre une position abaissée du couvercle (64, 164) en prise avec la chambre et une position soulevée hors de prise.

6. Appareil de séchage d'articles selon les revendications 2 ou 3, ou les revendications 4 ou 5 prises en dépendance des revendications 2 ou 3, caractérisé en ce qu'une ou plusieurs ouvertures (32, 63B, 132) est/sont prévue(s) dans l'appareil (10), à travers laquelle/lesquelles l'écoulement de gaz peut entrer dans la chambre (C).

7. Appareil de séchage d'articles selon la revendication 6 prise en dépendance avec les revendications 4 ou 5, caractérisé en ce que la ou chaque ouverture (63B) est prévue dans le couvercle (52).

8. Appareil de séchage d'articles selon l'une quelconque des revendications précédentes, caractérisé en ce que l'appareil (10) comprend des moyens (34) pour fermer hermétiquement un trou (32, 132) dans une partie inférieure de la chambre (C).

9. Appareil de séchage d'articles selon la revendication 8, caractérisé en ce que les moyens de fermeture (24) du trou inférieur sont actionnables par suite de ce qu'une pression inférieure à l'ambiante est produite dans la chambre (C).

10. Appareil de séchage d'articles selon la revendication 8 ou 9, caractérisé en ce que les moyens de fermeture du trou inférieur com-

prennent un élément de fermeture (34) mobile entre une position fermant ledit trou et une position dégagée dudit trou.

11. Appareil de séchage d'articles selon l'une quelconque des revendications précédentes, caractérisé en ce que les moyens applicateurs de chaleur (58) sont construits en sorte de pouvoir être placés à l'intérieur d'articles creux (60) lorsque la chambre est fermée. 5
12. Appareil de séchage d'articles selon l'une quelconque des revendications 1 à 10, caractérisé en ce que les moyens applicateurs de chaleur peuvent être placés sensiblement adjacents à des articles plats à l'intérieur de la chambre. 10
13. Appareil de séchage d'articles selon l'une quelconque des revendications précédentes, caractérisé en ce que les moyens applicateurs de chaleur (58, 158) comprennent un élément chauffant électrique. 15
14. Appareil de séchage d'articles selon la revendication 13, caractérisé en ce que l'élément chauffant (58, 158) est contrôlable. 20
15. Appareil de séchage d'articles selon la revendication 14, caractérisé en ce que l'élément chauffant (158) comprend une pluralité de zones chauffantes. 25
16. Appareil de séchage d'articles selon la revendication 15, caractérisé en ce que les zones chauffantes sont contrôlables séparément. 30
17. Appareil de séchage d'articles selon l'une quelconque des revendications 13 à 16, caractérisé en ce que l'élément chauffant (158) consiste en une source de rayonnement infrarouge. 35
18. Appareil de séchage d'articles selon l'une quelconque des revendications 5 à 17, prise en dépendance avec la revendication 4, caractérisé en ce que les moyens applicateurs de chaleur (58, 158) sont montés sur le couvercle (52, 152). 40
19. Appareil de séchage d'articles selon la revendication 6, ou l'une quelconque des revendications 7 à 18 prise en dépendance avec la revendication 6, caractérisé en ce qu'une ou plusieurs des ouvertures (638) permettant au gaz d'entrer dans la chambre (C) est/sont prévue(s) adjacente(s) aux moyens applicateurs de chaleur (58) en sorte que le gaz 45

entrant dans le chambre (C) est chauffé.

20. Appareil de séchage d'articles selon l'une quelconque des revendications précédentes, caractérisé en ce que les moyens de production d'une pression inférieure à l'ambiante comprennent une pompe à vide en communication avec l'intérieur de la chambre (C). 50
21. Appareil de séchage d'articles selon la revendication 20 prise en dépendance avec au moins la revendication 4, caractérisé en ce que la pompe à vide communique avec l'intérieur de la chambre (C) à travers le couvercle (52, 152). 55
22. Appareil de séchage d'articles selon la revendication 20 ou 21 prise en dépendance avec au moins la revendication 2, caractérisé en ce que la communication (64, 164) avec la pompe à vide fournit une sortie depuis l'intérieur de la chambre (C) à travers laquelle le gaz peut s'écouler.
23. Appareil de séchage d'articles selon la revendication 22, caractérisé en ce que les moyens de production d'une pression inférieure à l'ambiante provoquent substantiellement l'écoulement du gaz à travers la chambre (C).
24. Appareil de séchage d'articles selon la revendication 2, ou l'une quelconque des revendications 3 à 23, prise en dépendance avec la revendication 2, caractérisé en ce que les moyens permettant au gaz de s'écouler à travers la chambre consistent en des pores prévus dans la structure du moule (30, 130).
25. Appareil de séchage d'articles selon la revendication 24, caractérisé en ce qu'un revêtement est appliqué au moule (30, 130) pour réduire la porosité à une valeur convenable.
26. Machine automatique de formage d'articles, caractérisée en ce que la machine comprend un appareil de séchage (10) selon l'une quelconque des revendications précédentes.
27. Machine de formage d'articles selon la revendication 26, caractérisée en ce que la machine comprend une pluralité de moules (130) mobiles le long d'une voie sans fin (212).
28. Machine de formage d'articles selon la revendication 27, caractérisée en ce que certains des moules (130) sont agencés pour se placer à tout moment dans une partie (272) de la voie sans fin (212), et l'appareil de séchage est en

relation opérationnelle avec les moules (130) lorsque ces derniers sont dans ladite partie (222) de la voie (121).

- 29.** Machine de formage d'articles selon la revendication 28, caractérisée en ce qu'une unité de séchage est prévue pour chaque moule (130) dans ladite partie (272) de la voie. 5
- 30.** Machine de formage d'articles selon la revendication 28 ou 29, caractérisée en ce que ladite partie (272) de la voie sans fin est placée entre un endroit où de l'argile peut être mis en forme dans des moules (130) pour former les articles et un endroit où les articles formés peuvent être retirés des moules (130). 10 15
- 31.** Machine de formage d'articles selon l'une quelconque des revendications 28 à 30, caractérisée en ce que ladite partie (272) de la voie sans fin comprend des zones telles que des conditions de séchage différentes peuvent être appliquées aux moules (130) dans chaque zone. 20
- 32.** Machine de formage d'articles selon l'une quelconque des revendications 30 ou 31, caractérisée en ce que la machine comprend des moyens pour introduire de l'air chaud sur les moules (130) après le retrait des articles formés et avant le remplissage avec de l'argile. 25 30
- 33.** Machine de formage d'articles selon la revendication 32, caractérisée en ce que les moyens d'introduction d'air chaud sont en communication avec un ensemble pour chauffer l'air, en faisant passer l'air par-dessus les moyens applicateurs de chaleur (158) de l'appareil de séchage non situé dans les moules (130). 35 40
- 34.** Machine de formage d'articles selon l'une quelconque des revendications 27 à 33, caractérisée en ce que l'appareil de séchage (10) est monté sur un support mobile placé au-dessus de ladite partie (272) de la voie sans fin et abaissable de manière sélective pour se mettre en prise avec des moules respectifs sur la voie. 45
- 35.** Machine de formage d'articles selon la revendication 34, caractérisée en ce que le support comprend un carrousel rotatif. 50
- 36.** Procédé de séchage d'articles (60) dans un moule (30, 130), le procédé comprenant substantiellement le fait de fermer le moule (30, 130), de produire une pression inférieure à l'ambiante dans le moule fermé (30, 130), 55

d'appliquer de la chaleur, caractérisé en ce que les articles (60) sont placés entre les moyens applicateurs de chaleur (58, 158) et le moule (30, 130).

- 37.** Procédé selon la revendication 36, caractérisé en ce qu'un écoulement de gaz est établi à travers le moule (30, 130).
- 38.** Procédé selon l'une quelconque des revendications 37 à 67, caractérisé en ce que la pression inférieure à l'ambiante est produite pendant seulement une partie du procédé de séchage.
- 39.** Procédé selon la revendication 38, caractérisé en ce que la pression inférieure à l'ambiante est arrêtée lorsque le pourcentage d'eau dans les articles (60) a été réduit jusqu'à un pourcentage prédéterminé.
- 40.** Procédé selon la revendication 39, caractérisé en ce que le pourcentage prédéterminé est dans le domaine de 2 à 6%.

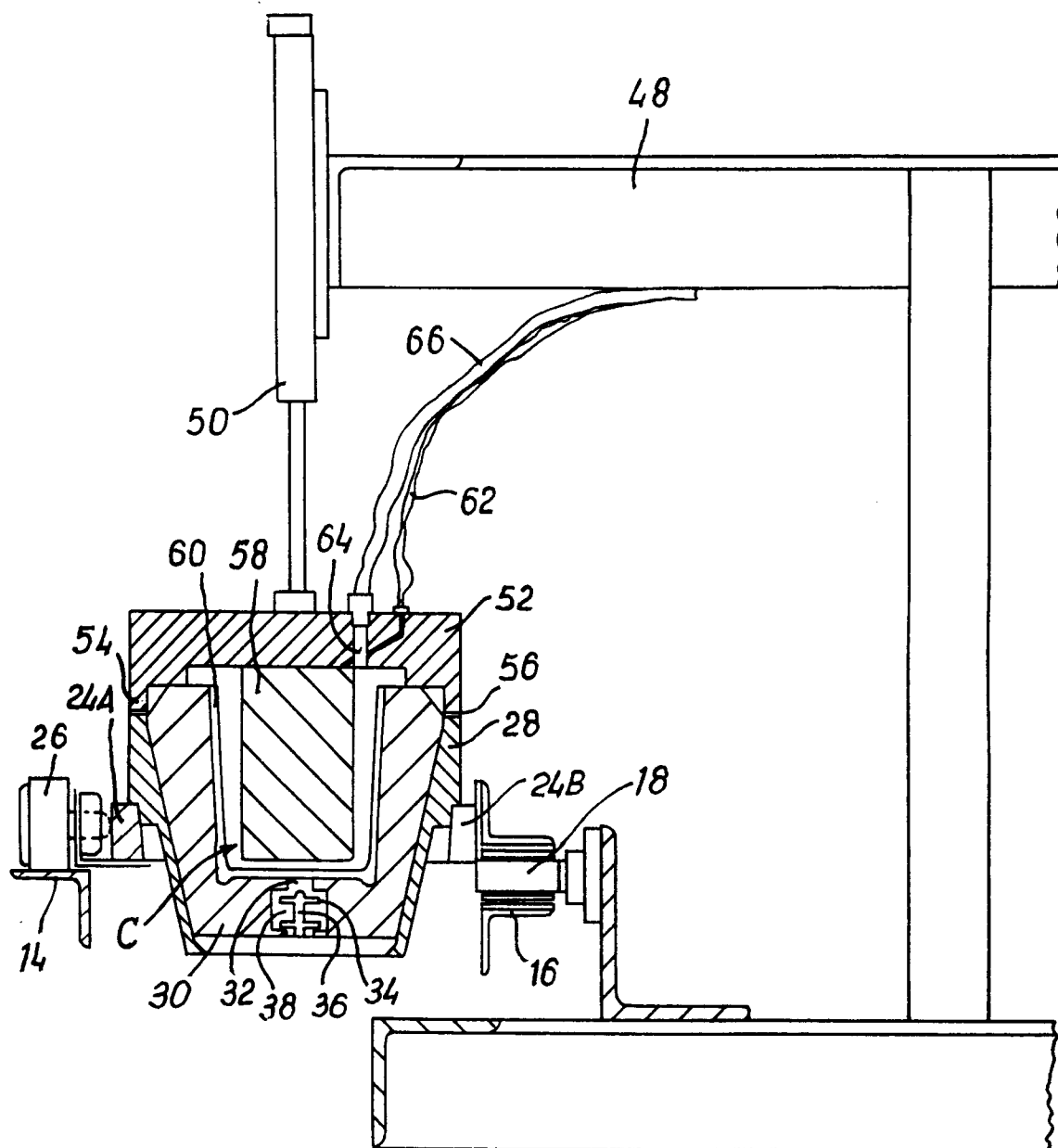
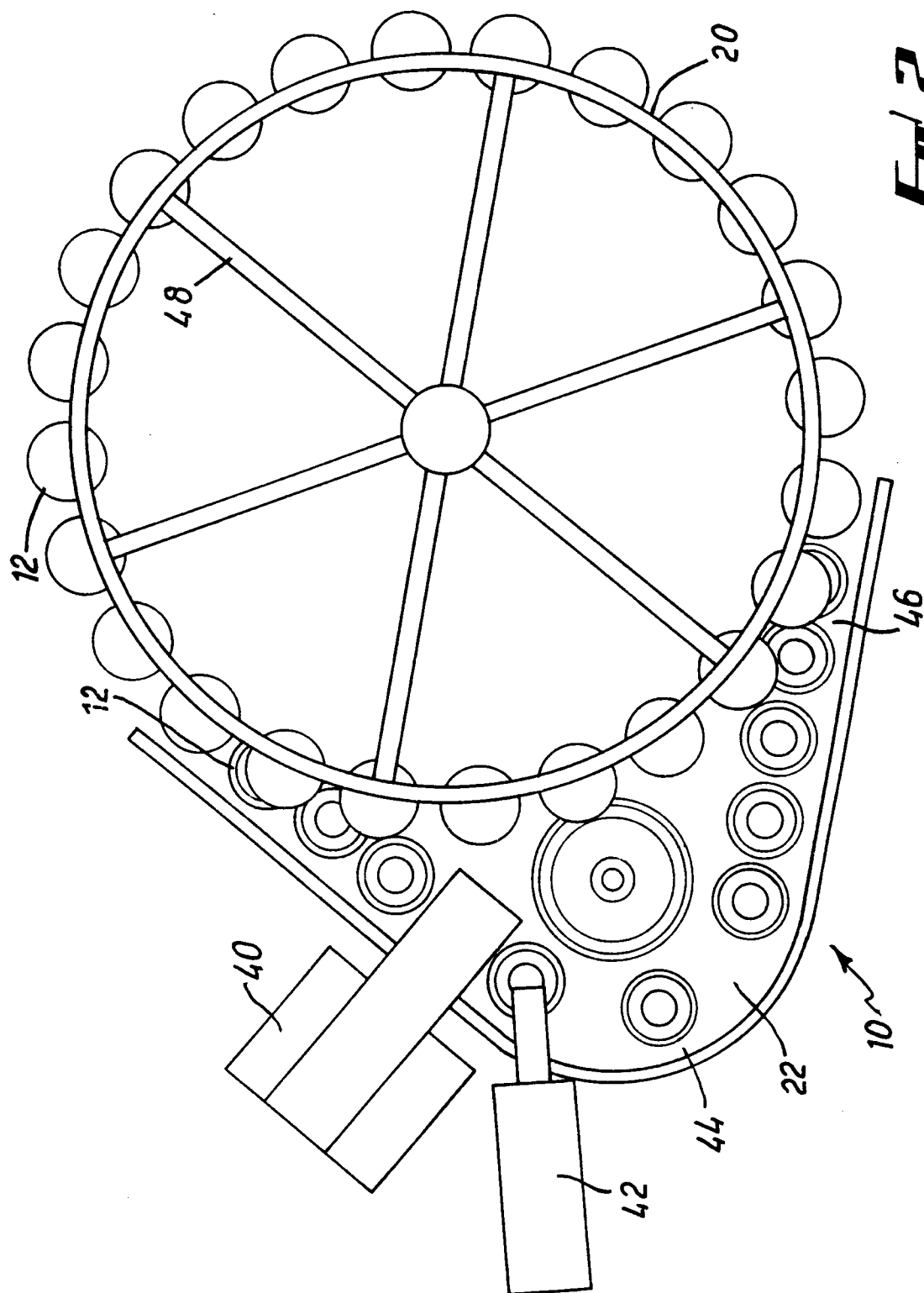


FIG. 1



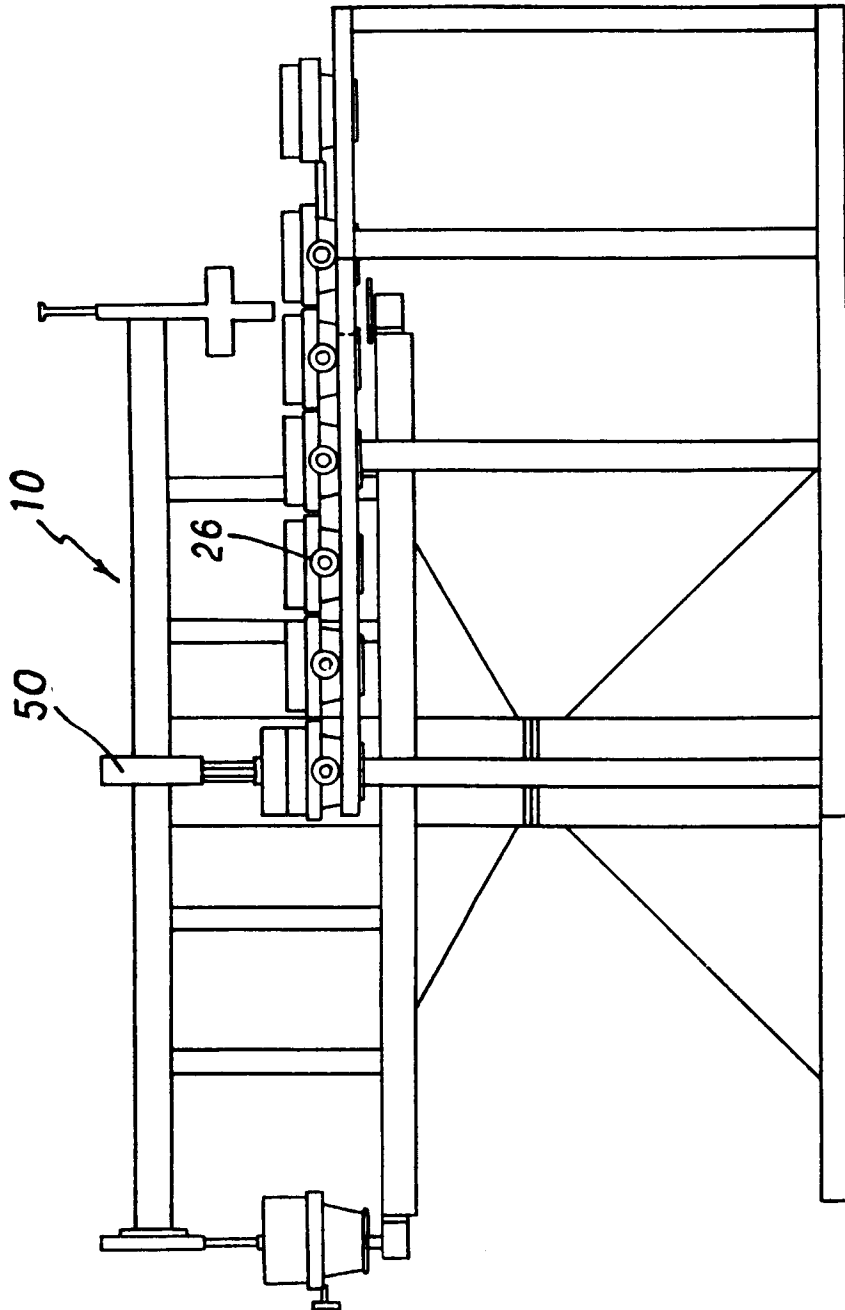


Fig. 3

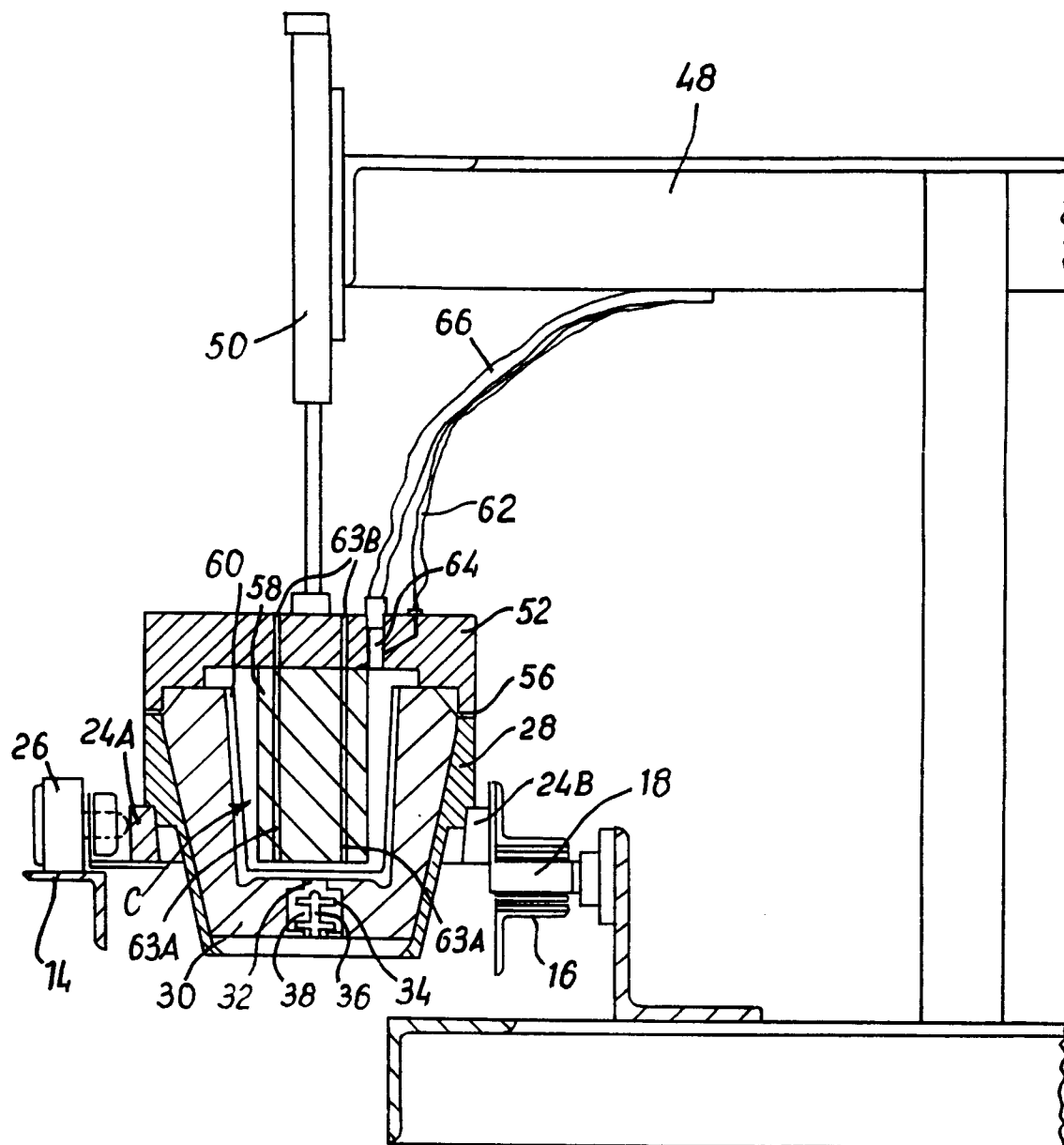


FIG. 4

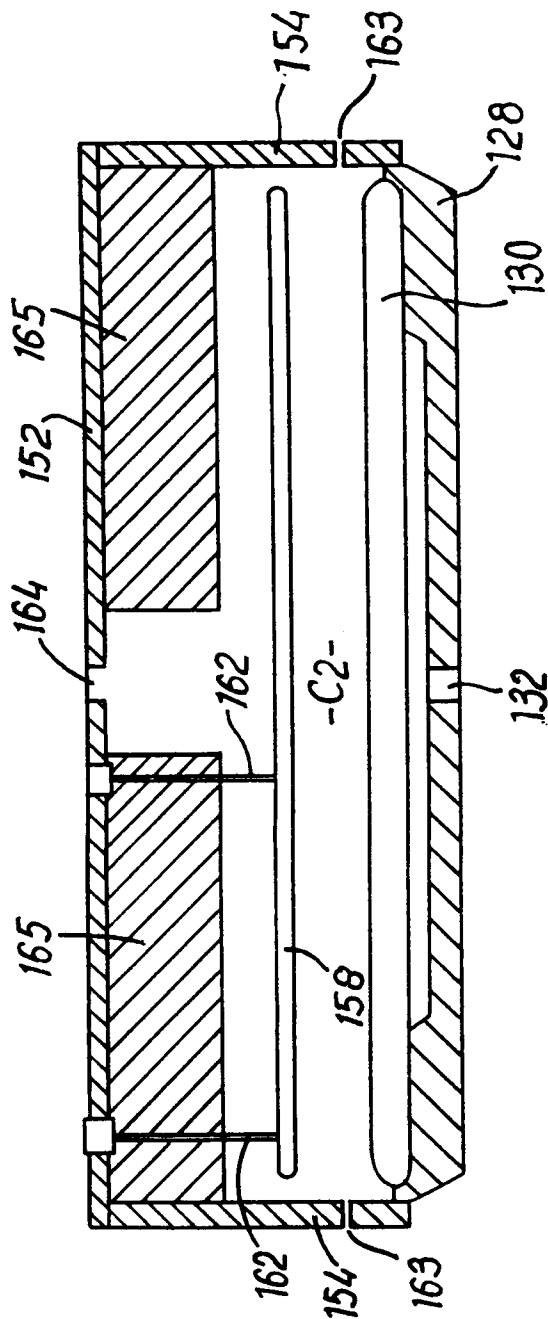


Fig. 5

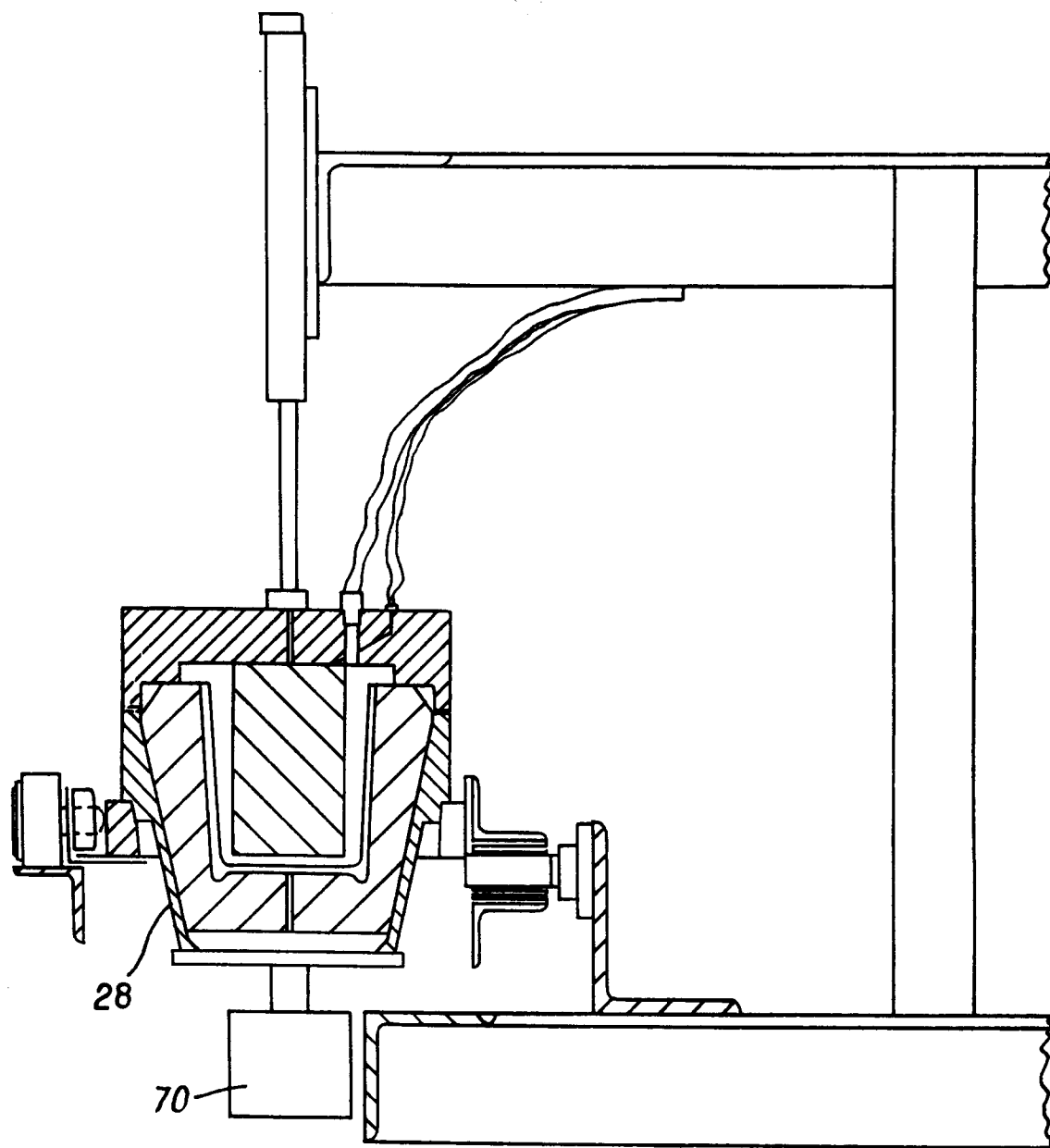


Fig. 6

